DY 29: Posters II

Time: Thursday 17:00–19:00 Location: Poster A

DY 29.1 Thu 17:00 Poster A

Bound states in bent waveguides — Stefan Bittner[1], Barbara Dietz[1], Jochen Isensee[1], Maksim Miski-Oglu[1], Achim Richter[1,2], and •Christopher Ripp[1] — [1]Institut für Kernphysik Darmstadt — [2]ECT* Trento

Bound states in quantum wires or open electromagnetic waveguides with curves, bends or bulges have received much interest for several reasons. Firstly, they can modify the transmission properties of such devices, and secondly, their existence is a purely wave-dynamical phenomenon which has no classical analogue. Different geometries and the properties of the bound states of quantum wires and electromagnetic waveguides, which are described by the same Helmholtz equation, have been investigated extensively both theoretically and experimentally. We present microwave experiments with sharply bent waveguides. The interesting feature of such waveguides is that not only one, but arbitrarily many bound states can exist depending on the angle of the bend: new bound states emerge at certain critical angles. Several waveguides with bend angles close to these critical ones were investigated. The resonance frequencies and field distributions were measured experimentally and compared to theoretical calculations. Good agreement was found and the values for the critical angles were confirmed. Furthermore, the effect of the finite length of the waveguide was investigated. The work presented on this poster was supported by the DFG within SFB 634.

DY 29.2 Thu 17:00 Poster A

Periodically driven microwave systems - theory and experimental realization — •Stefan Gehler[1], Ulrich Kuhl[1,2], Hans-Jürgen Stöckmann[1], and Timur Tudorovskiy[3] — [1]Fachbereich Physik, Philipps-Universität Marburg, Renthof 5, D-35032 Marburg, Germany — [2]LPMC, CNRS UMR 6622, Université de Nice Sophia-Antipolis, 06108 Nice, France — [3]Radboud Universiteit, IMM, Heyendaalsweg 135, 6525AJ Nijmegen, Netherlands

A theoretical description and an experimental realization of a periodically perturbed (Floquet) microwave system will be presented. In previous works perturbations of cavities by stationary antennas had been theoretically studied [1] and experimentally verified [2].

This work has now been extended to antennas with a time dependent coupling between antenna and cavity. For an isolated single perturbed resonance the description showed up to be similar to the description of a resonant circuit with a time dependent capacitance. For the experimental realization we developed a resonator with a small inductivity and resistance. Using a varicap as a capacitor the resonance frequency can be changed periodically. A microwave field was driven with a frequency close to the resonator resonance frequency leading to complicated sideband structures. The different obtained sideband structures could be explained perfectly well by the present theory.

[1] T. Tudorovskiy, R. Höhmann, U. Kuhl, and H.-J. Stöckmann, J. Phys. A 41, 275101, 2008.
[2] T. Tudorovskiy, U. Kuhl, and H.-J. Stöckmann, J. Phys. A 44, 135101 (2011).

DY 29.3 Thu 17:00 Poster A

Experimental Test of a Trace Formula for Chaotic Dielectric Resonators — Stefan Bittner[1], Barbara Dietz[1], •Jochen Isensee[1], Maksim Miski-Oglu[1], Achim Richter[1,2], and Christopher Ripp[1] — [1]Institut für Kernphysik Darmstadt — [2]ECT* Trento

Due to their applicability, e.g., as microlasers and or in integrated optics dielectric resonators have drawn a lot of attention in recent years. The correspondence between ray and wave dynamics is of particular interest to understand their properties and is provided by so-called trace formulas. We present an experimental test of a trace formula proposed by Bogomolny et al. in Ref. [1] for dielectric resonators with chaotic classical dynamics. The frequency spectra of two dielectric stadium resonators made of Teflon were measured in a microwave experiment. About 5% of the total number of resonances could be extracted from the measured frequency spectra. The corresponding length spectra were compared to semiclassical ones obtained with the help of the trace formula. Good qualitative agreement between the experimental and the semiclassical length spectrum was found. Further investigations with numerically calculated spectra revealed, however, that higher order corrections to the trace formula are needed. This work was supported by the DFG within SFB 634.

[1]: Bogomolny et al., Phys. Rev. E 78, 056202 (2008).

DY 29.4 Thu 17:00 Poster A

Integrable Approximation for Regular Regions Using the Optimized Canonical Transformation Method — Arnd Bäcker[1,2], Roland Ketzmerick[1,2], •Clemens Löbner[1,2], and Steffen Löck[1] — [1]Technische Universität Dresden, Institut für Theoretische Physik, 01062 Dresden — [2]MPI für Physik komplexer Systeme, 01187 Dresden

Our aim is to approximate the dynamics of a regular island in a non-integrable Hamiltonian H by an integrable Hamiltonian H_{reg}. For this purpose we introduce optimized canonical transformations in phase space such that the regular dynamics of H and H_{reg} agree as closely as possible.

We apply this optimized canonical transformation method to the standard map and the cosine billiard. In the second case the resulting integrable Hamiltonian describes a billiard with the same boundary, but a nontrivial time evolution. This provides a basis for the future determination of regular-to-chaotic tunneling rates for generic billiards with the fictitious integrable system approach.

DY 29.5 Thu 17:00 Poster A

Spectral Statistics in Systems with a Mixed Phase Space — Arnd Bäcker[1,2], •Steffen Löck[1], Normann Mertig[1,2], and Torsten Rudolf[1] — [1]Technische Universität Dresden, Institut für Theoretische Physik, 01062 Dresden — [2]MPI für Physik komplexer Systeme, 01187 Dresden

We study the consequences of flooding on spectral statistics in systems with a mixed phase space, in which regions of regular and chaotic motion coexist. With increasing density of states we observe a transition of the level-spacing distribution $P(s)$ from Berry-Robnik to Wigner statistics, although the underlying classical phase space remains unchanged. In order to explain this transition we present a flooding improved Berry-Robnik distribution which accounts for the disappearance of regular states. Furthermore, we extend this prediction by explicitly considering the tunneling couplings between regular and chaotic states [1]. We show that this approach excellently reproduces the observed transition of the level-spacing distribution and additionally describes the power-law level repulsion at small spacings.

[1] A. Bäcker, R. Ketzmerick, S. Löck, and N. Mertig, Phys. Rev. Lett. **106**, 024101 (2011).

DY 29.6 Thu 17:00 Poster A

Dynamical tunneling in 4D maps — Arnd Bäcker[1,2], Roland Ketzmerick[1,2], and •Martin Richter[1] — [1]Institut für Theoretische Physik, Technische Universität Dresden, 01062 Dresden, Germany — [2]Max-Planck-Institut für Physik komplexer Systeme, 01187 Dresden, Germany

Higher dimensional Hamiltonian systems show an involved phase-space structure including regular regions interwoven with chaotic trajectories of the Arnol'd web. For 4D quantum maps we investigate the regular-to-chaotic tunneling rates out of mostly regular region embedded inside a large chaotic sea. The tunneling rates are predicted using the fictitious integrable system approach. We address the consequences of resonances on the tunneling rates. Furthermore we study chaotic states approaching the Arnol'd web from outside.

DY 29.7 Thu 17:00 Poster A

Trapping of chaotic orbits in 4D maps — Arnd Bäcker[1,2], Roland Ketzmerick[1,2], •Steffen Lange[1], and Martin Richter[1] — [1]Institut für Theoretische Physik, Technische Universität Dresden, 01062 Dresden, Germany — [2]Max-Planck-Institut für Physik komplexer Systeme, 01187 Dresden, Germany

Generic Hamiltonian systems with more than two degrees of freedom lead to chaotic zones in phase space which are all interconnected by the Arnol'd web. We study 4D maps with a regular region embedded in a large chaotic sea, i.e. far away from the near-integrable regime. We investigate chaotic orbits trapped in the vicinity of the regular region for long times. These are visualized by 3D sections of the 4D phase space. We search for the trapping mechanism by analyzing the fractal dimension and time-dependent frequencies of trapped orbits.

DY 29.8 Thu 17:00 Poster A

The stationary state of time-periodically driven ideal gases coupled to a thermal bath. — •Daniel Vorberg[1,2], Waltraut Wustmann[2], André Eckardt[1], and Roland Ketzmerick[1,2] — [1]Max-Planck-Institut fuer Physik komplexer Systeme, Noethnitzer Str. 38, 01387 Dresden — [2]Institut fuer Theoretische Physik, Technische Universitaet Dresden, 01062 Dresden

Time-periodically driven quantum systems that are coupled to a thermal bath possess a stationary state that generically does not obey detailed balance. We consider ideal gases of many non-interacting bosonic or fermionic particles and show that, as a consequence, their stationary state is generally not described by a Gaussian density operator. Accordingly, also Wick's theorem does not hold. This contrasts the behavior of non-driven systems. However, studying rather generic time-periodically forced model systems with regular and chaotic states, we find that a Gaussian ensemble can still be a very good approximation to the stationary state. Hence, Wick's decomposition of n-particle correlation functions is possible in an approximative sense.

DY 29.9 Thu 17:00 Poster A

Spin transport in the XXZ model at high temperatures: Classical dynamics versus quantum $S = 1/2$ autocorrelations — •Robin Steinigeweg — J. Stefan Institute, Jamova 39, SI-1000 Ljubljana, Slovenia

The transport of magnetization is analyzed for the classical Heisenberg chain at and especially above the isotropic point. To this end, the Hamiltonian equations of motion are solved numerically for initial states realizing harmonic-like magnetization profiles of small amplitude and with random phases. Above the isotropic point, the resulting dynamics is observed to be diffusive in a hydrodynamic regime starting at comparatively small times and wave lengths. In particular, hydrodynamic regime and diffusion constant are both found to be in quantitative agreement with close-to-equilibrium results from quantum $S = 1/2$ autocorrelations at high temperatures. At the isotropic point, the resulting dynamics turns out to be non-diffusive at the considered times and wave lengths.

DY 29.10 Thu 17:00 Poster A

The Van Vleck propagator for bosonic fields — •Thomas Engl, Juan-Diego Urbina, and Klaus Richter — Institut für Theoretische Physik, Universität Regensburg, 93040 Regensburg

In single particle physics semiclassics provides a very powerful toolbox consisting of *e.g.* the Van Vleck propagator and Gutzwiller's Green function which are calculated from the properties of the real classical trajectories only.

We have derived an analogue of the Van Vleck propagator for bosonic quantum fields based on the usage of quadratures. We sketch the derivation of the propagator and present some applications to the Bose-Hubbard model as well.

DY 29.11 Thu 17:00 Poster A

Surface melting of wet granular matter in two dimensions — Christopher May, •Kai Huang, and Ingo Rehberg — Experimentalphysik V, Universitaet Bayreuth, 95440 Bayreuth, Germany

The transition from the solidlike to the liquidlike state of a monolayer of wet glass beads under horizontally swirling motion is investigated experimentally. Due to the cohesion arising from the formation of capillary bridges, the wet particles initially form a crystal like structure at moderate driving. As the driving frequency increases, this structure is found to melt with two steps: A rearrangement into a hexagonal packing sheltered by a premelted layer, followed by a melting from the surface. This process is characterized by means of Voronoi tessellation and bond orientational order parameters, and discussed within the scenario of KTHNY theory that accounts for crystal melting in two dimensions.

DY 29.12 Thu 17:00 Poster A

Phase Transitions in 2D colloidal systems subject to substrate-induced random potentials — •Sven Deutschländer, Georg Maret, and Peter Keim — University of Konstanz, Department of Physics, 78457, Konstanz, Germany

We investigate the effect of substrate-induced random potentials on the thermodynamics of a two-dimensional colloidal system with magnetic dipol-dipol interaction. In particular, we are interested in the structure and dynamics of possible phases, the order and mechanism of the phase transitions, and transition temperatures as a function of strength and randomness of the external potential. We show that the first occurrence of hexatic characteristics as well as the transition to a crystalline state are, triggered by the substrate potential, shifted to lower temperatures which is in agreement with theories by D. Nelson, and M.-C. Cha and H. Fertig. Further, we found that, at finite randomness and low system temperatures, the system occupies a solid state. This verifies simulations by S. Herrera-Velarde and H. H. von Grünberg, as well as Cha and Fertig's reconsiderations of Nelson's theory. The latter postulates a re-entrance from the solid to the hexatic phase at low temperatures for arbitrary small randomness what is not seen in our experiment. In addition, we observe the developing of phase equilibria indicating first order characteristics which also seem to be induced by the external potential, and show that their range is dependent on the randomness.

DY 29.13 Thu 17:00 Poster A

Loop length distributions in the Negative Weight Percolation (NWP) problem: Extension to 4 to 7 dimensions — •Gunnar Claussen, Oliver Melchert, and Alexander K. Hartmann — Institut für Physik, Carl-von-Ossietzky-Universität Oldenburg

The negative weight percolation (NWP) problem [1] on hypercubic lattice graphs is a bond percolation problem with disorder distributions that allow for edge weights of either sign. Under variation of the concentration ρ of negative edge weights "small" and percolating loops of total negative weight are found. The NWP problem shows no transitivity and has no simple definition of clusters, therefore it fundamentally differs from conventional percolation problems. A numerical examination of the models requires a sophisticated transformation of the original graph and the application of matching algorithms in order to find the minimum-weighted configuration of loops.

Here, we study the problem by numerical methods for ρ below the critical point ρ_c, where system-spanning loops appear. The core of the examination is the determination of the Fisher exponent τ, which describes the loop length distribution according to $n(l) \propto l^{-\tau}$, and the loop-size cut-off exponent σ. The latter determines the line tension T_L of the non-pecolating loops by $T_L(\rho) \propto |\rho - \rho_c|^{1/\sigma}$ and complies to a cut-off in loop lengths for $\rho < \rho_c$. In extension of previous works the model is examined for dimensions $d = 4...7$. The results are compared to previous finite-size scaling analyses [2].

[1] O. Melchert and A.K. Hartmann, New J. Phys. 10 (2008) 043039
[2] O. Melchert, L. Apolo and A.K. Hartmann, PRE 81 (2010) 051108

DY 29.14 Thu 17:00 Poster A

Perfect conducting channel in two-dimensional random lattices with XY-disorder and engineered hopping amplitudes — •Alberto Rodriguez[1,3], Arunava Chakrabarti[2], and Rudolf A. Römer[3] — [1]Phisikalisches Institut, Albert-Ludwigs Universität Freiburg, Hermann-Herder Strasse 3, D-79104, Freiburg, Germany — [2]Department of Physics, University of Kalyani, Kalyani, West Bengal-741 235, India — [3]Department of Physics and Centre for Scientific Computing, University of Warwick, Coventry, CV4 7AL, United Kingdom

We study the spectral and transport properties of two-dimensional lattices with random on-site energies $\epsilon_{x,y}$, and random vertical hopping amplitudes $\gamma_{(x,y)\to(x,y+1)}$. The disorder in the system is defined by three independent random sequences $\{\alpha_x\}, \{\beta_y\}, \{\xi_y\}$, in the following way: $\epsilon_{x,y} = \alpha_x\beta_y$, and $\gamma_{(x,y)\to(x,y+1)} = \alpha_x\xi_y$. By engineering the random distribution ξ_y, a full band of Bloch states emerges in the spectrum, and a perfect conducting channel in the x direction is induced in the system. We describe how to create the conductance channel in finite systems, and we study its robustness against deviations from the ideal requested values for ξ_y. Remarkably, we demonstrate that the channel persists in the thermodynamic limit —for the infinite two-dimensional system—. Furthermore, we also discuss how to modify the localization of the eigenstates almost at will in the x and y directions. Our results are constructed analytically and supported by extensive numerical calculations of localization lengths, conductance and density of states.

DY 29.15 Thu 17:00 Poster A

Efficient implementation of Sweeny's algorithm for simulations of the Potts model — •Eren Elçi[1] and Martin Weigel[1,2] — [1]Institut für Physik, Johannes Gutenberg-Universität Mainz, Staudinger Weg 7, 55099 Mainz, Germany — [2]Applied Mathematics Research Centre, Coventry University, Coventry, CV1 5FB,

England

The simulation of spin models close to points of continuous phase transitions is heavily impeded by the occurrence of critical slowing down. A number of cluster algorithms usually based on the Fortuin-Kasteleyn representation of the Potts model and suitable generalizations for continuous-spin models has been used to increase simulation efficiency. The first algorithm making use of this representation, suggested by Sweeny in 1983, has not found widespread adoption due to problems in its efficient implementation. It has been shown recently, however, that it is indeed more efficient in reducing critical slowing down that the more well-known variants due to Swendsen/Wang and Wolff. Here, we discuss efficient implementations of Sweeny's approach based on union-and-find algorithms and using recent algorithmic advances in dynamic connectivity algorithms, and show how these can be used for efficient simulations in the random-cluster model.

DY 29.16 Thu 17:00 Poster A

Mixed Ising ferrimagnets with next-nearest neighbour couplings on square lattices — •Walter Selke[1] and Cesur Ekiz[2] — [1]Institut für Theoretische Physik der Phasenübergänge, RWTH Aachen — [2]Department of Physics, Adnan Menderes University, Aydin

We study Ising ferrimagnets on square lattices with antiferromagnetic exchange couplings between spins of values S=1/2 and S=1 on neighbouring sites, couplings between S=1 spins at next–nearest neighbour sites of the lattice, and a single–site anisotropy term for the S=1 spins. Using mainly ground state considerations and extensive Monte Carlo simulations, we investigate various aspects of the phase diagram, including compensation points, critical properties, and temperature dependent anomalies. In contrast to previous belief, the next–nearest neighbour couplings, when being of antiferromagnetic type, may lead to compensation points. W. Selke and C. Ekiz, J. Phys. C: Condensed Matter 23, 496002 (2011); W. Selke and J. Oitmaa, J. Phys. C: Condensed Matter 22, 076004 (2010)

DY 29.17 Thu 17:00 Poster A

Mean-field theory of Active Brownian particles with velocity-alignment — •Robert Grossmann[1], Pawel Romanczuk[1,2], and Lutz Schimansky-Geier[1] — [1]Department of Physics, Humboldt-Universität zu Berlin, Newtonstraße 15, 12439 Berlin, Germany — [2]Max Planck Institute for the Physics of Complex Systems, Nöthnitzer Straße 38, 01187 Dresden, Germany

A model of active Brownian particles with velocity-alignment in two spatial dimensions is introduced. The individual dynamics is based on the so called Schienbein-Gruler model as well as thermal and active fluctuations. A macroscopic description is derived directly from the microscopic Langevin dynamics via a nonlinear Fokker-Planck equation and a moment expansion of the corresponding probability density function. We discuss the impact of different fluctuation types on the onset of collective motion, i.e. noise induced bistabilities.

DY 29.18 Thu 17:00 Poster A

One dimensional transport of colloids with attractive interactions — •Dortje Schirok, Ken Lichtner, and Sabine H.L. Klapp — Institute of Theoretical Physics, Secr. EW 7-1, Technical University Berlin - Hardenbergstr. 36, D-10623 Berlin, Germany

Considering a non-equilibrium one-dimensional system of interacting colloids in a tilted washboard potential, we find a certain flux of the center of mass along the congruent axis [1]. By adding an additional attractive part to the colloid's profile this flux is damped. In the time dependence of the mean-squared displacement we see the colloids being trapped for a certain time before going to the diffusive regime [2]. This system is examined with and without the attractive part to the colloid's potential. Furthermore we studied the effect of the potential's interaction stiffness on the transport mechanisms.

[1] K. Lichtner and S.H.L. Klapp, Europhys. Lett 92, 40007 (2010)
[2] R. Gernert, K. Lichtner, D. Schirok, S.H.L. Klapp, to be published

DY 29.19 Thu 17:00 Poster A

Characterizing heterogeneous diffusion by the distribution of diffusivities — •Michael Bauer and Günter Radons — Chemnitz University of Technology, Germany

Heterogeneous diffusion processes arise in many physical and biological applications where the diffusive behavior changes during the motion. For instance, diffusion in ultra-thin liquid films is governed by layer-dependent diffusion coefficients and jumps between the liquid layers. The observation of individual tracers by single-particle tracking (SPT) allows for a characterization of such processes. Hence, we suggested to investigate the distribution of diffusivities and their dependence on the time lag between snapshots [1]. This analysis should be preferred to conventional methods such as mean-squared displacements which conceal the effects of inhomogeneities. We also studied the relation to ensemble-based measurements obtained from pulsed field gradient nuclear magnetic resonance (PFG NMR) and applied it to the two-region exchange model [2]. In our contribution we extend the investigations to systems in the presence of observation noise, which is of high relevance for experimental data. Moreover, our objective is to consider higher moments of the distribution of diffusivities and their dependence on the time lag, which characterizes the diffusivity as a fluctuating quantity along a trajectory.

[1] M. Bauer et al., Diffus. Fundam. 11, 104 (2009)
[2] M. Bauer et al., J. Chem. Phys. 135, 144118 (2011)

DY 29.20 Thu 17:00 Poster A

Characterizing anisotropic diffusion via distribution of generalized diffusivities — •Mario Heidernätsch and Günter Radons — Chemnitz University of Technology, D-09126 Chemnitz, Germany

Anisotropic diffusion is one possible generalization of the homogeneous diffusion process. It occurs typically in anisotropic media such as liquid crystals and can be formally described by a Fokker-Planck-equation using a diffusion tensor. In experiments single molecule tracking often is used to observe the local diffusion properties of a tracer in a liquid. Due to the experimental setup only a projection of the diffusion volume is observed, in other words a projected diffusion tensor. We now apply our distribution of generalized diffusivities [1] to this projected anisotropic diffusion and assess the properties of the underlying process. Our objective is in particular to discriminate between anisotropic and heterogeneous diffusion processes.

[1] M. Bauer et al., J. Chem. Phys. 135, 144118 (2011)

DY 29.21 Thu 17:00 Poster A

Effective diffusion and quasi-deterministic transport of Brownian particles in a spatio-temporally oscillating potential — •Pawel Romanczuk[1], Felix Müller[2], and Lutz Schimansky-Geier[2] — [1]Max-Planck-Institut für Physik komplexer Systeme, 01187 Dresden — [2]Institut für Physik, Humboldt Universität zu Berlin, 12489 Berlin

We consider overdamped Brownian dynamics in an temporally oscillating and spatially periodic potential. We analyze the non-directed diffusive transport which shows oscillation induced enhancement of the effective diffusion and present an approximate formula for the effective diffusion coefficient. Furthermore we analyze the effect of the oscillating potential on directed transport due to the application of a constant force. We show via numerical simulations the existence of an optimal force at which the deterministic dynamics is in resonance with the potential oscillations giving rise to directed transport with extremely low dispersion.

[1] P Romanczuk, F Müller,L Schimansky-Geier, Quasi-deterministic transport of Brownian particles in an oscillating periodic potential, *Phys. Rev. E*, **81**, 061120 (2010)
[2] F Müller, P Romanczuk, L Schimanksky-Geier, Synchronization and Transport in an oscillating periodic potential, *Stochastics and Dynamics*, **11**, 2-3 (2011)

DY 29.22 Thu 17:00 Poster A

Forced Kramers escape with memory friction — •Jakob Tómas Bullerjahn, Sebastian Sturm, Lars Wolff, and Klaus Kroy — Institut für Theoretische Physik, Universität Leipzig, Germany

Starting from a generalized Langevin equation with arbitrary memory kernel, we describe the irreversible escape from a potential well, driven by a time-dependent external force protocol. Our model is analytically tractable and rectifies the unphysical behaviour of the escape rate under large pulling forces present in established models of stochastic bond breaking [1,2]. Beyond the Markovian limit, our approach directly applies to subdiffusive biological systems such as semiflexible polymers or membranes.

[1] Dudko, Hummer, Szabo, Phys. Rev. Lett. 96, 108101 (2006)
[2] Freund, PNAS 106, 8818 (2009)

DY 29.23 Thu 17:00 Poster A

Probing anomalous diffusion in a polymer melt with a continuous-time random walk ansatz — •Julian Helfferich[1], Falko Ziebert[2], Hendrik Meyer[2], Alexander Blumen[1], and Jörg Baschnagel[2] — [1]Theoretical Polymer Physics, University of Freiburg, Hermann-Herder-Str. 3, D-79104 Freiburg, Germany — [2]Institut Charles Sadron, Université de Strasbourg, CNRS, 23 rue du Loess, 67037 Strasbourg Cedex, France

Continuous time random walks (CTRW) have been repeatedly advanced for describing the dynamics of low-temperature polymer melts and binary mixtures. A CTRW picture allows for a systematic description of the long-time dynamics, averaging over the strongly correlated motions on small time- and length-scales; in this way it also serves in analysing the results of molecular dynamics (MD) simulations, allowing to determine the relevant parameters.

Using MD simulations we analyse the single particle trajectories, identify jumps and determine the waiting time and jump length distributions. Furthermore, based on tests for correlations, we determine the time- and length-scales on which the CTRW description is adequate.

DY 29.24 Thu 17:00 Poster A

Anomalous diffusion analyzed in terms of the distribution of generalized diffusivities — •Tony Albers and Günter Radons — Chemnitz University of Technology, Germany

We investigate two systems that show anomalous diffusion. The first one is the continuous time random walk model with an algebraically decaying waiting time distribution that does not have a finite first moment. This model shows subdiffusive behavior and exhibits so called Weak Ergodicity Breaking. Secondly, we consider the Hamiltonian dynamics of particles under the influence of quenched spatial disorder. Both systems are analyzed by a new tool that we call the distribution of generalized diffusivities $p_\alpha(D,\tau)$. This distribution is defined as the probability density to find a squared displacement of duration τ divided by the asymptotic time dependence of the mean squared displacement τ^α. Hence this distribution describes the fluctuations during the diffusion process around the generalized diffusion coefficient that can be obtained from the mean squared displacement and is also equal to the first moment of the distribution $p_\alpha(D,\tau)$. In this contribution we show for the subdiffusive continuous time random walks how the ensemble-averaged and time-averaged distribution of generalized diffusivities are related to each other and how the anomalous diffusion in phase space can be explained by a modified Levy walk model, which is deduced from the distribution of generalized diffusivities.

DY 29.25 Thu 17:00 Poster A

Investigation of dielectric and elastic properties of glasses at very low temperatures in the low frequency regime — •Annina Luck, Marius Hempel, Andreas Reiser, Andreas Fleischmann, and Christian Enss — Kirchhoff-Institut für Physik, Universität Heidelberg

In the last years, measurements of dielectric two-pulse polarisation echoes have revealed that nuclear electric quadrupole moments involved in atomic tunneling sytems can accord for the magnetic field dependence of the echo amplitude of non-magnetic glasses.

To investigate the influence of nuclear electric quadrupoles on the low frequency dielectric and elastic properties of glasses down to a temperature of 7 mK, we measured samples of the glass N-KZFS11 which contains 25 mass percent of tantalum oxide. As ^{181}Ta carries a very large nuclear electric quadrupole moment, the measured sample seems to be an ideal candidate to determine the influence of nuclear electric quadrupole moments on the physical properties of glasses at low temperatures.

The tunneling model predicts a slope ratio of 2 for the logarithmic temperature dependence of the susceptibility, caused by resonant and relaxational processes. Our results show a surprising accordance with this prediction of the tunneling model, which as of now has never been observed in other glasses.

We discuss these experimental results in the context of the tunneling model and possible extensions of it.

DY 29.26 Thu 17:00 Poster A

Thermal Conductivity of Normal Conducting and Superconducting Bulk Metallic Glasses at Very Low Temperatures — •Daniel Rothfuss[1], Uta Kühn[2], Andreas Fleischmann[1], and Christian Enss[1] — [1]Kirchhoff-Institute for Physics, Heidelberg University, INF 227, 69120 Heidelberg — [2]IFW Dresden, Institute for Complex Materials, P.O. Box 270116, 01171 Dresden

Bulk metallic glasses (BMG) have been produced for more than one decade, but their low temperature properties are still mostly unexplored although BMGs represent a new and very interesting kind of amorphous material with a wide range of electric and magnetic properties. At low temperatures the physical properties of non-magnetic BMGs should be governed by atomic tunneling systems, phonons and conduction electrons as well as the interactions among these degrees of freedom. We recently started the investigation of the thermal properties of superconducting BMGs well below T_c, as in these samples the electronic degree of freedom can be switched on and off by an external magnetic field. We present the thermal conductivity of a Zr based BMG in the superconducting state down to 6 mK. Our results show that sufficiently far below T_c the thermal conductivity can be described by the thermal diffusion of phonons and their resonant scattering with tunneling systems. Furthermore we present the thermal conductivity of the normal conducting BMG $Au_{49}Ag_{5.5}Pd_{2.3}Cu_{26.9}Si_{16.3}$ in the temperature range between 10 mK and 250 mK.
Both measurements were performed with a SQUID-based contact free technique with extremely small parasitic heating.

DY 29.27 Thu 17:00 Poster A

Non-linear single-particle-response of glassforming systems to external fields — •David Winter[1], Peter Virnau[1], Jürgen Horbach[2], and Kurt Binder[1] — [1]Johannes Gutenberg-Universität, Mainz, Germany — [2]Heinrich Heine-Universität, Düsseldorf, Germany

In this work, we study the behavior of single particles in a supercooled liquid under the influence of an external force. Our model system is a 50:50 binary mixture whose particles interact via a Yukawa potential. In the equilibrated system, we add a constant force field to one of these particles which as a consequence will be accelerated. After some time, this particle reaches a steady state. In this state we measure characteristic properties of the particle and the surrounding like the steady state velocity, the friction coefficient, mean square displacements and correlation functions in dependence of the external force and system temperature. We observe that for low temperatures and high enough force fields the particle leaves the linear response regime and enters the non-linear regime. Here, the friction coefficient is not constant any more. For even higher forces all curves reach a second plateau and fall on top of each other.

DY 29.28 Thu 17:00 Poster A

Colloidal structures on quasicrystalline substrates — •Matthias Sandbrink and Michael Schmiedeberg — Institut für Theoretische Physik 2: Weiche Materie, Heinrich-Heine-Universität Düsseldorf

Colloidal suspensions, dispersions of micro-sized particles in a fluid, are a well known model system in statistical physics. The behavior of such particles on substrates is important for a lot of applications like photonic crystals, colloidal nanofilms, or novel materials with special rheological or frictional properties. As substrate we consider different aperiodic tilings with long-range order. By using Monte-Carlo simulations, we study the growth process of colloidal structures on such quasicrystalline substrates. Our goal is to grow colloidal quasicrystals in a controlled way.

DY 29.29 Thu 17:00 Poster A

Critical Casimir forces in many-body systems — •Thiago Mattos[1], Ludger Harnau[1,2], and Siegfried Dietrich[1,2] — [1]Max-Planck-Institut für Intelligente Systeme, Stuttgart, Deutschland — [2]Institut für Theoretische und Angewandte Physik, Stuttgart, Deutschland

The confinement of a binary liquid mixture close to its critical (demixing) point leads to effective critical Casimir forces between the confining boundaries. These long-ranged forces can be either attractive or repulsive depending on the choice of the boundary conditions, i.e. the preference of the confining surfaces in adsorbing one of the two components of the liquid mixture. We investigate the effect of many-body interactions in the Casimir force, which is expected to be non-additive, for two spherical colloids close to a wall immersed in a binary liquid mixture close to criticality. We calculate this force for three different systems: (i) single spherical colloid close to a wall, (ii) two spherical colloids and (iii) two spherical colloids close to a wall. For all systems we consider several combinations of boundary conditions for the colloids and for the wall.

DY 29.30 Thu 17:00 Poster A

Spontaneous imbibition in a network of nanopores: A numerical study — •Zeinab Sadjadi and Heiko Rieger — Saarland University, Saarbrücken, Germany

We study numerically the spontaneous imbibition of water into nanoporous Vycor glass (NVG). NVG is a silica substrate with an interconnected network of cylindrical pores with characteristic radii of 3-5 nm, which we model by a two-dimensional network of cylindrical pipes with random radii and different aspect ratios. We model the spontaneous rise of water by solving the mass balance equation at each node. We analyze the temporal evolution of the average height and width of the invasion front. Our results predict an unusually weekly correlated menisci motion and an anomalously strong roughening of imbibition fronts. These findings, which are also observed experimentally by neutron imaging, show that spontaneous imbibition crucially depends on pore aspect ratio and reveal a new universality class of imbibition behaviour which is expected to occur in any matrix with elongated pores.

DY 29.31 Thu 17:00 Poster A

Drying fronts in colloidal films — Joaquim Li[1], Bernard Cabane[1], •Jan S. Vesaratchanon[2], Michael Sztucki[3], Jeremie Gummel[3], and Lucas Goehring[2] — [1]PMMH, ESPCI, Paris, France — [2]MPI for Dynamics and Self-Organization, Göttingen, Germany — [3]ESRF, Grenoble, France

The drying of a colloidal film involves multiple transport processes, with the film properties changing dramatically as drying proceeds. Many such films are applied as a liquid dispersion, begin to dry from the edges inward (directional drying), and change into a porous solid as the result of evaporation. In two extreme situations the film may either dry into a flat, homogeneous layer, or may dry via the iconic 'coffee-ring' effect, where nearly all solid material is deposited at the edge of the film. However, the conditions that discriminate between these two limits are not understood, nor is the general physics controlling dispersant/particle transport during drying. We have studied this problem via Small Angle X-ray/Neutron Scattering, on directionally dried films of colloidal silica, whereby we measure the ordering of particles, their volume fraction, the film thickness and the water content simultaneously. We find that far from an edge, where a flat film develops, all material transport occurs in a thin transition region, of finite width, that propagates ahead of the drying front. In this region, like a polarization wave in filtration experiments, the gradient of osmotic pressure balances the drag force exerted on the particles by capillary flow toward the liquid-solid front. The growth or decay of such a region may lead to uneven deposits, such as ridges near the film edges.

DY 29.32 Thu 17:00 Poster A

Motional patterns of particle trains in a microchannel — •Sebastian Reddig and Holger Stark — Institut für Theoretische Physik, Technische Universität Berlin, D-10623 Berlin, Germany

Microfluidic devices have emerged as powerful tools for manipulating, controlling, and analyzing various processes in chemistry, physics and biology. With the help of such devices one can make controlled studies on the influence of confinement and can easily drive suspended objects out of equilibrium, using a pressure driven Poiseuille flow. Thereby one can induce novel and intriguing dynamic structure formation in complex fluids, whose knowledge is essential, e.g., for developing tools to transport and sort particles on the micron scale.

We introduce a model for particle trains under the influence of a pressure driven flow, which are confined between two planar parallel walls. The colloids are neutrally buoyant and interact hydrodynamically via the solvent. We describe hydrodynamic interactions with the two-wall Green tensor that takes into account the no-slip condition at the walls[1]. We show that different initial conditions lead to different motional patterns, where the particle trains either form a propagating wave or one particle oscillates back and forth between its neighbors. We analyze the stability of these patterns and investigate how they depend on the ratio of colloid radius and channel width.

[1] *Spherical particle in Poiseuille flow between planar walls*, J. Chem. Phys, **121**, 483 (2004).

DY 29.33 Thu 17:00 Poster A

Bidisperse ferrofluid microstructure in a monolayer — •Elena Minina[1,3], Alla Muratova[1], Joan Cerda[2], Sofia Kantorovich[1,3], and Christian Holm[3] — [1]Ural Federal University, Lenin av. 51, Ekaterinburg, 620000, Russia — [2]Institute for Cross-Disciplinary Physics and Complex System, Campus Universitat de les Illes Balears, 07122, Palma de Mallorca — [3]Institut fuer Computerphysik, Universitaet Stuttgart, Pfaffenwaldring 27, 70569, Stuttgart, Deutschland

A bidisperse ferrofluid possesses a complex and versatile microstructure even in the absence of an external magnetic field. This system can be regarded as a model for a real polydisperse dipolar fluid. It is worth saying that the microstructure strongly depends not only on the polydispersity, but also on the sample geometry. It is well known that in three dimensions space there are three main chain classes [C. Holm at al, J. Phys.: Cond. Mat. 18 (2006)], but in the case of a constraint geometry (quasy-2D) it is necessary to consider 19 classes of chains, rings and single particles for the description of the microstructure in terms of a classical density functional theory that compared well to results obtained via by molecular dynamics simulations. The calculation of the virial coefficients allows us to demonstrate the influence of the geometry on the interparticle interaction and, as a result, on the cluster formation. In our contribution we compare the probabilities for chain formation of different length and particle composition in the 3D and quasy-2D geometries and also confirm the distinction of the microstructures in the geometries by using virial coefficients.

DY 29.34 Thu 17:00 Poster A

Structure and dynamics of suspensions of colloidal dumbbells — •Nils Heptner and Joachim Dzubiella — Helmholtz Zentrum Berlin, Germany

We investigate the static and dynamic structure of suspensions of colloidal dumbbells using Brownian dynamics computer simulations. The particular focus is the study of bulk structure at different densities and the dynamical properties under shear flow. We present preliminary results on the static structure factor, its response to shear, and stress-strain relations in the sheared purely liquid state.

DY 29.35 Thu 17:00 Poster A

Pulsed chaos synchronization in networks with adaptive couplings — •Marco Winkler and Wolfgang Kinzel — Institute for Theoretical Physics, University of Würzburg, Am Hubland, 97074 Würzburg, Germany

Networks of chaotic units with *static* couplings can synchronize to a common chaotic trajectory. The effect of *dynamic adaptive* couplings on the cooperative behavior of chaotic networks is investigated. The couplings adjust to the activities of its two units by two competing mechanisms: An exponential decrease of the coupling strength is compensated by an increase due to de-synchronized activity. This mechanism prevents the network from reaching a steady state. Numerical simulations of a coupled map lattice show chaotic trajectories of de-synchronized units interrupted by pulses of mutually synchronized clusters. These pulses occur on all scales, sometimes extending to the entire network. The fraction of synchronized pairs, as well as the duration of the pulses show a power-law distribution. Synchronization clusters can be triggered by stimulating a small group of synchronized units.

DY 29.36 Thu 17:00 Poster A

Effects of introducing a competing salmon species into a model of sockeye salmon population dynamics — •Christoph Schmitt[1], Barbara Drossel[1], and Christian Guill[2] — [1]Institut für Festkörperphysik, TU Darmstadt — [2]J.F. Blumenbach Institute of Zoology and Anthropology, Georg-August-University Göttingen

The number of spawning sockeye salmon in the Fraser River basin in Canada shows a remarkably strong and regular four-year oscillation. This so-called cyclic dominance phenomenon is reproduced as a stable attractor by a recently introduced three species model for salmon fry, their zooplankton food, and their main predator in the rearing lakes, rainbow trout.

However, this simple model does not take into account that all sockeye rearing lakes also contain kokanee salmon, which belong to the same species as sockeye. Unlike sockeye, which migrate to the ocean at age one, kokanee spend their entire life in the lakes.

We investigate the dynamics of models that include kokanee salmon in addition to the other three species. This increases the predator biomass by providing a stable food source. In the simplest version of the four-species model, cyclic dominance breaks down over a large parameter range, because it reduces the required strong coupling between sockeye and their predators. Because cyclic dominance is observed in nature nevertheless, we also study other versions of the four-species model. In particular, we investigate whether splitting kokanee and/or rainbow trout into different age classes can increase the parameter range over which cyclic dominance is observed.

DY 29.37 Thu 17:00 Poster A

Boundary effects in spatially embedded networks —

•Aljoscha Rheinwalt — Potsdam Institute for Climate Impact Research, Germany — Humboldt University of Berlin, Germany

What is the influence of boundaries in spatially embedded networks on network measures? A question that can be answered by a statistical method with the use of appropriate surrogate networks. This is shown by examples with the network measures degree, closeness centrality and shortest path betweenness.

DY 29.38 Thu 17:00 Poster A

Intrinsic Plasticity of Leaky Integrators Through Stochastic Adaptation — •Mathias Linkerhand and Claudius Gros — Institute for Theoretical Physics, Johann Wolfgang Goethe University, Frankfurt am Main, Germany

Intrinsic plasticity denotes the adaption of internal neural parameters, such as threshold and gain. It has been introduced and studied for discrete-time neurons. Since real world neurons respond continuously in time, here we introduce a continuous-time model of intrinsic plasticity in neurons. In this work we use rate coding leaky integrators. We show that the firing rate distribution of a single neuron efferently connected to a random noise input is driven by a target distribution through stochastic adaptation. For some target distributions this leads to self-organized stochastic escape. We also discuss the response to different kind of input stimuli and the behavior of small networks.

DY 29.39 Thu 17:00 Poster A

Structure of complex networks for minimizing traffic congestion and cost — Jelena Smiljanjić and •Igor Stanković — Scientific Computing Laboratory, Institute of Physics Belgrade, University of Belgrade, Pregrevica 118, 11080 Belgrade, Serbia

In process of design of optimal network, it is necessary to understand how traffic flow depends on network structure. We study data packet flow on complex networks, where the packet delivery capacity of each node or link is fixed. The comparison has been made on the following complex-network topologies: random, distance model, and regular. The optimal configuration of capacities to minimize traffic congestion is analyzed and the critical packet generating rate is determined, below which the network is at a free flow state but above which congestion occurs. The congestion is analyzed in comparison with cost of such network measured in number and length of the links or their capacity. Our analysis reveals a direct relation between network topology and traffic flow. Our analysis also makes it possible to compare the congestion conditions for different types of complex networks. In particular, we find that network with low critical generating rate is more susceptible to congestion.

DY 29.40 Thu 17:00 Poster A

Stochastic Analysis of Rogue Waves — •Ali Hadjihosseini, Matthias Wächter, and Joachim Peinke — ForWind - Center for Wind Energy Research, Institute of Physics, University of Oldenburg

We present an analysis of rogue wave data, with a stochastic approach based on the theory of Markov processes. In many cases Markov processes can be described completely by a Fokker-Planck or Langevin equation with parameters derived directly from experimental data. The method was applied to rogue wave measurement data. Their Markov properties were shown and first estimations for the parameters of the Fokker-Planck equation were performed.

DY 29.41 Thu 17:00 Poster A

Travelling wave solutions for multiphase flow in porous media — •Oliver Hönig[1] and Rudolf Hilfer[1,2] — [1]Institut für Computerphysik, Universität Stuttgart, 70569 Stuttgart, Deutschland — [2]Institut für Physik, Universität Mainz, 55099 Mainz,Deutschland

We study travelling wave solutions of multiphase flow in one-dimensional porous media on a macroscopic scale. A dimensionless system of two fractional flow equations with coupled flow functions and simplified capillarity is employed to formulate a dynamical system. This system is discussed in detail with analytical and numerical methods. It leads to a more complex behaviour than the case of a single fractional flow equation.

DY 29.42 Thu 17:00 Poster A

Quantitative validation of multi-scale modelling of porous media — •Andreas Lemmer and Rudolf Hilfer — Institut für Computerphysik, Universität Stuttgart, 70569 Stuttgart, Deutschland

Flow and transport through geological, biological and industrial porous media typically involve multiple length and/or time scales. Controlled approximations with quantitative error indicators on different scales are necessary to develop multi-scale models from single-scale approaches and to verify them. Based on a continuum model for porous media, we discretize three-dimensional images of a synthetic sample of a Fontainebleau sandstone with side length 1.5 cm at resolutions covering three decades from 117 μm down to 458 nm [1]. Calculating and analyzing geometric and transport parameters at different resolutions allow quantitative validation of different theoretical approaches and comparison with experiment.

[1] R. Hilfer and T. Zauner: High precision synthetic computed tomography of reconstructed porous media, Physcial Review E, in print (2011)

DY 29.43 Thu 17:00 Poster A

Comparison of paired and independent forecast ensembles by univariate and multivariate skill measures — •Stefan Siegert and Holger Kantz — Max-Planck-Institut für Physik komplexer Systeme, Dresden, Germany

A forecast ensemble is a collection of runs of a numerical model. The ensemble members are constructed by adding perturbations to the observed initial state (the analysis). In numerical weather prediction, the spread of such a forecast ensemble is used to estimate the uncertainty of the numerical model about the future state of the atmosphere.

The generation of perturbations for weather forecast ensembles is non-trivial and computationally expensive. A cheap method to increase K, the total number of ensemble members, without having to calculate further perturbations is the construction of pairs of ensemble members, by adding and subtracting the same perturbation from the analysis. However, such an ensemble can only span a (K/2)-dimensional subspace of the model space, whereas a fully independent ensemble can, in principle, span a K-dimensional subspace.

We study how well paired and fully independent ensembles are able to represent the variability of the verifying observation. We analyze their skill on a univariate (gridpoint-wise) basis, using the outlier statistic and the continuously ranked probability score. Further, ensemble variability is studied in a multivariate sense, using minimum spanning tree analysis. We find systematic differences between the two kinds of forecast ensembles.

DY 29.44 Thu 17:00 Poster A

Towards first-passage-time prediction in temperature time series — •Anja von Wulffen and Holger Kantz — Max Planck Institute for the Physics of Complex Systems, Dresden, Germany

Current operational weather forecasts are based on detailed models run for a lead time of about ten days. Efforts to issue seasonal forecasts further into the future using similar models are still very experimental and deal with a high uncertainty. On these longer time scales, very specific prediction tasks such as the first passage time until a threshold crossing, e.g. the time until first frost, are of significant interest.

In order to see whether for such specific questions predictions based solely on a statistical analysis of the time series might not only require less resources than the full models but also yield better results, we study these first passage time distributions for actual temperature data and evaluate their potential predictability.

We also investigate the possibility of improvements through incorporating a second time series supplying information about the relevant slower-evolving atmospheric patterns such as the North Atlantic Oscillation.

DY 29.45 Thu 17:00 Poster A

Fluidization of wet granulates under hydrodynamic shear — •Christoph Goegelein, Ilenia Battiato, and Juergen Vollmer — Max-Planck-Institut fuer Dynamik und Selbstorganisation, Goettingen

Very recently, the fluidization threshold of wet granular beds under hydrodynamic shear forces were predicted theoretically [1]. This theory describes the flow through a wet granular bed by a continuum model and provides analytical expressions for the averaged drag force on a single particle. Moreover, the theory predicts the stability of the granular bed in dependence of the strength of the capillary and buoyancy forces. These theoretical predictions are tested in the present study by a newly designed flow channel. We will present our first experimental results for the fluidization onset of wet granular beds.

[1] I. Battiato, and J. Vollmer, "Fluidization of wet granulates under hydrodynamic shear", submitted for publication.

DY 29.46 Thu 17:00 Poster A

Anomalous diffusion of a fluid domain suspended in a wet granular gas — •Mitja Kleider[1,2], Klaus Röller[1], and Jürgen Vollmer[1,2] — [1]Max-Planck-Institut für Dynamik und Selbstorganisation, Göttingen — [2]Georg-August-Universität Göttingen

By event-driven molecular dynamics simulations we study the evolution of a dense fluid phase in a fluid-gas coexistence regime of wet granular matter where external driving balances the dissipation in the granular fluid. In a shallow two-dimensional system the fluid phase can form a domain of a well-defined width, a *granular droplet* immersed in the granular gas phase. Surprisingly, its centre-of-mass position exhibits Brownian motion with anomalous diffusion: the mean square displacement shows super-diffusive behaviour. The origin of the Brownian motion and the super-diffusive behaviour will be discussed.

DY 29.47 Thu 17:00 Poster A

Ergodic Theory, free cooling and steady states of three wet granular disks — •Jan-Hendrik Trösemeier and Jürgen Vollmer — MPI for Dynamics & Self-Organization, Göttingen

We extend the Sinai billiard to a model of three granular disks with minimal capillary interactions. These dissipative interactions lead eventually to a clustered state representing a frozen arrangement of the disks. To study the system in a steady state energy is injected by applying shearing via Lees-Edwards boundary conditions. This model system allows us to explore how the frozen state, which acts as an absorbing state in phase space, influences the dynamics of phase-space structure, invariant measures, and attractors. Surprisingly, the lifetime distribution till a given initial condition reaches the frozen state shows an algebraic distribution, with a possibility that a finite number of initial conditions remain unbounded forever.

DY 29.48 Thu 17:00 Poster A

Fluctuation Dissipation Temperature in a Driven Granular Suspension — •Chih-Wei Peng and Matthias Schröter — Max-Planck-Institute for Dynamics and Self-Organization, Göttingen, Germany

The concepts of statistical mechanics have been widely applied to explain the phenomena observed in granular systems. Granular temperature in particular, is one of the most important quantities in the statistical approach to granular systems. Granular temperature can be defined on dynamical systems, namely, average kinetic energy temperature(T_{kin}) or fluctuation dissipation theorem based temperature(T_{FD})[1]. In our experiment, a torsion pendulum is set up, and one end of the pendulum is immersed into a granular suspension which is driven by water fluidization. By measuring the random torque due to the collision of particles and the dissipation of an external driven torque on the pendulum, we can obtain the energy scale which is related to fluctuation-dissipation temperature (T_{FD}). In addition, this setup can also be used to measure T_{FD} around the fluidization threshold, which can be related to glassy behavior.

[1] G. D'Anna, P. Mayor, A. Barrat, V. Loreto, and Franco Nori: *Nature* **424**, 909 (2003)

DY 29.49 Thu 17:00 Poster A

Transport Coefficients and Speed of Sound of a Granular Fluid from Static Correlation Functions — •Till Kranz[1,2] and Annette Zippelius[1,2] — [1]MPI für Dynamik & Selbstorganisation, Göttingen — [2]Institut für Theoretische Physik, Uni Göttingen

In order to reach a stationary state, granular, i.e., dissipative systems need an external driving. One of the many possible methods is to fluidize the system by a random force. It has been shown that the behavior of such a granular fluid on large length scales is well described by fluctuating hydrodynamics [1]. We exploit this description to extract material properties form event driven simulations.

For equilibrium fluids, the speed of sound, c, is directly related to the long wave length limit of the static structure factor, $S(q)$, via a fluctuation dissipation relation, $c^2 = k_B T/mS(q \to 0)$. We show that a generalized version of this relation also holds for the driven granular fluid. Using this relation, we measure the speed of sound of a granular fluid and find results that agree well with dynamic measurements [2] and with theoretical predictions.

The fluctuations dissipation theorem for equilibrium fluids makes it impossible to extract transport coefficients from static measurements. We show that, in contrast, it is possible to measure the viscosity of a granular fluid from the static current correlator.

[1] T. P. C. van Noije *et al.*, PRE 59, 4326 (1999)
[2] K. Vollmayr-Lee *et al.*, PRE 83, 011301 (2011)

DY 29.50 Thu 17:00 Poster A

Moving grains out of the way — •Jean-François Métayer[1], Annika Döring[1], Mario Scheel[2], and Matthias Schröter[1] — [1]Max Planck Institute for Dynamics and Self-organization, Göttingen, Germany — [2]European Synchrotron Radiation Facility Beamline ID15, Grenoble, France

A recent study on slowly sheared granular media [1] found that the fluctuations of the shear stress could be used to measure the elastic response of the granular medium.

Continuing this study, we made tomographies of a slowly sheared granular bed at ESRF synchrotron in Grenoble. Using particle tracking we were able to access the length of the shear zone, which is necessary to compute elastic moduli of the granular medium. We also visualized the local reorganisation of grains while the bed is sheared. These quantities are presented as a function of the initial packing fraction (before the bed is sheared) and allow more insight in the measurements shown in [1].

[1] J-F. Métayer, D. Suntrup, C. Radin, H. Swinney, and M. Schröter, EPL 93 (2011) 64003

DY 29.51 Thu 17:00 Poster A

Kontaktmodelle mit Zeitverfestigung und numerische Fließortmessung — •Alexander Weuster und Dietrich E. Wolf — Fakultät für Physik und CeNIDE, Universität Duisburg-Essen

Das Fließverhalten von Schüttgütern kann sich mit zunehmender Lagerungszeit verändern. Dieses Phänomen tritt im Alltag z.B. bei Zucker auf, der unter etwas erhöhter Luftfeuchtigkeit gelagert wird: Obwohl er sich zunächst unproblematisch in einen Behälter füllen lässt, bildet sich nach wenigen Tagen Lagerungszeit eine zumindest partiell verbackene Struktur. Mikroskopisch betrachtet bilden sich Festkörperbrücken zwischen den einzelnen Partikeln, die aus dem Partikelmaterial selbst bestehen. Aber auch auskristallierende Fremdpartikel aus einer die Partikel umgebenden Lösung, biologische, oder chemische Prozesse können zu einer zeitlichen Zunahme der Haftkraft im Schüttgut oder Pulver führen.

Wir möchten ein viskoelastisches- und ein elasto-plastisches Kontaktmodell vorstellen, das diese Zeitverfestigung berücksichtigt. Ausgangspunkt ist hierbei die Annahme, dass sich innerhalb einer charakteristischen Zeit (t_c) eine gewisse Haftkraft zwischen den Partikeln aufbaut. Ist t_c klein, spricht man von einem „adhäsionsbestimmten“ Kontakt. Ein großes t_c entspricht hingegen einem „zementierungsbestimmten“ Kontakt. In diesem Fall bilden sich Kristallisationsbrücken zwischen den Partikeln. Die Auswirkungen dieser mikromechanischen Eigenschaft auf das makroskopische Fließverhalten des Pulvers soll anhand von Computersimulationen des Fließorts diskutiert werden.

DY 29.52 Thu 17:00 Poster A

Measuring the configurational temperature in a binary disc packing — •Song-Chuan Zhao and Matthias Schröter — Max-Planck-Institute for Dynamics and Self-Organization, Göttingen,Germany

A statistic mechanics of granular packing has been suggested by analogy to thermodynamic systems [1]. A configurational temperature, called compactivity, is defined as $\partial V/\partial S$. The measurement of the compactivity plays an important role in testing the validity of this theory. A method to measure X is suggested as following: if the Volume probability distribution is Boltzmann like, then the ratio of two overlapping distributions at different configurational temperatures should be exponential. An extension of this method can be used to measure the entropy in a granular packing. McNamara and coworkers apply this method to sphere packing and conclude that the distribution of Voronoi volumes obeys the theoretical prediction [2].

Recently we have found that there are correlations between Voronoi volumes in disc packing [3]. These correlations raise the question on which scale a configurational temperature can be defined uniformly. We present the compactivity measurement of a bi-disperse disc system and show that the compactivity is uniform above a certain scale.

[1] S.F. Edwards and R.B.S. Oakeshott, Physica A, 157 1080 (1989)
[2] Sean McNamara, Patrick Richard, Sbastien Kiesgen de Richter, Grand Le Car and Renaud Delannay, Phys. Rev. E, 80 031301 (2009)
[3] Song-Chuan Zhao, Stacy Sidle, Harry L. Swinney and Matthias Schröter, arXiv:1109.0935

DY 29.53 Thu 17:00 Poster A

multiple shear band formation in granular materials — robabeh moosavi[1], •reza shaebani[2], maniya maleki[1], janos torok[2], and dietrich wolf[2] — [1]Department of Physics, Institute for Ad-

vanced Studies in Basic Sciences (IASBS), Zanjan 45137-66731, Iran — [2]Department of Theoretical Physics, University of Duisburg-Essen, 47048 Duisburg, Germany

We present numerical and experimental evidences for multiple shear band formation in sheared granular materials. A modified Couette cell with a split bottom near the outer cylinder is made rough by gluing glass beads on all boundaries. The cell is filled with the same beads and sheared by slowly rotating the inner cylinder and the attached bottom disk. A wide shear band is mostly observed at the free surface of the material. However, depending on the filling height and grain size, simultaneous shear bands may form near the confining walls and in the middle of the system. By minimizing the rate of energy dissipation, we numerically find similar velocity profiles for intermediate filling heights and relatively large grain sizes.

DY 29.54 Thu 17:00 Poster A

Dynamics of an Intruder in Dense Granular Fluids — •Matthias Grob, Andrea Fiege, and Annette Zippelius — Institut für Theoretische Physik, Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany

We investigate the dynamics of an intruder pulled by a constant force in a dense two-dimensional granular fluid by means of event-driven molecular dynamics simulations. We show how a propagating momentum front develops and compactifies the system when reflected by the boundaries. We then add a frictional force acting on each particle, proportional to the particle's velocity. Frictional motion in an event-driven simulation is implemented which allows us to carry out extensive numerical simulations aiming at the dependence of the intruder's velocity on packing fraction and pulling force. We identify a linear relation for small and a nonlinear regime for high pulling forces.