Section Dynamics and Statistical Physics
Fachverband Dynamik und Statistische Physik (DY)

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Overview of Invited Talks and Sessions

(lecture rooms H2, H3, H5, and H23; Poster D)

Prize Talk

The prize talk (Max Planck Medal) by Prof. Joel Lebowitz takes place Tuesday, 13:00, H1. See the plenary section for the abstract.

Invited Talks

DY 5.1	Mon	14:00–14:30	H2	**Dynamics of Dunes** — •Hans Herrmann
DY 11.1	Tue	9:30–10:00	H2	**A single Josephson junction for atomic Bose-Einstein condensates: Dynamics and finite temperature effects** — •Markus Oberthaler
DY 14.6	Tue	12:30–13:00	H2	**Instabilities and pattern formation in phase-separating fluids** — •Jürgen Vollmer
DY 20.1	Wed	14:00–14:30	H2	**Semiclassical approach to universality in quantum chaos** — Stefan Heusler, •Sebastian Müller, Alexander Altland, Petr Braun, Fritz Haake
DY 25.1	Thu	9:30–10:00	H2	**Surprises in the time-evolution of wave-packets** — •Arnd Bäcker

Invited Talks of internal symposia within DY

DY1 Symposium "Physics of Fracture"

Organization: H. Herrmann (ETH Zürich)

DY 1.1	Mon	9:30–10:00	H2	**Towards a Dynamical Theory of Crack Propagation** — •Itamar Procaccia
DY 1.2	Mon	10:00–10:30	H2	**Scaling properties of fracture surfaces** — •Elisabeth Bouchaud
DY 1.3	Mon	10:30–11:00	H2	**Scaling of Fronts in Gradient Percolation** — •Alex Hansen
DY 1.4	Mon	11:00–11:30	H2	**Fragmentation phenomena** — •Ferenc Kun, Falk Wittel, Hans Herrmann

DY15 Symposium "Finite Size Effects at Phase Transitions"

Organization: W. Janke (Universität Leipzig), W. Selke (RWTH Aachen)

DY 15.1	Tue	14:00–14:30	H2	**Unconventional types of phase transitions due to interplay of finite size and interfacial effects** — •Kurt Binder, Andrey Milchev, Marcus Mueller
DY 15.2	Tue	14:30–15:00	H2	**Successes and limitations of current renormalization group approaches to the study of finite size effects** — •Hans Werner Diehl, Daniel Grüneberg
DY 15.3	Tue	15:00–15:30	H2	**Thermodynamic Casimir Forces** — •Siegfried Dietrich
DY 15.4	Tue	15:45–16:15	H2	**Diversity of critical behavior within a universality class** — •Volker Dohm
DY 15.5	Tue	16:15–16:45	H2	**Spin Dynamics Simulations of Excitations and Critical Dynamics in a Heisenberg Antiferromagnet: Resolution of a controversy via finite size scaling** — •David P. Landau

Invited Talks of joint symposia with other Divisions

Symposium "Nonlinear and Fractional Transport in Complex Systems (SYNF)"

See SYNF for the full program of the symposium.

SYNF 1.1	Wed	14:45–15:15	H1	**Depolymerization of microtubules by kinesins** — •Jonathon Howard
SYNF 1.2	Wed	15:15–15:45	H1	**Hydra Molecular Network Reaches Criticality at the Symmetry-Breaking Axis-Defining Moment** — Jordi Soriano, Cyril Colombo, •Albrecht Ott
SYNF 1.3	Wed	15:45–16:15	H1	**Morphogen Transport in Epithelia** — •Tobias Bollenbach
SYNF 1.4	Wed	16:15–16:45	H1	**Flocks, Herds and Schools - Physical Models of Animal Motion** — •Udo Erdmann
SYNF 1.5	Wed	16:45–17:15	H1	**Nonlinear transport processes in large-scale ecological networks** — •Bernd Blasius

Symposium "Bioinspired Materials (SYBM)"

See SYBM for the full program of the symposium.

SYBM 1.1	Thu	9:30–10:00	H1	**Using Ice to Mimic Nacre: From Structural Materials to Artificial Bone** — •A. P. Tomsia, S. Deville, E. Saiz
SYBM 1.2	Thu	10:00–10:30	H1	**On the structure of biogenic $CaCO_3$** — •B. Pokroy
SYBM 1.3	Thu	10:30–11:00	H1	**Bio-Inspired Hybrid Materials from Block Copolymer Assemblies and Nanoparticle Co-assemblies** — •U. Wiesner
SYBM 1.4	Thu	11:15–11:45	H1	**Bio-Inspired Organic-inorganic Hybrid Materials** — •U. Steiner
SYBM 1.5	Thu	11:45–12:15	H1	**Structural, Nanomechanical, and Nanotribological Characterization of Human Hair Using Atomic Force Microscopy and Nanoindentation** — •Bharat Bhushan

Symposium "Entanglement (SYEN)"

See SYEN for the full program of the symposium.

SYEN 1.1	Thu	14:00–14:30	H1	**Probabilities (and more) from entanglement** — •Wojciech Zurek
SYEN 1.2	Thu	14:30–15:00	H1	**Entanglement and the Foundations of Statistical Mechanics** — •Sandu Popescu
SYEN 1.3	Thu	15:00–15:30	H1	**Universality and classical simulation of quantum computation** — Maarten van den Nest, Wolfgang Dür, Akimasa Miyake, Guifre Vidal, •Hans Briegel
SYEN 1.4	Thu	15:30–16:00	H1	**Towards the convex roof of multipartite entanglement measures** — •Andreas Osterloh, Jens Siewert, Robert Lohmayer, Armin Uhlmann
SYEN 1.5	Thu	16:00–16:30	H1	**Decoherence induced by interacting quantum spin baths** — •Rosario Fazio
SYEN 1.6	Thu	16:30–17:00	H1	**Sweep a qubit to learn about its environment** — •Peter Hänggi, Martijn Wubs, Keiji Saito, Roland Doll, Sigmund Kohler, Yosuke Kayanuma

Symposium "Polyelectrolytes (SYPE)"

See SYPE for the full program of the symposium.

SYPE 2.1	Thu	14:00–14:30	H37	**Coulomb and Flory: Fathers of SONS. Polyelectrolytes in Self Organized Nano Systems** — •Martien Cohen Stuart
SYPE 2.7	Thu	16:00–16:30	H37	**Bundling Phenomena in Semiflexible Polyelectrolytes** — •Christian Holm, Mehmet Sayar, Berk Hess
SYPE 3.1	Fri	10:30–11:00	H1	**Behaviour of polyelectrolyte solutions under confinement** — •Dominique Langevin, César Marquez, Heinig Peter, Dan Qu
SYPE 3.4	Fri	11:30–12:00	H1	**Polymers at Surfaces: Sticking and Gliding** — •Roland Netz

Sessions

DY 1.1–1.6	Mon	9:30–12:00	H2	**Internal Symposium: Physics of fracture**
DY 2.1–2.6	Mon	10:30–12:00	H3	**Time-delayed feedback and neural networks**
DY 3.1–3.4	Mon	12:00–13:00	H2	**Critical phenomena and phase transitions**
DY 4.1–4.4	Mon	12:00–13:00	H3	**Statistical physics of complex networks I**
DY 5.1–5.7	Mon	14:00–16:00	H2	**Fluid dynamics I**
DY 6.1–6.7	Mon	14:30–16:15	H3	**Statistical physics of complex networks II**
DY 7.1–7.7	Mon	14:30–16:15	H5	**Statistical physics far from thermal equilibrium**
DY 8.1–8.7	Mon	16:15–18:00	H2	**Quantum dynamics, decoherence and quantum information**
DY 9.1–9.6	Mon	16:30–18:00	H3	**Statistical physics in biological systems**
DY 10.1–10.5	Mon	16:30–17:45	H5	**Growth processes and surface properties**
DY 11.1–11.5	Tue	9:30–11:00	H2	**Superfluidity and Bose-Einstein condensation**
DY 12.1–12.8	Tue	10:00–12:00	H3	**Statistical physics (general)**
DY 13.1–13.11	Tue	10:00–13:00	H23	**Glass I (joint session with DF)**
DY 14.1–14.6	Tue	11:15–13:00	H2	**Fluid dynamics II**
DY 15.1–15.5	Tue	14:00–16:45	H2	**Internal Symposium: Finite size effects at phase transitions**
DY 16.1–16.8	Tue	14:30–16:30	H3	**Brownian motion and transport I**
DY 17.1–17.10	Tue	14:30–17:50	H23	**Glass II (joint session with DF)**
DY 18.1–18.6	Tue	16:45–18:15	H3	**Brownian motion and transport II**
DY 19.1–19.6	Tue	17:00–18:30	H2	**Finite size effects at phase transitions I (session accompanying the symposium of the same name)**
DY 20.1–20.5	Wed	14:00–15:30	H2	**Quantum chaos I**
DY 21.1–21.6	Wed	14:00–15:30	H3	**Finite size effects at phase transitions II (session accompanying the symposium of the same name)**
DY 22.1–22.6	Wed	15:45–17:15	H2	**Granular matter / contact dynamics I**
DY 23.1–23.6	Wed	15:45–17:15	H3	**Finite size effects at phase transitions III (session accompanying the symposium of the same name)**
DY 24.1–24.62	Wed	16:00–18:00	Poster D	**Poster I**
DY 25.1–25.5	Thu	9:30–11:00	H2	**Quantum chaos II**
DY 26.1–26.10	Thu	10:30–13:00	H3	**Ferrofluids / Liquid crystals**
DY 27.1–27.6	Thu	11:15–12:45	H2	**Quantum chaos III**
DY 28.1–28.10	Thu	14:00–16:30	H2	**Nonlinear stochastic systems**
DY 29.1–29.7	Thu	14:00–15:45	H3	**Soft matter**
DY 30.1–30.69	Thu	16:00–18:00	Poster D	**Poster II**
DY 31.1–31.11	Fri	10:15–13:00	H2	**Granular matter / contact dynamics II**
DY 32.1–32.6	Fri	10:15–11:45	H3	**Synchronization**
DY 33.1–33.5	Fri	12:00–13:15	H3	**Nonlinear dynamics and pattern formation**

Annual General Meeting of the Section Dynamics and Statistical Physics

Thursday 18:30–19:30 H2

Tagesordnung:

- Bericht des Fachverbandsleiters
- Tagungsnachlese
- Verschiedenes

DY 1: Internal Symposium: Physics of fracture

Time: Monday 9:30–12:00 Location: H2

Invited Talk DY 1.1 Mon 9:30 H2

Towards a Dynamical Theory of Crack Propagation — •Itamar Procaccia — The Weizmann Institute of Science, Rehovot 76100, Israel

The failure of amorphous materials under stress often results in a crack, whose propagation is described by the dynamics of the free boundary between material and void. Due to the stress concentration (above the normal yield stress of the material) one must take into account plastic deformations. In this lecture I will describe the derivation of an Eulerian theory which respects all the conservation laws and all the symmetries, allowing a consistent description of the dynamics of free boundaries in elasto-plastic media. The interesting predictions of this theory will be exemplified in the context of a few examples.

Invited Talk DY 1.2 Mon 10:00 H2

Scaling properties of fracture surfaces — •Elisabeth Bouchaud — Fracture Group, SPCSI, CEA-Saclay, France

For very different materials, the morphology of fracture surfaces reveals anisotropic scale invariance properties which can be described with two sets of parameters: roughness exponents and characteristic length scales, measured either along the direction of crack propagation, or perpendicularly to it. If characteristic length scales depend on the material, its microstructure, and the external loading, roughness exponents, on the contrary, are *universal*. The same roughness exponents are indeed observed for metallic alloys and for glasses, for example, albeit at length scales three orders of magnitude smaller in the latter case. An exception, however, was recently found for sintered glasses, which exhibit the same kind of scale invariance properties, but with a different set of roughness exponents. A model depicting fracture in these materials as the quasi static propagation of an elastic line (the crack front) through an array of randomly distributed obstacles (the microstructure) can reproduce these observations. It is suggested that this model is valid when the roughness measurements are performed at length scales much larger than the damaged zone size, which is the case for sintered glasses. On the contrary, roughness measurements for metallic alloys and silicate glasses are performed within the damaged zone. The critical exponents observed in this case, as well as in the case of metallic materials, are hence conjectured to reflect damage screening occurring at length scales smaller than the process zone size.

Invited Talk DY 1.3 Mon 10:30 H2

Scaling of Fronts in Gradient Percolation — •Alex Hansen — Inst. for fysikk, NTNU, Trondheim, Norway

Recent advances in uncovering the intricacies of the scaling properties of fracture surfaces have necessitated a careful rethinking of concepts that by now should have been quite well understood: fractals, self affinity, multiaffinity, multifractals. We use the well-studied example of percolation in a gradient in the occupation probability to clarify the concepts. We then proceed to describe fracture surfaces using these concepts.

Invited Talk DY 1.4 Mon 11:00 H2

Fragmentation phenomena — •Ferenc Kun[1], Falk Wittel[2], and Hans Herrmann[2] — [1]Department of Theoretical Physics, University of Debrecen, P.O.Box:5 H-4010 Debrecen, Hungary — [2]IfB, HIF, E18, ETH, Hönggerberg, 8093 Zürich, Switzerland

Fragmentation, i.e. the breaking of particulate materials into smaller pieces is abundant in nature and underlies various types of industrial processes. Fragmentation usually occurs when solids are subject to energetic loading in the form of explosion or impact. Fragmentation phenomena can be observed on a broad range of length scales from the collisional evolution of asteroids in the Solar system through geological phenomena and the usage of explosives in mining down to the breakup of fullerenes and heavy nuclei by energetic collisions.

During the last ten years much progress had been achieved in the understanding of fragment mass and velocity distributions as a function of the imparted energy, the geometry and material properties of the fragmenting system. We present an overview of the most important recent experimental and theoretical results which revealed the background of the emergent universal behavior of fragmenting systems. As a specific example we consider the breakup of shells and demonstrate that beyond the well known scaling laws of fragmentation phenomena the shape of fragments also show scaling behavior.

DY 1.5 Mon 11:30 H2

Continuum theory of fracture — •Denis Pilipenko, Robert Spatschek, and Efim Brener — Institut für Festkörperforschung, Forschungszentrum Jülich, 52425 Jülich

A macroscopic theory of fracture in the spirit of nonequilibrium growth processes in pattern formation is discussed. It is commonly believed that crack growth is dictated by microscopic details in the vicinity of the tip. Nevertheless, our continuum theory predicts many important features of fracture. The model is based only on the dynamical theory of elasticity, surface energy and elastically induced phase transitions between a hard and soft solid phase, which corresponds to a nonconserved order parameter. A sharp interface model of crack propagation based on a multipole expansion technique to solve this problem numerically is presented. Here we extend our model to crack growth with a conserved order parameter which is driven by surface diffusion. We obtain steady state solutions with a self-consistently selected propagation velocity and shape of the crack, provided that elastodynamic effects are taken into account. Also, we find a saturation of the steady state crack velocity below the Rayleigh speed, tip blunting with increasing driving force and a tip splitting instability above a critical driving force.

DY 1.6 Mon 11:45 H2

Minimal Phase-Field Modeling For Fast Crack Propagation — •Clemens Müller-Gugenberger, Robert Spatschek, and Efim Brener — Institut für Festkörperforschung, Forschungszentrum 52425 Jülich

Usually, fracture is understood at the microscopic level by the breaking of bonds between atoms at sharp crack tips. However, in many materials, one observes rounded crack tips and a macroscopic description becomes possible. Such a description should not only determine the crack speed but also the crack shape self-consistently.

We developed a minimal model in the framework of a continuum theory of pattern formation. It is based on the Grinfeld instability and overcomes the usual finite time cusp singularity by incorporating elastodynamic effects which restore the selection of the steady state tip radius and velocity. The phase-field method is particularly suited for solving this moving free boundary problem.

We show that with large-scale computations, the quantitative results of this fully dynamical approach can be compared to approaches based on sharp-interface steady-state methods. The model encompasses many generic features of crack growth such as a tip speed well below the Rayleigh speed and tip splitting for high applied tension.

DY 2: Time-delayed feedback and neural networks

Time: Monday 10:30–12:00 Location: H3

DY 2.1 Mon 10:30 H3

Refuting the odd number limitation of time-delayed feedback control — Bernold Fiedler[2], Valentin Flunkert[1], Marc Georgi[2], Philipp Hövel[1], and •Eckehard Schöll[1] — [1]Institut für Theoretische Physik, Technische Universität Ber lin, Hardenbergstr. 36, 10623 Berlin — [2]Institut für Mathematik I, Freie Universität Berlin, Arnimalle 2-6, 14195 Berlin

We refute an often invoked theorem which claims that a periodic orbit with an odd number of real Floquet multipliers greater than unity can never be stabilized by time-delayed feedback control in the form proposed by Pyragas [1]. Using a generic normal form, we demonstrate that the unstable periodic orbit generated by a subcritical Hopf bifurcation, which has a single real unstable Floquet multiplier, can in fact be stabilized. We derive explicit analytical conditions for the control matrix in terms of the amplitude and the phase of the feedback control gain, and present a numerical example. Our results are of relevance for a wide range of systems in physics, chemistry, technology, and life sciences, where subcritical Hopf bifurcations occur.

[1] B. Fiedler, V. Flunkert, M. Georgi, P. Hövel, and E. Schöll: *Refuting the odd number limitation of time-delayed feedback control*, Phys. Rev. Lett. (2006), submitted http://arxiv.org/abs/nlin.CD/0609056

DY 2.2 Mon 10:45 H3

Control of unstable fixed points by extended time-delayed feedback — •Thomas Dahms, Philipp Hövel, and Eckehard Schöll — Institut für Theoretische Physik, TU Berlin, Hardenbergstr. 36, D-10623 Berlin

Time-delayed feedback methods can be used to control unstable periodic orbits as well as unstable steady states. We present an application of extended time delay autosynchornization introduced by Socolar et al. to an unstable focus. This system represents a generic model of an unstable steady state which can be found for instance in a Hopf bifurcation. In addition to the original controler design, we investigate effects of control loop latency and a band pass filter on the domain of control. Furthermore, we consider coupling of the control force to the system via a rotational coupling matrix parametrized by a variable phase. We present an analysis of the domain of control and support our results by numerical calculations.

DY 2.3 Mon 11:00 H3

Controlling the Phase in a Neuronal Feedback Loop Through Asymmetric Temporal Delays — Sebasitan Brandt[1], •Axel Pelster[2], and Ralf Wessel[1] — [1]Department of Physics, Campus Box 1105, Washington University in St. Louis, MO 63130-4899, USA — [2]Fachbereich Physik, Campus Duisburg, Universität Duisburg-Essen, 47048 Duisburg, Germany

We consider the effect of asymmetric temporal delays in a system of two coupled Hopfield neurons. For couplings of opposite signs, a limit cycle emerges via a supercritical Hopf bifurcation when the sum of the delays reaches a critical value. We show that the angular frequency of the limit cycle is independent of an asymmetry in the delays. However, the delay asymmetry determines the phase difference between the periodic activities of the two components. Specifically, when the connection with negative coupling has a delay much larger than the delay for the positive coupling, the system approaches in-phase synchrony between the two components. Employing variational perturbation theory, we achieve an approximate analytical evaluation of the phase shift, in good agreement with numerical results.

DY 2.4 Mon 11:15 H3

Oscillatory associative memory in an electrochemical system — •Robert Hölzel and Katharina Krischer — TU München, Physik Department (E 19), James Franck Str. 85748 Garching

A system of globally coupled Kuramoto oscillators with a weak time-dependent coupling can act as a Hopfield-like neural network with the pattern information stored in the relative phase shifts of the oscillators [Hoppensteadt FC Izhikevich EM, PHYSICAL REVIEW LETTERS 82 (14): 2983-2986 APR 5 1999].

We investigate the Hopfield-like properties of a realistic network of electrochemical oscillators with a time-dependent, weak global coupling through the electric field. Averaged evolution equations for the phase shifts are derived based on phase response curves.

Our results indicate that pattern recognition with two memorized patterns is possible in the realistic system without qualitative modification of constraints compared to the Kuramoto model. However, further refinement of the time-dependent coupling is necessary for general pattern recognition with more than two memorized patterns.

DY 2.5 Mon 11:30 H3

Stable Irregular Dynamics in Complex Neural Networks — •Sven Jahnke, Raoul-Martin Memmesheimer, and Marc Timme — Network Dynamics Group, Max Planck Institute for Dynamics and Self-Organization, and Bernstein Center for Computational Neuroscience (BCCN), Bunsenstrasse 10, 37073 Göttingen

Models mimicking the 'ground state' of neural networks in the cortex exhibit highly irregular spiking dynamics of individual neurons and weak cross-correlations between the neurons. In their mean field study v.Vreeswijk and Sompolinsky (Science, 1996) suggest that this irregular dynamics in general is chaotic.

Here we investigate this irregular dynamics in finite networks keeping track of all individual spike times. For delayed, purely inhibitory interactions we give strong evidence that the irregular dynamics is not chaotic but in fact stable and convergent towards periodic orbits.

Moreover, we show that every generic periodic orbit of these dynamical systems is stable. These results indicate that chaotic and stable dynamics are equally capable of generating irregular neuronal activity. We investigate possible transitions to chaotic dynamics by changing features of the neurons and their interactions.

DY 2.6 Mon 11:45 H3

Dynamics of neural cryptography — •Andreas Ruttor[1], Ido Kanter[2], and Wolfgang Kinzel[1] — [1]Institut für Theoretische Physik, Universität Würzburg, Am Hubland, 97074 Würzburg — [2]Minerva Center and Department of Physics, Bar Ilan University, Ramat Gan 52900, Israel

Synchronization of neural networks has been used for novel public channel protocols in cryptography. In the case of Tree Parity Machines the dynamics of both bidirectional synchronization and unidirectional learning is driven by attractive and repulsive stochastic forces. Thus it can be described well by a random walk model for the overlap between participating neural networks. For that purpose transition probabilities and scaling laws for the step sizes are derived analytically. Both these calculations as well as numerical simulations show that bidirectional interaction leads to full synchronization on average. In contrast, successful learning is only possible by means of fluctuations. Consequently, synchronization is much faster than learning, which is essential for the security of the neural key-exchange protocol.

DY 3: Critical phenomena and phase transitions

Time: Monday 12:00–13:00 Location: H2

DY 3.1 Mon 12:00 H2

Tricritical dynamix at the demixing-superfluid transition in ^{3}He-^{4}He mixtures — •Reinhard Folk[1] and Günter Moser[2] — [1]Institute fot theoretical Physics, University of Linz, Linz Austria — [2]Department for Material Sciences, University of Salzburg, Salzburg, Austria

We calculate in two loop order the dynamical critical behavior at the tricritical point occuring in ^{3}He-^{4}He mixtures. Model F$'$ introduced by Siggia and Nelson [Phys. Rev. B **15**, 1427 (1977)] - already problematic in one loop order - is shown to lead to a divergence of the mass diffusion D in contradiction to experiments. Within the complex symmetric version this model (model E$^{\star\prime}$) the dynamical critical exponents of the kinetic coefficients can be calculated exactly leading to a mass diffusion going to zero at the tricitical point as $D(t_X) \sim t_X^{1/2}$ (t_X the relative temperature distance at constant concentration) and the thermal diffusion ratio $k_T \sim t_X^{-1}$ diverges proportional to the concentration susceptibility in the experimental region.

Supported by the Austrian Fonds zur Förderung der wissenschaftlichen Forschung, project No P18592

DY 3.2 Mon 12:15 H2

Improved Borel summation of critical exponents and amplitude ratios of the $d = 3$, $n = 2$ universality class — •Daniel Cremer and Volker Dohm — Institut für Theoretische Physik, RWTH Aachen

Borel summations are performed for the critical exponents α and γ of the $d = 3$, $n = 2$ universality class on the basis of seven-loop perturbation series of the φ^4 field theory with an n component order parameter in d dimensions. A new extremum criterion is introduced that reduces the error bars compared to earlier Borel summations [1]. Furthermore, Borel resummed results are presented for the universal amplitude ratios $(1 - A^+/A^-)/\alpha$, R_ξ^+, and R_ξ^T. Our results are compared with experimental data for the lambda transition of ^{4}He [2] and with numerical data for XY type lattice models [3,4].

[1] R. Guida, J. Zinn-Justin, J. Phys. A 31, 8103 (1998).
[2] J.A. Lipa et al., Phys. Rev. B 68, 174518 (2003).
[3] M. Campostrini et al., Phys. Rev. B 74, 14450 (2006).
[4] M. Hasenbusch, J. Stat. Mech. P08019 (2006).

DY 3.3 Mon 12:30 H2

Percolation of Vortex Networks in the $U(1)$ Lattice Higgs Model — •Sandro Wenzel[1], Adriaan Schakel[2], Elmar Bittner[1], and Wolfhard Janke[1] — [1]Institut für Theoretische Physik, Universität Leipzig, Postfach 100920, 04109 Leipzig — [2]Institut für Theoretische Physik, Freie Universität Berlin, Arnimallee 14, 14195 Berlin

We study the properties of vortex networks in the $U(1)$ lattice Higgs model in $d = 3$ dimensions. Specifically, we investigate network percolation properties at a point in the parameter space of the theory where we see a distinct crossover from confining to non-confining behaviour in local observables, which is not accompanied by a thermodynamic phase transition. Recently, we argued that this crossover can be regarded as a Kertèsz line [1]. The aim of the present study is to explicitly determine the scaling behaviour of those global clusters and to give direct evidence of our previous argument. To get independent and unbiased results for critical exponents we have developed an automated tool in conjunction with multihistogramm reweighting which maximises the data collapse quality. For the clusters under consideration here, we get scaling exponents that are compatible with ordinary percolation theory.

[1] S. Wenzel, E. Bittner, W. Janke, A.M.J Schakel, A. Schiller, Phys. Rev. Lett. **95** (2005) 051601.

DY 3.4 Mon 12:45 H2

Influence of long-range correlated surface and near the surface disorder on the process of adsorption of long-flexible polymer chains — •Zoryana Usatenko[1,2] and Jens-Uwe Sommer[1,3] — [1]Institute of Polymer Research Dresden,01069 Dresden, Germany — [2]Institute for Condensed Matter Physics, NASU, 79011 Lviv, Ukraine — [3]Institute for Theoretical Physics, Technische Universitat Dresden, 01062 Dresden, Germany

The influence of long-range correlated surface and decaying near surface disorder with correlation function for the defects of the form $\frac{e^{-z/\xi}}{r^a}$, where $a < d - 1$ and z being the coordinate in the direction perpendicular to the surface and r denotes the distance parallel to the surface. We investigate the process of adsorption of long-flexible polymer chains with excluded volume interactions on a "marginal"and attractive wall in the framework of renormalization group field theoretical approach up to first order of perturbation theory in a double(ϵ,δ)- expansion ($\epsilon = 4 - d$,$\delta = 3 - a$) for the semi-infinite $|\phi|^4$ $O(m, n)$ model with the above mentioned type of surface and near the surface disorder in the limit $m, n \to 0$. We obtained series for bulk and the whole set of surface critical exponents, characterizing the process of adsorption of long-flexible polymer chains at the surface. The polymer linear dimensions parallel and perpendicular to the surface and the behavior of monomer density profiles and the fraction of adsorbed monomers at the surface and in the interior are studied.

DY 4: Statistical physics of complex networks I

Time: Monday 12:00–13:00 Location: H3

DY 4.1 Mon 12:00 H3

Ranking and Community detection in unweighted networks — •Andrea Baldassarri[1], Ciro Cattuto[1,2], Vito Servedio[1,2], Vittorio Loreto[1], Miranda Grahl[3], Andreas Hotho[3], Christoph Schmitz[3], and Gerd Stumme[3] — [1]Dipartimento di Fisica, Università La Sapienza, P.le A. Moro 2, 00185 Roma, Italy — [2]Museo Storico della Fisica e Centro Studi e Ricerche Enrico Fermi, Compendio Viminale, 00184 Rome, Italy — [3]Knowledge & Data Engineering Group, University of Kassel, Wilhelmshöher Allee 73, 34121 Kassel, Germany

Networks are a way to encode relational informations between many interacting entities (nodes). This information can be used in different ways in order to capture relevant features of the system. Site ranking algorithms, as for instance the PageRank algorithm, use topological informations embedded in a directed network to infer the relative importance of nodes. Recently, we introduced a ranking procedure, the FolkRank algirthm, for a new class of social annotation networks, so-called folksonomies. Differently to PageRank, it allows for undirected networks.

On the other hand, community detection algorithms try to detect relation similarities at a higher level. An example is the Markov Clustering algorithm (MCL), in which a renormalization-like scheme is used in order to detect communities of nodes in weighted networks.

In this paper, we will analyse the commonalities ot the two approaches. In particular we identify the relationship between ranking and community building in folksonomies.

DY 4.2 Mon 12:15 H3

Applying direct weighted networks to recommendation systems — •Stefano Battiston, Frank Walter, and Frank Schweitzer — Chair of Systems Design, ETH Zurich, Kreuzplatz 5, 8032 Zurich, Switzerland

Models of large evolving social networks find today numerous applications in on-line web services, in particular for recommendation systems. We model an evolving weighted directed network in which agents ask for recommendations to their peers about a set of items. A node represents an agent with expertise in a specific domain and with heterogenous preferences (summarized in a profile), while the weight of a link represents the trust of an agent towards another one. Differently from other network models, here the weights of the outgoing links of a node evolve according to a utility function of the node. By means

of mean field approximations, we derive an expression for the performance of the system as a function of the frequency and heterogeneity of profiles across agents. We find that the critical parameters for the performance of the system are network density, preference heterogeneity among agents, and expertise sparseness. The mean-field approximation leads to accurate predictions in a broad range of these parameters and provides useful constraints for the design of real applications.

DY 4.3 Mon 12:30 H3

Generating random networks with arbitrary two-point correlations — •Sebastian Weber and Markus Porto — Institut für Festkörperphysik, Technische Universität Darmstadt, Hochschulstr. 8, 64289 Darmstadt, Germany

Random networks are heavily used as null models to investigate properties of complex networks. We describe a generator of two-point correlated undirected random networks without self- or multiple-connections among vertices [1]. With the goal to systematically investigate the influence of two-point correlations, we develop a formalism to construct a joint degree distribution $P(k, k')$ which allows to fix an arbitrary degree distribution $P(k)$ and an average nearest neighbor function $k_{\mathrm{nn}}(k)$ simultaneously. The formalism is demonstrated with scale-free networks ($P(k) \propto k^{-\gamma}$) and empirical complex networks ($P(k)$ taken from graph) as an example. Finally, we introduce the notion of an annealed graph which allows a graph to be represented in a mean-field like manner.

[1] S. Weber and M. Porto, in preparation

DY 4.4 Mon 12:45 H3

Graphpartitioning and modularity of graphs with arbitrary degree distribution — •Jörg Reichardt[1] and Stefan Bornholdt[2] — [1]Universität Würzburg, Institut für Theoretische Physik III, Am Hubland, 97074 Würzburg — [2]Universität Bremen, Institut für Theoretische Physik, Otto-Hahn-Allee, 28359 Bremen

We solve the graph bi-partitioning problem in dense random graphs with arbitrary degree distribution using the replica method. We find the cut-size to scale universally with $\langle\sqrt{k}\rangle$, regardless of the degree distribution. In contrast, earlier results studying the problem only in graphs with a Poissonian degree distribution had found a scaling with $\sqrt{\langle k\rangle}$ [Fu and Anderson, J. Phys. A: Math. Gen. **19**, 1986], which, however, does not generalize to other degree distributions. The new scaling also applies to the problem of q-partitioning. Further, the result can be used to find expectation values of an important quality measure for graph clusterings, namely the modularity Q [Newman and Grivan, Phys. Rev. E, **69**, 2004] , which allows for assessing the statistical significance of the output of community detection or graph clustering algorithms.

DY 5: Fluid dynamics I

Time: Monday 14:00–16:00 Location: H2

Invited Talk DY 5.1 Mon 14:00 H2

Dynamics of Dunes — •Hans Herrmann — ETH, Zürich, Switzerland

Dunes exist along coasts, in deserts and also on other planets like Mars. They are aerodynamic instabilities formed on free granular surfaces. By formulating a set of equations of motion for the height of the surface, the sand flow and the shear stress of the wind it is possible to describe the formation and evolution of dunes. Using adecuate boundary conditions one gets quantitative agreement with field measurements. Including a further equation for the growth of vegetation one can also calculate dune fixation and observe the transition between croissant-shaped "barchan" dunes and parabolic dunes. Inserting the parameters for Mars also the recently observed shapes of Mars dunes can be reproduced.

DY 5.2 Mon 14:30 H2

Development of a sphere-anemometer for measuring wind velocities in the open air test site — •Bianca Schulte, Michael Hölling, Stephan Barth, and Joachim Peinke — Institut für Physik, Universität Oldenburg

In nature wind rarely occurs in a laminar form, but the wind flow is mostly turbulent. Therefore, it is necessary to use a setup with short response time to measure the current wind velocity. On the other hand the setup has to withstand the harsh conditions of an open air test site. The conventional cup-anemometer often used in an open air situation has the drawback that the response time at increasing and decreasing wind velocity is different. This asymmetric inertia of the anemometer leads to a wrong averaging of the current wind velocity. Conversely the fast responding hot wire anemometer can not be utilized in long term free field measurements because of its aging and vulnerability of the filigree wire.

A new kind of anemometer, the sphere-anemometer, is presented to overcome these problems. This kind of anemometer principle relies on drag acting on a sphere which is fixed to the end of a flexible rod. The deflection of the rod gives a measure for the force acting on the sphere and is measured by means of a light pointer. In wind tunnel measurements we compared the three devices in a wake configuration. The signals taken from the different setups are opposed via statistical methods.

DY 5.3 Mon 14:45 H2

Correlation measurements of temperature and velocity in turbulent flows — •Marino Beenhakker, Michael Hölling, Stephan Barth, Marco Munzel, Joachim Peinke, and Achim Kittel — Institut für Physik, Universität Oldenburg

The knowledge of the statistics of velocity and temperature fluctuations at a certain position in turbulent flow is important for the development of theory on turbulence. Two different sensors are presented to measure flow velocity and temperature of fluids.

A Laser-Cantilever-Anemometer (LCA) detects the flow velocity by means of the deflection of a microscopic cantilever. The measurement principle is predestined to be combined with a temperature measurement because in contrast to a hot wire anemometer the fluid is not heated. The high-speed thermometer used is based on submicrometer-size thermocouples. The thermocouple is formed at the tip of a glass-micropipette with a platinum core and a coating of gold. Both sensors are embedded in waterproof shielded enclosures which both include a preamplification circuit. These type of sensors are able to measure with high spatial and temporal resolution and small crosstalk which is necessary for correlation measurements.

The characterization features of both sensors are discussed and compared with other methods.

DY 5.4 Mon 15:00 H2

Vertically Correlated Signals in Turbulent Windfields — •Thomas Laubrich and Holger Kantz — Max-Planck-Institut für Physik Komplexer Systeme, Nöthnitzer Str. 38, 01187 Dresden

The wind velocities at different points in the atmosphere are highly spatial correlated. The understanding of turbulent wind fields and its correlated structures plays an important role for atmospheric applications, e.g. the design of wind turbines. The focus is put on the exchange of spatial-temporal structures in the Prandtl Layer using data collected at a windmast with cup-anemometers installed at different altitudes. Examining the cross-correlation between the wind speeds at different altitudes helps us to gather information about the nature of highly correlated signals.

DY 5.5 Mon 15:15 H2

Beitrag abgesagt — •XXX XXX —

DY 5.6 Mon 15:30 H2

Gas Flow through Nanopores — •Simon Grüner and Patrick Huber — Saarland University, Saarbrücken, Germany

We present gas flow experiments on both narrow capillaries and silicon membranes which are permeated by a bundle of parallel, tubular channels of approx. 10nm diameter. Applying pressures between 1 and 10^{-5}bar this arrangement allows us to study flows of compressible fluids over a wide range of Knudsen numbers, Kn, which refers to the ratio of the mean free path λ to the channel diameter. We find for both helium and argon gas flow the expected breakdown of continuum-like behavior at $Kn \approx 0.45$. At higher Kn, on the other hand, the flow

dynamics is in perfect agreement with a Knudsen diffusion-like particle transport. This is confirmed by measurements of temperature and molar mass dependencies of the diffusion coefficient D.

In our latest experiments we've been probing the influence of pore wall modification on the helium gas diffusion through the nanopores via condensing monolayers of argon at $T = 30$K.

DY 5.7 Mon 15:45 H2

On the nonlinear dynamics of a sonoluminescing bubble — •Joachim Holzfuss — Institut für Angewandte Physik, TU Darmstadt, Schlo8gartenstr. 7, 64289 Darmstadt

A bubble in water is driven by ultrasound. In a small parameter region strong nonlinear oscillations are observed that give rise to the emission of ultrashort light pulses, termed sonoluminescence (SBSL). The parameter space is bounded by several instability mechanisms which are discussed in detail. Recent results including period doubled unisotropic emissions, rescaling of stability boundaries and nobel gas - free stable SBSL are reported.

DY 6: Statistical physics of complex networks II

Time: Monday 14:30–16:15 Location: H3

DY 6.1 Mon 14:30 H3

Fluctuation-dissipation relations in complex networks — Agata Fronczak, Piotr Fronczak, and •Janusz Holyst — Faculty of Physics and Center of Excellence for Complex Systems Research, Warsaw University of Technology, Koszykowa 75, PL-00-662 Warsaw, Poland

In this paper, we study fluctuations over several ensembles of maximum-entropy random networks. We derive several fluctuation-dissipation relations characterizing the susceptibilities of different networks to changes in external fields. In the case of networks with a given degree sequence, we argue that the scale-free topologies of real-world networks may arise as a result of the self-organization of real systems into sparse structures with low susceptibility to random external disruptions. We also show that the ensembles of networks with a given degree sequence and networks characterized by two-point correlations are equivalent to random networks with hidden variables.

DY 6.2 Mon 14:45 H3

Ising model on two connected Barabasi-Albert networks — •Krzysztof Suchecki and Janusz Hołyst — Faculty of Physics and Center of Excellence for Complex Systems Research, Warsaw University of Technology, Koszykowa 75, PL-00-662 Warsaw, Poland

We have investigated analytically the behavior of Ising model on two connected Barabasi-Albert networks. Depending on the temperature and the number of inter-network connections, the system can order in one or two possible phases. In the first phase both networks are ordered paralelly. In the second phase there is a ferromagnetic order inside each networks and antiparallel order between them.

At low temperatures both phases can exist depending on initial conditions. At a certain critical temperature Tc-, the antiparallel state becomes unstable and one of the networks reverses its magnetization. This is a first order phase transition. At a higher temperature Tc+ the networks do not maintain common ordering, and the system becomes paramagnetic. This is a standard second order phase transition.

Both critical temperatures Tc- and Tc+ depend on network size and internetwork connections ratio p, defined as amount of internetwork links to intranetwork links. While Tc+ increases with p in linear fashion, the dependence Tc- on p is much more complex, but strictly decreasing. At p=1 the temperature Tc-=0.

Analytic calculations of critical temperatures, based on a mean field approach, are in qualitative agreement with Monte Carlo simulations of above systems.

DY 6.3 Mon 15:00 H3

Evolution of a Population of Boolean Networks — •Tamara Mihaljev and Barbara Drossel — Institut für Festkörperphysik, Technische Universität Darmstadt, Deutschland

Boolean network models share several dynamical features with real genetic regulatory networks, although they are much simpler. Studying the evolution of such models may therefore help to gain insights into how evolutionary forces shape real genetic networks. Starting with a population of random Boolean networks with canalyzing update functions, we obtain subsequent generations of this population by producing offspring according to the fitness criterion "robustness" (i.e. the probability that an attractor remains stable under small perturbations), and by performing in some offspring mutations that change the logical structure and the topology of the networks. The fitness landscape has a huge neutral space with maximum fitness. We study the features of the evolutionary process and the properties of the evolved populations as function of the mutation rate and the strength of selection. Quantities investigated are the speed of evolution, the homogeneity of the population, and the mean and the maximum fitness of the population.

DY 6.4 Mon 15:15 H3

Scaling and criticality in finite dynamical networks at the SP limit — •Thimo Rohlf[1], Natali Gulbahce[2], and Christof Teuscher[3] — [1]Santa Fe Institute, 1399 Hyde Park Road, Santa Fe, NM 87501, USA — [2]LANL, Center for Nonlinear Studies, MS B258, Los Alamos, NM 87545, USA — [3]LANL, Advanced Computing Laboratory, MS B287, Los Alamos, NM 87545, USA

It has been shown that both Random Boolean Networks (RBN) and Random Threshold Networks (RTN) exhibit a order-disorder transition at a critical average connectivity K_c in the thermodynamical limit [1,2]. Looking at the statistical distributions of damage spreading for both RBN and RTN, we go beyond this mean-field approximation.

We study the scaling properties of damage size distributions as a function of system size N and initial perturbation size $d(t = 0)$ in the sparse percolation (SP) limit (i.e. $d(t = 0)/N \to 0$ for large N). We present evidence that another characteristic point, K_s exists for finite systems, where the expectation value of damage spreading in the network is independent of N. We find that damage distributions strongly depend on the order of averages taken over dynamics and network ensembles, possibly limiting the validity of mean-field predictions.

Finally, we discuss the implications of our findings for evolutionary processes and learning applied to networks which solve specific computational tasks.

[1] Derrida, B. and Pomeau, Y. (1986), Europhys. Lett., 1, 45-49
[2] Rohlf, T. and Bornholdt, S. (2002), Physica A 310, 245-259

DY 6.5 Mon 15:30 H3

Rich dynamical behavior of simple canalyzing Kauffman networks — •Florian Greil and Barbara Drossel — Institut für Festkörperphysik, Technische Universität Darmstadt, Deutschland

We investigate Threshold Random Boolean Networks with $K = 2$ inputs per node, which are equivalent to Kauffman networks, with only part of the canalyzing functions as update functions. While these models should be critical according to the simplest consideration, it turns out that they show in reality a rich variety of behaviors as the relative weights of the different canalyzing functions are changed. We see frozen, critical and chaotic behavior, as well as oscillations with period 2, and several critical points between these different regimes. The results are supported by analytical calculations and computer simulations.

DY 6.6 Mon 15:45 H3

Emergence of networks from optimizing local interaction — •Michael König, Stefano Battiston, and Frank Schweitzer — Chair of Systems Design, ETH Zurich, Kreuzplatz 5, 8032 Zurich, Switzerland

We model evolving complex networks in which agents select their interactions with other agents on the basis of a local nonlinear utility function and study the resulting global network structure. Agents can increase each others utility as catalytic processes on a directed dynamic network. Two cases are discussed: (i) Agents can either bilaterally increase each others utility (direct reciprocity) or (ii) unilaterally increase the utility of other agents and hope that they will benefit from the support of another agent (indirect reciprocity). Direct reciprocity

corresponds to a cycle of order k=2 in the network, while indirect reciprocity corresponds to a cycle of order k > 2. The emergence of an autocatalytic set (ACS) is the driving process of growth and sustainability in our model. An ACS is a subgraph of a network, each of whose nodes has at least one incoming link belonging to the same subgraph. The core of an ACS consists of a closed cycle. We argue that in case (i) the network evolves towards a random graph consisting of bilateral links, while in case (ii) an ACS will only form if agents percive an extra profit from being part of a directed cycle.

DY 6.7 Mon 16:00 H3

Networks interacting with matter — •Bartlomiej Waclaw[1], Zdzislaw Burda[2], and Wolfhard Janke[1] — [1]Institut für Theoretische Physik, Universität Leipzig, Augustusplatz 10/11, 04109 Leipzig, Germany — [2]M. Smoluchowski Institute of Physics, Jagellonian University, Reymonta 4, 30-059 Krakow, Poland

Many processes taking place in nature can be described in terms of complex networks. They can be divided into three classes: the evolution of networks, the dynamics on networks, and the dynamical interaction between the network topology and matter degrees of freedom living on the network. The latter process has two characteristic time scales: the first one related to the dynamics of the matter, and the second one related to the dynamics of network connections. Many results have been found for the case where these two scales differ significantly, but less is known what happens when they are comparable. Here we would like to propose a simple model, being a composition of the Zero Range Process and a dynamically changing network, which allows for studying the regime where the dynamics of network topology significantly affects the dynamics of the processes on the network. We show that the model possesses a phase transition between a condensed and uncondensed state resulting from the interplay of these two dynamical degrees-of-freedom.

DY 7: Statistical physics far from thermal equilibrium

Time: Monday 14:30–16:15 Location: H5

DY 7.1 Mon 14:30 H5

Studies on a Quantum Work-Fluctuation Theorem — •Jens Teifel and Günter Mahler — Universität Stuttgart, 70550 Stuttgart, Pfaffenwaldring 57/IV

If an external force acts on a thermodynamic system on a finite time scale, it may be driven out of equilibrium. The Jarzynski relation, a classical fluctuation theorem, connects the work performed on the system and the difference of the free energy of the initial and final state, respectively. A quantum analogue has been established by S. Mukamel [Phys. Rev. Lett. 90, 170604 (2003)]. Here, we study different models of bipartite systems for which we prove that the Jarzynski relation holds.

DY 7.2 Mon 14:45 H5

Switching in time-periodic quantum systems with dissipation — •Waltraut Wustmann and Roland Ketzmerick — Institut für Theoretische Physik, Technische Universität Dresden, 01062 Dresden, Germany

A novel switching mechanism for open time-periodic quantum systems is demonstrated. We derive the consequences of isolated avoided crossings on the time-periodic stationary dynamics for weak system-bath coupling using a Floquet-Markov approach. For an asymmetric double well potential under variation of the driving amplitude the dominant probability switches from a state in the lower well to a state in the other well with a higher average energy. We propose an experimental demonstration with atoms in optical potentials and time-periodic magnetic fields.

DY 7.3 Mon 15:00 H5

Breakdown of Gallavotti-Cohen symmetry for stochastic dynamics — •Rosemary Harris[1], Attila Rákos[2], and Gunter Schütz[3] — [1]Universität des Saarlandes, Saarbrücken, Germany — [2]Weizmann Institute of Science, Rehovot, Israel — [3]Forschungszentrum Jülich, Jülich, Germany

We consider the behaviour of current fluctuations in the one-dimensional partially asymmetric zero-range process with open boundaries. Significantly, we find that the distribution of large current fluctuations does not satisfy the Gallavotti-Cohen symmetry and that such a breakdown can generally occur in systems with unbounded state space. We also discuss the dependence of the asymptotic current distribution on the initial state of the system.

DY 7.4 Mon 15:15 H5

Crossover from the pair contact process with diffusion to the directed percolation — •Su-Chan Park[1] and Hyunggyu Park[2] — [1]Institut für Theoretische Physik, Universität zu Köln, Köln, Germany — [2]Korea Institute for Advanced Study, Seoul, Korea

To figure out the universality class to which the pair contact process with diffusion (PCPD) belongs has become a controversial issue in the field of the absorbing phase transition since the reinvention of the model in 1997. The main question is whether the PCPD belong to the directed percolation (DP) universality class or not. To find out the answer to this question, the crossover behavior from the pair contact process with diffusion (PCPD) to the directed percolation (DP) is studied in one dimension by introducing a single particle annihilation/branching dynamics. The crossover exponent ϕ is estimated numerically as $1/\phi = 0.58$. Nontriviality of the PCPD crossover exponent strongly supports non-DP nature of the PCPD critical scaling, which is further evidenced by the anomalous critical amplitude scaling near the PCPD point. The universal nature of the crossover exponent is also confirmed by the study of the crossover from the PCPD to the parity conserving class, which evidences the existence of well-defined PCPD fixed point distinct from the DP.

DY 7.5 Mon 15:30 H5

Strongly Correlated Fermions after a Quantum Quench — •Salvatore Manmana[1,2,3], Stefan Wessel[1], Reinhard Noack[2], and Alejandro Muramatsu[1] — [1]Institut für Theoretische Physik III, Universität Stuttgart, Pfaffenwaldring 57, D-70550 Stuttgart — [2]AG Vielteilchennumerik, Fachbereich Physik, Philipps-Universität Marburg, D-35032 Marburg — [3]Institute of Theoretical Physics, EPFL, CH-1015 Lausanne (Switzerland)

Using the adaptive time-dependent density-matrix renormalization group method (adaptive t-DMRG), we study the time evolution of strongly correlated spinless fermions on a one-dimensional lattice after a sudden change of the interaction strength. For certain parameter values, two different initial states (e.g., metallic and insulating), lead to observables which become indistinguishable after relaxation. We find that the resulting quasi-stationary state is non-thermal. This result holds for both integrable and non-integrable variants of the system.

DY 7.6 Mon 15:45 H5

How microscopic fluctuations give rise to viscoplastic behavior in anisotropic solids — •Markus Hütter and Theo Tervoort — Institute for Polymers, Department of Materials, ETH Zurich, 8093 Zurich, Switzerland.

Temporal coarse-graining in the context of nonequilibrium thermodynamics is used to examine the interrelation between microscopic fluctuations and the viscoplastic behavior in anisotropic solids on the macroscopic scale. As a guideline to complete this task, the general equation for the nonequilibrium reversible-irreversible coupling (GENERIC) framework is used. The state of deformation in elasto-viscoplasticity can be described in terms of the elastic part of the deformation gradient as an internal variable, with its relaxation described by a so-called plastic strain rate tensor. To arrive at a closed set of evolution equations, a constitutive relation for the plastic strain rate tensor is needed. While this is often done phenomenologically on purely macroscopic grounds, we here illustrate a procedure to relate the plastic strain rate tensor to the rapid microscopic fluctuations of the deformation gradient. It is shown how common ansatzes for the plastic strain rate tensor for anisotropic amorphous solids and crystalline solids are obtained by temporal coarse-graining. A major benefit of such a procedure consists in guiding microscopic simulations. In particular, they must be used primarily for the determination of the kinetic coefficients, rather than for extracting the tensorial structure

of the plastic strain rate tensor.

DY 7.7 Mon 16:00 H5

Time-dependent structure factors of a disordering system — •Robert Stück and Timo Aspelmeier — Institut für Theoretische Physik, Universität Göttingen

The non-equilibrium disordering dynamics of an initially phase-separated crystal via atom-vacancy exchanges is studied by investigating the time-dependent static structure factor. Just before complete disorder, it shows some anomalies such as an dip for periodic boundary conditions and a plateau for reflecting boundary conditions. For the plateau we found an analytic mean field solution which matches perfectly the simulation data. The dip can not be derived by a mean field approximation since it is due to correlations induced by the random walk of the vacancies. The nature of these correlations is studied numerically.

DY 8: Quantum dynamics, decoherence and quantum information

Time: Monday 16:15–18:00 Location: H2

DY 8.1 Mon 16:15 H2

Normal and Ballistic Transport in Coupled Spin Chains — •Hendrik Weimer, Mathias Michel, and Günter Mahler — Institut für Theoretische Physik I, Universität Stuttgart

We consider a three-dimensional model of coupled spin chains. The interaction inside the chains is a Heisenberg coupling while the interaction between the chains is random. In the one-particle excitation band we obtain ballistic transport along the spin chains and normal transport in the perpendicular direction. The numerical solution of the time-dependent Schrödinger equation confirms these results.

DY 8.2 Mon 16:30 H2

Dephasing by non-Gaussian shot noise in an electronic which-path experiment — •Florian Marquardt[1], Izhar Neder[2], and Mordehai Heiblum[2] — [1]Arnold Sommerfeld Center for Theoretical Physics, Department für Physik, und Center for NanoScience, Ludwig-Maximilians-Universität München, Germany — [2]Braun Center for Submicron Research, Department of Condensed Matter Physics, Weizmann institute, Rehovot, Israel

The usual models for dissipative environments involve a bath of harmonic oscillators, producing Gaussian fluctuations. However, modern experiments on dephasing in qubits and electronic interferometers indicate strong coupling to *non-Gaussian* quantum noise. Most strikingly, the coherence (interference contrast) may oscillate as a function of interaction time and other control parameters (such as detector voltage). We discuss in detail the theory behind a recent "controlled dephasing"experiment involving a Mach-Zehnder interferometer strongly coupled to the non-Gaussian shot noise of a detector edge channel [cond-mat/0610634,cond-mat/0611372].

DY 8.3 Mon 16:45 H2

Room Temperature Coherence Transfer between a Single Electron and Nuclear Spin in Diamond — •Philipp Neumann, Torsten Gaebel, Fedor Jelezko, and Jörg Wrachtrup — 3. Physikalisches Institut, Universität Stuttgart, Germany

Coherent control of single spins is one basic requirement for quantum information technology. For the processing of qubit information the coupling to at least one other spin is necessary. Especially when it comes to storage of quantum information the coherence of one spin has to be transferred to another very long lived spin system. Promising candidates for this are nuclear spin states. We demonstrate recent progress on the coherence transfer between the electron spin of a single NV center in diamond and its ^{15}N nuclear spin at room temperature. For this we present a novel method to initialize the nuclear spin and by this cool it down from room temperature to μK. In addition its long lasting coherent evolution will be shown.

DY 8.4 Mon 17:00 H2

Quantum Thermodynamic Machines and their Limits — •Markus Henrich, Mathias Michel, and Günter Mahler — 1. Institut für Theoretische Physik, Universität Stuttgart, Deutschland

How small can a system be to act as a thermodynamic machine? We show that a 3-spin system driven with finite speed and interfaced between two split baths constitutes such a minimal model. The spins are arranged in a chain with nearest-neighbor interaction and different local Zeeman-splittings. The working spin in the middle is driven in σ_Z-direction and exercises Carnot cycles the area of which defines the exchanged work [1].

We compare the numerical results of this machine with an ideal one which can be solved analytically. It can be shown under which conditions the Carnot efficiency should be reached and that a critical temperature exists where the machine begins acting as a heat pump [2]. The influence of leakage heat currents on the efficiency are investigated additionally.

[1] M. J. Henrich et al, "'Small quantum networks operating as quantum thermodynamic machines"', cond-mat/0604202
[2] T. D. Kieu, "'Quantum heat engines, the second law and Maxwell's daemon"', Eur. Phys. J. D **39**, 115-128 (2006)

DY 8.5 Mon 17:15 H2

A Boltzmann equation approach to transport in finite modular quantum systems — •Mehmet Kadiroglu and Jochen Gemmer — Departement of Physics, University of Osnabrück, D-49069

We investigate the transport behaviour of finite quantum systems based on a Boltzmann equation [1] (BE). To make the BE applicable for our quantum systems we consider quasiparticles which are essentially the current eigenmodes of the system. We propose to identify the classical particle density in the BE with the quantum mechanical occupation numbers of the current eigenstates. It is demonstrated analytically and numerically by solving the time dependent Schrödinger equation that this concept is justifiable and that the dynamics of the quantum mechanical occupation numbers are indeed well described by an appropriate linear BE. Furthermore we determine the diffusion coefficient of a diffusive solution of the linear BE which is in accordance with results of previous works [2]. An ab initio numerical analysis of the full dynamics of the quantum system shows that it indeed exhibits diffusive behaviour controlled by this diffusion constant under certain conditions.

[1] L. Boltzmann, *Lectures on Gas Theory*, University of California Press, Los Angeles, (1964)
[2] M. Michel, J. Gemmer, G. Mahler, *Phys. Rev. Lett.*, **95**, 180602, (2005)

DY 8.6 Mon 17:30 H2

Transport in the Anderson model — •Robin Steinigeweg and Jochen Gemmer — Physics Department, University of Osnabrück, Barbarastr. 7, 49069 Osnabrück, Germany

We investigate a model of non-interacting spinless fermions on a finite lattice with a disordered on-site potential or, shortly, the Anderson model. It is well-known that strong disorder causes localized eigenstates such that the model behaves like an insulator. Inversely, weak disorder causes extended eigenstates which are Bloch waves in the the case of no disorder. Between these extreme cases the model is believed to exhibit diffusive dynamics. We examine the intermediate case in more detail and especially address the conditions under which diffusion occurs. Our approach uses projection operator techniques (TCL) and the Hilbertspace Average Method (HAM). These methods have been already applied successfully to another model which turns out to be very similar to the Anderson model in the intermediate case.

DY 8.7 Mon 17:45 H2

Efficiency of quantum and classical transport on graphs — •Oliver Mülken and Alexander Blumen — Theoretische Polymerphysik, Universität Freiburg, 79104 Freiburg i.Br., Germany

We propose a measure to quantify the efficiency of classical and quantum mechanical transport processes on graphs. The measure is given by the temporal decay of the space average of the probability to be still or again at the initial node of the graph, i.e., classically by $\overline{p}(t)$

and quantum mechanically by $\overline{\pi}(t)$, where

$$\overline{p}(t) \equiv \frac{1}{N}\sum_{j=1}^{N} p_{j,j}(t) \qquad \text{and} \qquad \overline{\pi}(t) \equiv \frac{1}{N}\sum_{j=1}^{N} \pi_{j,j}(t) \geq |\overline{\alpha}(t)|^2.$$

Quantum mechanically we use the envelope env$[|\overline{\alpha}(t)|^2]$ of a lower bound obtained via the Cauchy-Schwarz inequality. Both measures only depend on the density of states (DOS). For some DOS, the measure shows a power law behavior, where the exponent for the quantum transport is twice the exponent of its classical counterpart, i.e.,

$$\overline{p}(t) \sim t^{-(1+\nu)} \qquad \text{and} \qquad \text{env}[|\overline{\alpha}(t)|^2] \sim t^{-2(1+\nu)}.$$

For small-world networks, however, the measure shows rather a stretched exponential law but still the quantum transport outperforms the classical one. Some finite tree-graphs have a few highly degenerate eigenvalues, such that, on the other hand, on them the classical transport may be more efficient than the quantum one.

[1] O. Mülken and A. Blumen, Phys. Rev. E **73**, 066117 (2006)

DY 9: Statistical physics in biological systems

Time: Monday 16:30–18:00 Location: H3

DY 9.1 Mon 16:30 H3

Anomalous diffusion of migrating biological cells — Peter Dieterich[1], •Rainer Klages[2], Roland Preuss[3], and Albrecht Schwab[4] — [1]Institut für Physiologie, Medizinische Fakultät Carl Gustav Carus, Dresden, Germany — [2]School of Mathematical Sciences, Queen Mary, University of London, UK — [3]Center for Interdisciplinary Plasma Science, Max-Planck-Institut für Plasmaphysik, Garching, Germany — [4]Institut für Physiologie II, Münster, Germany

Cell migration is a complex dynamical process resulting from an intricate interplay of multiple components of the cellular migration machinery. Our work starts from the experimental observation of single cells moving on substrates. At first view, their paths look like the ones of Brownian particles. However, a detailed data analysis reveals a superdiffusive increase of the long-time mean squared displacement, non-Gaussian probability distributions for the cell positions and power law decays of velocity autocorrelations. This dynamics includes intermittent features resembling the one of foraging animals. On long time scales, all of our experimental data matches to a modeling of anomalous diffusion in terms of a fractional Klein-Kramers equation.

DY 9.2 Mon 16:45 H3

Meanfield dynamics of evolutionary and coevolutionary processes in infinite populations and finite-size corrections in finite populations — Arne Traulsen[1], •Jens Christian Claussen[2], and Christoph Hauert[1] — [1]Center for Evolutionary Dynamics, Harvard — [2]Institut f. Theoret. Physik & Astrophys., Univ. Kiel, Germany

Coevolutionary dynamics arises in a wide range from biological to social dynamical systems. For infinite populations, a standard approach to analyze the dynamics are deterministic replicator equations, however lacking a systematic derivation. In finite populations modelling finite-size stochasticity by Gaussian noise is not in general warranted [1]. We show that for the evolutionary Moran process and a Local update process, the explicit limit of infinite populations leads to the adjusted or the standard replicator dynamics, respectively [2]. In addition, the first-order corrections in the population size are given by the finite-size update stochasticity and can be derived as a generalized diffusion term of a Fokker-Planck equation [2]. We explicitely discuss the differences for the Prisoner's Dilemma, and Dawkin's Battle of the Sexes, where we show that the stochastic update fluctuations in the Moran process exhibit a finite-size dependent drift reversal [2]. This framework can be readily transferred to other microscopic processes, as the local Fermi process [3] or the inclusion of mutations [4].

[1] J.C.Claussen & A.Traulsen, Phys.Rev. E 71, 025101(R) (2005) [2] A.Traulsen, J.C.Claussen, C.Hauert, Phys.Rev.Lett, 95, 238701 [3] A.Traulsen, M.A.Nowak, J.M.Pacheco, Phys.Rev.E 74, 011909 (2006) [4] A.Traulsen, J.C.Claussen, C.Hauert, Phys.Rev. E 74, 011901 (2006)

DY 9.3 Mon 17:00 H3

Pattern Formation and Collective Motion in Bacterial Colonies — •Pawel Romanczuk[1], Udo Erdmann[2], Harald Engel[3], and Lutz Schimansky-Geier[1] — [1]Humboldt Universität zu Berlin, Newtonstr. 15, 12489 Berlin — [2]Helmholtz-Gemeinschaft, Anna-Louisa-Karsch-Str. 2, 10178 Berlin — [3]Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin

Complex spatio-temporal patterns of cell clusters were observed in colonies of chemotactic bacteria such as *Escherichia coli* or *Sallmonella typhimurium* [1]. The production of a potent chemoattractor by the bacteria themselves as a reaction to certain nutrients is the essential factor for this pattern formation. Additional collective dynamics, such as collective translocation and rotation of bacterial clusters were reported from experiments on bacterial colonies.

We are able to reproduce the macroscopic behaviour, as well as the collective types of motion using Active Brownian particles including chemotaxis and velocity alignment.

We compare analytical results for macroscopic pattern formation obtained from the overdamped limit approximation with numerical simulations and discuss the collective dynamics of our model. Further on we propose a simple explanation for the occurrence of different collective types of motion in bacterial colonies.

[1] Budrene, E. O. und H. C. Berg: *Dynamics of formation of symmetrical patterns by chemotactic bacteria.* Nature, 376:49-53, 1995.

DY 9.4 Mon 17:15 H3

Non-equilibrium phenomena in rod-shaped self-propelled particles — •Fernando Peruani[1,2], Andreas Deutsch[1], and Markus Baer[3] — [1]Technische Universitaet Dresden, Dresden, Germany — [2]Max Planck for the Physics of Complex Systems, Dresden, Germany — [3]Physikalisch-Technische Bundesanstalt, Berlin, Germany

Motivated by orientation and aggregation phenomena in gliding bacteria, we study collective motion in a twodimensional model of active, self-propelled rods interacting through volume exclusion. In simulations with individual particles, we find that particle clustering is facilitated by a sufficiently large packing fraction or length-to-width ratio. The transition to clustering in simulations is well captured by a mean-field model for the cluster size distribution, which predicts that critical value of the aspect ratio is given by C/Eta - 1 where C is a constant and Eta is the packing fraction [1].

In order to study orientational order in more detail, we simplify the above model by considering self-propelled point-like particles interacting through a liquid crystal-based alignment mechanism. We provide numerical evidence that such a system exhibits a continuous phase transition and long-range orientation order. The results are qualitative in line with prediction of a simple mean-field theory.

[1] F. Peruani, A. Deutsch and M. Bär, Phys. Rev. E, 74, 030904 (2006) (R)

DY 9.5 Mon 17:30 H3

The role of heterogeneity in the dynamics of infectious diseases — •Alejandro Morales Gallardo, Dirk Brockmann, and Theo Geisel — MPI for Dynamics and Self-organization, Göttingen, Germany

Most sexually transmitted diseases cannot be understood without the strong variability of sexual activity within human populations. Furthermore, emergent infectious diseases such as SARS showed that social heterogeneities play a vital role in the spread and prevalence of some diseases. It is commonly believed that inhomogeneities, for instance the existence of superspreaders can lead to a larger basic reproduction number R_0. We examined the role of heterogeneities in a SIS model with variable contact rates. The time between infections as well as the time of being infectious are considered as Poisson processes. The heterogeneity is introduced by variable individual contact rates. Our results show that the degree of fluctuation increases as a function of contact rate variability around the SIS endemic state. Moreover, fluctuations tend to be asymmetric in strongly heterogeneous systems. Although heterogeneities lead to more explosive outbreaks, the number of infected individuals in the endemic state is smaller than predicted for homogeneous populations. Both results indicate that epidemiolog-

ical data could be misleading when estimating the basic reproduction number R_0, a key epidemiological parameter, and in consequence erroneous measures would be adopted in diseases where heterogeneities dominate.

DY 9.6 Mon 17:45 H3

The role of commuting in spread of infectious diseases — •Vitaly Belik and Dirk Brockmann — MPI für Dynamik und Selbstorganisation, Göttingen, FRG

Numerous spreading phenomena in population dynamic and ecological systems are successfully accounted for by the Fischer-Kolmogorov-Petrovsky-Piskunov (FKPP) equation. This equation can be derived on the assumption of diffusive dispersal of the reacting species. In epidemiological systems however, host individuals often perform commuting movements between their habitat and its surrounding. For instance, humans travel back and forth between their homes and their place of work day by day, and infectious diseases spread indirectly by a combination of transmission between and commuting of host individuals. Incorporating bidirectional transport of the host we develop a mean field discription for wave propagation that is structurally different from the ordinary FKPP equation, i.e. the diffusion and nonlinear logistic growth term do not decouple. We find that the velocity of the wave front is approximately proportional to the infection rate, unlike the square root dependence of the ordinary FKPP equation. For systems with high reaction rates, this implies a much faster spread of the infection as compared to common FKPP dynamics. On the other hand, the front shape exhibits a significantly smaller dependence on the infection rate. We conclude that spreading phenomena which are triggered by commuting movements of the host can spread much faster than those carried by diffusing agents, a result of particular importance for human infectious disease dynamics.

DY 10: Growth processes and surface properties

Time: Monday 16:30–17:45 Location: H5

DY 10.1 Mon 16:30 H5

Phase Field Crystal Modeling of Dry and Wet Grain Boundaries — •Jesper Mellenthin[1], Alain Karma[2], and Mathis Plapp[1] — [1]Laboratoire de Physique de la Matière Condensée, École Polytechnique, 91128 Palaiseau, France — [2]Physics Department, Northeastern University, Boston, MA 02115 USA

The phase field crystal model has emerged as a powerful tool to simulate microstructural evolution in polycrystalline materials under a variety of nonequilibrium conditions. The crystal is represented by a local-time-averaged density field $\psi(\vec{r},t)$, which has the same symmetry as the crystalline structure. This density field is obtained by minimizing a free energy functional, which also allows for a second phase of constant ψ (a liquid phase) and coexistence between the two phases. The model naturally includes the elastic energy and the symmetry properties of the crystal and is therefore a convenient choice to investigate grain boundary properties.

In this work, we explore the influence of the misorientation between two crystals on the grain boundary structure. Dry grain boundaries become wet when the misorientation exceeds some threshold, in which case it becomes energetically favorable for a thin liquid film to exist between the two crystals. This produces an effective repulsion between the two solid-liquid interfaces that coalesce at a temperature below the normal melting point of a bulk crystal. Wet and dry grain boundaries are analyzed numerically and interpreted in the framework of phenomenological models for grain boundary structure.

DY 10.2 Mon 16:45 H5

Relevance of surface viscous flow, surface diffusion and ballistic effects in keV ion smoothing of amorphous surfaces — •Sebastian Vauth and S. G. Mayr — I. Physikalisches Institut, Georg-August-Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany

Amorphous metal or semiconductor thin films often show a dramatic smoothing reaction, when appropriately bombarded with keV heavy ions. Surface diffusion, surface viscous flow and ballistic effects have been suggested as possible candidates for the dominant atomic-scale smoothing mechanism. In the present study we compare the relative relevance of these processes by employing multiscale modeling, viz. a combination of molecular dynamics (MD) and continuum rate equations. This is achieved by deriving continuum expressions for a coarse-grained picture and calculating the corresponding coefficients from MD simulations. For this purpose diffusion constants, viscosities and lateral transport due to momentum transfer are evaluated. We observe the dominance of surface viscous flow over surface diffusion for any surface morphology while ballistic smoothing dominates for structures above a certain size threshold. These results are found to be valid for both, strong and fragile glasses, as represented by amorphous Si and CuTi.

This work is financially supported by the DFG Sonderforschungsbereich 602, TP B3.

DY 10.3 Mon 17:00 H5

Dynamics of steps on vicinal surfaces: Step-step interactions, sublimation and the Schwoebel effect — •Marian Ivanov, Vladislav Popkov, and Joachim Krug — Institut für Theoretische Physik, Universität zu Köln, Zülpicher Str.77, D-50937 Köln

Using morphological instabilities one can produce templates for nanoscale technology. One example of such an instability is step bunching, which splits a regular vicinal surface into regions of low and high density of monoatomic steps. The dynamics of the surface is described by the Burton-Cabrera-Frank model with boundary conditions provided by mass conservation at the steps. The instability condition can be found by linear analysis of the equations. For the case of pure sublimation with step-step interactions and Schwoebel effect, a new term arises in comparison to earlier calculations. In the continuum limit this leads to a restriction for the maximum bunch slope and to novel scaling properties for sufficiently large bunches.

DY 10.4 Mon 17:15 H5

Submonolayer growth of binary alloys — •Mario Einax[1], Sonja Ziehm[2], Wolfgang Dieterich[2], and Philipp Maass[1] — [1]Institut für Physik, Technische Universität Ilmenau, 98684 Ilmenau — [2]Fachbereich Physik, Universität Konstanz, 78457 Konstanz

We investigate the submonolayer growth of binary alloys, formed by co-deposition of A- and B atoms on a flat substrate. The dependence of the number densities of stable islands is determined as a function of incoming fluxes, adatom diffusion coefficients and binding energies of A and B atoms. Based on a generalization of mean-field rate equation theory novel scaling relations are predicted, which are in good agreement with kinetic Monte Carlo simulations of the growth process. Suggestions are made how to test the new theoretical predictions in experiments.

DY 10.5 Mon 17:30 H5

Rigorous selection theory for crystal growth with nonlinear transport — •Thomas Fischaleck and Klaus Kassner — Institut für Theoretische Physik, Otto von Guericke Universität Magdeburg, Postfach 4120, D-39016 Magdeburg

Asymptotic matching in the complex plane is a strategy for calculating exponentially small terms that has been pioneered for nonlinear equations by Kruskal and Segur. The method has been successfully applied to pattern-forming systems that could be cast into the form of a single ordinary differential or differential-integral equation. Examples are viscous fingering, dendritic crystal growth, or capillary water waves. Interestig problems that are modeled by nonlinear field equations with free boundaries, however, remained untractable.

We show how to combine asymptotic matching in the complex plane with Zauderer's decomposition scheme of nonlinear partial differential equations to study this class of problems. The method is exemplified by dendritic growth limited by nonlinear heat transport.

DY 11: Superfluidity and Bose-Einstein condensation

Time: Tuesday 9:30–11:00 Location: H2

Invited Talk DY 11.1 Tue 9:30 H2

A single Josephson junction for atomic Bose-Einstein condensates: Dynamics and finite temperature effects — •Markus Oberthaler — Kirchhoff Institut für Physik, University of Heidelberg, Im Neuneheimer Feld 227, 69120 Heidelberg

The recent realization of a single weak link for an atomic Bose-Einstein condensate in an optical double-well potential allows for the first time the observation of Josephson oscillations directly on the level of populations on either side of the junction. Furthermore it opens up the way to fully characterize the tunneling dynamics since not only the dynamics of the population difference can be measured but even the time evolution of the relative phase is detectable. How the residual interaction of the atoms can lead to a new dynamical regime, which is characterized by an inhibition of tunneling, will be discussed in detail.

The good experimental control of the atomic system also allows for a quantitative study of thermally induced fluctuations of the relative phase between the weakly linked condensates. These fluctuations even persist in the ultra low temperature limit and thus can be employed for the realization of a new type of thermometer for atomic Bose-Einstein condensates. Our recent results on the measurement of the heat capacity of a quantum gas at ultra low temperatures using this new noise-thermometer will be presented.

DY 11.2 Tue 10:00 H2

Transport of Bose-Einstein condensates beyond the Gross-Pitaevskii approach — •Thomas Ernst[1], Michael Hartung[1], Tobias Paul[2], and Peter Schlagheck[1] — [1]Institut für Theoretische Physik, Universität Regensburg — [2]Laboratoire de Physique Théorique et Modèles Statistiques, Université Paris Sud, Orsay

We study the transport of Bose-Einstein condensates through scattering potentials in quasi one-dimensional waveguides. While previous works used the Gross-Pitaevskii equation to calculate this process, we employ an approach which goes beyond this mean field theory and which is able to take into account excitations of the condensate as well as its depletion rate. This approach is based on a cumulant expansion [1], where we use a truncation scheme that is formally valid for weak interactions and a large number of atoms. We apply it to the scattering problem of a propagating BEC on a double barrier potential, where resonant transmission of the condensate takes place via the population of dynamically unstable scattering states. Our results confirm the validity of previous calculations of these processes based on the Gross-Pitaevskii equation [2].

[1] T. Köhler and K. Burnett, Phys. Rev. A **65**, 033601 (2002)
[2] T. Paul, K. Richter and P. Schlagheck, Phys. Rev. Lett. **94**, 020404 (2005)

DY 11.3 Tue 10:15 H2

Complex Dynamics in Systems of Interacting Bosons — •Moritz Hiller[1,2], Joshua Bodyfelt[3], Tsampikos Kottos[1,3], and Theo Geisel[1,2] — [1]Max-Planck-Institut für Dynamik und Selbstorganisation, D-37073 Göttingen — [2]Fakultät für Physik, Universität Göttingen, D-37077 Göttingen — [3]Department of Physics, Wesleyan University, CT-06459 Middletown, USA

We consider interacting bosons described by a Bose-Hubbard Hamiltonian (BHH) and analyze the evolving energy distribution as an experimentally controllable parameter, the coupling strength k between neighboring sites, is changed. Three driving schemes of k are considered: (a) the sudden limit (LDoS analysis), (b) the one-pulse scheme (wavepacket dynamics), and (c) the time-reversal scheme (fidelity). We find in all cases two distinct regimes: the Linear Response regime where we can trust the Fermi-Golden-Rule picture, and what we call the non-perturbative regime where the perturbation k is quantum mechanically large. In the former regime, the evolving distribution can be described by an improved Random Matrix Theory (RMT) which takes into accont the structured energy landscape of the perturbation operator. Instead, in the latter regime, non-universal features of the underlying classical dynamics dictate the energy spreading thus leading to a clash with the predictions of RMT. Our results are relevant to a vast number of experimental realizations of the BHH, like condensate systems in optical lattices and intra-molecular energy flow of vibrational degrees of freedom.

DY 11.4 Tue 10:30 H2

Phase diagram for interacting Bose systems — •Michael Maennel[1], Klaus Morawetz[1,2], and Michael Schreiber[1] — [1]Institute of Physics, Chemnitz University of Technology, 09107 Chemnitz, Germany — [2]Max Planck Institute for the Physics of Complex Systems, Nöthnitzer Str. 38, 01187 Dresden, Germany

We propose a new form of the inversion method in terms of selfenergy expansion to access the phase diagram of the Bose-Einstein transition. The dependence of the critical temperature on the interaction parameter is calculated. This is discussed with the help of a new condition for Bose-Einstein condensation in interacting systems which follows from the pole of the T-matrix the same way as from the divergence of the medium-dependent scattering length. A conserving many-body approximation consisting of screened ladder diagrams is proposed which describes the MC data more appropriate. The specific results are that a non-selfconsistent T-matrix leads to a linear coefficient in leading order of 4.7, the selfconsistent T-matrix due to the effective mass to a coefficient of 1.3 and the screened ladder approximation to 2.3 close to the Monte Carlo data.

DY 11.5 Tue 10:45 H2

Density Distribution for Ideal Trapped Bose Gases — •Walja Korolevski[1], Konstantin Glaum[1], and Axel Pelster[2] — [1]Institut für Theoretische Physik, Freie Universität Berlin, Arnimallee 14, 14195 Berlin, Germany — [2]Fachbereich Physik, Universität Duisburg-Essen, Lotharstraße 1, 47048 Duisburg, Germany

Within the path integral formulation of density matrices, a recursion relation for the density distribution of N ideal harmonically confined bosons is derived. The respective canonical results are compared with calculations within the grand-canonical ensemble. Thereby, we show near the transition temperature that the densities of the ground state and the excited states have the same order of magnitude. Whereas the standard semiclassical approximation of the grand-canonical calculation yields appropriate results only in the thermodynamic limit, its correactions lead to finite-size effects which contain divergent terms. Therefore, we follow Ref. [1] and work out a modified semiclassical approximation which leads to reasonable finite-size corrections not only for the density distribution but also for the critical temperature and the specific heat.

[1] V.I. Yukalov, Phys. Rev. A **72**, 033608 (2005)

DY 12: Statistical physics (general)

Time: Tuesday 10:00–12:00 Location: H3

DY 12.1 Tue 10:00 H3

Energy correlations for a random matrix model of disordered bosons — •Tobias Lück[1], Hans-Jürgen Sommers[2], and Martin Zirnbauer[1] — [1]Institut für Theoretische Physik, Universität zu Köln, Zülpicher Straße 77, 50937 Köln, Germany — [2]Fachbereich Physik, Universität Duisburg-Essen, Campus Essen, 45117 Essen, Germany

Linearizing the equations of motion around the ground state of an interacting quantum many-body system, one gets a time-evolution generator in the positive cone of a real symplectic Lie algebra. The presence of disorder in the physical system determines a probability measure with support on this cone. We analyzed a discrete family of such measures of exponential type using a simple random matrix model. Some generic statistical features of the characteristic frequencies of disordered bosonic quasi-particle systems can be derived. The level correlation functions of the said measures are shown to be those of a determinantal process, and the kernel of the process is expressed

as a sum of bi-orthogonal polynomials. While the correlations in the bulk scaling limit are in accord with sine-kernel or GUE universality, at the low-frequency end of the spectrum an unusual type of scaling behavior is found.

DY 12.2 Tue 10:15 H3

Haar measures, relative entropy and the relativistic canonical velocity distribution — •Jörn Dunkel, Peter Talkner, and Peter Hänggi — Institut für Physik, Universität Augsburg, Theoretische Physik I, Universitätsstrasse 1, D-86135 Augsburg, Germany

The concept of equipartition (uniform distribution) can be extended to locally compact, topological groups by means of the Haar measure. Guided by this fact, we propose that the relative entropy with respect to the Haar measure of the Lorentz group provides the most natural choice for the canonical equilibrium entropy in relativistic thermostatistics. Maximization of this entropy under the usual constraints yields a modified one-particle Jüttner distribution that differs from the standard Jüttner distribution by a prefactor which is proportional to the inverse relativistic kinetic energy. The argument shows that only the modified distribution is consistent with the principle of Lorentz invariance, whereas the standard Jüttner function is not. The relevance of this result with regard to applications in high energy physics and astrophysics is discussed.

DY 12.3 Tue 10:30 H3

Nonanalyticities of entropy functions of finite and infinite systems — •Michael Kastner — Physikalisches Institut, Universität Bayreuth, 95440 Bayreuth

In contrast to the canonical ensemble where thermodynamic functions are smooth for all finite system sizes, the microcanonical entropy can show nonanalytic points also for finite systems, even if the Hamiltonian is smooth. The relation between finite and infinite system nonanalyticities is illustrated by means of a simple classical spin-like model which is exactly solvable for both, finite and infinite system sizes, showing a phase transition in the latter case. The microcanonical entropy is found to have exactly one nonanalytic point in the interior of its domain. For all finite system sizes, this point is located at the same fixed energy value $\varepsilon_c^{\text{finite}}$, jumping discontinuously to a different value $\varepsilon_c^{\text{infinite}}$ in the thermodynamic limit. Remarkably, $\varepsilon_c^{\text{finite}}$ equals the average *potential* energy of the infinite system at the phase transition point. The result, supplemented with results on nonanalyticities of the microcanonical entropy for other models, indicates that care is required when trying to infer infinite system properties from finite system nonanalyticities.

DY 12.4 Tue 10:45 H3

The density of states in complex systems: the case of RNA secondary structures — •Stefan Wolfsheimer, Bernd Burghardt, and Alexander Hartmann — Institut für theoretische Physik, Friedrich-Hund-Platz 1, 37077 Göttingen

Models for RNA secondary structures (the topology of folded RNA) without pseudo knots have interesting properties: On one side they are complex systems with an ultrametric-like state-space structure, leading to high entropic barriers. Due to this fact Monte Carlo methods to obtain ground-state properties (energy, degeneracy etc.) and density of states become stuck very quickly. On the other side, in contrast to many complex systems, the ground states and the density of states can by computed in polynomial time exactly. Hence, RNA secondary structures provide an ideal benchmark system for new Monte Carlo methods. Recently the ParQ algorithm, a transition matrix approach, was introduced by Heilmann et.al. (Euro.Phys.Lett.**70(2)**: 155-161,2005) In this study we investigate the impact of the ParQ annealing schedule on the performance of the algorithm. We als characterize the ground-state structure using the overlap distribution and the degree of ultrametricity, which turns out to be directly related to tunneling times and performance of the algorithm.

DY 12.5 Tue 11:00 H3

Fluctuations in subsystems of the zero temperature XX chain: emergence of an effective temperature — •Viktor Eisler[1], Örs Legeza[2], and Zoltan Racz[3] — [1]Fachbereich Physik, Freie Universität Berlin, Arnimallee 14, D-14195 Berlin, Germany — [2]Research Institute for Solid State Physics and Optics, H-1525 Budapest, P.O. Box 49, Hungary — [3]Institute for Theoretical Physics, Eötvös University, 1117 Budapest, Pazmany setany 1/a, Hungary

The zero-temperature XX chain is studied with emphasis on the properties of a block of spins inside the chain. We investigate the quantum fluctuations resulting from the entanglement of the block with the rest of the chain using analytical as well as numerical (density matrix renormalization group) methods. It is found that the rest of the chain acts as a thermal environment and an effective temperature can be introduced to describe the fluctuations. We show that the effective temperature description is robust in the sense that several independent definitions (through fluctuation dissipation theorem, comparing with a finite temperature system) yield the same functional form in the limit of large block size. The effective temperature can also be shown to satisfy the basic requirements on how it changes when two bodies of equal or unequal temperatures are brought into contact.

DY 12.6 Tue 11:15 H3

Optimization of packing problems — •Johannes Josef Schneider, Gösta Kroll, Pavel Metelitsyn, Philipp Roos, and Elmar Schömer — Department of Physics, Mathematics, and Computer Science, Johannes Gutenberg University of Mainz, Staudinger Weg 7, 55099 Mainz, Germany

Packing many homogeneous or heterogeneous objects is a challenging mathematical task with many applications in physics and logistics, ranging from the field of soft and granular matter to the question how to pack suitcases and some bulky goods in a rear trunk.

We use both global methods like Simulated Annealing [1,2] and local methods for the optimization of packing problems. In a first attempt, we studied the packing of discs with various radii within a circle of minimum radius and took part in an international competition, in which we were able to set the world record for one benchmark instance.

[1] S. Kirkpatrick, C. D. Gelatt Jr., and M. P. Vecchi, Science **220**, 671, 1983.

[2] J. J. Schneider and S. Kirkpatrick, *Stochastic Optimization*, Springer, Berlin, Heidelberg, 2006.

DY 12.7 Tue 11:30 H3

Force dependence of transition rates in atomic friction — •Mykhaylo Evstigneev[1], Andre Schirmeisen[2], Lars Jansen[2], Harald Fuchs[2], and Peter Reimann[1] — [1]Universität Bielefeld, Fakultät für Physik, Universitätstr. 25, 33615, Bielefeld — [2]Universität Münster, Center for Nanotechnology, Heisenbergstr. 11, 48149, Münster

The lateral forces during stick-slip motion of an atomic force microscope cantilever on highly oriented pyrolytic graphite are measured and analyzed. We identify the regimes where thermally activated interstitial hopping of the cantilever tip proceeds according to a single-step reaction scheme and extract the corresponding force-dependent transition rates directly from the experimental data. We find that such a single-step reaction scenario is valid only at relatively high velocities, while at slower pulling speeds a more complicated hopping mechanism must be at work. We suggest formation of multiple bonds of the tip-sample contact as a possible candidate for this mechanism.

DY 12.8 Tue 11:45 H3

Football fever: goal distributions in football — •Andreas Nussbaumer[1], Elmar Bittner[1], Wolfhard Janke[1], and Martin Weigel[2] — [1]Institut für Theoretische Physik, Universität Leipzig, Postfach 100 920, 04009 Leipzig, Germany — [2]Department of Mathematics, Heriot-Watt University, Riccarton, Edinburgh, EH14 4AS, Scotland, UK

Analyzing football score data with statistical techniques, we investigate how the highly co-operative nature of the game is reflected in averaged properties such as the distributions of scored goals for the home and away teams. It turns out that in particular the tails of the distributions are *not* well described by independent Bernoulli trials, but rather well modeled by negative binomial or generalized extreme value distributions. To understand this behavior from first principles, we suggest to modify the Bernoulli random process to include a simple component of *self-affirmation* which seems to describe the data surprisingly well and allows to interpret the observed deviation from Gaussian statistics. The phenomenological distributions used before can be understood as special cases within this framework. We analyzed historical football score data from many leagues in Europe as well as from international tournaments and found the proposed models to be applicable rather universally. In particular, here we compare men's and women's leagues and the separate German leagues during the cold war times and find some remarkable differences.

DY 13: Glass I (joint session with DF)

Time: Tuesday 10:00–13:00 Location: H23

DY 13.1 Tue 10:00 H23

Connection of the slow β-relaxation and physical aging in metallic glasses — •Jörg Hachenberg, Dennis Bedorf, and Konrad Samwer — I. Physikalisches Institut, Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany

Metallic glasses are commonly used as model systems for glassy dynamics. This is due to the fact that their interactions can be simplified as such of hard spheres. Special attention has been attracted by recent experimental studies [1] and computer simulations [2] revealing the existence of a secondary, slow β-relaxation as a universal feature of the glass transition. Here, heat rate dependant mechanical spectroscopy is used to investigate the connection between this β-relaxation and physical aging, commonly described as a change in fictive temperature. The close dependence of both phenomena can be interpreted as a single relaxation showing up on two timescales (heating rate resp. spectroscopy frequency). It is proposed that both phenomena share a common origin.

This work is supported by DFG, Graduiertenkolleg 782 and SFB 602, TP B8.

[1] J. Hachenberg, K. Samwer, J. Non-Cryst. Sol. 352, 5110 (2006)
[2] H. Teichler, Phys. Rev. E 71, 031505 (2005)

DY 13.2 Tue 10:15 H23

Fast β-relaxation of Na in Na_2O-xB_2O_3 melts — •Florian Kargl[1], Andreas Meyer[2], and Michael Marek Koza[3] — [1]Physik Department E13, TU München, 85748 Garching, Present Address: Department of Applied Physics, Chalmers University of Technology, 41296 Göteborg, Schweden — [2]Physik Department E13, TU München, 85748 Garching, Permanent Address: Institut für Raumsimulation, DLR, 51147 Köln — [3]Institut Laue-Langevin, 38042 Grenoble, France

We report on a fast β-relaxation process in a network-glass forming system that is up to the melt a fast-ion conductor. The process is evidenced by means of quasielastic neutron scattering [1]. The data are analysed in the framework of the mode-coupling theory (MCT) of the liquid to glass transition [2]. It is shown that this fast β-relaxation process, that can consistently be described within the framework of this theory, prepares the α-relaxation of the fast diffusing Na ions. We discuss the q- and T-dependence of the relevant parameters of the β-scaling law of the MCT and its dependence on Na concentration.

[1] F. Kargl, A. Meyer, M. M. Koza (submitted).
[2] W. Götze, J. Phys.: Condens. Matter **2**, 8485 (1990).

DY 13.3 Tue 10:30 H23

Microscopic mechanism of the β-process in metallic glass formers: molecular dynamics results for NiZr — •Helmar Teichler — Inst. f. Materials Physics, University of Göttingen

For glass formers around and below the dynamical critical temperature Tc of mode coupling theory (MCT), the fluctuation spectrum shows the β-regime in the time domain as precursor of the final α-decay. Recently, the β-regime has re-attracted much interest due to observation of the β-excess wing in spectroscopic data of a metallic glass by Rösner, Samwer, and Lunkenheimer (Europhys. Lett. 92, 105701(2004)) and the evaluation of the interconnection between Cole-Cole peak and spectral properties of the β-regime in the MCT by Sperl (PRE, 74, 011503(2006)). Here we address the question of the microscopic mechanisms that take place in the corresponding frequency regime in metallic glasses. Regarding this, molecular dynamics simulation data of vitrifying Ni0.5Zr0.5 melts are investigated by studying their inherent structure dynamics in order to eliminate the masking, predominant effect of thermal single-particle vibrations. Analysis of the remaining dynamics by nearest neighbour correlation functions, aimed at identifying topological fluctuations of the system, yields reversible over-barrier transitions of correlated chains of atoms as source of a β-peak between single-particle vibrations and the α-decay.

DY 13.4 Tue 10:45 H23

Liquid-to-glass transition of bulk-glass forming Cu60Ti20Zr20 alloy by molecular dynamics simulations — •Xiujun Han[1,2] and Helmar Teichler[1] — [1]Inst. f. Materials Physics, University of Göttingen — [2]IFF, Forschungszentrum Jülich

The present work reports results from molecular dynamics studies about microscopic structure and dynamics of the ternary, bulk metallic glass forming Cu60Ti20Zr20. In detail we consider nearest neighbour numbers, specific heat, simulated glass temperature, diffusion coefficients, and the incoherent intermediate scattering function (ISF). The applied atomic model reproduces well experimental X-ray data of total radial distribution function. It provides for Cu60Ti20Zr20 a structure with marked intermediate range order. The incoherent ISFs are analyzed within an extension of the mode coupling theory (MCT), where the memory kernel is evaluated from Laplace transform of the ISF. The dynamics of the system fulfils in most respects the predictions of the MCT, up to a suppression of the algebraic t^{-a}-decay in the early β-range, which is traced back to effects of single particle vibrations in the effective memory kernel that are not fully included in the MCT. As by-product, our investigation provides a method to re-construct, around the critical temperature, major parts of the memory kernel from λ and the plateau-value of the ISF.

DY 13.5 Tue 11:00 H23

Neutron scattering on levitated metallic droplets — •Andreas Meyer[1], Dirk Holland-Moritz[1], Sebastian Stueber[2], Thomas Hansen[3], and Tobias Unruh[4] — [1]Institut für Materialphysik im Weltraum, DLR Köln — [2]Physik Department E13, TU München — [3]ILL, Grenoble — [4]FRM-II, TU München

We report on first quasielastic neutron scattering experiments on metallic droplets using an electromagnetic levitation device on the neutron time of flight spectrometer ToF-ToF of the FRM-II. With this containerless processing undercoolings of the liquids up to 230K below the melting point were achieved. In binary ZrNi and ternary ZrNiAl glass forming melts the undercooling leads to a slowing down of the atomic mobility. The relation to the atomic dynamics in bulk glass forming metallic alloys in a Zr base will be discussed. We measured static structure factors of these systems on the neutron diffractometer D20 of the ILL. By isotopic substitution partial structure factors are accessible in liquid ZrNi. The partial structure factors also serve as an input for numerical mode coupling calculations.

15 min. break.

DY 13.6 Tue 11:30 H23

Understanding the fragility of supercooled liquids in terms of the properties of the potential energy landscape — •Andreas Heuer — Inst. f. Phys. Chemie, Corrensstr. 30, 48149 Münster

According to the Angell representation supercooled liquids are classified according to their fragility, i.e. the degree of non-Arrhenius behavior. Although in recent years fragility has been empirically correlated with different properties such as, e.g., mechanical behavior no microscopic understanding of the fragility exists. We report computer simulations of different glass-forming systems (silica, binary Lennard-Jones) where a detailed characterization of the potential energy landscape has been achieved. A crucial parameter is the crossover energy scale above which the local dynamics is fluid-like and below which it becomes activated. For these systems the macroscopic diffusion constant can be analytically expressed in terms of landscape parameters, reflecting its thermodynamic properties and its local dynamics. In this way we can show that the fragility strongly depends on the crossover energy scale and that for fragile systems the crossover to activated behavior only starts for very low-energy configurations. This result is interpreted in qualitative terms.

DY 13.7 Tue 11:45 H23

Molecular dynamics of a bioprotective fluid confined to nanopores — •Nicolas Ubrig[1], Rémi Busselez[2], René Berwanger[1], Denis Morineau[2], and Rolf Pelster[1] — [1]Fachrichtung 7.2, Experimentalphysik, Universität des Saarlandes, Postfach 151150, 66 041 Saarbrücken, Germany — [2]GMCM, campus de Beaulieu, 35042 Rennes Cedex, France

We study structure and molecular dynamics of a bioprotective fluid. This is a solution of glycerol and trehalose , the glass transition of which depends on the mixing ratio. The fluid is confined in parallel rodlike nanopores of a silicon matrix. Different techniques such as temperature dependent NMR, Raman-, infrared- and dielectric spectroscopy are applied in order to detect confinement-induced deviations

from the bulk behavior.

DY 13.8 Tue 12:00 H23

Continuous Time Random Walk Description of the Dynamics of a Model Glass Former — •Oliver Rubner and Andreas Heuer — Institut für Physikalische Chemie, Universität Münster

In this work we present an analysis of data obtained by simulations on a 65 particle binary Lennard-Jones Mixture (BMLJ65). We show that the dynamics of this system can be interpreted on the grounds of a Continuous Time Random Walk (CTRW) description. The basic assumptions of the CTRW model are well fulfilled and thus the picture of spatially and temporally independent jump processes between metabasins is supported.

Given the waiting time distribution of the jumps, it is then possible to deduce analytically some of the properties of the incoherent scattering function F(q,t). These predictions are compared to the numerical data and show very good agreement which supports strongly the notion of the BMLJ65-dynamics as a CTRW-process.

DY 13.9 Tue 12:15 H23

Complex Dynamics in a Binary Glass Former investigated by Dielectric Spectroscopy — •Philipp Gutfreund, Thomas Blochowicz, and Bernd Stühn — TU Darmstadt

Previous work on binary glass forming mixtures showed pronounced dynamic heterogeneities and a broad distribution of relaxation times of the smaller molecules in the mixture and in some cases even a distinct secondary relaxation peak was observed. It was also demonstrated that an additional power law contribution at the high frequency side of the main relaxation peak in neat glass-formers, called excess wing, can be separated as a distinct secondary relaxation peak if the molecule is contained in a slower matrix.

In the present work a mixture of Methyl-Tetrahydrofuran (M-THF) in Tristyrene was investigated by dielectric spectroscopy. The dielectric spectra are dominated by the smaller M-THF molecules due to the much stronger dipole moment. Calorimetry measurements show full miscibility in the whole concentration and temperature range. Pure M-THF is known to show a pronounced high frequency wing and a small secondary relaxation process, it is shown that in the mixtures several other processes emerge. The fastest of these processes seems to show certain typical signs of liquid dynamics far below T_G of the mixture. The fact of coexisting glassy and liquid states in a binary mixture below T_G was already shown in NMR measurements [1] and was previously anticipated by theoretical considerations [2].

[1] T. Blochowicz et al., J. Phys. Chem. B 103 (1999) 4032
[2] J. Bosse and Y. Kaneko, Phys. Rev. Lett. 74 (1995) 4023

DY 13.10 Tue 12:30 H23

Ab-inito calculations of atomic cluster configurations for ion conducting glasses — •Christian Müller and Philipp Maass — Institut für Physik, Technische Universität Ilmenau, 98684 Ilmenau, Germany

Ab-inito quantum mechanical simulations of atomic configurations are carried out in order to explore structural properties of ion conducting glasses and in order to develop effective pair potentials for molecular dynamics simulations. Such potentials are of crucial importance for the modelling of ionic transport properties, which require a realistic identification of ion-sites and diffusion pathways [1]. In previous work mostly small structural units of a glass with high symmetry were considered. The computational power nowadays allows one to simulate much larger clusters, and to take into account the medium range order by means of Hartree Fock and density functional theory calculations. We present calculations for lithium borate and lithium sulphate glasses. In particular a comparison of calculated and experimental infra-red and Raman spectra is shown, which allows to judge the quality of the energy-optimized disordered cluster configurations.

[1] C. Müller, E. Zienicke, St. Adams, J. Habasaki, P. Maass, Phys. Rev. B, in press; condmat/0607523

DY 13.11 Tue 12:45 H23

Evaluation of effective one-particle potentials for the identification of ion conduction pathways in glasses — •Egbert Zienicke, Christian Müller, and Philipp Maass — Institut für Physik, Technische Universität Ilmenau, 98684 Ilmenau, Germany

The energetic characteristics of sites and the topology of diffusion pathways of mobile ions in network glasses play a key role for the understanding ion transport in vitreous electrolytes [1], which are used in many different technological applications. In molecular dynamics simulations of such systems the sites and diffusion pathways can be identified from the local number density of mobile ions determined from their motion [2,3]. Here we study the possibility of determining them from the time-averaged immobile network structure by applying an effective one-particle potential. To this end we compare the results of such analysis with those obtained from molecular dynamics simulations of lithium silicate glasses at various temperatures and compositions. In addition a comparison is made to results obtained from a bond valence analysis [3].

[1] W. Dieterich, P. Maass, Chem. Phys. **284**, 439 (2002).
[2] H. Lammert, M. Kunow, A. Heuer, Phys. Rev. Lett. **90**, 215901 (2003).
[3] C. Müller, E. Zienicke, St. Adams, J. Habasaki, P. Maass, Phys. Rev. B, in press; condmat/0607523.

DY 14: Fluid dynamics II

Time: Tuesday 11:15–13:00 Location: H2

DY 14.1 Tue 11:15 H2

Boudany effects in fluids with internal orientational degree of freedom. — •Sebastian Heidenreich[1], Patrick Ilg[2], and Siegfried Hess[1] — [1]Technische Universität Berlin, D-10623, Germany — [2]ETH Zürich, Wolfgang-Pauli-Str. 10, 8093 Zürich

In nano- and microfluidics the length scales of devices are comparable to the molecular lengths and fluid-wall interactions become significant for the flow behavior. In our contribution we consider fluids with an internal orientational degree of freedom. We use the relaxation equation [1], an amended Landau-de Gennes potential [2] to model the spatially inhomogeneous orientational dynamics and the momentum balance equation to couple the velocity on the orientation. In order to model fluid-wall interactions we use different boundary conditions on the alignment tensor (anchoring) as well as on the alignment flux tensor (consequences of irreversible thermodynamics [3]). We show analytically that for stationary flows (plane Couette and Poiseuille flows) in the isotropic phase boundary conditions on the alignment flux tensor lead to an apparent velocity slip. Furthermore the interplay between the flow velocity and the orientation dynamics in the nematic phase under consideration of the different boundary conditions is presented.

[1] S. Hess, Z. Naturforsch. **30a**, 728, 1224 (1975)
[2] S. Heidenreich, P.Ilg and S. Hess, Phys. Rev. E **73**, 061710 (2006)
[3] L. Waldmann, Z. f. Naturf. **22a**, 1269 (1967); L. Waldmann and H. Vestner, Physica **99A**, 1 (1979); S. Hess and H. M. Koo, J. Non-Equilibrium Thermodyn. **14**, 159 (1989)

DY 14.2 Tue 11:30 H2

Influence of inhomogenous magnetic field on the electric potential distribution in liquid metal channel flow — •Egbert Zienicke and Evgeny Votyakov — Institut für Physik, Technische Universität Ilmenau, Postfach 100565, 98684 Ilmenau

If an electrical conducting fluid, for example a liquid metal, flows through a stationary external generated magnetic field, electrical currents are induced which on their turn act on the fluid by the Lorentz force. The flow in the channel together with the magnetic field create an electrical field, respectice an electrical potential distribution inside the liquid metal. We derive by physical inspection and numerical simulations of MHD channel flow how the potential distribution changes from homogenous magnetic field to streamwise inhomogenous, and to streamwise and spanwise inhomogenous magnetic field (corresponding to magnetic poles above and below the channel). In the latter case closed level lines of the electric potential in the middle plane appear for high enough magnetic field, indicating the possibility of reverse flow

under the magnet [1]. This finding is also confirmed experimentally by potential measurements in a liquid metal channel [2].

References

[1] E. Votyakov, E. Zienicke, Fluid Dynamics and Materials Processing, accepted for publication.

[2] O. Andreev, Y. Kolesnikov, A. Thess, Phys. Fluids 18 (2006) 065108

DY 14.3 Tue 11:45 H2

Response thin liquid films with splitted tongues? — •Bernhard Heislbetz — DLR Lampoldshausen, Institut für Raumfahrtantriebe, D-74239 Hardthausen

The stability of free fluid films in the presence of a harmonic modulated pressure or gravity field is investigated analytically. A linear stability analysis for the infinitesimal disturbances of the hydrodynamic problem for inviscid and also viscous fluids shows, that the dynamic of the interfaces of fluid films can be described by two coupled differential equations of the Mathieu-type. In the range of very thin film thicknesses we can show, that the time evolution of the film shapes is governed by an membrane-like equation coupled with an linear KdV-equation. By means of multiple time scale analysis we exemplify if and why thin liquid films response with splitted tongues.

DY 14.4 Tue 12:00 H2

Linear analysis of instability in a binary-liquid layer — •Ion Dan Borcia and Michael Bestehorn — Lehrstuhl für Theoretische Physik II, Brandenburgische Technische Universität Cottbus, Germany

Oscillatory and monotonic long wave Marangoni instability in a binary-liquid layer with deformable interface in the presence of Soret effect was studied using two simplified sets of equations [1,2]. The vertical dependency of the temperature and concentration was approximated with polynomials. The actual work is devoted to the study of the validity domain of this approximation in the parameter space, for the early stage of the instability. Thus, we compare the results from previous models with those computed for an extended system considering the temperature distribution and the concentrations described by time-dependent three-dimensional equations.

[1]I.D. Borcia, R. Borcia, M. Bestehorn, Europhys. Lett., 75(1),112 (2006).

[2]I.D. Borcia, R. Borcia, M. Bestehorn, J. Optoelectr. Adv. Mater., 8(3), 1033 (2006).

DY 14.5 Tue 12:15 H2

Verdampfungsinduzierte Musterbildung in dünnen Filmen — •Domnic Merkt und Michael Bestehorn — Technische Universität Cottbus, Lehrstuhl nichtlineare Dynamik und statistische Physik, Erich Weinert Strasse 1, 03046 Cottbus

Wir stellen eine Erweiterung der sogenannten Dünnfilmgleichung vor, die das für diese Systeme typische "Coarsening" unterdrückt und zur Bildung von regelmäßigen, stationären Mustern der Oberfläche mit endlicher Wellenzahl führt (Hexagone, Streifen). Der zur Musterbildung notwendige Mechanismus beruht hier auf der Berücksichtigung von Verdampfung und Kondensation der Flüssigkeit bei spezieller Systemkonfiguration. In diesem Vortrag wird diese Erweiterung physikalisch motiviert und es werden lineare sowie nichtlineare Ergebnisse vorgestellt.

Invited Talk DY 14.6 Tue 12:30 H2

Instabilities and pattern formation in phase-separating fluids — •Jürgen Vollmer — Fachbereich Physik, Philipps Universität, Renthof 6, 35032 Marburg, Germany

The thermodynamic equilibrium of fluid mixtures and their isothermal relaxation to equilibrium after a rapid temperature quench are well understood due to extensive experimental, numerical and theoretical studies in the past decades. In many technological and natural processes one is however confronted with phase-separating systems where the temperature is slowly drifting. In this case it is of interest to follow the evolution of the local composition also while the temperature is evolving. A simple estimate shows that even for very small drift the composition cannot quasi-statically (in the sense of local thermodynamic equilibrium) follow the change of temperature. The temporal evolution of the composition consequently becomes a problem of pattern formation: For small temperature drift convection arises, and a large drift induces repeated waves of precipitation.

We derive a phase diagram accounting for the cross-over between the quasi-static, convective and oscillatory regimes, and present a minimal theoretical model addressing the parameter dependence of the oscillations. The latter agrees well with recent experimental data of D. Vollmer and G.K. Auernhammer (MPI Polymer Research, Mainz).

DY 15: Internal Symposium: Finite size effects at phase transitions

Time: Tuesday 14:00–16:45 Location: H2

Invited Talk DY 15.1 Tue 14:00 H2

Unconventional types of phase transitions due to interplay of finite size and interfacial effects — •Kurt Binder[1], Andrey Milchev[1,2], and Marcus Mueller[3] — [1]Institut für Physik, Johannes Gutenberg Universität, 55099 Mainz — [2]Institute for Physical Chemistry, Bulgarian Academy of Sciences, 1113 Sofia, Bulgaria — [3]Institut für Theoretische Physik, Universität Göttingen, 37077 Göttingen

As generic system for confined nano systems, Ising models are considered confined between "competing walls"on which surface fields of opposite sign act. Such systems do not acquire a nonzero total magnetization at the transition temperature of the bulk, since domains of opposite magnetization are stabilized. At a lower temperature, a magnetization appears, discontinuously, in the thermodynamic limit, though this transition can be the limiting case of a second order transitions. Depending on the geometry, this transition is related to wetting corner filling, or cone filling transitions. Phenomenological finite size scaling concepts about these transitions are discussed, and evidence from Monte Carlo simulations is presented. The double-pyramide geometry can be modeled by a Landau-type free energy, but with size-dependent coefficients.

Invited Talk DY 15.2 Tue 14:30 H2

Successes and limitations of current renormalization group approaches to the study of finite size effects — •Hans Werner Diehl and Daniel Grüneberg — Fachbereich Physik, Universität Duisburg-Essen, Campus Duisburg, D-47048 Duisburg, Germany

A survey of what current renormalization group (RG) approaches based on expansions about the upper critical dimension can contribute to the study of finite size effects near continuous bulk phase transitions is given. In particular, systems in slab geometries — the simplest geometries encountered in studies of the Casimir effect — are considered. Recent work[1,2] revealing that previous approaches break down at the bulk critical temperature T_c in those cases where the boundary conditions entail the presence of a zero mode at the level of Landau theory is elucidated. The proposed reorganization of RG-improved perturbation theory makes the theory well-defined at T_c and yields temperature dependent scaling functions in conformity with phenomenological analyticity requirements. This improves the theory for slabs under such "zero-mode boundary conditions" basically to the level known from the cases of boundary conditions for which no zero modes are present at T_c in Landau theory. The challenge to go beyond this level by developing successful feasible approximation schemes by which the finite size behavior can be systematically studied for slabs also for temperatures below T_c, including eventual dimensional crossovers, remains.

[1] H. W. Diehl, D. Grüneberg, and M. A. Shpot, Europhys. Lett. **75**, 241 (2006), cond-mat/0605293.

[2] D. Grüneberg, H. W. Diehl, and D. M. Dantchev, to be published.

Invited Talk DY 15.3 Tue 15:00 H2

Thermodynamic Casimir Forces — •Siegfried Dietrich — Max-Planck-Institut für Metallforschung, Stuttgart, Germany — Institut für Theoretische und Angewandte Physik, Universität Stuttgart, Germany

Long-ranged correlations in a fluid near its critical point lead to clearly identifiable effective forces acting on confining walls. The corresponding universal scaling functions are discussed for different boundary conditions and geometries. The theoretical predictions are compared with high precision experimental data for He4 and He3/He4 wetting

films near the superfluid phase transition as well as with synchrotron scattering data from classical binary liquid mixtures. Applications for colloidal suspensions are discussed.

15 min. break.

Invited Talk DY 15.4 Tue 15:45 H2

Diversity of critical behavior within a universality class — •Volker Dohm — RWTH Aachen

The notion of a universality class of critical phenomena in bulk and confined systems is discussed. The Privman-Fisher hypothesis [1] states that, for given geometry and boundary conditions, finite-size scaling functions are universal, i.e., independent of microscopic details, and that two-scale factor universality is valid for confined systems. In recent years it has been shown that renormalization-group (RG) theory is well compatible with a certain degree of diversity of finite-size critical behavior within a universality class. There are at least two microscopic sources of nonuniversal effects near criticality : (i) van der Waals type interactions in fluids and (ii) anisotropic interactions in solids. While critical exponents are not affected by these sources, a nontrivial dependence of finite-size scaling functions on these sources has been predicted [2, 3]. New RG results of the anisotropic φ^4 theory are presented that illustrate the nonuniversality of finite-size critical behavior. Recent MC simulations [4] for anisotropic Ising models support this diversity.

[1] V. Privman and M.E. Fisher, Phys. Rev. B 30, 322 (1984).

[2] X.S. Chen and V. Dohm, Phys. Rev. E 70, 056136 (2004); Physica B 329-333, 202 (2003).

[3] V. Dohm, J. Phys. A 39, L 259 (2006).

[4] M. Schulte and C. Drope, Int. J. Mod. Phys. C 16, 1217 (2005); W. Selke and L.N. Shchur, J. Phys. A 38, L 739 (2005).

Invited Talk DY 15.5 Tue 16:15 H2

Spin Dynamics Simulations of Excitations and Critical Dynamics in a Heisenberg Antiferromagnet: Resolution of a controversy via finite size scaling — •David P. Landau — Center for Simulational Physics, The University of Georgia, Athens, GA , U.S.A.

The classic Halperin-Hohenberg classification of "dynamic" universality classes separates models with stochastic and deterministic behavior. Stochastic, e.g. Ising, models have long been studied using Monte Carlo simulations but research on magnetic systems with true dynamics is less detailed because of limitations in both computer speed and algorithms. Spin dynamics simulation methods have developed sufficiently that they now provide a powerful tool for the examination of excitations and dynamic critical behavior in magnetic models. From the Fourier transform of the space-displaced, time-displaced correlation functions the dynamics structure factor $S(q, \omega)$ can be extracted. After briefly describing modern decomposition methods for the time integration we shall present results for a classical, Heisenberg antiferromagent on a simple cubic lattice. This model is an excellent "testing ground" since it is expected to describe the magnetic behavior of $RbMnF_3$ quite well. The estimation of the dynamic critical exponent z is non-trivial and relies on finite size scaling of the dynamic structure factor. We shall compare our results with theoretical predictions as well as with detailed neutron scattering data.

+Work performed in collaboration with S.-H. Tsai and A. Bunker

* Research supported by the National Science Foundation

DY 16: Brownian motion and transport I

Time: Tuesday 14:30–16:30 Location: H3

DY 16.1 Tue 14:30 H3

Dispersionless transport in a washboard potential — •Igor Sokolov — Institut für physik, Humboldt Universität zu Berlin

Based on extensive numerical simulations of thermally agitated classical particles in a tilted washboard potential we have identified and characterized a transport regime that involves dispersionless motion of particles over several decades of time in appropriate parameter regimes. This remarkably coherent behavior requires the presence of thermal fluctuations, and is restricted to underdamped systems. The associated distribution of the particle positions moves at an essentially constant velocity and is far from Gaussian. This new regime is complementary to, and entirely different from, well-known nonlinear response and large dispersion regimes observed for other values of the external force. We provide a theoretical framework to estimate the times of onset and duration of dispersionless transport and the parameter regimes in which it occurs. A similar regime is also observed in numerical simulations in two dimensions with a tilted separable potential. Our results may be testable on the motion of molecules and clusters on surfaces as well as in Josephson junctions.

K. Lindenberg, J. M. Sancho, A. M. Lacasta, and I. M. Sokolov, Phys. Rev. Lett., in press.

DY 16.2 Tue 14:45 H3

Traffic phenomena in driven transport with internal states — •Tobias Reichenbach, Thomas Franosch, and Erwin Frey — Arnold Sommerfeld Center for Theoretical Physics (ASC) and Center for NanoScience (CeNS), Department of Physics, Ludwig-Maximilians-Universität München, Theresienstrasse 37, D-80333 München

Traffic phenomena occur in biological contexts as well as in mesoscopic quantum systems. Molecular motors move along parallel one-dimensional filaments in cells, serving as biological engines. On the other hand, spintronic devices aim to exploit quantum effects, the spin of electrons, when passing these trough nanowires. Here, we present a generic model that underlies both situations [1]. Allowing particles in an exclusion process to possess internal states, the latter account for several parallel lanes as well as different spin states, where Pauli's exclusion principle is respected. Exploring the system's behavior, we find that it can be tuned by controlling the particle fluxes at the boundaries. In particular, a spontaneous polarization may occur at a certain spatial position and, upon changing the fluxes at the boundaries, be driven in or out of the system. We derive the shape of the density profiles as well as resulting phase diagrams analytically by a mean-field approximation and a continuum limit.

[1] T. Reichenbach, T. Franosch, E. Frey, Phys. Rev. Lett. 97, 050603 (2006)

DY 16.3 Tue 15:00 H3

Experimental characterization of a Brownian Motor based on Ferrofluids — •Jens Nawitzki and Achim Kittel — Institute of Physics, Energy and Semiconductor Research Laboratory, Carl von Ossietzky University of Oldenburg, 26111 Oldenburg, Germany

We characterize the dynamics of an experimental Brownian Motor. The Brownian Motor consists of a hollow plastic sphere filled with a ferrofluid. The orientation dynamics of the ferrofluids ferromagnetic particles ist strongly influenced by thermal fluctuations. The sphere is suspended on a thin filament in the center of two crossed pairs of Helmholtz coils. One of the pair forms a static magnetic field in x direction and the other on applies a time dependent magnetic field in y direction. The time dependent field consists of a harmonic oscillation with a higher harmonic of the basic frequency. The magnetic fields act as potential for the orientation of the ferromagnetic particles. Directed motion of the ferromagnetic particles manifests as a rotation around the z Axis. Through the viscous coupling of the particles with the ferrofluids carrier liquid and their combined effective action results in a macroscopic torque of the plastic sphere. We measure the torque by means of applying a countertorque to the sphere's suspension. The control parameters for the measurements are the amplitude, frequency and phase of the time dependent and the magnitude of the static magnetic field. The measurements are done with varying viscosities of the ferrofluid. We observe the dynamical behavior of the sphere under variation of the control parameters and compare the results with the theoretical expectations.

DY 16.4 Tue 15:15 H3

Anomalous response behavior of a Josephson junction — •David Speer, Ralf Eichhorn, and Peter Reimann — Universität Bielefeld, Universitätsstr. 25, 33615 Bielefeld

We predict unusual transport properties of a Josephson Junction in

the form of average current and voltage of opposite sign. The effect survives in the presence of not too large (thermal) noise. Numerical simulations are complemented by intuitive explanations of the basic mechanism and analytical approximations.

DY 16.5 Tue 15:30 H3

contribution moved to Dy 16.8 (Tue, 16:15) — •XXX XXX —

DY 16.6 Tue 15:45 H3

Quasiperiodic ratchets with cold atoms — •Sergey Denisov — Institute of Physics, University of Augsburg, 86135 Augsburg, Germany

We investigate experimentally the route to quasiperiodicity in a driven ratchet for cold atoms, and examine the relationship between symmetries and transport while approaching the quasiperiodic limit.

Depending on the specific form of driving, quasiperiodicity results in the complete suppression of transport, or into the restoration of the symmetries which hold for a periodic driving.

DY 16.7 Tue 16:00 H3

Multifractal conductance fluctuations — •Angelo Facchini[1], Andrea Tomadin[2], and Sandro Wimberger[3] — [1]University of Siena, Center for the Study of Complex Systems, Via Tommaso Pendola37, I-53100 Siena — [2]Scuola Normale Superiore, Piazza dei Cavalieri 7, I-56126 Pisa. — [3]CNISM and Dipartimento di Fisica del Politecnico, C. Duca degli Abruzzi 24, I-10129 Torino.

To characterize complexity on many different scales a standard tool is offered by the multifractal analysis. Yet often used in the study of classical complex systems, there are not many results on the quantum level, which would show multifractality surviving the quantum coarse-graining. A multifractal scaling of eigenfunctions at phase-transitions is one of the few well-known "quantum" examples. In this contribution, we show that multifractality is found in a *single* and easily measurable observable which characterizes *global* quantum transport in a paradigmatic model of quantum chaos. More specifically, we predict a multifractal scaling of the survival probability of the opened δ-kicked rotor in the deep quantum regime. Our analysis intrinsically focuses on intermediate and large-scale correlations of the survival probability as the global transport signal [1], and it generalizes previous results predicting parametric monofractal fluctuations on small scales [2].

[1] A. Facchini, A. Tomadin, S. Wimberger, Physica A, doi:10.1016/j.physa.2006.10.012.

[2] A. Tomadin, R. Mannella, and S. Wimberger, J. Phys. A **39**, 2477 (2006).

DY 16.8 Tue 16:15 H3

Josephson vortex ratchet: experiment and simulations — •Edward Goldobin, Markus Beck, Reinhold Kleiner, and Dieter Koelle — Physikalisches Institut – Experimentalphysik II, Universität Tübingen, Auf der Morgenstelle 14, D-72076 Tübingen, Germany

We investigate a Josephson vortex ratchet — a fluxon in an asymmetric periodic potential driven by a deterministic force with zero time average. Our recent experiments[1] show that the average velocity of the ac driven fluxon may reach 91% of the Swihart velocity. In this talk we describe our experiment and give some further insights on the fluxon dynamics in such a ratchet, obtained by numerical simulations.

[1] Phys. Rev. Lett. **95**, 090603 (2005).

DY 17: Glass II (joint session with DF)

Time: Tuesday 14:30–17:50 Location: H23

DY 17.1 Tue 14:30 H23

Mikrostrukturierung silbernanopartikelhaltiger Gläser durch elektrische Felder — •Stefan Wackerow[1], Amin Abdolvand[2], Gerhard Seifert[1] und Heinrich Graener[1] — [1]FG Optik, Institut f. Physik, MLU Halle-Wittenberg, Hoher Weg 8, 06120 Halle — [2]LPRC, University of Manchester, UK

Silbernanopartikel haben eine charakteristische Absorptionsbande im optischen Spektralbereich, die durch Oberflächenplasmonen hervorgerufen wird. Silberpartikel in Glas finden Anwendung als Farbfilter, bzw. in Form elliptischer Partikel als Polarisatoren. Mögliche neue Anwendungen sind mikroskopische optische Bauelemente, die die besonderen optischen Eigenschaften der Partikel ausnutzen.

Ein technisch einfacher Weg zur Erzeugung von Strukturen in silberpartikelhaltigen Gläsern ist die Auflösung von Partikeln in starken elektrischen Feldern. Dazu werden zwei Elektroden auf das Glas gepresst und bei einer Temperatur um $250°C$ an diese eine Spannung von etwa $1kV$ angelegt. Unter der Anode entsteht dadurch ein kationenarmer Bereich, der eine um mehrere Größenordnungen geringere Leitfähigkeit als das unveränderte Glas hat. Über diese wenige μm dicke Schicht fällt der größte Teil der anliegenden Spannung ab, wodurch Feldstärken um $10^8 V/m$ erreicht werden. Diese starken elektrischen Felder führen zur Ionisierung und Zerstörung der Partikel.

Benutzt man als Anode einen leitfähigen photonischen Kristall aus makroporösem Silizium, erhält man im Glas eine Partikelverteilung, die der inversen Struktur des photonischen Kristalls entspricht und die theoretisch eine photonische Bandlücke aufweisen kann.

DY 17.2 Tue 14:50 H23

Characterization of silver nanoparticles in glasses by X-ray absorption spectroscopy — •Jörg Haug, Manfred Dubiel, Holger Kruth, and Angelika Chassé — Department of Physics, Martin Luther University Halle-Wittenberg, Friedemann-Bach-Platz 6, D-06108 Halle, Germany

Glasses containing metal nanoparticles are of interest because of their specific linear and non-linear optical properties. In the present work, there are represented structural investigations of Ag nanoparticles as well as of neighbourhood of Ag ions embedded in the glass matrix by means of EXAFS spectroscopy at the Ag K-edge. In a first step, EXAFS investigations are reported concerning the thermal expansion behaviour of bulk silver to test this method for investigations of nanoparticles. In a second step, in situ experiments at elevated temperatures of particle generation are described in order to evaluate the elementary processes of particle formation as well as the specific structure of nanoscaled particles.

DY 17.3 Tue 15:10 H23

Finite size effect of the conductivity of sputtered lithium-borate glasses — •Frank Berkemeier, Mohammad Reza Shoar Abouzari, and Guido Schmitz — Westfälische Wilhelms-Universität Münster, Institut für Materialphysik, Wilhelm-Klemm-Str. 10, 48149 Münster

The specific dc-conductivity of ion-conducting, sputtered glass films of the compositions $x\,Li_2O \cdot (1-x)\,B_2O_3$, with $x = 0.15$, 0.20 and 0.35, are determined by temperature dependent impedance spectroscopy. The thickness of the films varies between 7 nm and 1000 nm. In the case of relatively thick glass films (> 100 nm) each glass composition shows a specific dc-conductivity independent of the film thickness. For glasses with less than 20% alkali oxide, a significant increase of the specific dc-conductivity of about three orders of magnitude is observed, when decreasing the film thickness down to some nanometers. Three different models are suggested to explain this non-trivial 'finite size effect': structural modifications at the interfaces between glass layer and metallic electrode, formation of space-charge regions at the interfaces, and the existence of ion-conducting pathways inside the glass layers. Computer simulations based on percolation theory are presented to show the link between the experimental data and the assumption of conducting clusters inside the glass films.

DY 17.4 Tue 15:30 H23

Evidence for fast interfacial ion conduction in nanostructured solid electrolytes — •Ahmet Taskiran[1], Andre Schirmeisen[1], Harald Fuchs[1], Hartmut Bracht[2], and Bernhard Roling[3] — [1]Physikalisches Institut,Wilhelm-Klemm-Str.10,48149 Münster,Germany — [2]Institut für Materialphysik,Wilhelm-Klemm-Str.10,48149 Münster,Germany — [3]Intsitut für Physikalische Chemie,Hans-Meerwein-Str.,35032 Marburg,Germany

Solid ion conductors are used for applications like super-capacitors, high storage batteries and chemical sensors. Recent investigations have revealed that the overall conductivity can be enhanced by creating interfaces between different phases of the ion conductor. However, more

detailed investigations have to be carried out on the nanoscopic length scale in order to understand the ion transport mechanism in the bulk and at the interface. We use electrostatic force microscopy (EFM) operating in the non-contact mode to measure the ionic conductivity in nanoscale volumes. In this method the temperature dependent ion conductivity was monitored in the range from 100 K to 675 K, yielding the activation energies of the ion hopping processes [1]. This work mainly focuses on the interfacial conductivity between the nanocrystallites and the glass phases of a partially crystal. LiAlSiO sample. Additionally to the activation energies found for the nanocrystallites and glass phase, which are in good agreement with macroscopic results [2], we identified a third activation energy, which can be attributed to the interfacial ion conductivity. [1] Schirmeisen et al., Appl. Phys. Lett. 85(2004)2053 [2] Roling et al., Phys.Chem.Chem.Phys. 7(2005)1472

DY 17.5 Tue 15:50 H23

Thickness-dependence of dc-conductivity in $Li_2O - B_2O_3$ Glasses — Mohammad Reza Shoar Abouzari, Frank Berkemeier, and •Guido Schmitz — Institut für Materialphysik, Universität Münster, Wilhelm-Klemm Str. 10, D-48149 Münster

Thin films of $(x)Li_2O \cdot (1-x)B_2O_3$ glasses with different concentrations of Li_2O, $0.15 < x < 0.35$, are prepared by ion-beam sputtering.The thickness of glass films vary from 1400 nm down to 7 nm. Thin metallic films of Al Li on each sides of glass film serving as metallic electrodes. To determine dc-conductivity of glass layers we used impedance spectroscopy at different temperatures. Considering the system of glass layer and electrodes as two parallel (R+CPE) circuits, the measured data are described by Nyquist diagrams and the specific dc-conductivities of the glass layers are determined. It is observed that the specific dc-conductivity depend significantly on the layer thickness. For x = 0.2, the specific dc-conductivity of layers with a thickness between 700 nm and 100 nm is constant, while it increases monotonously for thinner layers with a thickness of 100 nm down to 7 nm with decreasing of the thickness. The increase of dc-conductivity amounts to three orders of magnitude. The obtained result for x = 0.15 shows the thickness dependency of the dc-conductivity up to 300 nm. It seems that this peculiar behaviour of the glass films stems from finite size effects disappears with increasing of layer thickness.

DY 17.6 Tue 16:10 H23

A binary Yukawa mixture under shear: A computer simulation study — •Jochen Zausch and Jürgen Horbach — Inst. f. Physik, Universität Mainz, Staudinger Weg 7, 55099 Mainz

Extensive Non-Equilibrium Molecular Dynamics (NEMD) simulations are performed to investigate a binary mixture of like-charged colloids under shear. The interactions between the colloidal particles are modelled by an effective screened Coulomb (Yukawa) potential, without considering explicitly any solvent degrees of freedom. The system is coupled to a DPD thermostat while determining dynamic properties in equilibrium. The DPD thermostat is also used for the NEMD runs where the system is sheared by means of Lees-Edwards boundary conditions. We investigate the dynamic properties in equilibrium and at different constant shear rates in steady state. Moreover, we study how the sheared system relaxes back to equilibrium when we suddenly switch off the shear. To this end, we consider a dynamic four-point susceptibility that measures fluctuations around the mean dynamics.

DY 17.7 Tue 16:30 H23

Free energy fluctuations in the Sherrington Kirkpatrick spin glass — •Martin Goethe and Timo Aspelmeier — Institut für Theoretische Physik, Georg-August-Universität Göttingen, Germany

A new numerical method of calculating the sample to sample fluctuations ΔF of the free energy in the Sherrington Kirkpatrick spin glass will be presented which is based on an interpolating Hamiltonian and works for all temperatures $0 < T < \infty$. By its use the scaling behaviour of ΔF in the spin glass phase is obtained. It strongly disagrees with previous numerical studies at zero temperature. Finally possible explanations for the difference and arising consequences will be discussed.

DY 17.8 Tue 16:50 H23

Free energy fluctuations and chaos in mean-field spin glasses — •Timo Aspelmeier — Institut für Theoretische Physik, Universität Göttingen

The sample-to-sample fluctuations ΔF of the free energy in the mean-field Ising spin glass are a long standing unsolved problem in spin glass physics. Here we show that ΔF is intimately connected to an apparently unrelated phenomenon, namely chaos in spin glasses. Chaos in spin glasses, first suggested within the droplet model for finite-dimensional spin glasses, also exists for the mean-field spin glass. This opens up a new way to calculate ΔF analytically. Since ΔF is related not only to chaos but also to domain wall energies in finite dimensional spin glasses, our results have direct bearing on spin glass physics in finite dimensions.

DY 17.9 Tue 17:10 H23

Long-time behavior of the velocity autocorrelation function in the overlapping Lorentz model — •Thomas Franosch and Felix Höfling — Arnold-Sommerfeld-Center for Theoretical Physics, LMU München, Germany

The long-time behavior of transport coefficients in the overlapping Lorentz model in two and three dimensions is investigated by means of extensive Molecular Dynamics simulations. The behavior of the velocity auto-correlation function can be rationalized in terms of a competition of the critical relaxation due to the underlying percolation transition and the hydrodynamic power-law anomalies. In two dimensions and in the absence of a diffusive mode, another power law anomaly due to trapping is found with an exponent -3 instead of -2. Further, the logarithmic divergence of the super Burnett coefficient is corroborated in the dilute limit; at finite density, however, it is dominated by a linear divergence.

DY 17.10 Tue 17:30 H23

The Jamming Transition in Granular Systems — •Matthias Sperl[1], Trushant Majmudar[1], Stefan Luding[2], and Robert Behringer[1] — [1]Duke University — [2]TU Delft

Recent simulations have predicted that near jamming for collections of spherical particles, there will be a discontinuous increase in the mean contact number, Z, at a critical volume fraction, ϕ_c. Above ϕ_c, Z and the pressure, P, are predicted to increase as power laws in $\phi - \phi_c$. In experiments using photoelastic disks we corroborate a rapid increase in Z at ϕ_c and power-law behavior above ϕ_c for Z and P. Specifically we find power-law increase as a function of $\phi - \phi_c$ for $Z - Z_c$ with an exponent beta around 0.5, and for P with an exponent ψ around 1.1.

DY 18: Brownian motion and transport II

Time: Tuesday 16:45–18:15 Location: H3

DY 18.1 Tue 16:45 H3

Lévy diffusion in thermal equilibrium — •Eric Lutz — Institut für Physik, Universität Augsburg, 86135 Augsburg

We show how anomalous Lévy diffusion can occur for systems coupled to a thermal bath of harmonic oscillators. The fluctuation-dissipation relation is satisfied and leads both to a natural truncation of the process and to an algebraically slow relaxation to thermal equilibrium.

DY 18.2 Tue 17:00 H3

Electrical resistance of disordered one-dimensional quantum conductors — •Christophe Deroulers — Institut für Theoretische Physik, Köln, Deutschland

In some (quasi-)one-dimensional quantum conductors (nanowires, anisotropic crystals, ...), it is observed that the electrical resistance R behaves, in some temperature range, as a power of the temperature T. Some results do not coincide with the well-known predictions of Kane and Fisher for a Luttinger liquid with a few weak impurities, and we study if these results could be due to disorder (many strong impurities in the wire). In our model, the wire is randomly cut in a chain of weakly-coupled "quantum dots" between which electrons hop. Because of competition betweenn tunneling and activation, and because of some interesting statistical effects, R behaves at low temper-

atures like $\exp(1/\sqrt{T})$ and, at higher temperatures, like a complicated function that may look like a power-law over one or two decades, as in experiments. We show, based on numerical simulations, that these two regimes are also distinguished by the repartition of current in the network of resistances equivalent to one wire, and that the statistical distribution of $\ln R$ is non-trivial and is given, for some temperatures, by an extreme value statistics (Gumbel law).

DY 18.3 Tue 17:15 H3

Anomalous Diffusion on Fractals — •Janett Prehl, Do Hoang Ngoc Anh, Peter Blaudeck, and Karl Heinz Hoffmann — Institut für Physik, Technische Universität Chemnitz, D-09107 Chemnitz

Diffusion in porous materials shows anomalous behavior over certain length scales. As an appropriate model we apply Sierpinski carpets with finite iteration depth [1]. Modeling anomalous diffusion usually random walks on regular fractals are used. We study disordered fractals in an attempt to capture the random nature of disordered material by randomly mixing different Sierpinski carpet generators [2]. Besides we consider biased diffusion of charge particles with external field applied on fractal pattern. In order to analyze the diffusive process on such structures we utilize different methods to determine important quantities as e.g. the random walk dimension d_{w}. We find that this exponent d_{w} shows a strong dependence on the mixture composition and on the structural features of the carpets analyzed.

[1] S. Tarafdar, et al., *Physica A*, **292**, 1 (2001)
[2] D. Anh, et al., *Europhys. Lett.*, **70**, 109 (2005)

DY 18.4 Tue 17:30 H3

Hydrodynamic properties of fractal aggregates — •Rainer Bedrich and Roland Ketzmerick — Institut für Theoretische Physik, Technische Universität Dresden, 01062 Dresden, Germany

For aggregates with a fractal-like structure, e.g. pyrogenic silica, it is important to relate their translational and rotational diffusion coefficients to their geometrical properties. We present a new algorithm, that allows for generating aggregates with any desired fractal dimension between $d_f = 1$ (chains) and $d_f = 3$ (spheres). Hydrodynamic properties are determined by a multipole expansion of the flow velocity at low Reynolds number [1]. We introduce hydrodynamic dimensions in analogy to the fractal dimension and obtain a universal relation between these dimensions for fractal aggregates. Aggregates from standard algorithms, like DLA, are in agreement with this relation.

[1] A. V. Filippov, J. Colloid Interface Sci. **229**, 184 (2000)

DY 18.5 Tue 17:45 H3

Exact solution for the diffusion coefficient of nonlinear Brownian motion — •Benjamin Lindner — Max-Planck-Institut, Dresden, Germany

A quadrature formula for the diffusion coefficient of a Brownian particle with nonlinear velocity dependent friction and diffusion coefficients is derived for the one-dimensional case. The result is discussed for three different systems: (1) an equilibrium system with nonlinear friction function; (2) a model of relativistic Brownian motion; (3) a phenomenological model of biological motion (active Brownian motion).

DY 18.6 Tue 18:00 H3

Hydrogen recombination on interstellar dust: A first-passage problem with disorder — •Ingo Lohmar and Joachim Krug — Institute for Theoretical Physics, University of Cologne, Germany

Hydrogen recombination on the surface of interstellar dust grains is both a crucial ingredient in the complex astrochemistry of gas clouds and a prime example for the effect of a confined geometry on diffusion-mediated reactions. We have studied this problem theoretically: based on the first-passage problem of two diffusing (and desorbing) random walkers on the surface, we formulate a consistent revised definition of the *sweeping rate* of a single atom, which allows us to introduce the spatial aspects of the problem to standard master or rate equation treatments. For simple (spherical and homogeneous) grains, the effect on the recombination efficiency can be calculated exactly and is appreciable compared to previous approximations [1].

The astrophysical puzzle in this context is that H_2 recombination still occurs efficiently at temperatures higher than predicted by the theory. The commonly accepted reason is the complex surface structure of the dust grains, which leads to a spatially inhomogeneous binding strength for reactants. While numerical simulations routinely confirm this explanation, analytical results for such first-passage problems in truly *disordered* environments are rare and limited to certain classes of systems. Our aim is to improve the theory in this respect, both for fundamental reasons as well as in view of the applicability to astrophysics.

[1] I. Lohmar, J. Krug, Month. Not. R. Astron. Soc. **370**, 1025 (2006)

DY 19: Finite size effects at phase transitions I (session accompanying the symposium of the same name)

Time: Tuesday 17:00–18:30 Location: H2

DY 19.1 Tue 17:00 H2

Finite-size adapted Wang-Landau/multibondic cluster simulations for second-order phase transitions — •Wolfhard Janke[1] and Bernd Berg[2] — [1]Institut für Theoretische Physik and Centre for Theoretical Sciences (NTZ), Universität Leipzig, Postfach 100900, 04009 Leipzig, Germany — [2]Department of Physics and School of Computational Science, Florida State University, Tallahassee, FL 32306, USA

For a second-order phase transition the critical energy range of interest is larger than the energy range covered by a canonical Monte Carlo simulation at the critical temperature. Such an extended energy range can be covered by performing a Wang-Landau recursion for the density of states followed by a multicanonical simulation with fixed weights. But in the conventional approach one loses the advantage due to cluster algorithms. A cluster version of the Wang-Landau recursion together with a subsequent multibondic simulation improves for 2D and 3D Ising models the efficacy of the conventional Wang-Landau/multicanonical approach by power laws in the lattice size. By suitably adapting the extended energy range to the system size, in our simulations real gains in CPU time reach two orders of magnitude.

[1] B.A. Berg and W. Janke, cond-mat/0610647, to appear in Phys. Rev. Lett.(in print).

DY 19.2 Tue 17:15 H2

Finite-size effects in anisotropic antiferromagnets — •Martin Holtschneider[1], Walter Selke[1], and Stefan Wessel[2] — [1]Institut für Theoretische Physik, RWTH Aachen — [2]Institut für Theoretische Physik, Universität Stuttgart

Square lattice Heisenberg antiferromagnets with an uniaxial anisotropy display, when applying a field parallel to the easy axis, antiferromagnetic, spin-flop, and paramagnetic phases. In particular, the transition region of the two ordered phases is studied carefully, using Monte Carlo simulations both in the classical and the spin-$\frac{1}{2}$ quantum version of the model. Finite-size analyses are found to play an essential role in investigating that region. We also present results on the closely related classical anisotropic XY antiferromagnet on a square lattice.

DY 19.3 Tue 17:30 H2

Finite-size scaling of droplets in two-dimensional ±J Ising spin glasses — •Alexander Hartmann — Institut für Theoretische Physik, Universität Göttingen, Germany

The behavior of two-dimensional Ising spin glasses is currently heavily discussed. Of particular interest is the question whether the low-temperature behavior close to the $T = 0$ phase transition depends on the type of disorder, i.e. Gaussian vs. bimodal (±J) distribution. From the finite-size scaling behavior of domain walls previously obtained via ground-state (GS) calculations, it appears that both classes behave differently, while recent Monte Carlo (MC) simulations claim universality. Here, the finite-size scaling of droplet excitations, which are dominating the low-temperature behavior, is studied numerically using a combination of suitable perturbations of the realizations together with exact GS calculations. The GS calculations are based on a matching approach, which allows to treat large system sizes up to $N = 256 \times 256$ spins. The main result is that the finite-size scaling

behavior of the droplets is different from the domain-wall scaling, but similar to the scaling of droplets for the Gaussian model. Hence, this could explain the results observed in MC simulations.

DY 19.4 Tue 17:45 H2

Critical Casimir force scaling function of the mean spherical model — •Boris Kastening and Volker Dohm — Institut für Theoretische Physik, RWTH Aachen

Motivated by recent unexplained experimental data [1,2] concerning the scaling function of the critical Casimir force in Helium films below T_λ, we carry out an analysis of the finite-size scaling functions of the excess free energy and of the critical Casimir force within the mean spherical model below T_c in film geometry with $d-1$ infinitely extended dimensions and one direction of finite extent. We consider various boundary conditions.

[1] R. Garcia and M.H.W. Chan, Phys. Rev. Lett. 83, 1187 (1999).

[2] A. Ganshin, S. Scheidemantel, R. Garcia, and M.H.W. Chan, Phys. Rev. Lett. 97, 075301 (2006).

DY 19.5 Tue 18:00 H2

Scaling Theory for Logarithmic-Correction Exponents — •Ralph Kenna[1], Des Johnston[2], and Wolfhard Janke[3] — [1]Applied Mathematics Research Centre, Coventry University, Coventry, CV1 5FB, England — [2]Department of Mathematics and the Maxwell Institute for Mathematical Sciences, Heriot-Watt University, Riccarton, Edinburgh, EH144AS, Scotland — [3]Institut für Theoretische Physik and Centre for Theoretical Sciences (NTZ),, Universität Leipzig, Augustus Platz 10/11, 04109 Leipzig, Germany

Multiplicative logarithmic corrections frequently characterize critical behaviour in statistical physics. Here it is shown that the various exponents of such corrections are interrelated just as the exponents characterizing leading scaling behaviour are. A new set of scaling relations for these logarithmic-correction exponents are proposed. These relations are then confronted with results from the literature and new predictions for logarithmic corrections in certain models are made.

DY 19.6 Tue 18:15 H2

On finite-time effects in non-equilibrium critical phenomena — •Malte Henkel — Laboratoire de Physique des Materiaux, Universite Henri Poincare Nancy I, Frankreich

The long-time regime in the dynamics of non-equilibrium systems, usually described in terms of dynamical scaling, is often sensible to strong finite-time corrections which can affect the conclusions on the kind of scaling description to be used (e.g. ageing vs sub-ageing or superageing). This will be illustrated in several examples from the ageing of disordered systems.

DY 20: Quantum chaos I

Time: Wednesday 14:00–15:30 Location: H2

Invited Talk DY 20.1 Wed 14:00 H2

Semiclassical approach to universality in quantum chaos — Stefan Heusler[1], •Sebastian Müller[2], Alexander Altland[3], Petr Braun[1,4], and Fritz Haake[1] — [1]Fachbereich Physik, Universität Duisburg-Essen, 47048 Duisburg, Germany — [2]Cavendish Laboratory, University of Cambridge, Cambridge CB30HE, UK — [3]Institut für Theoretische Physik, Zülpicher Str 77, 50937 Köln, Germany — [4]Institute of Physics, Saint-Petersburg University, 198504 Saint-Petersburg, Russia

According to the so-called Bohigas-Giannoni-Schmit conjecture the quantum spectra of classically chaotic systems display universal fluctuations. We explain this universality using periodic-orbit theory. To do so, we work with a generating function whose semiclassical limit is determined by quadruplets of sets of periodic orbits. We show that the interference between the contributions of these orbits gives rise to universal spectral correlations, agreeing with the predictions of random-matrix theory. In contrast to previous work the present approach yields both the non-oscillatory and the oscillatory parts of the universal spectral correlator. In particular, a semiclassical understanding of (the different possible degrees of) level repulsion is thus reached.

[1] S. Heusler, S. Müller, A. Altland, P. Braun, and F. Haake, `nlin.CD/0610053`, accepted for publication in Phys. Rev. Lett. (2007).

DY 20.2 Wed 14:30 H2

Statistical theory of irregular eigenfunctions: a semiclassical approach — •Juan Diego Urbina and Klaus Richter — Institute for Theoretical Physics, Regensburg University, 93040 Regensburg, Germany

The spatial fluctuations of quantum wavefunctions in systems with chaotic classical dynamics or in the presence of disorder, show a remarkable universality.

In clean chaotic systems, such universality is encoded in Berry's Random Wave Model (RWM)[1] while the exact theory of wavefunction statistics in disordered systems has been conjectured to describe not only the diffusive, but also the clean, ballistic case [2] by the so-called Ballistic Sigma Model (BSM). In particular, the BSM seems not to be compatible with the Gaussian distribution for the wavefunction's amplitude typical of the RWM.

However, the results of the BSM can indeed be derived by means of a natural generalization of Berry's conjecture, keeping the wavefunction's distribution strictly Gaussian [3]. The key point is the consistent use of the diagonal approximation in order to eliminate oscillatory contributions neglected by the BSM.

In this contribution, we present the three basic ingredients of this generalization, namely, how to incorporate arbitrary boundaries into the Random Wave Model, the semiclassical approximation for the averages, and the diagonal approximation providing the link with the results for disordered systems.

[1] M. V. Berry *J. Phys. A: Math. Gen.* **10**, 2083 (1977).
[2] A. D. Mirlin *Phys. Rep.* **326**, 259 (2000).
[3] J. D. Urbina and K. Richter *Phys. Rev. Lett.* **97**, 214101 (2006).

DY 20.3 Wed 14:45 H2

Nodal domains in open microwave systems — •Ulrich Kuhl, Ruven Höhmann, and Hans-Jürgen Stöckmann — AG Quantenchaos, Fachbereich Physik, Philipps-Universität Marburg, Renthof 5, D-35032 Marburg, Germany

Nodal domains in the wavefunctions ψ of closed systems have been proposed as a tool to discriminate between regular and chaotic systems [1], and interpreted for chaotic systems in terms of percolation models [2]. The theoretical predictions have been verified experimentally in a closed microwave billiard [3]. In open systems ψ is complex and has no longer nodal lines but nodal points. Still one can define nodal domains for real part ψ_R and imaginary part ψ_I of ψ. They show the same behavior as wavefunctions in closed billiards. In addition we investigate the variation of the number of nodal domains and the signed area correlation by changing the global phase φ_g according to $\psi_R + i\psi_I = e^{i\varphi_g}(\psi'_R + i\psi'_I)$. This variation can be qualitatively, and the signed area correlation quantitatively explained in terms of the phase rigidity characterizing the openness of the billiard [4].

[1] G. Blum, S. Gnutzmann, and U. Smilansky, Phys. Rev. Lett. 88, 114101 (2002).
[2] E. Bogomolny and C. Schmit, Phys. Rev. Lett. 88, 114102 (2002).
[3] N. Savytskyy, O. Hul, and L. Sirko, Phys. Rev. E 70, 056209 (2004).
[4] Y.-H. Kim, U. Kuhl, H.-J. Stöckmann, and P. W. Brouwer, Phys. Rev. Lett. 94, 036804 (2005)

DY 20.4 Wed 15:00 H2

Nodal Domains Statistics in the Barrier Billiard — •Maksim Miski-Oglu — 64291-Darmstadt, Schlossgartenstr.9, Institut für Kernphysik

Using the experimentally obtained wave functions of the barrier billiard we analyse the properties of the nodal domains of its wave functions. The total number of nodal domains, rescaled number of the inner nodal domains and the nodal domains area distribution are analyzed. We found that the mean value of the rescaled number of the

inner nodal domains shows a clear deviation from the value predicted by the percolation like model, however the nodal domain area distribution agrees well with the prediction of the percolation theory.

DY 20.5 Wed 15:15 H2

Spectrum, wave functions and effective index of refraction of a circular dielectric billiard — •Stefan Bittner, Barbara Dietz-Pilatus, Thomas Friedrich, Maksim Miski-Oglu, Pedro Oria Iriarte, Achim Richter, and Florian Schäfer — Institut für Kernphysik, Schloßgartenstraße 9, 64289 Darmstadt

The goal of the presented work is to investigate the correctness and precision of effective index of refraction calculations for open dielectric resonators. For this purpose, the spectrum and wave functions of circular dielectric billiards in different geometries were measured with high resolution and the corresponding quantum numbers identified. The general structure of the spectrum and resonance frequencies were compared to the calculations. General agreement was found, but also a high dependence on geometric parameters and perturbations, motivating further investigations and precision measurements.

DY 21: Finite size effects at phase transitions II (session accompanying the symposium of the same name)

Time: Wednesday 14:00–15:30 Location: H3

DY 21.1 Wed 14:00 H3

Nonequilibrium relaxation and critical Casimir forces — •Andrea Gambassi and Siegfried Dietrich — Max-Planck-Institut fuer Metallforschung, Heisenbergstrasse 3, 70569 Stuttgart and Institut fuer Theoretische und Angewandte Physik, Pfaffenwaldring 57, 70569 Stuttgart

Fluctuation-induced forces play a relevant role in the physics of soft matter. Among them, those induced by confined critical fluctuations (thermodynamic Casimir effect) are characterized by a certain degree of universality which makes them actually independent of many microscopic details of the specific system and therefore it allows for theoretical investigations in terms of simplified models. In this contribution we focus on some dynamical aspects of the thermodynamic Casimir effect and in particular on the way this force builds up in time when the fluctuating medium is rapidly quenched to its critical point.

DY 21.2 Wed 14:15 H3

On the breakdown of finite-size scaling in high dimensional periodical systems — •Alfred Hucht and Sven Lübeck — Theoretische Physik, Universität Duisburg-Essen, D-47048 Duisburg

Finite-size scaling functions of continuous phase transitions exhibit a scaling anomaly above the upper critical dimension d_c. This so-called breakdown of finite-size scaling is well-established on the basis of field theoretical and numerical approaches for system with periodic boundary conditions (BC), both in equilibrium (e.g. the Ising model) and non-equilibrium (e.g. directed percolation [1]). Less work was done for geometric phase transitions and for Dirichlet BC. Therefore, we numerically investigate the bond percolation transition in $2 \leq d \leq 10$ dimensions with various boundary conditions. For $d < d_c = 6$ the spatial correlation length is limited by the systems size at criticality for all BCs, whereas it exceeds the systems size in systems with periodic BC above d_c, the hallmark of the breakdown of finite-size scaling. We present, to our knowledge for the first time, a phenomenological and descriptive interpretation of this breakdown of finite-size scaling. Furthermore, we show that the high-dimensional behavior depends strongly on the boundary conditions.

[1] S. Lübeck and H.-K. Janssen, Phys. Rev. E 72, 016119 (2005)

DY 21.3 Wed 14:30 H3

High precision Monte Carlo analysis of tails for the order-parameter distribution of the two-dimensional Ising model — •Rudolf Hilfer[1], Bibudhananda Biswal[1], Hans-Georg Mattutis[2], and Wolfhard Janke[3] — [1]ICP, Universitaet Stuttgart, Pfaffenwaldring 27, 70569 Stuttgart, Germany — [2]Tokyo University of Electro-communications, Dept. of Mechanical and Control Engineering, Chofu, Tokyo 182-8585, Japan — [3]Institut für Theoretische Physik, Universität Leipzig, Augustusplatz 10/11, D-04109 Leipzig, Germany

The tails of the critical order-parameter distribution of the two-dimensional Ising model have been investigated through extensive multicanonical Monte Carlo simulation. Results for fixed boundary conditions are reported here, and compared with known results for periodic boundary conditions. Clear numerical evidence for "fat" stretched exponential tails exists below the critical temperature, indicating the possible presence of fat tails at the critical temperature. Our results suggest that, contrary to common belief, the true order parameter distribution at the critical temperature must be considered to be unknown at present.

DY 21.4 Wed 14:45 H3

Fisher renormalized exponents in an Ising fluid? — •Wolfgang Fenz[1], Reinhard Folk[1], Igor Mryglod[1,2], and Igor Omelyan[1,2] — [1]Institute for Theoretical Physics, Linz University, A-4040 Linz, Austria — [2]Institute for Condensed Matter Physics, 1 Svientsitskii Street, UA-79011 Lviv, Ukraine

We study the ferromagnetic order-disorder phase transition in Ising spin fluids with hard-core Yukawa interaction truncated at various cut-off radii r_c. We have performed extensive Monte Carlo simulations in the canonical ensemble at a fixed density, making use of the histogram reweighting technique and finite-size scaling methods. The system sizes range up to 10000 particles.

We focus our interest on the dependence of critical quantities such as the Binder cumulant and various exponent ratios on the value of r_c, and on the question whether the Fisher-renormalized exponents expected for these systems can be observed in the simulations. It turns out that the corrections to scaling decaying with a rather small exponent make it impossible to reach the asymptotic region with the limited computational power available. Thus, we observe only effective exponents, with different values depending on the chosen cut-off radius. The same dependence is also found for the critical Binder cumulant obtained with the crossing technique. Nevertheless, a closer investigation of γ_{eff} as a function of temperature seems to point towards a Fisher-renormalized asymptotic value.

Supported by the Austrian Fonds zur Förderung der wissenschaftlichen Forschung, project No P18592.

DY 21.5 Wed 15:00 H3

Finite-size effects on subcritical chemical potential isotherms in two- and three-dimensional square-well fluids — •Horst Vörtler[1], Katja Schäfer[1], and William Smith[2] — [1]Institut für Theoretische Physik, Universität Leipzig, Germany — [2]Faculty of Science, UOIT Oshawa, Canada

We study the influence of system size on chemical potentials of bulk square-well fluids and planar square-well films under subcritical conditions over wide ranges of densities and particle numbers using canonical MC simulations with test particle insertions. In the range between the stable vapour and liquid densities we find van der Waals-like loops in the chemical potential isotherms which show distinct finite size effects. Similarly to recent findings (MacDowell et al., J. Chem. Phys. 120(2004)5293; 125(2006)034705) for bulk Lennard-Jones fluids we observe a significant shrinking of the van der Waals-like loops with increasing number of particles for both bulk fluids and planar monolayers. In the stable gaseous and liquid ranges the system size dependence is found to be quite weak. Estimating the vapour-liquid coexistence densities from the simulated chemical potential isotherms by integration via a Maxwell equal area rule (Vörtler, Smith, J. Chem. Phys. 112(2000)5168) we find for bulk fluids only weak finite size effects on the coexistence data and the obtained results are very close to the best-known literature data. In two-dimensional layers the size effects on the coexistence data are significantly larger than on bulk conditions.

DY 21.6 Wed 15:15 H3

Phase transitions of fluids in mesopores assessed by NMR — •Rustem Valiullin and Jörg Kärger — Department of Interface

Physics, University of Leipzig, Germany

The adsorption hysteresis phenomenon is a classical example of a mesoscalic confinement effect upon macroscopical properties of fluids. It is suggested that the history-dependent character of the adsorbate accommodation in random nanoporous structures may result from a rugged free energy landscape with many local minima separated by free energy barriers. As it was inferred from computer simulation studies [1], activated crossing of these barriers leads to an extremely slow relaxation to the equilibrium state. In the present work, these predictions have been addressed experimentally using NMR methods. Based on a self-consistent set of experimental data provided by NMR, namely on adsorption kinetics and local self-diffusivities, the anomalously slow intra-pore density relaxation in mesoporous glasses with random porous structure has been proved in the hysteresis region [2]. At the same time, in the out-of-hysteresis region, as expected, the density relaxation has been measured to be diffusive. The observed slowing down of the density relaxation is discussed in the frame of a random field Ising model [3], which has been successfully used to describe critical phenomena of binary liquids in random glasses.

[1] H. J. Woo and P. A. Monson, Phys. Rev. E 67, 041207 (2003).
[2] R. Valiullin et al., Nature 443, 965 (2006).
[3] D. A. Huse, Phys. Rev. B 36, 5383 (1987).

DY 22: Granular matter / contact dynamics I

Time: Wednesday 15:45–17:15 Location: H2

DY 22.1 Wed 15:45 H2

Ripples in weakly turbulent flows in an annular channel — •Andreas Wierschem[1], Tobias Edtbauer[1,2], Christopher Groh[2], Christoph Krülle[2], Ingo Rehberg[2], and Nuri Aksel[1] — [1]Technische Mechanik und Strömungsmechanik, Universität Bayreuth, D-95440 Bayreuth — [2]Experimentalphysik V, Universität Bayreuth, D-95440 Bayreuth

One of the most conspicuous examples of pattern formation in nature are the dunes and ripples formed in sand, either by wind or by surface waves and shear flows in water. The environmental flow conditions are usually highly turbulent. In laboratory studies, research has also mainly been focused on the formation of ripples and dunes in fully turbulent flow. Here, we present an experimental study of ripple generation in an annular channel at rather low Reynolds numbers in weakly turbulent flow. We detect the granular motion, the resulting ripples, and characterize the velocity field in the overlying fluid that provokes the ripple formation.

DY 22.2 Wed 16:00 H2

Granular detachment from a moving bulk — •Claas Bierwisch, Torsten Kraft, Michael Moseler, and Hermann Riedel — Fraunhofer-Institut für Werkstoffmechanik, Wöhlerstraße 11, 79108 Freiburg, Germany

Powder discharge under gravity from a moving reservoir into a cavity has been investigated using discrete element simulations. Agglomerate models were used besides spherical grain representations. Granular friction and cohesion have been calibrated within quasi two dimensional reference and validation experiments. While all models were able to predict flow rates for simple geometries they differ strongly when tested in fully three dimensional cavities and in the angles of repose which they form. Coarse graining effects on static and dynamic properties as well as universal scaling properties of velocity fields will be presented furthermore.

DY 22.3 Wed 16:15 H2

In-situ investigation of the structural and electrical properties of nanosized silicon powders — •Ingo Plümel[1,2], Hartmut Wiggers[2], and Axel Lorke[1] — [1]Experimental Physics and CeNIDE, University Duisburg-Essen, Lotharstr. 1, 47057 Duisburg, Germany — [2]Institute of Combustion and Gas Dynamics, University Duisburg-Essen, Lotharstr. 1, 47057 Duisburg, Germany

Nanosized Silicon powders were characterized by determining in-situ the conductivity, impedance, and mechanical compaction while applying a mechanical pressure. In porous systems like powders, the macroscopic electrical properties result from transport mechanisms such as hopping and tunneling between particles as well as from structural properties such as the amount and shape of particle contacts. Thus the density change of the powder during electrical measurements was characterized by means of a laser interferometer. Conductivity measurements as a function of the applied pressure show an exponential dependence for nanosized particles and a power law for microsized particles which can be partly associated to scaling effects for decreasing particle size. A time dependent change in conductivity together with an increase in density was observed while applying a constant pressure suggesting friction limited compaction of the powder. To separate the contributions of the particle cores and particle contacts to the complex conductivity and capacity, impedance spectroscopy was performed. In agreement with the observed compaction of the powder, the spectra show a strong increase of the sample capacity and conductivity as a function of the applied pressure.

DY 22.4 Wed 16:30 H2

Memory effects in wet granular matter — •Christoph Kohlhammer and Michael Schulz — Universität Ulm, Institut für Theoretische Physik, Albert Einstein-Allee 11, 89069 Ulm

We found that a wet granular matter model introduced on the basis of a lattice Monte-Carlo-Model shows memory effects. Those effects are typical for wet granulates as it recenly had been published in different papers dealing experimentally with this subject. The memory effects for example concern the grain density representing the opening angle of the sandpile in dependence of the degree of wetness. So we deal with a non Marcovian model behaving very senitive in the phase transition region. The memory effect allows to define a characteristic time scale.

DY 22.5 Wed 16:45 H2

Fluidization of granular materials wetting by liquid helium — •Kai Huang, Masoud Sohaili, and Stephan Herminghaus — Max-Planck-Institut für Dynamik und Selbstorganisation, Bunsenstr. 10, 37073 Göttingen, Germany

Fluidization of granular media wetting by liquid helium in normal and super-fluid states under vertical vibrations is studied experimentally. The critical acceleration of fluidization is found to depend strongly on the amount of liquid helium condensed on the particles. By comparison of results from normal fluid and superfluid wetting, we explore the effect of viscosity on the dynamics of wet granular materials.

DY 22.6 Wed 17:00 H2

Wet granular matter under pressure and shear forces — •Beatrix Schulz[1] and Michael Schulz[2] — [1]Institut für Physik, Martin-Luther-Universität Halle-Wittenberg — [2]Abteilung für Theoretische Physik, Universität Ulm

Granular matter is a central topic of physical research in complex systems during the last two decades. Although the main stream of investigations is focussed on dry granular materials, the predominant part of real granular matter contains a liquid fraction. The combination of solids, liquids and gas phases leads to several new interactions effects due to the capillar forces. We present a combined numerical and analytical study of wet granular matter under time-dependent pressure and shear forces. Furthermore, we consider in this study reversible and irreversible bridging processes which allow to explain geophysical phenomena observed in wet granular matter.

DY 23: Finite size effects at phase transitions III (session accompanying the symposium of the same name)

Time: Wednesday 15:45–17:15 Location: H3

DY 23.1 Wed 15:45 H3

Probing surface characteristics of diffusion-limited aggregation clusters with particles of variable size — •Lev Shchur — Landau Institute for Theoretical Physics, 142432 Chernogolovka, Russia

We develop a technique for probing harmonic measure of the diffusion limited aggregation (DLA) cluster surface with the variable size particle and generate one thousand clusters with 50 million particles using original off-lattice killing-free algorithm. Taking, in sequence, the limit of the vanishing size of the probing particles and then sending the growing cluster size to infinity, we achieve the unprecedented accuracy determining the fractal dimension, $D = 1.7100(2)$ crucial to characterization of geometric properties of the DLA clusters.

DY 23.2 Wed 16:00 H3

Phase transition in optimal foraging of bats — •Magnus Jungsbluth and Alexander K. Hartmann — Institut für Theoretische Physik, Georg-August-Universität Göttingen

Phase transitions have been found in many combinatorial optimization problems. The phase transitions can be analyzed using statistical mechanics methods like finite-size scaling. We study the so-called optimal foraging problem, which arises in biology. The aim is to find optimal ways how animals find their food. In collaboration with the biologists group of York Winter (Bielefeld) we got extensive data for a system of bats that eat nectar from flowers. We introduce a model for the biological system and solve it with a genetic algorithm. We observe a phase transition when varying the amount of nectar each bat has to collect per night. Using finite-size scaling we obtain a critical exponent for the correlation length $\nu = 1.7(3)$ similar to the traveling salesman problem. Other results include the emergence of two different length scales when looking at clustered resources and flight-time distributions that match with those measured in nature.

DY 23.3 Wed 16:15 H3

Finite-size scaling study of the six-vertex F model on regular and random lattices — •Martin Weigel[1] and Wolfhard Janke[2] — [1]Department of Mathematics and the Maxwell Institute for Mathematical Sciences, Heriot-Watt University, Edinburgh, EH14 4AS, UK — [2]Institut für Theoretische Physik, Universität Leipzig, Augustusplatz 10/11, 04109 Leipzig, Germany

Finite-size scaling (FSS) has been established as a powerful standard technique for the analysis of phase transitions, in particular from numerical simulation data. While in the common situation of a second (or even first) order phase transition, FSS techniques easily lead to high-precision estimates, more care is needed in some special circumstances such as the case of infinite-order Berezinski-Kosterlitz-Thouless phase transitions, where the power laws are replaced by exponentials *and* logarithmic corrections occur. We consider FSS in the six-vertex F model representative of this universality class, using high-precision, cluster-update Monte Carlo simulations [1]. The availability of an *exact solution* for the thermodynamic limit of this model allows for a rather detailed investigation of the occurring corrections. Extending on this, a further complication is introduced by considering this model coupled to a class of random lattices with a non-trivial fractal dimension, confining the analysis to very small effective linear system sizes [2].

[1] M. Weigel and W. Janke, J. Phys. A **38** (2005) 7067.
[2] M. Weigel and W. Janke, Nucl. Phys. B **719** (2005) 312.

DY 23.4 Wed 16:30 H3

Bosonic Nature of the Meissner Transition at finite magnetic Field — •Thomas Neuhaus — NIC, FZ-Jülich, Jülich

We study the low temperature 3d finite size rounded Meissner transition at finite magnetic field i.e., in vicinity of the lower critical field. For a type II superconductor one has a line of continuous phase transitions, which at magnetic field zero terminates in the well known 3d XY superfluid critical point. At finite field, the transition is however not of the superfluid kind, but of bosonic nature. The finite size scaling at the tranistion differs from Fisher scaling. This has its origin in the fact, that two length scales : the mean distance of vortices, and the size of vortex line orthogonal fluctuations, are both relevant at the transition.

DY 23.5 Wed 16:45 H3

Out-of-equilibrium processes in confined geometries — •Florian Baumann[1,2] and Michel Pleimling[3] — [1]Laboratoire de Physique des Matériaux (CNRS UMR 7556), Université Henri Poincaré Nancy I, B.P. 239 — [2]Institut für Theoretische Physik I, Universität Erlangen-Nürnberg, D – 91058 Erlangen, Germany — [3]Department of Physics, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061-0435, USA

Non-equilibrium dynamics have attracted considerable attention in recent years. Most of the studies however have been restricted to systems with an infinite geometry. A first step towards a more realistic situation is to consider a semi-infinite system, in which one is particularly interested in the behavior close to the surface. I present here some analytical and numerical results, both for quenches below and onto the critical point. It turns out that certain known statements about critical exponents do not necessarily hold for the corresponding surface exponents.

DY 23.6 Wed 17:00 H3

Jamming Transition in Two-Dimensional Shear-Driven Aggregation — •Daniel Rings and Klaus Kroy — Institut für theoretische Physik, Universität Leipzig, Vor dem Hospitaltore 1, 04103 Leipzig

Aggregation of colloids has an impact on various technological as well as biological systems. Examples range from accumulation of dust in bearings to clotting within blood vessels. While percolation theory describes the thermodynamic limit, we are interested in the specific features of such finite systems.

We study the shear-induced jamming transition within a toy model for colloidal suspensions. Implementing the rather novel simulation method of Collision-Driven Dynamics (CD) powered by Interval Arithmetics, we find a transition from kinetic aggregation to percolative behavior above a critical density in finite systems. Intriguingly, different density regimes show distinct structure formation encoded in fractal dimension and jamming time. A kinetic model has been developed in order to predict that time based on the specific density-dependent clustering mechanism.

DY 24: Poster I

Time: Wednesday 16:00–18:00 Location: Poster D

DY 24.1 Wed 16:00 Poster D

Transition from ballistic to diffusive transport in finite quantum systems — •Jochen Gemmer[1], Robin Steinigeweg[1], and Heinz-Peter Breuer[2] — [1]Universität Osnabrück, Fachbereich Physik, Barbarastr. 7 49069 Osnabrück — [2]Albert-Ludwigs-Universität Freiburg, Physikalisches Institut, Hermann-Herder Str. 3, 79104 Freiburg

Standard tools in transport theory like the Kubo formula or quantum Boltzmann equations face, apart from some conceptual difficulties, the problem of being inapplicable to finite quantum systems. Thus we investigate the dynamics of spatial densities of e.g. energy or particles directly by projection operator techniques similar to those known from the field of open quantum systems. We find that periodic quantum systems may exhibit diffusive transport at intermediate sizes. However,

in the limit of small and remarkably also in the limit of large systems, transport tends to be ballistic.

DY 24.2 Wed 16:00 Poster D

Environment-induced transition from diffusive to ballistic transport in a tight-binding model — •Kirsten Wedderhoff and Jochen Gemmer — University of Osnabrueck, Osnabrueck, Germany

We investigate the transport-behavior in a tight-binding model with an additional environment by means of a quantum master equation in Lindblad-form. Starting with the most simple form of two lattice-sites, we try to compare the resulting dynamics with those generated by a discrete diffusion equation. Apparently the environment induces a transition from ballistic to diffusive behavior.

DY 24.3 Wed 16:00 Poster D

Transport properties of finite quantum systems — •Christian Bartsch and Jochen Gemmer — Physics Department, University of Osnabrück, Barbarastr. 7, 49069 Osnabrück, Germany

It has been observed that normal transport behaviour can appear in finite quantum systems for certain quantities. This means, the dynamics of these quantities are statistical, i.e. they are controlled by rate equations, although the time evolution of the complete system is generated by the Schrödinger Equation. The exponential relaxation can be described correctly by the Hilbert Space Average Method (HAM) [1] or the time-convolutionless (TCL) projection operator technique [2]. Both methods also yield some necessary criteria for the occurrence of normal transport concerning rough system parameters like bandwidths and average interaction strengths. Additionally, the structure of the interaction must be taken into account, too. One possibility is to check if the squared interaction matrix is essentially diagonal, which seems to be a crucial feature for statistical decay to occur. A similar approach was proposed by van Hove in [3] for continuous systems. Alternatively, one can evaluate higher orders of the TCL expansion and determine the magnitude of the deviation from the rate equations.

[1] J. Gemmer, M. Michel, G. Mahler, Quantum Thermodynamics, Springer (2004)
[2] H.-P. Breuer, F. Petruccione, The Theory of Open Quantum Systems, Oxford (2002)
[3] L. van Hove, *Physica* **XXI** 517 (1955)

DY 24.4 Wed 16:00 Poster D

Quantum heat transport in harmonic chains — •Christopher Gaul and Helmut Büttner — Universität Bayreuth, Deutschland

We investigate the mechanism of heat conduction in harmonic 1D models — including disorder — with the quantum mechanical Langevin ansatz.

In our quantum mechanical calculations we recover some classical results: The temperature gradient vanishes and heat flux is independent of the length of the chain. In the case of disordered chains normal heat conduction is partially recovered: There is a finite temperature gradient, but the overall heat resistance does not increase linearly with the length of the chain.

Furthermore we observe characteristic quantum mechanical features like freezing of the heat conductivity, entanglement and Bose statistics of the occupation numbers.

DY 24.5 Wed 16:00 Poster D

On the characterization of generalized quantum thermodynamic machines — •Georg Reuther, Markus Henrich, and Günter Mahler — Institut für Theoretische Physik 1, Universität Stuttgart, 70569 Stuttgart

Quantum thermodynamic machines have attracted more and more attention in the past years. It is possible to show that a spin chain with a nearest neighbor Heisenberg interaction which is exposed to a global temperature gradient provided by two heat baths behaves like a heat pump or heat engine if parts of the chain are modulated periodically [1]. We characterize the behavior of different spin chain and spin network configurations with regard to efficiency and other thermodynamic properties.

[1] M. J. Henrich, M. Michel, G. Mahler, cond-mat/0604202

DY 24.6 Wed 16:00 Poster D

Implementation of classical driving on the quantum level — •Heiko Schröder and Günter Mahler — Universität Stuttgart, 1. Institut für Theoretische Physik, Pfaffenwaldring 57, 70550 Stuttgart

The development of Quantum Thermodynamics [1] in the recent years has shown that thermodynamical concepts can be observed in and produced by quite small quantum systems. The existence of and relaxation to a thermal equilibrium has been found to be dependent on the existence of a suitable, but not necessarily big quantum environment. On this background, we have dealt with the question of the implementation of classical control in quantum systems by quantum systems as another important concept of thermodynamics. Here, we present a sufficient condition for a quantum environment in order to operate as a classical driver of another quantum system.

[1] J. Gemmer, M. Michel and G. Mahler: Quantum Thermodynamics, Springer 2004

DY 24.7 Wed 16:00 Poster D

On the derivation of diffusion in randomly coupled modular systems — •Pedro Alejandro Vidal Miranda and Günter Mahler — Universität Stuttgart, 1. Institut für Theoretische Physik Pfaffenwaldring 57 // IV,70550 Stuttgart ,Germany

We analyze the Schrödinger evolution of the Wigner transform of the wave function in a randomly coupled modular system in order to obtain a macroscopic equation for the dynamics of observables such as the energy. For this we average over the randomess in the system and we make use of the long time van Hove limit.

DY 24.8 Wed 16:00 Poster D

Decoherence, entanglement and entropy in non-Markovian quantum Brownian motion — •Christian Hörhammer and Helmut Büttner — Theoretische Physik I, Universität Bayreuth, 95440 Bayreuth

Decoherence is associated with the formation of quantum correlations of an open quantum system with the environment. The fact that the Brownian particle and its environment become entangled may lead to deviations between the thermodynamic entropy of a quantum Brownian oscillator derived from the partition function of the subsystem and the von Neumann entropy of its reduced density matrix. We give an explanation for these findings and point out that these deviations become important in cases where statements about the information capacity of the subsystem are connected to thermodynamic properties.

DY 24.9 Wed 16:00 Poster D

Cyclical Algorithmic Cooling — •Florian Rempp and Günter Mahler — 1. Institut für Theoretische Physik, Universität Stuttgart, Deutschland

Algorithmic cooling is a method to obtain highly polarized spins in a spin system, without cooling down the environment. We introduce a system to perform the cooling algorithm, first presented by Tal Mor et al. in 2002 [1], multiple times on the same set of qbits. we achieve this goal by adding an additional SWAP-gate and a bath contact to the algorithm.

In order to compute the state of the spins after an arbitrary application of the algorithm we introduce a thermalisation super operator to need not to solve the Liouville von Neumann equation for the bath contact for each application step. furthermore we draw a connection to general thermodynamic machines in order to locate algorithmic cooling in a bigger context.

[1] Tal Mor, P. Oscar Boykin, Vwani Roychowdhury, Farrokh Vatan and Rutger Vrijen, "Algoritmic Cooling and Scalable NMR Quantum Computers", *Proc. Natl. Acad. Sci. USA*, 99:3388-3393, 2002

DY 24.10 Wed 16:00 Poster D

Numerical computations for spin models using weighted graph states — •Simon Anders[1], Hans J. Briegel[1,2], and Wolfgang Dür[1,2] — [1]Institut für Theoretische Physik, Universität Innsbruck, Austria — [2]Institut für Quantenoptik und Quanteninformation (IQOQI) der ÖAW

Recently, a number of novel techniques have been proposed for numerical treatment of spin systems, specifically aiming at the study of ground state properties and time evolution. We have introduced [1] a variational method based on so-called weighted graph states, a class of states with intrinsic long-range entanglement and suitability for arbitrary geometries. Here, we present new results, specifically on the application of our method for bosonic systems such as the Bose-Hubbard model and also compare it with other methods. Further, we have investigated possibilities to form a hybrid technique using the weighted graph states and projected entangled pair states [2] or tensor tree networks [3].

[1] Anders et al., Phys. Rev. Lett. **97** (2006), 107206
[2] Verstraete and Cirac, ArXiv cond-mat/0407066 (2004)
[3] Shi, Duan, Vidal, ArXiv quant-ph/0511070 (2004)

DY 24.11 Wed 16:00 Poster D

Investigations of Ericson fluctuations and time-reversal symmetry in quantum billiards — Stefan Bittner, Barbara Dietz-Pilatus, Thomas Friedrich, Pedro Oria Iriarte, Maksim Miski-Oglu, Achim Richter, and •Florian Schäfer — Institut für Kernphysik, Schloßgartenstraße 9, 64289 Darmstadt

In the presented work, flat microwave resonators were studied experimentally. Those resonators provide a means to simulate corresponding quantum billiards. The theoretical description of those billards is based on the scattering formalism as introduced by Mahaux and Weidenmüller and requires transmission as well as reflection measurements.

We focus here on two special aspects of our investigations. First, the regime of strongly overlapping resonances is studied. Here, the transmitted power through the resonator shows pronounced fluctuations (so called Ericson fluctuations). Their autocorrelation functions are compared to a theory by Verbaarschot, Weidenmüller and Zirnbauer. Second, we investigate the influence of a broken time-reversal symmetry on nearly degenerate resonances and extract the T-violating matrix elements of the effective Hamiltonian describing the quantum billiard.

DY 24.12 Wed 16:00 Poster D

Chaos-assisted tunneling: the effect of Cantori — Mirjam Schmid, Christopher Eltschka, and •Peter Schlagheck — Institut für Theoretische Physik, Universität Regensburg

Dynamical tunneling rates between symmetry-related regular islands in quantum system with a mixed regular-chaotic classical phase space can be semiclassically estimated by means of the effect of prominent nonlinear resonances that manifest within the islands [1]. This approach is implicitly based on the assumption that the classical dynamics of the system is perfectly regular within and fully chaotic outside the islands. To improve on this assumption, we take into account the presence of important partial barriers and Cantori in the chaotic part of the phase space, which may lead to a significant enlargement of the effective island size. Using such partial barriers, and including prominent resonances that are located in between them into the calculation, we obtain a rather good reproduction of the exact quantum tunneling rates in driven one-dimensional model systems.

[1] C. Eltschka and P. Schlagheck, Phys. Rev. Lett. 94, 014101 (2005).

DY 24.13 Wed 16:00 Poster D

Level statistics and bifurcations for a Hamiltonian system — Marta Gutiérrez, •Andreas Koch, Matthias Brack, and Klaus Richter — Institut für Theoretische Physik, Universität Regensburg

We study the effect of bifurcations on the spectral form factor and rigidity of a Hamiltonian quantum system with mixed classical dynamics. The system possesses periodic librational orbits along the axes that undergo an infinite sequence of non-generic pitchfork bifurcations. We show that the signature of these bifurcations is two fold: beside the known effect of an enhanced periodic orbit contribution due to its stronger hbar dependence at the bifurcation, the orbits involved at the bifurcation give a non-diagonal contribution yielding deviations from universality.

DY 24.14 Wed 16:00 Poster D

Mushroom billiards — Stefan Bittner, Barbara Dietz-Pilatus, •Thomas Friedrich, Maksim Miski-Oglu, Pedro Oria-Iriarte, Achim Richter, and Florian Schäfer — Institut für Kernphysik, Schloßgartenstraße 9, 64289 Darmstadt

Mushroom billiards are mixed systems providing a clearly separated phase space. Using a superconducting microwave billiard the spectral properties of quantum mushroom billiards are investigated. Particularly a supershell modulation in the level density and a substructure in the nearest neighbor spacing distribution of levels are found. By decomposing the spectrum in a regular and chaotic part the influence of dynamic tunneling on the eigenfrequencies is reveiled. Wave functions of mushroom billiards have also been determined at room temperature. They are related to the classical dynamics of the billiard. Finally, the decay behavior of classical and quantum mushroom billiards is considered.

DY 24.15 Wed 16:00 Poster D

Dynamical tunneling in a mixed phase space — Arnd Bäcker, Roland Ketzmerick, •Steffen Löck, and Lars Schilling — Institut für Theoretische Physik, Technische Universität Dresden, 01062 Dresden, Germany

The phase space of mixed systems consists of regular islands being dynamically separated from the chaotic sea. Quantum mechanically these phase space regions are connected by dynamical tunneling. We derive a formula predicting dynamical tunneling rates of regular states to the chaotic sea. Agreement with numerics for kicked systems with resonance-free islands will be presented. In addition this approach is applied to resonance assisted tunneling in systems with one dominating resonance chain.

DY 24.16 Wed 16:00 Poster D

Classical Dynamics of the Time-Dependent Elliptical Billiard — •Florian Lenz[1] and Peter Schmelcher[1,2] — [1]Physikalisches Institut, Universität Heidelberg, 69120 Heidelberg, Germany — [2]Theoretische Chemie, Institut für Physikalische Chemie, Universität Heidelberg, 69120 Heidelberg, Germany

We study classically the dynamics of harmonically driven elliptical billiards with the focus lying on escape rates by performing numerical simulations. In the static ellipse, we find algebraic decay laws due to the integrable dynamics of the system. Besides the energy, the product of the angular momenta (PAM) around the foci is preserved. Depending on the sign of the PAM, particles are confined to either librator or rotator orbits. By varying the hole position, the saturation value (SV) of the decay, caused by librator orbits that are not connected with the hole, can be tuned. We apply harmonic oscillations to the boundary to examine the effect of the driving on this SV. Two universal fundamental processes that are able to destroy this SV via changing librator into rotator orbits (they are scattered across the separatrix) are discussed and a simple qualitative model is established that explains the decay and the amplitude-dependent emission rate of the driven system. The analysis of the time-evolution of velocity distributions suggests that the driven ellipse can be used as a cooling device for particles, provided a suitable preparation of the initial ensemble.

DY 24.17 Wed 16:00 Poster D

Lattice dynamics of polycrystalline Beryllium — •Irmengard Fischer, Alexei Bossak, and Michael Krisch — European Synchrotron Radiation Facility, BP220, F-38043 Grenoble Cedex, France

The phonon dispersion along high-symmetry directions of a single crystal gives access to a large range of physical properties such as electron-phonon coupling, anharmonicity, specific heat, sound velocities and elastic constants. Novel materials and crystals under extreme conditions are, however, often only available as polycrystals, and consequently investigations are limited to orientationally averaged properties such as the phonon density of states (PDOS) and the average sound velocity. To overcome these limitations, we developped a method to extract the single crystal phonon dispersion from inelastic x-ray scattering (IXS) measurements of a polycrystalline material. We chose as test case Be, because of its well known dispersion and its high IXS efficiency. The spectra were recorded with an energy resolution of 3 meV spanning the 2-80 nm-1 momentum transfer range. The experimental IXS spectra were fitted with a least-square routine using a Born - von Karman model, starting from a known set of force constants. The refined dispersion is in remarkable agreement with inelastic neutron measurements. Furthermore, the reconstructed PDOS is in excellent agreement with calculations, thus allowing the precise determination of macroscopic parameters such as the Debye temperature, the vibrational contribution to the specific heat and the internal energy. This novel application of IXS promises to be a valuable spectroscopic tool in cases where single-crystalline materials are not available.

DY 24.18 Wed 16:00 Poster D

contribution moved to poster session EP — •XXX XXX —

DY 24.19 Wed 16:00 Poster D

Verkehrslenkung mit Hilfe von Onlinesimulationen auf komplexen Autobahnnetwerken — •Florian Mazur, Andreas Pottmeier und Michael Schreckenberg — Universität Duisburg-Essen, Physik von Transport und Verkehr, Lotharstr. 1, D-47057 Duisburg

Ziel eines Verkehrsinformationssystems sollte es sein, möglichst vielen Autofahrern zuverlässige Informationen über den Verkehrszustand auf Autobahnen zu geben. Ein erster Schritt in diese Richtung war

die Entwicklung des Verkehrsinformationssystems autobahn.NRW in Nordrhein-Westfalen. Mit Hilfe von Zellularautomatenmodellen wird hier der Verkehr auf dem Autobahnnetzwerk von NRW realitätsnah in Echtzeit simuliert und Informationen über den Verkehrszustand berechnet. Die Datenbasis liefern über 4000 Induktionsschleifen, die online Messdaten über das Verkehrsaufkommen übertragen.

Seit einiger Zeit ist unter der Internetadresse www.autobahn.nrw.de das Ergebnis der Simulation zugänglich und wird von ca. 25.000 Usern täglich genutzt. Um auch während der Fahrt Informationen über Staus geben zu können, wurden in NRW 38 dWiSta-Tafeln (dynamische Wegweiser mit integrierten Stauinformationen) auf den Autobahnen aufgestellt. Über sie können Informationen und Umlenkungsempfehlungen, für die auch die Reisezeiten von autobahn.NRW genutzt werden, an die Verkehrsteilnehmer weitergegeben werden.

Das Poster beschäftigt sich mit dem Simulationsmodell, welches dem Verkehrsinformationssystem autobahn.NRW zugrunde liegt, und erläutert, wie die so gewonnenen Informationen für eine effektive Verkehrslenkung genutzt werden.

DY 24.20 Wed 16:00 Poster D

Networks of chaotic units mutually coupled by their delayed variables — •Johannes Kestler, Markus Mützel, and Wolfgang Kinzel — Theoretische Physik, Universität Würzburg

Identical chaotic systems which are mutually coupled by some of their time-delayed variables can synchronize to a common chaotic trajectory. We investigate this phenomenon for small networks of iterated maps. Analytic calculations of Lyapunov spectra show that high-dimensional chaos is synchronized by delayed couplings. The phase diagrams of complete and sublattice synchronization are calculated analytically for several networks. Time-shifted correlations between different units are calculated numerically. Results are presented for complete, sublattice, achronal and generalized synchronization, de- and re-synchronization after closing the connection and mutual chaos pass filter.

DY 24.21 Wed 16:00 Poster D

Modelling Counterflow Situations of Pedestrian Traffic — •Maike Kaufman, Tobias Kretz, and Michael Schreckenberg — Universität Duisburg-Essen, Physik von Transport und Verkehr, Lotharstr. 1, D-47057 Duisburg

A Cellular Automaton-based model of Pedestrian Dynamics which encorporates intelligent agent behavior in counterflow situations is presented.

The described model is an extention of the F.A.S.T. model of Pedestrian Dynamics. It is discrete in space and time and probabilistic in the pedestrians choice of direction of movement. An agent chooses his next position from the set of accessible cells allowed by his velocity. This choice is made according to a precomputed probability which depends on the agent's neighborhood. In this work a spheric direction-dependant potential surrounds each pedestrian. It is repulsive for agents walking in opposite directions and attractive for agents moving in the same direction, thus ensuring that pedestrians are able to avoid collisions and follow persons in front of them. This modification of the model allows for reproduction of lane formation and higher fluxes at critical densities.

DY 24.22 Wed 16:00 Poster D

Spatio-temporal dynamics of the action potential during atrial fibrillation — •Claudia Hamann, Thomas Hennig, and Philipp Maass — Institut für Physik, Technische Universität Ilmenau, 98684 Ilmenau, Germany

Under normal conditions the contraction of the heart muscles is controlled by the regular propagation of an action potential. Atrial fibrillation (AF) is a common arrhythmia with multiple reentry of the action potential and self-excitation in certain regions of the tissue, which after transduction through the atrio-ventricular node can give rise to different distributions of ventricular beat intervals [1]. On the basis of the model of FitzHugh and Nagumo we simulate the dynamics of the electrical potential in the atrium. The spatio-temporal patterns are analysed with emphasis on the conditions necessary for the occurrence of reentry and self-oscillation phenomena. Characteristic features of the propagation retrieved from the model are compared to statistical properties of the intra-atrial electrocardiogram.

[1] C. Hamann, Th. Hennig, P. Maass, Proceedings of the "Conference of the European Study Group on Cardiovascular Oscillations 2006"(ESGCO 2006), Jena, Germany, 15-17 May 2006, p. 36.

DY 24.23 Wed 16:00 Poster D

Dynamical Behavior and Control of Coupled — Heinz Georg Schuster[1], Michel Le Van Quyen[2], Mario Chavez[2], •Jan Köhler[1], and Jörg Mayer[1] — [1]Institut für Theoretische Physik und Astrophysik, Christian-Albrechts Universität, Olshausenstraße 40, 24098 Kiel, Germany — [2]LENA CNRS UPR640, Hopital de la Salpetriere,Paris, France

We investigate the dynamical behavior of all to all coupled threshold elements with selfinhibition. Coupled threshold elements with selfinhibition display a phase transition to an oscillating state where the elements fire in synchrony with a period T that is of the order of the dead time caused by selfinhibition . This transition is noise activated and therefore displays strong collectively enhanced stochastic resonances. For an exponentially decaying distribution of dead-times the transition to the oscillating state occurs, coming from high noise temperatures, via a Hopf bifurcation and coming from low temperatures, via a saddle node bifurcation. The transitions can be triggered externally by noise and oscillating signals.

DY 24.24 Wed 16:00 Poster D

Current instabilities in resonant tunneling quantum dot structures — •Kathy Lüdge and Eckehard Schöll — Technische Universität Berlin, Hardenbergstraße 36, 10623 Berlin

In this work we investigate the current transport through quantum dots (QDs) embedded in a double barrier structure that is operated in an external circuit with a dc bias voltage Uo and a series resistance R and a parallel capacitance C. We show that the performance of such nonlinear devices is crucially depending on the chosen external circuit parameters, so that they can be used either as switches or as self-sustained current oscillators.

For analyzing the dynamics of the QD system a Master equation approach for sequential tunneling through two parallel, electrostatically coupled quantum dots has been used, followed by a linear stability analysis of the fixed points of the five dimensional system, taking into account also the dynamic degree of freedom of the voltage drop across the QD structure due to Kirchhoff's circuit equation. Interesting effects are found if the nullclines of the external circuit and of the QD system intersect such that three operating points exist. For the usual case of a positive capacitance C we show that oscillatory instabilities caused by a Hopf bifurcation cannot occur. For negative capacitance, which can easily be realized by an active circuit consisting of operation amplifiers, a Hopf bifurcation leading to uniform limit cycle oscillations can be found. At a certain value of C the limit cycle collides with the saddle-point on the low current branch and disappears which represents a global homoclinic bifurcation (or blue-sky catastrophe).

DY 24.25 Wed 16:00 Poster D

Time-delayed feedback control of fixed points with variable phase-dependent coupling — •Thomas Dahms, Philipp Hövel, and Eckehard Schöll — Institut für Theoretische Physik, TU Berlin, Hardenbergstr. 36, D-10623 Berlin

During the last decade time-delayed feedback methods have been successfully used to control unstable periodic orbits as well as unstable steady states. [1] In most of the theoretical analysis, this control method is considered in the realization of diagonal coupling, i.e., the control force applied to the i-th component of the system is a function of exclusively the same component. Although diagonal coupling is suitable for a theoretical investigation, it is often not feasible for an experiment. Therefore we consider the more general case where control is effected by a nondiagonal coupling matrix. Specifically, we investigate the time-delayed feedback scheme for a rotational coupling matrix parametrized by a variable phase. We present an analysis of the domain of control for simple time-delay autosynchronization (TDAS) as well as for multiple time extended feedback (ETDAS). We demonstrate the application to optical systems [2,3] where the optical phase is an additional degree of freedom.

[1] P. Hövel and E. Schöll, Phys. Rev. E **72**, 046203 (2005).
[2] V. Z. Tronciu, H.-J. Wünsche, M. Wolfrum, and M. Radziunas, Phys. Rev. E **73**, 046205 (2006).
[3] S. Schikora, P. Hövel, H.-J. Wünsche, E. Schöll, and F. Henneberger, Phys. Rev. Lett. **97**, 213902 (2006).

DY 24.26 Wed 16:00 Poster D

Experiments on a Ferrofluidic Torsional Pendulum Suspended in an Oscillating Magnetic Field — •Harald Brendel, Reinhard Richter, and Ingo Rehberg — Experimentalphysik 5, Universität Bayreuth, D-95444 Bayreuth

Recently a new type of torsional pendulum was proposed (M.I. Shliomis, M.A. Zaks, Phys. Rev. E, vol.73, 066208 (2006)) which we realize by suspending a DISC SHAPED container in a Helmoltz pair of coils driven by an alternating sinusodial current. In contrast to a spherical pendulum the orientation of the disc is expected to be sensitive to the field direction: It exposes its edge to the stationary oscillating magnetic field and its broad side to the field of high frequency. Increasing the field amplitude the state of rest gives way to oscillations near the equilibrium. Further growth of the driving amplitude is predicted to give rise to rotational motion. We study the scenarios for the case of magnetic fluids of different composition.

DY 24.27 Wed 16:00 Poster D

Reorientation of a scroll ring under an electrical current in a chemical excitable medium — •Chaiya Luengviriya[1,2], Stefan C. Müller[1], and Marcus J. B. Hauser[1] — [1]Otto-von-Guericke-Universtität Magdeburg, Institut für Experimentelle Physik, Abteilung Biophysik, Universitätsplatz 2, 39106 Magdeburg, Germany — [2]Kasetsart University, Department of Physics, Bangkok, 10900, Thailand

Scroll rings are three-dimensional wave structures in excitable media whose filaments form closed loops. Such filaments are subject to wave instabilities which cause the scroll rings to expand or contract intrinsically depending on the excitability of the medium. Even though the length of filament changes due to expansion or contraction, the position and orientation of the scroll ring are approximately stationary - the filament does almost neither drift nor rotate.

We present a study of the dynamics of a scroll ring in a Belosov-Zhabotinsky (BZ) reaction under a constant electrical current. The scroll ring reoriented itself with respect to the direction of the applied electric current. In addition, a linear drift against the direction of the current was observed. These effects were coupled with an intrinsic contraction leading to a self-annihilation of the scroll ring. Numerical calculations show that electrical current and temperature gradients have similar effects on the dynamics of a scroll ring in a BZ reaction. However, temperature gradients cannot cause drifts of scroll rings as in the case of electrical current.

DY 24.28 Wed 16:00 Poster D

Kinematics of excitation waves rotating within an annular channel — Harald Engel, •Hartmut Lentz, and Vladimir Zykov — Technische Universität Berlin

Excitation waves are typical examples for pattern formation processes in reaction-diffusion media of quite different nature. We consider rotating wave patterns in an annular channel of arbitrary inner radius. Varying the inner radius from zero to the outer radius we connect the limiting cases of a two-dimensional disc and a one-dimensional ring.

We study the free-bounday formulation of the waves, which reduces the underlying reaction-diffusion system to the kinematics of the propagating wave fronts. The inner and the outer radii of the channel are considered as the most important control parameters. The refractoriness of the medium is also taken into account. The results of this simplified approach are compared with the direct integration of the excitation medium model.

DY 24.29 Wed 16:00 Poster D

Rigidly rotating wave patterns in excitable media of a circular shape — Grigory Bordyugov, •Vladimir Zykov, and Harald Engel — TU Berlin, Hardenbergstr. 36, 10623 Berlin, Germany

Spiral waves represent a famous example of self-organized spatio-temporal patterns in excitable media. It is well known that rigidly rotating spirals, moving at a constant angular velocity and shape can be induced in a two-dimensional disk. Here, the existence of another type of rigidly rotating patterns is demonstrated which are excitation spots localized near the no-flux boundary of the disk and moving along it. Using the kinematical description of the moving wave fronts and the established continuation engine AUTO we show that spiral waves and boundary spots coexist in a disk of given size below some critical value of the medium excitability. They coincide at this bifurcation point and no rigidly rotating patterns exist above this critical excitability. The results of these simplified approaches are compared with direct integration of the underlying reaction-diffusion models.

DY 24.30 Wed 16:00 Poster D

Stabilization of unstable trajectories of the wave tip in excitable media — •Jan Schlesner, Vladimir Zykov, and Harald Engel — TU Berlin, Hardenbergstr. 36, 10623 Berlin, Germany

In a variety of excitable media, depending on the parameters different regimes of rotation have been observed for spiral waves including rigid rotation, meandering and hypermeandering. A proportional and a time-delayed feedback algorithms are elaborated to stabilize unstable regimes of the tip of spiral waves in a parameter range where these regimes are unstable in the absence of the feedback. As both control methods are non-invasive their application allows us to determine the characteristic parameters of unstable rigid rotation. As representative example of excitable media we use the FHN model in our calculations. In many system there are additional latencies in the control loop that shrink the control domain for successful stabilization. We propose an effective method to overcome its destabilizing influence.

DY 24.31 Wed 16:00 Poster D

Stabilizing chaotic behaviour in a model of ventricular fibrillation — •Zhuchkova Ekaterina[1], Radnayev Boris[2], and Loskutov Alexander[2] — [1]Institut of Theoretical Physics, Technical University Berlin, Germany — [2]Physics Faculty, Moscow State University, Moscow, Russia

It is believed that lethal heart pathology - ventricular fibrillation (VF) is caused by re-entrant activity, which represents multiple rotating spiral waves in 2D and scroll waves in 3D. We have made a comparative analysis of the spatio-temporal complex patterns of activation during VF in the Fenton-Karma model by three methods: counting and tracking phase singularities (PSs) - tips of re-entrant waves, computing invariant characteristics used in the theory of dynamical systems and implementing compression algorithm sensitive to regularity (CASToRe). The processes in excitable media may be more complex than a given set of re-entrant waves. Hence counting singularities is not enough. To find an amount of order in the system (quantify complexity) and determine a possibility to predict the system's dynamics and suppress chaotic behaviour CASToRe is more appropriate.

Choosing quite complex spiral-wave dynamics for stabilizing, in contrast to defibrillation by pulses (single shocks) applied to an entire tissue or a quite large part of it we applied low-amplitude non-feedback periodic excitation of monophasic and biphasic shapes to a point (or a small group of points) of medium. We have found that under some conditions re-entrant waves can be eliminated by a mild stimulation by two-three orders of magnitude less than that used in clinical practice.

DY 24.32 Wed 16:00 Poster D

Hydrodynamic Lyapunov modes and strong stochasticity threshold in Fermi-Pasta-Ulam models — •Hongliu Yang and Günter Radons — Chemnitz University of Technology, Chemnitz, Germany

The strong stochasticity threshold (SST) is characterized by a crossover of the system dynamics from weak to strong chaos with increasing the energy density . Correspondingly, the relaxation time to energy equipartition and the largest Lyapunov exponent exhibit different scaling behavior in the regimes below and beyond the threshold value. In this paper, we attempt to explore further changes in the energy density dependence of all Lyapunov exponents and of hydrodynamic Lyapunov modes (HLMs). In particular, we find that for the FPU- and FPU- model the scaling of the energy density dependence of all Lyapunov exponents shows similar changes at SST as those of the largest Lyapunov exponent. This supports the point of view that the crossover in the system dynamics at SST reflects a global change in the geometric structure of the phase space. Furthermore, the FPU-model is used as an example to show that HLMs exist in Hamiltonian lattice models with continuous symmetries. Numerical simulations demonstrate that there exist a smooth transition in Lyapunov vectors corresponding to the crossover in Lyapunov exponents at SST. In particular, our numerical results indicate that strong chaos is essential for the appearance of HLMs.

DY 24.33 Wed 16:00 Poster D

Complex behavior of simple maps with fluctuating delay times — •Günter Radons, Hongliu Yang, Jian Wang, and Jianfeng Fu — Chemnitz University of Technology, Chemnitz, Germany

Delay systems used to model retarded actions are relevant in many fields such as optics, mechanical machining, biology or physiology. A frequently encountered situation is that the length of the delay time changes with time. In this study we use a simple map system to investigate the influence of the fluctuating delay time on the system dynamics. For simplicity, the delay time in our system takes only the value of one or two discrete time steps, where the system dynamics

reduces to the logistic map and Henon map, respectively. Two cases, periodic or random variation of the delay, have been studied. Rich dynamics including coexisting multiple attractors, strange nonchaotic attractors, and on-off intermittency are observed.

DY 24.34 Wed 16:00 Poster D

Cellular automata under minimally perturbed timing — David Reichelt[1] and •Konstantin Klemm[2] — [1]Wilhelm-Ostwald-Gymnasium, Willi-Bredel-Straße 15, 04279 Leipzig — [2]Bioinformatik, Uni Leipzig, Haertelstr. 16-18, 04107 Leipzig

Elementary cellular automata (ECA) produce a wealth of complex patterns for various rules when cells are updated synchronously. Under a randomized update order for the cells, however, many of the complex patterns are no longer observed [Ingerson and Buvel, Physica D 10, 59 (1984)]. Here we revisit the issue of update modes in ECA. While asynchronous update corresponds to maximally noisy clocking, we here deviate from synchronous update in the mildest manner, by introducing minimal perturbations to timing. Some but not all of the complex patterns that vanish under asynchronous update are recovered when timing perturbations become smaller and smaller.

DY 24.35 Wed 16:00 Poster D

Long-range memory elementary 1D cellular automata: Dynamics and nonextensivity — •Thimo Rohlf[1] and Constantino Tsallis[2] — [1]Santa Fe Institute, 1399 Hyde Park Road, Santa Fe, NM87501, USA — [2]Centro Brasileiro de Pesquisas Fisicas, Xavier Sigaud 150, 22290-180 Rio de Janeiro-RJ, Brazil

We study the dynamics of elementary 1D cellular automata (CA), where the state $\sigma_i(t) \in \{0,1\}$ of a cell i does not only depend on the states in its local neighborhood at time $t-1$, but also on the memory of its own past states $\sigma_i(t-2), \sigma_i(t-3), ..., \sigma_i(t-\tau), ...$ [1]. We assume that the weight of this memory decays proportionally to $\tau^{-\alpha}$, with $\alpha \geq 0$. Since the memory function is summable for $\alpha > 1$ and nonsummable for $0 \leq \alpha \leq 1$, we expect pronounced changes of the dynamical behavior near $\alpha = 1$, particularly for the time evolution of the Hamming distance H of initially close trajectories. We typically expect the asymptotic behavior $H(t) \propto t^{1/(1-q)}$, where q is the entropic index associated with nonextensive statistical mechanics.

In all cases, the function $q(\alpha)$ exhibits a sensitive change at $\alpha \simeq 1$. We focuse on the class II rules 61 and 111. For rule 61, $q = 0$ for $0 \leq \alpha \leq \alpha_c \simeq 1.3$, and $q < 0$ for $\alpha > \alpha_c$, whereas the opposite behavior is found for rule 111. These facts point at a rich dynamics intimately linked to the interplay of local lookup rules and the range of the memory. Finite size scaling studies varying system size N indicate that the range of the power-law regime for $H(t)$ typically diverges $\propto N^z$ with $0 \leq z \leq 1$.

[1] Rohlf, T. and Tsallis, C., preprint: cond-mat/0604459

DY 24.36 Wed 16:00 Poster D

Transport of Brownian Particles in a Velocity Field — •Felix Müller and Lutz Schimansky-Geier — Institut für Physik, Humboldt Universität zu Berlin, Newtonstr. 15, 12489 Berlin

We consider transport in a two dimensional periodic velocity field which is due the addition of two planar waves. The field does not have a underlying potential and possesses extended lines of fixpoints where the deterministic motion stops.

Inclusion of additive noise makes the lines penetrable and an oscillatory motion along tori of the periodic field is excited. We characterize this motion by properties of the distribution density, the stationary mean velocity, the diffusion coefficient and escape times and find regimes where the noise plays a constructive role enhancing the transport of particles compared to the case without noise.

DY 24.37 Wed 16:00 Poster D

Noise- and delay-induced dynamics near a global bifurcation — •Roland Aust, Johanne Hizanidis, and Eckehard Schöll — Institut für Theoretische Physik, Technische Universität Berlin, Hardenbergstraße 36, 10623 Berlin, Germany

A generic model exhibiting a saddle-node bifurcation on a limit cycle is investigated. The model has served as a prototype example of excitability, strongly related to the existing global bifurcation, and coherence resonance, when a stochastic force is added [1]. We extend the system including time-delayed feedback control according to the Pyragas scheme and study it both in the presence and absence of noise. We find that the delay itself is able to create new, interesting dynamics. A delay-induced homoclinic bifurcation governed by a characteristic period scaling-law is reported. Using DDE-BIFTOOL [2] a bifurcation diagram in the $K - \tau$ plane is given (K being the strength of the control force and τ the time delay). In addition, multistability, including various bifurcations (e. g. saddle-node bifurcation of limit cycles, period-doubling), is found. Finally, we choose our parameters such that no delay-induced bifurcations occur and switch on Gaussian white noise. We compare our results to those of the uncontrolled system, in particular, the coherence resonance curve and features of the oscillations and the related power spectra.

[1] Hu Gang, T. Ditzinger, C.Z. Ning, and H. Haken, Phys. Rev. Lett. **78**, 807 (1993).
[2] K. Engelborghs, T. Luzyanina, and D. Roose, ACM Transactions on Mathematical Software, **28**, 1 (2002).

DY 24.38 Wed 16:00 Poster D

Multiple time-delayed feedback control of noise-induced space-time patterns in a reaction-diffusion system — •Niels Majer, Grischa Stegemann, and Eckehard Schöll — Institut für Theoretische Physik, Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin

We study the influence of noise upon the nonlinear dynamics of current density patterns in a semiconductor nano-structure, and its control by multiple time delayed feedback methods. The investigated system is a double barrier resonant tunnelling diode described by a nonlinear reaction-diffusion model.

The parameters of the system are fixed at values below a Hopf bifurcation where the only stable state of the deterministic uncontrolled system is a spatially inhomogeneous "filamentary" steady state, and oscillating space-time patterns do not occur. The addition of weak Gaussian white noise to the system gives rise to spatially inhomogeneous oscillations.

We introduce a multiple time-delayed feedback control scheme (ETDAS) with a memory parameter R, and investigate its influence on the regularity of the noise induced dynamics under variation of R. The obtained results are explained using linear stability analysis.

DY 24.39 Wed 16:00 Poster D

Coherence resonance - a mean field approach — Eckehard Schöll, •Valentin Flunkert, and Philipp Hövel — Institut für Theoretische Physik, Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin

We study the constructive influence of noise upon a nonlinear dynamic system in terms of a self-consistent mean field approach [1]. Two different types of coherence resonance of noise-induced oscillations are found in systems close to, but below, a sub- or supercritical Hopf bifurcation, respectively [2]. They can be explained analytically by a mean-field approximation of the Hopf normal forms, elucidating the different effect of noise upon the power spectrum near sub- and supercritical bifurcations.

[1] J. Pomplun, A. Amann, and E. Schöll, Europhys. Lett. 71, 366 (2005)
[2] O. V. Ushakov, H. J. W**nsche, F. Henneberger, I. A. Khovanov, L. Schimansky-Geier, and M. A. Zaks, Phys. Rev. Lett. 95, 123903 (2005)

DY 24.40 Wed 16:00 Poster D

Stochastic and Deterministic Dynamics in Hysteretic Systems — •Sven Schubert and Günter Radons — Chemnitz University of Technology, D-09107 Chemnitz

Many physical and technical systems such as shape memory alloys, nanowires, or certain friction models are characterized by a non-trivial hysteretic behavior, implying e.g. the appearance of nested sub-loops and a complex dependence on previous input events (hysteretic memory).

We study properties of hysteretic output time series $\{y_n\}$ for stochastic and chaotic input scenarios with similar characteristics using a discrete Preisach-hysteresis transducer. Our results show that stochastic and deterministic trajectories are treated differently by hysteresic systems. The probability distributions $p(y)$ show differing behavior. In addition, return maps (y_{n+1}, y_n), referring to higher order correlations of the signals, show different structures, especially taking into account values belonging to even or odd memory length. Using the sensitivity of the Preisach-hysteresis transducer to properties of the input time series one is able to distinguish deterministic chaos from noise. On the other hand, since hysteresis creates long-term memory we observe a slow decay of the autocorrelation function $C_y(\tau)$ for both types of signals. Spectral properties are changed correspondingly.

DY 24.41 Wed 16:00 Poster D

Validity criteria for the Fick-Jacobs equation — •P.S. Burada[1], G. Schmid[1], P. Hänggi[1], D. Reguera[2], and J.M. Rubí[2] — [1]Institut für Physik, Universität Augsburg, Germany — [2]Department de Física Fonamental, Facultat de Física, Universidad de Barcelona, Spain

We analyze the validity of the *Fick-Jacobs* equation for transport of biased Brownian particles in periodic, quasi-one-dimensional structures [1]. The condition of validity for the critical applied bias up to which the Fick-Jacobs equilibration assumption holds is found to be a quadratic function of the periodicity of the structure, and is numerically verified. The comparison is performed through the average particle current for which an analytic expression within the Fick-Jacobs approach is derived. The validity criteria is established from particle distributions along the main direction of transport and the transversal direction obtained numerically. Finally, we construct a phase diagram for the validity of the equilibration assumption in terms of the periodicity of the structure and the ratio between the work done to the particles and available thermal energy.

[1] D. Reguera, G. Schmid, P.S. Burada, J.M. Rubí, P. Reimann, and P. Hänggi, *Phys. Rev. Lett.* **96**, 130603 (2006).

DY 24.42 Wed 16:00 Poster D

A microscopic view on the Stokes–Einstein relation: anomalous translational and rotational motion of macromolecules in solution — •Alexander Uvarov and Stephan Fritzsche — Institut für Physik, Universität Kassel, D–34132 Kassel, Germany; uvarov@physik.uni-kassel.de.

In this contribution, we re-analyze the translational and rotational diffusion of non-rigid macromolecules in solution, starting from the microscopic view point. If a molecule is immersed into a solvent, its shape and dynamical behaviour will depend not only on the interaction among the individual beads but will be affected also by the solvent particles. Phenomenologically, the dynamical properties of the macromolecules are hereby described in terms of the friction and diffusion coefficients which follow the known Stokes–Einstein relation (SER).

By using a semi–phenomenological expression, derived for the friction of macromolecules [1], we calculate the boundary and diffusion coefficients of the free macromolecule as well as the orientation and relaxation correlation function of the non-rigid macromolecule immobilized on a surface [1, 2]. When compared with modern experiment [3] and dynamical simulations [4], excellent agreement is found even for low temperatures of the system when SER can not be apply.

[1] A. Uvarov and S. Fritzsche, PRE73, 011111 (2006); PRL, submitted (2006). [2] A. Uvarov and S. Fritzsche, JCM 121(13), 6561 (2004); Progr. Colloid and Polymer Science 133, 95 (2006). [3] B. Chen, E. Sigmund and W. Halperin, PRL 96, 145502 (2006). [4] J. Schmidt and J. Skinner, JPC B. 108, 6767 (2004)

DY 24.43 Wed 16:00 Poster D

Persistent and directed random walks with speed and angular fluctuations in two dimensions — Fernando Peruani[1,2] and •Luis Guillermo Morelli[1] — [1]Max Planck for the Physics of Complex Systems, Dresden, Germany — [2]Technische Universitaet Dresden, Dresden, Germany

We study the motion of self-propelled particles with fluctuations in the speed and the direction of motion, in two dimensions. We consider the case in which fluctuations in the speed are not correlated to fluctuations in the direction of motion, and assume that both processes can be described by independent characteristic times. We investigate the dynamics of persistent and directed random walks, and derive exact expressions for the mean displacement and the mean squared displacement for arbitrary speed and angular stationary distributions. We show that both persistent and directed random motion with speed fluctuations exhibit a series of alternating ballistic and diffusive regimes, which arise from the interplay between the different time-scales involved. Our results could be relevant to estimate motility indexes from experiments involving living cells or other self-propelled particles.

DY 24.44 Wed 16:00 Poster D

Dry and wet granular shock waves — •Vasily Zaburdaev and Stephan Herminghaus — MPI for Dynamics and Self-Organization, Bunsenstr. 10, D-37073 Göttingen, Germany

The formation of a shock wave in one-dimensional granular gases is considered, for both the dry and the wet case, and the results are compared with the analytical shock wave solution in a sticky gas. Numerical simulations show that the behavior of the shock wave in both cases tends asymptotically to the sticky limit. In the inelastic gas (dry case) there is a very close correspondence to the sticky gas, with one big cluster growing in the center of the shock wave, and a step-like stationary velocity profile. In the wet case, the shock wave has a non-zero width which is marked by two symmetric heavy clusters performing breathing oscillations with slowly increasing amplitude. All three models have the same asymptotic energy dissipation law, which is important in the context of the free cooling scenario. For the early stage of the shock formation and asymptotic oscillations we provide analytical results as well.

DY 24.45 Wed 16:00 Poster D

Extension of the entropy fluctuation theorem to non-equilibrium phase transitions — •Axel Fingerle and Stephan Herminghaus — MPI for Dynamics and Self-Organization, Bunsenstr. 10, D-37073 Göttingen, Germany

The Gallavotti-Cohen fluctuation theorem [1] is one of the few exact results known for chaotic systems in non-equilibrium states. It predicts that the fluctuations Δs_{p} of the phase space volume obey the symmetry relation $P(\Delta s_{\mathrm{p}}) = \exp\left(\Delta s_{\mathrm{p}}\right)\, P(-\Delta s_{\mathrm{p}})$. We point out that for wet granular matter the assumption of time reversibility in the GCFT is not fulfilled and that the phase space volume is conserved, $\Delta s_{\mathrm{p}} \equiv 0$, so that the Gallavotti-Cohen entropy Δs_{p} does not contribute to entropy production. We also show that the similar definition $\Delta s_E = \ln P(\Delta E)/P(-\Delta E)$, in terms of exchanged heat, ΔE, at oscillating walls is not linear in ΔE, so that the distribution $P(\Delta E)$ does not fulfill the symmetry relation, in contrast to observations [2,3] of dry granular matter with less statistics. Finally it is shown that this non-linearity is an instable branch of entropy as a function of energy, $\partial s/\partial E < 0$, which corresponds to the fluid-gas transition of wet granular matter [4].

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[2] K. Feitosa and N. Menon, Phys. Rev. Lett. **92**, 164301 (2004).
[3] A. Puglisi, *et al.*, Phys. Rev. Lett. **95**, 110202 (2005).
[4] A. Fingerle, K. Röller and S. Herminghaus, submitted.

DY 24.46 Wed 16:00 Poster D

Surface Melting and Leidenfrost Effect in Wet Granular Matter — •Klaus Röller, Axel Fingerle, and Stephan Herminghaus — MPI for Dynamics and Self-Organization, Bunsenstr. 10, D-37073 Göttingen, Germany

We report two vertical phase separations occurring in wet granular matter when placed on top of a sinusoidally oscillating bottom plate. The system has been studied by means of a molecular dynamic simulation which takes the hysteretic liquid bridge force between wetted particles into account [1]. For low accelerations of the shaking bottom plate we observe a pure solid phase. At a certain value of the acceleration, the top layer starts to melt as indicated by the height dependent diffusion coefficient. As the acceleration is increased further, the height of the fluid phase floating on top of the solid phase grows until it diverges at a well defined solid to fluid transition. As we increase the acceleration further a second vertical phase separation sets in: the condensed phase hovers on top of a gas phase, quite reminiscent of the classical Leidenfrost effect. This is the first observation of density inversion in wet granular matter. The chunk above the gas is thermally isolated by the low heat conductivity of the gas in which the upward stream of injected energy is dissipated in frequent ruptures of liquid bridges. Finally, above an acceleration depending on the filling height the condensed phase evaporates completely.

[1] Advances in Physics **54**, 221 (2005).

DY 24.47 Wed 16:00 Poster D

The Phase Diagram of Wet Granular Matter under Vertical Agitation — •Axel Fingerle, Klaus Röller, and Stephan Herminghaus — MPI for Dynamics and Self-Organization, Bunsenstr. 10, D-37073 Göttingen, Germany

Wet granular matter has numerous industrial applications and there is some phenomenological knowledge about soil liquefaction caused by earth quakes for such systems. We provide physical insight in the critical behavior of wet granular matter under vertical agitation. The minimal capillary model [1,2] has been applied to simulations, and a continuum descriptions for wet granular matter has been derived. We could reveal two distinct mechanism for phase transitions far from thermal equilibrium, which are confirmed by experiments: The *solid-*

fluid transition sets in when the vertical acceleration Γ of the plates confining the wet granulate is strong enough to overcome the cohesion force of the interstitial liquid phase. The *fluid-gas* transition defines a critical line at a mean squared velocity $\langle v^2 \rangle$ of the shaking, which is proportional to the surface tension of the wetting liquid. Furthermore, there are two disjoint domains of solid-gas and fluid-gas coexistence in the Γ-v-plane. We introduced dynamical order parameters to quantify the states of wet granular matter and derived a local equation of state. With these results and the piecewise symplectic structure of the capillary model, wet granular matter serves as a paradigmatic system for nonequilibrium physics with favorable mathematical properties.

[1] S.H., Adv. Phys. **54**, 221 (2005).
[2] A.F. and S.H., Phys. Rev. Lett. **97**, 078001 (2006).

DY 24.48 Wed 16:00 Poster D

Fluctuations due to the nonlocal character of collisions — •Klaus Morawetz — Institute of Physics, Chemnitz University of Technology, 09107 Chemnitz, Germany — Max Planck Institute for the Physics of Complex Systems, Noethnitzer Str. 38, 01187 Dresden, Germany

It is shown that the collision integral describing the nonlocal character of collisions leads to the same mean-field fluctuations in the one-particle distribution as proposed by Boltzmann-Langevin pictures. It is argued that this appropriate collision integral contains the fluctuation-dissipation theorems in equilibrium itself and therefore there is no need to assume additionally stochasticity. This leads to tremendous simplifications in numerical simulation schemes. [nucl-th/0609025]

DY 24.49 Wed 16:00 Poster D

Spatiotemporal memory in a one-dimensional reaction-diffusion system — •Knud Zabrocki[1], Steffen Trimper[1], and Michael Schulz[2] — [1]Institut für Physik, Martin-Luther-Universität Halle-Wittenberg, 06099 Halle (Saale), Deutschland — [2]Fachbereich Physik, Universität Ulm, 89069 Ulm, Deutschland

To analyze possible generalizations of reaction-diffusion schemes due to feedback coupling and memory effects we investigate simple scalar evolution equations for the mass density or the probability density where long-range correlations and time delay are coupled. The influence of such a spatiotemperal delay is studied in a reaction-diffusion model. All processes within a sphere of radius $R(t) = \kappa t^{\alpha}$ around a certain spatial point contribute to the instantaneous reaction and diffusion process. Due to the competition between both processes and the delay the system features a non-trivial stationary state. The resulting concentration profiles are calculated analytically for a ballistic behavior with $\alpha = 1$ and for an additional local diffusive transport with $\alpha = \frac{1}{2}$. Moreover the concentration profile offers an anisotropic behavior due to the delay. The model is exactly soluble.

DY 24.50 Wed 16:00 Poster D

Ageing, intermittency and metastability in spin glass systems — •Andreas Fischer[1], Karl Heinz Hoffmann[1], and Paolo Sibani[2] — [1]Institut für Physik, Technische Universität Chemnitz, D-09107 Chemnitz, Germany — [2]Fysisk Institut, Odense Universitet, Campusvej 55, DK5230 Odense M, Denmark

Spin glasses are important prototypes for complex systems. They show numerous different phenomena including intermittency, metastability and ageing. Complex dynamical behavior is revealed in the low-temperature regime, especially below the spin glasses transition temperature. There a variety of features can be found, which show the systems' inability to attain thermodynamic equilibrium with its ambient during observable time scales. The resulting ageing and memory effects have been observed in many experiments. In particular spin glasses are good model systems as their magnetism provides an easy and accurate measurable observable representing important information about the systems state.

In order to understand the features observed, different model approaches have been applied for describing the systems internals. One prominent example of these model systems is the so called L-S-tree, a hierarchical model of the complex systems' state spaces within the low-temperature regime. The L-S-tree has proven its applicability by various successful reproductions of experimentally observed features.

Here we show some newly observed spin glass features and how these can be reproduced by L-S-tree models.

DY 24.51 Wed 16:00 Poster D

Shear fluidisation of wet granulates — •Seyed Habibollah Ebrahimnazhad Rahbari, Martin Brinkmann, and Stephan Herminghaus — Dynamics of Complex Fluids, Max- Planck Institute for Dynamics and Self- Organization, Bunsenstr. 10, 37073 Göttingen, Germany

The fluidization of dense wet granular matter in the presence of externally applied shear forces is examined by molecular dynamics-type simulations in two and three dimensions. The granulate is modeled as an assembly of frictionless soft discs, respectively, spheres with a bidisperse size distribution. A short ranged constant attractive force accounts for liquid bridges between adjacent spheres, including the hysteretic nature of capillary interaction [1]. As reported in earlier works on similar models of wet granulates by Schultz [2] and Goll [3], a critical transition between a quiescent and a fluidized state is observed as the amplitude of the shear forces is increased. Since it has been suggested that Lennard-Jones potentials may be too soft to account for the jamming effects at high density [3], we alternatively examined interactions via Hertzian forces. Different dynamic regimes are identified and characterized by the magnitude of drift motion, particle diffusion and the spatial distribution of stresses. In our simulations, shear forces are generated either through a spatially varying force field or by sliding side walls being decorated with a immobilized monolayer of particles.

[1] S Herminghaus, *Adv. Phys.* **54**: 221, (2005)
[2] M Schulz et al., *Phys. Rev. E* **67**: 052301 (2003)
[3] C M Goll and K Mecke, *private communication*

DY 24.52 Wed 16:00 Poster D

El Nino and the Delayed Action Oscillator — •Rudolf Andreas Römer, Ian Boutle, and Richard Taylor — Department of Physics and Centre for Scientific Computing, University of Warwick, Coventry CV4 7AL, UK

We study the dynamics of the El Nino phenomenon using the mathematical model of delayed-action oscillator (DAO). Topics such as the influence of the annual cycle, global warming, stochastic influences due to weather conditions and even off-equatorial heat-sinks can all be discussed using only modest analytical and numerical resources. Thus the DAO allows for a pedagogical introduction to the science of El Nino and La Nina while at the same time avoiding the need for large-scale computing resources normally associated with much more sophisticated coupled atmosphere-ocean general circulation models. It is an approach which is ideally suited for student projects both at high school and undergraduate level.

DY 24.53 Wed 16:00 Poster D

Numerical simulation of the air flow through a pipe organ for the purpose of identification of sound anomalies — •Werner Jürgens and Markus Abel — UP Transfer GmbH an der Universität Potsdam, Am Neuen Palais 10, 14469 Potsdam

Some pipe organs exhibit an irregular pipe sound, which can partly be ascribed to perturbations in the air supply. However, the details of this process, which can involve multiple pipes, are insufficiently understood. In order to determine the nature and origin of the perturbations, the present investigation focuses on the wind chest of an organ. The wind chest is located below the pipes and supplies them with air.

The velocity and pressure distributions of the flow inside the wind chest are calculated numerically. By this means, it is possible to study how disturbances propagate inside the wind chest and how they affect the sound generated by the pipes.

DY 24.54 Wed 16:00 Poster D

Dynamik turbulenter Strukturen in einem Rayleigh Bénard System — •Michael Langner und Joachim Peinke — Institut für Physik, Universität Oldenburg

Wir präsentieren experimentelle Ergebnisse eines Rayleigh Bénard Systems bei hohen Rayleighzahlen (10^9). Der experimentelle Aufbau besteht aus einer zylindrischen Zelle von 30cm Durchmesser und ebensolcher Höhe. Die Temperaturdifferenzen im System betragen maximal etwa $20°C$. Bei den von uns durchgeführten Geschwindigkeitsmessungen kommt ein Doppler Ultraschall Anemometer zur Anwendung, welches eine Datenerfassung entlang einer frei wählbaren Linie erlaubt (Ortsauflösung 3mm, Zeitauflösung 150ms). Insbesondere analysieren wir das Verhalten der "Large Scale Circulation", indem wir die Geschwindigkeiten entlang zweier sich kreuzenden Linien in der Nähe der unteren Heizplatte untersuchen. Anhand der statistischen Analyse dieser Daten sollen Übergänge zwischen unterschiedlichen Zuständen des System identifiziert werden.

DY 24.55 Wed 16:00 Poster D

Phase field simulations for drops and bubbles — •Rodica Borcia and Michael Bestehorn — Lehrstuhl Statistische Physik/ Nichtlineare Dynamik, Brandenburgische Technische Universität Cottbus, Erich-Weinert-Straβe 1, 03046, Cottbus, Germany

Recently we proposed a phase field model to describe Marangoni convection in a compressible fluid of van der Waals type far from criticality [Eur. Phys. J. B **44** (2005), 101]. The model previously developed for a two-layer geometry is now extended to drops and bubbles. A randomly distributed initial density evolves towards drops in a vapor atmosphere or bubbles in a liquid, depending on the total mass. Finally, as applications, we report on numerical simulations for drop Marangoni migration in a temperature gradient and for drop spreading on a solid surface.

DY 24.56 Wed 16:00 Poster D

Statistical analysis of coherent structures in transitional pipe flow — Tobias Schneider, Bruno Eckhardt, and •Jürgen Vollmer — Fachbereich Physik, Philipps Universität, 35032 Marburg, Germany

The transition to turbulence in pipe flow is an outstanding problem in fluid dynamics. Although linear stability theory suggests that the laminar state always remains stable, the transition to turbulence occurs at rather moderate flow speeds. Recently, computer simulations and the numerical discovery of unstable travelling waves have supported a transition scenario that is inspired by ideas from dynamical systems theory. According to these ideas, the transition is connected with a strange saddle that forms in the state space of the system in the neighbourhood of the travelling waves. One indicator for this saddle is the transient appearance of the travelling waves in the flow field. Time traces of correlation functions clearly show regions dominated by four or six vortices, in agreement with experimental observations. We study the time spent near each travelling wave and characterise the dynamics by transition probabilities between the states. This allows us to make a first and empirically feasible step towards an analysis of the turbulence characteristics in terms of travelling waves.

DY 24.57 Wed 16:00 Poster D

Blocking method in model reduction for nonlinear dynamics — •Thorsten Bogner — Condensed Matter Theory, Fakutät für Physik,* Universität Bielefeld, Postfach 100131, D-33501 Bielefeld, Germany

In many fields where nonlinear dynamical systems arise, e.g. fluid dynamics, already advanced numerical methods are known. Unfortunately, these methods often lead to a very high dimensional description if an acceptable error bound is desired. In these cases model reduction can simplify the numerical description significantly. It can also make new applications possible, where speed is necessary or computational power is limited.

An established method in model reduction is the Proper Orthogonal Decomposition (POD) that aims on finding a subspace of the phase space that can reproduce the dynamics 'optimally'. This is based on the spatial correlation matrix, which is numerically approximated from sample trajectories. It has the disadvantage, that the large system has to be solved to perform the POD.

Instead of treating the large system directly, we use a blocking method to get an approximate POD of the full system. Also an iteration is possible to increase the accuracy. For our method only calculations on small systems are necessary. This leads to a significant reduction of work load and memory size for the POD itself.

We test our method on the linear 1D diffusion equation as a toy modell with is also accessible analytically. Further we introduce nonlinearities resulting in the Burgers equations and the KPZ equation.

DY 24.58 Wed 16:00 Poster D

Combined path-following and time integration methods applied to lubrication equations — •Philippe Beltrame and Uwe Thiele — Current address: Max-Planck-Institut für Physik komplexer Systeme, Nöthnitzer Straße 38, D-01187 Dresden, Germany

Pattern formation in thin liquid films represents a highly nonlinear phenomena far from equilibrium. To understand the evolution beyond the weakly nonlinear stage requires a numerical treatment of the of the full nonlinear system either by time integration of the dynamics or by path-following to track the (relative) equilibria directly. We develop a code unifying the time integration and path following tasks for generic lubrication equations [1] following similar projects for the Navier-Stokes equations [2]. However, the presence of the bilaplacian operator in the curvature term deteriorates drastically the Jacobian matrix conditioning which is the crucial point in such methods. Furthermore the presence of an ultrathin precursor film (typically below 100 nm thickness) leads to a strong scale separation for macroscopic drops. In order to tackle these specific problems we developed an original algorithm using exponential propagation. The code proves its reliability and efficiency compared to more classical methods. Our common numerical framework is applied to 2D sliding drops and 2D/3D depinning problem.

References [1] Oron, A et al. Reviews of Modern Physics, 1997, 69, 931-980 [2] Tuckerman, L. et al., Doedel (Eds) Bifurcation analysis for timesteppers Springer, New York, 2000

DY 24.59 Wed 16:00 Poster D

Dynamics of Vortex Filaments in Layered Media — •Pavel Popov, Alexey Romanov, and Konstantin Chukbar — Russian Research Center "Kurchatov Institute", Moscow, Russia

We perform theoretical investigation of the dynamics of a single vortex filament in layered superconducting structures, assuming the conductivity between layers to be zero. The language we use is purely classical, quantum effects being responsible only for the finite size and internal structure of vortex kernel, and for discretization of its amplitude. Using the general fact that generalized vorticity $\Omega = \nabla \times \vec{P}$ is freezed into motion of medium (in our case, superconducting electrons $\vec{P} = m\vec{v} - q\vec{A}/c$) we derive the equations that allow us to get the velocity of medium motion and thus describe self-induced dynamics of a vortex filament. Similar problems have already been solved in the cases of hydrodinamic media and isotropic charged fluids.

Particularly, we consider linear waves on infinitely thin vortex filament. For this case we obtain dispersion relation and find out that, due to anisotropy, there is significant dependece of filament behaviour on the angle of its slope: when the inclination is larger than the critical value filament oscilations become unstable. Next, we get dispersion relations for various longitudial and transverse modes for a vortex with finite kernel size. We note that consideration of the energy of a finite vortex suggests that it could also be unstable (although, this is not the case with linear approximation).

DY 24.60 Wed 16:00 Poster D

Higher-order study of vesicle dynamics in shear flow — •Gerrit Danker and Chaouqi Misbah — LSP, UJF-Grenoble 1 and CNRS, BP 87, 38402 Saint Martin d'Hères, France

Vesicles, which consist of a closed fluid membrane surrounding a Newtonian liquid, have been studied extensively in recent years. They can, for example, act as simple mechanical models of biological cells in an external flow, giving insights into challenging problems like blood rheology.

Recent experiments [1] and theoretical studies in the small excess area limit [2] demonstrate that vesicles in a shear flow display different dynamical behaviour, depending on the viscosity contrast between inner and outer fluid. For small viscosity contrast one observes a time-independent vesicle shape with fixed orientation in the flow (tank-treading) and for sufficiently large viscosity ratio an unsteady motion (either tumbling or vacillating-breathing). We extend the analytical study in [2] to higher order in the excess area and discuss consequences for vesicle dynamics and applications to rheology of dilute vesicle suspensions [3].

[1] V. Kantsler and V. Steinberg, Phys. Rev. Lett. **96**, 036001 (2006).
[2] C. Misbah, Phys. Rev. Lett. **96**, 028104 (2006).
[3] G. Danker and C. Misbah, preprint (2006).

DY 24.61 Wed 16:00 Poster D

LONGITUDINAL HEAT FLOWS IN COLLISIONLESS ANISOTROPIC PLASMAS, ARISING IN MHD MOTIONS. — •igor grigoriev[1] and vladimir pastukhov[2] — [1]RRC "Kurchatov Institute" Moscow Russia — [2]RRC "Kurchatov Institute" Moscow Russia

Magnetohydrodynamic motions of finite-beta collisionless plasmas with anisotropic pressure confined by magnetic field are considered. For convenience and simplicity we analyze Z-pinch-like magnetic configuration with purely azimuthal magnetic field. Non-axisymmetric Alfven modes are analyzed within one-fluid MHD-like model, however, perturbations of longitudinal and transversal plasma pressures are calculated from kinetic equation using path-integral method. It is shown that adiabats of Chew-Goldberger-Low fail their applicability in

the case of low-frequency (below bounce-frequency) non-axisymmetric plasma perturbations due to arising longitudinal energy fluxes. The obtained pressure perturbations are used to analyze the stability of non-axisymmetric (Alfven) modes.

DY 24.62 Wed 16:00 Poster D

Temperature fluctuations in a heated free jet measured by a new microscopic temperature sensor — •Florian Heidemann, Marco Munzel, and Achim Kittel — University of Oldenburg, D-26111 Oldenburg

Turbulence is a phenomenon whose basic principles are still not well understood. One approach to investigate its nature is the charaterization of passiv scalars such as temperature. With a new developed fast thermosensor we are able to measure the temperature fluctuations in a heated free jet of water in a water tank with high spatial and temporal resolution at different positions and for different flow velocities. The used nozzle has a diameter of $2mm$, which provides a laminar flow with a rectangular velocity profile at the outlet. The sensor is based on a miniaturized thermocouple and has an active area of approx. $0.05\mu m^2$ and a response time of approx. $10\mu s$ in water with a temperature resolution of $50mK$ (measured with a bandwidth of $100kHz$). Our aim is to characterize the temperature fluctuations of the free jet with power spectra and increment distributions depending on the position perpendicular and parallel to the symmetry axis with respect to the nozzle.

DY 25: Quantum chaos II

Time: Thursday 9:30–11:00 Location: H2

Invited Talk DY 25.1 Thu 9:30 H2

Surprises in the time-evolution of wave-packets — •Arnd Bäcker — Institut für Theoretische Physik, Technische Universität Dresden, 01062 Dresden, Germany

Hamiltonian systems show a large variety of dynamical behaviour ranging from integrable over mixed to fully chaotic dynamics. Quantum mechanically this is reflected in the properties of eigenfunctions and eigenvalue statistics. In this talk the quantum-to-classical correspondence is investigated using the time evolution of wave-packets. While classical and quantum dynamics coincide at short times, the question is what happens at larger times? For fully chaotic systems one expects that an initially localized wave-packet becomes random for sufficiently long times. It is shown that this randomization time-scale is surprisingly large. For systems with a mixed phase space it turns out that a wave-packet, initially placed in the chaotic sea, may ignore the classical phase space boundaries and that the randomized wave-packet substantially floods into the region of the regular island. This is explained in terms of the eigenstates [1] and with a random matrix model. One interesting application are rough nano-wires in a magnetic field where surprisingly large localization lengths can be understood by this flooding process [2].

[1] A. Bäcker, R. Ketzmerick, and A. Monastra, Phys. Rev. Lett. **94** 054102 (2005).

[2] J. Feist, A. Bäcker, R. Ketzmerick, S. Rotter, B. Huckestein, and J. Burgdörfer, Phys. Rev. Lett. **97** 116804 (2006).

DY 25.2 Thu 10:00 H2

Chaotic billiards: Loschmidt echo decay due to local deformations of boundaries — •Arseni Goussev and Klaus Richter — Institute for Theoretical Physics, University of Regensburg, Germany

We study the stability of the quantum dynamics against perturbations of the Hamiltonian in systems that are chaotic in the classical limit. For this purpose, we address the time dependence of the Loschmidt echo (LE), also known as fidelity, for semiclassical wave packets in two-dimensional chaotic billiards. The LE is the overlap between two wave functions that are obtained in the course of time evolution of the same initial quantum state under two different Hamiltonians. We investigate, analytically and numerically, the time decay of the LE for the case that the difference between the two Hamiltonians, i.e. the Hamiltonian perturbation, is due to a local deformation of the billiard's boundary. We find the LE to decay exponentially in time, with the rate equal to the classical escape rate from an open billiard obtained from the original one by removing the deformation-affected region of its boundary. This result provides an appealing connection between the quantum fidelity in the regime of strong Hamiltonian perturbations and properties of the chaotic dynamics of the underlying classical system.

DY 25.3 Thu 10:15 H2

Fidelity Decay in chaotischen Quantensystemen — •Heinerich Kohler — Institut für theoretische Physik, Philosophenweg 19, Universität Heidelberg, 69120 Heidelberg

Fidelity is defined as the modulus square of the overlap integral of an initial wave function which is propagated in time by a Hamiltonian H_0 with the same initial wave function which is propagated by a slightly modified Hamiltonian $H_0 + \delta V$. The surprisingly complex time behaviour of fidelity is described and calculated within the framework of Random Matrix Theory. Non perturbative phenomena like the freeze of fidelity on a high plateau and for long times as well as a revival at Heisenberg time are found. There exists an interesting relation to parametric level correlations. The universality of this relation will be discussed.

DY 25.4 Thu 10:30 H2

Survival probability of an open circular microwave resonator — Stefan Bittner, Barbara Dietz-Pilatus, Thomas Friedrich, Maksim Miski-Oglu, •Pedro Oria Iriarte, Achim Richter, and Florian Schäfer — Institut für Kernphysik, Schloßgartenstraße 9, 64289 Darmstadt

An experimental study of an open circular quantum billiard simulated by a flat microwave cavity is presented. A piece of absorber material placed on the boundary simulates a hole and opens the system. The survival probability is determined and compared to its classical counterpart obtained by a numerical simulation. It is connected to the famous Riemann hypothesis in the limit of a small opening. This connection might be accessible in further experiments.

DY 25.5 Thu 10:45 H2

Leaking Billiards — •Jan Nagler, Moritz Krieger, Marco Linke, Johannes Schönke, and Jan Wiersig — Institut für Theoretische Physik, Universität Bremen, Otto-Hahn-Allee, 28334 Bremen

Billiards are idealizations for systems where particles or waves are confined to cavities, or to other homogeneous regions. In billiard systems a point particle moves freely except for specular reflections from rigid walls. However, billiard walls are not always completely reflective and measurements inside can also open the billiard. Since boundary openings have been studied extensively in the literature, we rather model leakages inside the billiard. In particular, we investigate the classical dynamics of a leakage for a continuous family of billiard systems, that is, the stadium-lemon-billiard family. With a single parameter the geometry of the billiard can be tuned from stadium (being fully hyperbolic) over circle (integrable) to the lemon-shaped billiard (mixed chaotic). For the stadium billiard we found an algebraically decaying mean escape time with the linear size ϵ of the leakage $\langle n_{\mathrm{esc}} \rangle \sim \epsilon^{-1}$ together which an exponential decay of the survival probability distribution. The finding is nearly independent of the position and size of the leakage, as long as the leakage is much smaller than the system size. Due to the mixed phase space for lemon billiards, the mean escape time depends both on the position and geometry of the leakage. For systems where quasi-regular motion dominates, we found a linear dependence of the mean escape time, $\langle n_{\mathrm{esc}} \rangle \sim 1 - \epsilon$ which we refer to as *flooding law*. Our findings are helpful in understanding dynamics of leaking Hamiltonian systems.

DY 26: Ferrofluids / Liquid crystals

Time: Thursday 10:30–13:00 Location: H3

DY 26.1 Thu 10:30 H3

Localized and Decomposable States at the Rosensweig Instability — •Reinhard Richter — Experimentalphysik 5, Universität Bayreuth, D-95444 Bayreuth

Recently it was demonstrated in experiment [1] and numerics [2] that two-dimensional static localized structures can be generated in the bistable regime of the Rosensweig instability by means of a local perturbation. Here we investigate whether these *ferrosolitons* are decomposable [3], in the sense that packets of bumps or holes can be created at will. Moreover we show for the first time that information can be stored in the decomposable pattern without any extrinsic grid, as suggested by [4].

- [1] R. Richter, I.V. Barashenkov, Phys. Rev. Lett **94** , 184503 (2005).
- [2] O. Lavrova, G Matthies, T. Mitkova, V. Polevikov and L. Tobiska, J. Phys.: Condens. Matter **18**, S2657 (2006).
- [3] P. Coullet, C. Riera, C. Tresser, Phys. Rev. Lett. **84**, 3069 (2000).
- [4] P. Coullet, C. Toniolo, C. Tresser, Chaos, **84** 193 (2004).

DY 26.2 Thu 10:45 H3

Structure formation in ferrofluid monolayers-I: Simulations. — •Juan J. Cerda[1], Sofia Kantorovich[2,3], and Christian Holm[1,2] — [1]FIAS, Frankfurt am Main, Germany — [2]MPI-P, Mainz, Germany — [3]Ural State Univ., Ekaterinburg, Russia

Molecular dynamics (MD) is used to study thoroughly the microstructure formation of monodisperse and bidisperse ferrofluid monolayers. Long-range dipolar interactions are computed using a recently developed dipolar-P3M-layer correction algorithm. In comparison to the traditional Ewald sum methods, this approach allows to handle and characterize larger systems. An extensive comparison with theoretical density functional theory, and experimental results from in situ cryogenic tansmission electron microscopy [Klokkenburg et al., PRL 97,185702,(2006)] will be also presented.

DY 26.3 Thu 11:00 H3

Structure formation in ferrofluid monolayers-II: Theory. — •Sofia Kantorovich[1,3], Joan Cerda[2], and Christian Holm[2,3] — [1]Ural State University, Ekaterinburg, Russia — [2]Frankfurt Institute for Advanced Studies, Frankfurt, Germany — [3]Max Planck Institute for Polymer Research, Mainz, Germany

Due to specific interactions inherent to single domain ferroparticles in magnetic fluids complex nanostructures might exist in ferrocolloids. Unfortunately the particle size and the optical properties of carrier liquids make the natural studies of the aggregation processes in 3D samples difficult, but it is possible to use cryo-TEM in 2D (in monolayers) [Klokkenburg et al., PRL 97, 185702, (2006)].

Here we present theoretical investigation of the mono- and bidisperse ferrofluid monolayers. We allow for the probability of chains and rings coexistence in the thermodynamic equilibrium at room temperatures. Predictions obtained via the theoretical density functional approach are extensively compared to simulation data and experimental results of Klokkenburg et al.

DY 26.4 Thu 11:15 H3

Maximal growth rate at the Rosensweig instability — •Adrian Lange[1], Holger Knieling[2], Gunar Matthies[3], Ingo Rehberg[2], and Reinhard Richter[2] — [1]Fraunhofer Institut für Werkstoff- und Strahltechnologie, Winterbergstraße 28, D-1277 Dresden — [2]Experimentalphysik V, Universität Bayreuth, D-95440 Bayreuth — [3]Ruhr-Universität Bochum, Universitätsstraße 150, D-44780 Bochum

Instabilities in magnetic fluids (MFs) have had a long history with the most eye-catching phenomenon being the Rosensweig instability [1]. When a critical value B_c of the vertical magnetic induction is surpassed, static liquid peaks arranged in a hexagonal pattern are rising on the free surface of the fluid. A linear description of the Rosensweig instability is amenable in theory, but restricted to small amplitudes. In experiments they can be observed only for a very short time during the increase of the pattern of ridges, which bifurcate supercritically. Thus a new pulse technique has been developed and applied [2,3]. It is assumed that in the linear state of the pattern forming process the wave number with the largest growth rate will prevail. This contribution is devoted to present theoretical, experimental, and numerical results for the maximal growth rate for two different MFs. The results show that the experimental and numerical data agree satisfyingly whereas the theoretical data show a sizeable disagreement.

[1] M. D. Cowley, R. E. Rosensweig, J. Fluid Mech. **30**, 671 (1967).
[2] A. Lange, B. Reimann, R. Richter, Phys. Rev. E **61**, 5528 (2000).
[3] B. Reimann, R. Richter, I. Rehberg, A. Lange, Phys. Rev. E **68**, 036220 (2003).

DY 26.5 Thu 11:30 H3

Pattern Formation in Isotropic Ferrogels - Nonlinear Analysis Using the Energy Method — •Stefan Bohlius[1], Harald Pleiner[1], and Helmut Brand[2] — [1]Max Planck Institute for Polymer Research, 55021 Mainz, Germany — [2]Theoretische Physik III, Universität Bayreuth, 95440 Bayreuth, Germany

Ferrogels are chemically cross-linked polymer networks that are generated using a ferrofluid as a solvent. Just as ferrofluids, ferrogels undergo an instability from an initially flat surface to a stationary spike structure, if an external magnetic field applied perpendicular to the surface exceeds a certain critical value. In the case of isotropic ferrogels this critical magnetic field is enhanced by the shear modulus of the network. The wavelength of the critical mode, however, does not change with respect to usual ferrofluids at the onset of the instability.

For a nonlinear discussion of this instability, we extend the previous discussions for magnetic fluids of Gailitis and Friedrichs and Engel, who used an energy minimizing method, to media with elastic degrees of freedom. In addition to the known surface energy density of ferrofluids we add the contribution due to elasticity.

Stripes turn out to be never stable with respect to one of the other two regular patterns. At the linear threshold the flat surface transforms into hexagons. This hysteretic region of this transition shrinks with increasing shear modulus. For higher magnetic fields the hexagonal pattern becomes unstable in favor of squares. Also this transition shows a hysteresis for the back transformation to hexagons. With increasing shear modulus this hysteretic region shrinks.

DY 26.6 Thu 11:45 H3

The deformation of a ferrogel in uniform magnetic fields — •Christian Gollwitzer[1], Alexander Turanov[2], Marina Krekhova[3], Ingo Rehberg[1], Günter Lattermann[3], and Reinhard Richter[1] — [1]Experimentalphysik V, Universität Bayreuth — [2]Zavoisky Physical-Technical Institute. KSC, RAS, Kazan, Russia — [3]Makromolekulare Chemie I, Universität Bayreuth

Ferrogels are an interesting new class of materials that enhance the properties of magnetic fluids by elastic components. Ferrogels are able to exert forces when exposed to magnetic field gradients [1]. But also in homogeneous fields there can be shape changes, albeit much smaller ones. This has been predicted already by Landau [2] for the case of a sphere. We expose a sphere of a thermoreversible magnetoelastic material [3] to a homogeneous magnetic field and observe the elongation laterally with a highspeed camera. To compensate the deformation of the sample under gravity, we immerse it into water. We compare the outcome of this magnetic stress experiment to mechanical creep experiments and to the theoretical predictions by Landau [2] and Raikher [4].

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[2]Landau, L. D. & Lifschitz, E. M. 1960 *Electrodynamics of Continuous Media*, 3rd edn., vol. 8. Oxford: Pergamon.
[3]Lattermann, G. & Krekhova, M. 2006 *Macromol. Rapid Commun.* **27**, 1373–1379.
[4]Raikher, Y. & Stolbov, O. 2005 *Journal of Applied Mechanics and Technical Physics* **46** (3), 434–443.

DY 26.7 Thu 12:00 H3

Role of interactions in ferroluid thermal ratchets — •Volker Becker — Charite, Augustenburger Platz 1, 13353 Berlin

Orientational fluctuations of colloidal particles with magnetic moments may be rectified with the help of external magnetic fields with suitably chosen time dependence [1]. As a result a noise-driven rotation of particles occours giving rise to a macroscopic torque per volume of the

carrier liquid. We have theoretically analyzed the influence of mutual interactions between the particles on this ratchet effect by studying a model system with mean-field interactions. The stochastic dynamik may be described by a nonlinear Fokker-Planck equation for the collective orientation of the particles which we have solved aproximately. We have found that interactions favouring the parallel alignment of the magnetization of the ferrofluid particles reinforce the ratchet effect. Morover we have determined an intevall for the ratio between coupling strength and noise intensity for which a self-sustained rectification of fluctuations can be observed. The ratchet effect then operates under conditions for which it where impossible in the absence of fluctuations.

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[2] V. Becker, A.Engel, *cond. Mat.*/0609546

DY 26.8 Thu 12:15 H3

Rheological investigations of ferrofluids with a shear stress controlled rheometer — •Hamid Shahnazian and Stefan Odenbach — Lehrstuhl für Magnetofluiddynamik, Technische Universität Dresden, 01062 Dresden

Ferrofluids, suspensions of magnetic nanoparticles with a mean diameter of about 10 nm in appropriate carrier liquids, show normal liquid behaviour coupled with superparamagnetic properties. This enables to influence significantly their flow behaviour by moderate magnetic field strengths, giving rise to numerous technical and biomedical applications. One of the major attributes of ferrofluids is the change of viscosity (magnetoviscous effect) and the appearance of viscoelastic effects caused by applied magnetic fields. Different theoretical approaches have been developed to explain these effects. The predictions of these models differ in a point, which comes into a question of an appearance and field dependence of yield stress in ferrofluids. For the investigations concerning yield stress a shear stress controlled rheometer for magnetic fluids has been designed. For different kind of ferrofluids, a dependence of the yield stress on magnetic field strength is observed. In order to get information on the size of the structures, formed by the particles under magnetic field influence, and its dependence on field strength as well as on interparticle interaction, variation of geometry - cone/plate or plate/plate - and distance of the walls in plate/plate geometry of the shear cell have been used.

DY 26.9 Thu 12:30 H3

Parametric modulation of thermal and thermomagnetic convection in magnetic fluids — •Harald Engler and Stefan Odenbach — Lehrstuhl für Magnetofluiddynamik, Technische Universität Dresden, 01062 Dresden

Former theoretical investigations of the behaviour of thermal convection under the influence of a time modulated driving force have shown that the threshold where heat flux converts from diffusion to convective flow depends on the frequency of the driving force. However experimental setups to generate thermal convection with a time modulated driving force fails due to the immense technical problems. Recent research activities on heat and mass transfer phenomena in ferrofluids - superparametric suspensions of magnetic particles with an average diameter of 10 nm in appropriate carrier liquids - are focused on the influence of time modulated driving force on the critical temperature difference of thermomagnetic convection. The driving force in convection in ferrofluids, so called thermomagnetic convection, depends on temperature difference, geometric boundary and the additional magnetic force provided by an external magnetic field. A time modulated magnetic field that provides the required time dependent driving force with frequencies in the order of 1 Hz can easily be realized. The experimental setup designed for the investigation of thermomagnetic convection under the influence of time varying magnetic force as well as the first results will be presented.

DY 26.10 Thu 12:45 H3

Synthesis and magnetoviscosity of nanotube/nanorod ferrofluids — •Zhenyu Wu[1], Dörte Junk[2], Xiong Liu[3], Alexander Bittner[3], Christina Wege[4], and Carl Krill[1] — [1]Institute of Micro and Nanomaterials, Ulm University, D-89081 Ulm — [2]Technical Physics, University of the Saarland, D-66123 Saarbrücken — [3]Max Planck Institute for Solid State Research, D-70569 Stuttgart — [4]Institute of Molecular Biology and Virology of Plants, D-70550 Stuttgart

As colloidal suspensions of ferromagnetic nanoparticles in a carrier liquid, ferrofluids combine the magnetic properties of solids with the flow properties of liquids. Their viscosity increases dramatically in the presence of an externally applied magnetic field; however, this magnetoviscosity is lost when the ferrofluid is subjected to shear forces. One strategy to suppress such shear thinning is to replace the spherical nanoparticles of a conventional ferrofluid with nanotubes or nanorods. We report the synthesis of nanotube ferrofluids based on the metallization of the tobacco mosaic virus (TMV) with Co. The magnetoviscous properties of these samples were studied using a squeeze-flow viscometer at magnetic fields up to 150 mT and frequencies up to 400 Hz. The measured viscosity behavior is compared to that of conventional ferrofluids and to suspensions of Fe nanorods prepared by aerosol condensation.

DY 27: Quantum chaos III

Time: Thursday 11:15–12:45 Location: H2

DY 27.1 Thu 11:15 H2

Beitrag abgesagt — •XXX XXX —

DY 27.2 Thu 11:30 H2

Semiclassical studies of the influence of spin-orbit interaction on transport through ballistic chaotic quantum dots — Jens Bolte[1] and •Daniel Waltner[2] — [1]Institut für Theoretische Physik, Universität Ulm, Albert-Einstein-Allee 11, 89081 Ulm, Germany — [2]Institut für Theoretische Physik, Universität Regensburg, Universitätsstraße 31, 93040 Regensburg, Germany

The semiclassical justification of the results obtained by Random Matrix Theory for spectral statistics and transport is an important issue of current research in quantum chaos.

By using the Landauer approach and semiclassical methods, we investigate the influence of weak spin-orbit interaction on transport through classically chaotic billiards. By assuming the ergodicity of the combined phase-space dynamics, we are able to reproduce the complete result for the conductivity of the system from the circular symplectic ensemble of Random Matrix Theory and to explain weak localization and weak antilocalization.

DY 27.3 Thu 11:45 H2

Semiclassical theory of weak localization in regular billiards: the role of diffractive effects — •Iva Brezinova[1], Christoph Stampfer[2], Joachim Burgdörfer[1], Ludger Wirtz[3], and Stefan Rotter[1] — [1]Institute for Theoretical Physics, Vienna University of Technology, Wiedner Hauptstraße 8-10&136, A-1040 Vienna, Austria, EU — [2]Chair of Micro and Nanosystems, Swiss Federal*Institute of Technology Zurich (ETH Zurich), Tannenstr. 3, 8092 Zurich, Switzerland — [3]Institute for Electronics, Microelectronics and Nanotechnology, B.P. 60069, 59692 Villeneuve d*Ascq Cedex, France, EU

Weak localization is a quantum interference effect observed in quantum billiards: the conductance through the system is suppressed compared to the classical prediction. Application of a perpendicular magnetic field increases the conductance giving rise to a characteristic dip.

We present a semiclassical theory of weak localization applicable to both regular as well as chaotic quantum billiards. The theory includes pseudo-paths consisting of classical paths joined by diffractive scatterings at the entrance and exit of the billiard. These pseudo-paths connect the classically disjoint path sets of reflected and transmitted paths and thus improve the unitarity of the semiclassical theory. For regular systems we have succeeded in adding up all classical paths as well as the pseudo-paths up to a given length. We compare the semiclassical resistance and conductance with quantum results and find good agreement. We show for a regular system (circular billiard) that the characteristic dip of the conductance as a function of the magnetic field disappears if all non-classical paths are removed.

DY 27.4 Thu 12:00 H2

Breakdown of retracing in Andreev eigenstates — •Florian Libisch, Stefan Rotter, and Joachim Burgdörfer — Vienna University of Technology, Wiedner Hauptstraße 8-10, Vienna, Austria, EU

Modern manufacturing techniques of semiconductor devices allow the study of single electrons confined to two-dimensional cavities, with linear dimension of the order of a micrometer and below. Such devices are typically referred to as "quantum billiards". Replacing part of the hard wall of the billiard by a superconductor (S) gives rise to coherent scattering of an incoming electron into an outgoing hole. This process, generally known as Andreev reflection, connects the electron and hole degrees of freedom. Classically, the hole emitted by the S-boundary follows the time-reversed path of the electron. At its next contact with the superconductor the hole is converted back into an electron, thereby forming a periodic electron-hole orbit. As a consequence, a semiclassical model based on Andreev retroreflection predicts the electron- and hole eigenstates to mirror each other.

We explicitly calculate the quantum mechanical eigenstates of Andreev billiards, whose classical counterparts feature regular as well as chaotic dynamics. By comparing the wave functions for holes and electrons, the degree of quantum-classical correspondence of the dynamics can be probed. We find eigenstates whose electron and hole components feature qualitatively different patterns, marking the influence of purely quantum mechanical effects.

Supported by FWF Grant No. FWF-P17359.

DY 27.5 Thu 12:15 H2

Classical phase space revealed by coherent light — •Martina Hentschel[1] and Takahisa Harayama[2] — [1]MPIPKS Dresden, Nöthnitzer Str. 38, 01187 Dresden — [2]ATR Wave Engineering Laboratories, 2-2-2 Hikaridai, Kyoto 619-0228, Japan

We study the far field characteristics of oval-resonator laser diodes made of an AlGaAs/GaAs quantum well. The resonator shapes are various oval geometries, thereby probing chaotic, mixed, and integrable classical dynamics. The far field pattern of the lasing cavities shows a pronounced fine structure that strongly depends on the cavity shape. We compare the experimental data with ray-model simulations for a Fresnel billiard and find convincing agreement for all geometries. This allows us to trace back the origin of the far field characteristics fine structure and reveals the importance of the underlying classical phase space for the lasing characteristics.

DY 27.6 Thu 12:30 H2

Temporal flooding of regular islands by chaotic wave packets — Arnd Bäcker, •Lars Bittrich, and Roland Ketzmerick — Institut für Theoretische Physik, Technische Universität Dresden, 01062 Dresden, Germany

We investigate the time evolution of wave packets in systems with a mixed phase space where regular islands and chaotic motion coexist. If a wave packet is started in the chaotic sea, the weight on a quantized torus of the regular island increases with time until a saturation plateau is reached. This saturation value varies from torus to torus with a maximum value corresponding to a uniform distribution of the wave packet. The initial behaviour of this flooding process is quantitatively described by dynamical tunneling rates. The saturation value is obtained from a suitable random matrix model. The results are in good agreement with numerical data.

DY 28: Nonlinear stochastic systems

Time: Thursday 14:00–16:30 Location: H2

DY 28.1 Thu 14:00 H2

Polymer translocation through a nanopore - A twodimensional Langevin dynamics study — •Dirk Hennig, Simon Fugmann, and Lutz Schimansky-Geier — Institut für Physik, Humboldt Universität zu Berlin, Newtonstr. 15, 12489 Berlin

We study the process of translocation of a polymer through a nanopore using a two-dimensional Langevin dynamics simulation. Initially the whole chain is placed on one side of the nanopore in a certain distance to the entrance of the latter. Special attention is paid to the influence of the chain length on the time it takes till the first segment of the chain enters the nanopore as well as the translocation time. It is demonstrated that depending on the flexibility of the chain and the width and longitudinal extension of the nanopore several translocation scenarios arise. For narrow nanopores the chain can pass the nanopore only in a completely stretched configuration whereas if the width of the nanopore is beyond a critical value the chain is translocated even in folded shape. Thus in the last case any segment of the chain can be the one that enters first the nanopore in contrast to the former case for which necessarily an end segment of the chain enters first the nanopore and is consecutively followed by the remaining segments.

DY 28.2 Thu 14:15 H2

Self-organized critical control in human balance behaviour — •Markus Riegel, Christian Eurich, and Klaus Pawelzik — Institut für Theoretische Physik, Universität Bremen, Otto-Hahn Allee 1, D-28334 Bremen

Humans are known to exhibit power law distributed fluctuations in their behaviour e.g. when trying to stand still. Here we show, that power law distributed fluctuations generically arise in control of unstable dynamical systems driven with gaussian noise when an optimal controller can use observations only from the immediate past to estimate the parameters of the controlled subsystem. With increasing memory the exponent of the distributions grows and the auto-correlations of fluctuation amplitude decays faster. We tested the predictions of this self-organized critical control (SOCC) in a simple task where humans where required to stabilize an unstable target on a computer screen with the computer mouse. We found that also here the resulting dynamics are close to Levy-flights and exhibit power law distributed fluctuations. In stationary tasks the exponent of the distributions and the decay rates of auto-correlations increased with duration indicating that in this case the memory span utilized by humans expands. No such changes were seen in experiments where the systems parameters where constantly changed. Taken together our results indicate that the nervous system indeed employs self-organzed critical control and furthermore adapts its memory span depending on the stationarity of the task.

DY 28.3 Thu 14:30 H2

Generalized Markov approximations — •Detlef Holstein and Holger Kantz — Max-Planck-Institut fuer Physik komplexer Systeme, Dresden

In general arbitrary dynamics can be highly nonmarkovian, i.e. the future evolution of the dynamics can in principle depend on quite a lot of time points in the far past. For practical purposes it is often necessary to truncate a rather irrelevant part of the memory. Hence a criterion based on information theory and statistics is developed, which identifies the relevant memory terms. Consequences for prediction, especially wind speed prediction, are investigated.

DY 28.4 Thu 14:45 H2

Cooperative escape dynamics of an oscillator chain under microcanonical conditions — •Simon Fugmann, Dirk Hennig, and Lutz Schimansky-Geier — Institut fuer Physik, Humboldt Universitaet zu Berlin, Newtonstrasse 15, 12489 Berlin, Deutschland

We consider the self-organized escape of a chain of coupled oscillators from a metastable state over an energetic barrier. The underlying dynamics is conservative and deterministic. Supply of sufficient total energy or application of external forces brings the chain into the nonlinear regime from which an initially almost uniform lattice state becomes unstable and nonlinear redistribution leads to strong localization of energy. A spontaneously emerging critical localized mode grows to the unstable transition state and the chain, passing through the latter, performs a collective escape process over the barrier. It turns out that this nonlinear barrier crossing in a microcanonical situation is more efficient compared with a thermally activated chain for small ratios between the total energy of the chain and the barrier energy.

DY 28.5 Thu 15:00 H2

Stochastic Modeling of fast Hamiltonian Chaos — •Anja Riegert[1], Niluefer Baba[2], Wolfram Just[3], and Holger Kantz[1]

— [1]Max Planck Institute for the Physics of Complex Systems, Dresden, Germany — [2]TU München, Germany — [3]Queen Mary/University of London, United Kingdom

The study of the long time behavior of systems with time scale separation is considerably facilitated if the fast degrees of freedom can be eliminated without affecting the slow dynamics. By applying projection operator techniques we show that in chaotic Hamiltonian systems the fast subsystem can be replaced by a suitable stochastic process so that the slow motion is effectively described by a Fokker-Planck equation where the interplay of viscous damping and diffusion conserves the total energy and ensures the correct long time behavior. The accuracy and efficiency of this approach is verified by a numerical investigation of suitable model systems.

DY 28.6 Thu 15:15 H2

How to characterize chaotic time series distorted by interacting dynamical noise — •Achim Kittel[1], Tobias Letz[1], and Joachim Peinke[2] — [1]Energy and Semiconductor Research Laboratory, Institute of Physics, University of Oldenburg — [2]Hydrodynamics and wind energy, Institute of Physics, University of Oldenburg

Results of commonly used time series analysis methods on experimental and, therefore, noisy data become often questionable if the underlying deterministic part of the dynamics is a priori unknown and additionally chaos is involved. We apply a recently proposed method, based on the theory of Markovian processes, for extracting the deterministic dynamics from data distorted by dynamical noise. We treat the typical experimental situation where only one variable is measurable of a higher dimensional dynamics. Here we show that an improved estimation of power spectrum, attractor dimension, and Lyapunov exponents can be achieved for the hidden pure deterministic dynamics. In particular we study exemplarily two different systems, namely, the Roessler system distorted by noise and an experimental laser system supposed to behave in low dimensional nonlinear manner.

DY 28.7 Thu 15:30 H2

Supressing noise-induced intensity pulsations in semiconductor lasers by means of time-delayed feedback — •Valentin Flunkert and Eckehard Schöll — Institut für Theoretische Physik, Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin

We investigate the possibility to suppress noise-induced intensity pulsations (relaxation oscillations) in semiconductor lasers by means of the Pyragas control scheme. This idea is first studied in a generic normal form model, where we find an analytic expression for the mean square radius of the oscilltions. We also investigate the control scheme numerically in a model of Lang-Kobayashi type.

DY 28.8 Thu 15:45 H2

Analysis of Nonstationary Stochastic Processes with Application to the Fluctuations in the Oil Price — •Fatemeh Ghasemi[1], Mohammad Reza Rahimi Tabar[2,3], Muhammad Sahimi[4], Joachim Peinke[5], and Rudolf Friedrich[6] — [1]The Max Planck Institute for the Physics of Complex Systems, Nöthnitzer Strasse 38, 01187 Dresden, Germany — [2]Dep. of Physics, Sharif University of Technology, P.O. Box 11365-9161, Tehran 11365, Iran — [3]CNRS UMR 6529, Observatoire de la Côte d'Azur, BP 4229, 06304 Nice Cedex 4, France — [4]Mork Family Department of Chemical Engineering & Materials Science, University of Southern California, Los Angeles,CA 90089-1211 — [5]Carl von Ossietzky University, Institute of Physics, D-26111 Oldenburg, Germany — [6]Institute for Theoretical Physics, University of Münster, D-48149 Münster, Germany

We describe a method for analyzing a nonstationary stochastic process, and utilize it to study the fluctuations in the oil price. Evidence is presented that the fluctuations in the returns constitute a Markov process, characterized by a Markov time scale t_M. We compute the coefficients of the Kramers-Moyal expansion for the probability distribution function, and show that $P(y,t|,y_0,t_0)$ satisfies a Fokker-Planck equation, which is equivalent to a Langevin equation for $y(t)$. The Langevin equation provides quantitative predictions for the oil price over Markov time scale t_M. The method described is applicable to a wide variety of nonstationary stochastic processes.

DY 28.9 Thu 16:00 H2

Theoretical description of the statistics of ventricular beat intervals during atrial fibrillation — •Thomas Hennig and Philipp Maass — Institut für Physik, Technische Universität Ilmenau, 98684 Ilmenau, Germany

Atrial fibrillation (AF) is the most common arrhythmia of the heart. It is characterised by rapid electrical excitations in the atria with a mean fibrillation rate (AF rate) of 3-12 Hz and an irregular relation with respect to the excitations in the ventricles. Recent studies showed that the AF rate is an important parameter for estimating the risk of a transition from paroxysmal to chronical AF and for predicting the probability of a conversion to sinus rhythm by pharmaceutical treatment. In this work it is our goal to determine the AF rate from the statistics of ventricular beat intervals taken from the surface electrocardiogram (ECG) based on a model [1] for the transduction of impulses through the atrio-ventricular node. The model can be rewritten in terms of a first passage time problem for a random walk with moving boundary, which is solved analytically by applying the Wiener-Hopf technique. It successfully reproduces specific characteristics found in the statistics of ventricular beat intervals during AF [2]. Tests with clinical data yield good agreement with the theoretical predictions.

[1] P. Jørgensen, C. Schäfer, P. G. Guerra, M. Talajic, S. Nattel, L. Glass, Bull. Math. Bio. **64** 1083 (2002).

[2] Th. Hennig, P. Maass, J. Biol. Phys., in press; cond-mat/0605295.

DY 28.10 Thu 16:15 H2

Detrended Fluctuation Analysis in Stochastic Global Optimization — •Kay Hamacher — Max-Planck-Institut fuer Physik komplexer Systeme, Dresden

Global optimization (GO) is one of the key numerical tools in computational physics. Among the GO algorithms the ones originating in statistical physics (e.g. Monte Carlo) are particular powerful. We show how an approach to time series analysis (detrended fluctuation analysis) can be leveraged to analyze the dynamics of GO algorithms. The emergence of random walks indicates suboptimal, diffusive behavior. This can be dealt with by adaptive schemes for general GO procedures, such as stochastic tunneling [1,2] and energy landscape paving [3].

[1] K. Hamacher. Adaptation in Stochastic Tunneling Global Optimization of Complex Potential Energy Landscapes, Europhys.Lett. **74** 944, 2006

[2] W. Wenzel and K. Hamacher. A Stochastic tunneling approach for global minimization. Phys. Rev. Lett. **82** 3003, 1999

[3] K. Hamacher. Energy Landscape Paving As A Perfect Optimization Approach Under Detrended Fluctuation Analysis, Physica A 2007, *in press*

DY 29: Soft matter

Time: Thursday 14:00–15:45 Location: H3

DY 29.1 Thu 14:00 H3

Polymers and star polymers in correlated environments — Viktoria Blavatska[1,2], •Christian von Ferber[3,4], and Yurij Holovatch[2,5] — [1]Institute for Condensed Matter Physics, National Academy of Sciences Ukraine, Lviv — [2]Institut für Theoretische Physik, Universität Leipzig — [3]Applied Mathematics Research Centre, Coventry University, UK — [4]Theoretische Polymerphysik, Universität Freiburg — [5]Institut für Theoretische Physik, Johannes Kepler Universität Linz, Österreich

We show that correlated environments have significant and quantitatively measurable impacts on the scaling properties of polymers and branched polymer structures such as star polymers. These result in experimentally accessible effects on their osmotic behavior in differently correlated environments. We calculate these quantitative effects by appropriately extending a field theoretic renormalization group approach for spin models in long range correlated disorder [Weinrib and Halperin, Phys Rev B (1983)]. We find new universal scaling exponents for linear and star polymers in such environments with consequences for their entropic behaviour as well as for the effective interactions be-

tween these polymers. Surprisingly, these effects have opposite signs for linear and star polymers. We predict quantitatively measurable segregation effects at the interface between correlated and uncorrelated environments, e.g. introduced by an aerogel-structure immersed in a solution of a mixture of linear and star polymers.
Yu.H. was supported by FWF (Austria), Project P16574.
V Blavats'ka, C v Ferber, Yu Holovatch, Phys Rev E, 74 031801 (2006)

DY 29.2 Thu 14:15 H3

Elasticity of randomly cross-linked particles — •Stephan Ulrich[1], Annette Zippelius[1], Xiaoming Mao[2], and Paul Goldbart[2] — [1]Institut für Theoretische Physik, Georg-August-Univeristät Göttingen — [2]Department of Physics, University of Illinois at Urbana-Champaign, USA

Starting from a microscopic model of randomly cross-linked particles with quenched disorder, we calculate the Landau-Wilson free energy $\mathcal{S}$ for arbitrary cross-link densities. Considering pure shear deformations, $\mathcal{S}$ takes the form of the elastic energy of an isotropic amorphous solid state, from which the shear modulus can be identified. It is found to be an universal quantity, not depending on any microscopic length-scales of the model.

DY 29.3 Thu 14:30 H3

Collective Monte Carlo updating for off-lattice systems — •Markus Bellion[1], Werner Krauth[2], Heiko Rieger[1], and Ludger Santen[1] — [1]Saarland University, Theoretical Physics, D-66041 Saarbrücken, Germany — [2]CNRS-Laboratoire de Physique Statistique, Ecole Normale Supérieure 24, rue Lhomond, F-75231 Paris Cedex 05, France

The introduction of Cluster Monte Carlo algorithms led to much larger computational efficiency compared to (conventional) local Monte Carlo schemes. For example, by using cluster algorithms it was possible to reduce critical slowing down or even to avoid this problem. Unfortunately, up to now most such cluster algorithms have been designed for classical and quantum mechanical models that are defined on a lattice. In fact, currently there is only one known cluster algorithm for off-lattice models which is based on the exchange of clusters generated by overlaying a rotated particle configuration with the original (non-rotated) configuration [1,2]. Although this algorithm has been successfully applied to a number of models (phase separation in fluid mixtures, stabilisation of colloidal suspensions by nanoparticles, polydisperse systems), it works rather inefficiently for higher densities. Here we present an alternative approach, which iterates a translational move in order to generate particle clusters. The main advantage of this approach is that the distribution of cluster sizes can be tuned by varying the step width of the elementary move.
[1] C. Dress and W. Krauth, J. Phys. A 28, 597 (1995).
[2] J. Lui and E. Luijten, PRL 92, 035504 (2004).

DY 29.4 Thu 14:45 H3

Structure of the inhomogeneous hard-spherocylinder fluid from an improved density functional theory — •Hendrik Hansen-Goos[1,2] and Klaus Mecke[3] — [1]Max-Planck-Institut für Metallforschung, Heisenbergstr. 3, 70569 Stuttgart — [2]ITAP, Universität Stuttgart, Pfaffenwaldring 57, 70569 Stuttgart — [3]ITP, Universität Erlangen-Nürnberg, Staudtstr. 7, 91058 Erlangen

The performance of a new density functional theory (DFT) for fluids of nonspherical hard particles is tested in a study of structural properties of the inhomogeneous hard-spherocylinder fluid. The new DFT results from an extension of Rosenfeld's fundamental measure theory (FMT) [1] which is based on a deconvolution of the Mayer-f-function into weight functions encoding the geometry of the constituents. While in the case of hard-sphere mixtures an exact deconvolution is feasible, for nonspherical particles it holds only as an approximation. Using a result from differential geometry it is possible to improve the approximate deconvolution compared to the one of Rosenfeld. The performance of the resulting DFT is shown to improve w.r.t. the original FMT by comparing with results from Monte-Carlo simulations of the inhomogeneous hard-spherocylinder fluid. The connection of the new FMT with the version of Tarazona [2] is established. Tarazona's modification in order to avoid spurious divergencies for the hard-sphere crystal can be understood as a stabilization of the theory against deviations from sphericity.

[1] Y. Rosenfeld, Phys. Rev. Lett. **63**, 980 (1989); [2] P. Tarazona, Phys. Rev. Lett. **84**, 694 (2000).

DY 29.5 Thu 15:00 H3

Influence of long-range correlated surface and near the surface disorder on the process of adsorption of long-flexible polymer chains — •Zoryana Ustenko[1,2] and Jens-Uwe Sommer[1,3] — [1]Leibniz-Institute of Polymer Research Dresden ,01069 Dresden, Germany — [2]Institute for Condensed Matter Physics, NASU, 79011 Lviv, Ukraine — [3]Institute for Theoretical Physics, Technische Universitat Dresden, 01062 Dresden, Germany

The influence of long-range correlated surface and decaying near surface disorder with correlation function for the defects of the form $\frac{e^{-z/\xi}}{r^a}$, where $a < d-1$ and z being the coordinate in the direction perpendicular to the surface and r denotes the distance parallel to the surface. We investigate the process of adsorption of long-flexible polymer chains with excluded volume interactions on a "marginal"and attractive wall in the framework of renormalization group field theoretical approach up to first order of perturbation theory in a double(ϵ,δ)- expansion ($\epsilon = 4-d$,$\delta = 3-a$) for the semi-infinite $|\phi|^4$ $O(m,n)$ model with the above mentioned type of surface and near the surface disorder in the limit $m,n \to 0$. We obtained series for bulk and the whole set of surface critical exponents, characterizing the process of adsorption of long-flexible polymer chains at the surface. The polymer linear dimensions parallel and perpendicular to the surface and the behavior of monomer density profiles and the fraction of adsorbed monomers at the surface and in the interior are studied.

DY 29.6 Thu 15:15 H3

Quantifying Cation Transport in Polymer Electrolytes in Terms of Microscopic Properties — •Arijit Maitra[1,2] and Andreas Heuer[1] — [1]Institute of Physical Chemistry, University of Muenster, Germany 48149 — [2]NRW Graduate School of Chemistry, Muenster, Germany 48149

We present an analytical approach to relate the *macroscopic* cation dynamics in polymer electrolytes via three principal time scales which characterize the *local* modes of cation transport. These are: polymer/segmental relaxation, the motion of the cation along the chain and cation jump events between different chains. With the knowledge that cationic motion is coupled to the segmental dynamics of polymers and applying the concept of renewal process (from dynamic bond percolation model) we are able to express the cation diffusion constant in terms of these three time scales. For the description of polymer dynamics, depending on chain length, we invoke the Rouse model and the Reptation model. Our theory is complemented by all-atom molecular dynamics simulation of a model system comprising of poly(ethylene oxide) and lithium tetrafluoroborate. Apart from furnishing a complete picture (both quantitative and qualitative) of the variety of cation transport mechanisms through the combination of theory and simulation, we are able to explain the chain length (N) dependence of lithium diffusivity (D) over a large range of N. This is supported by experimental data. Specifically, we find that the plateau regime of D(N) for large N does not require the presence of polymer entanglements, as has been speculated in the literature.

DY 29.7 Thu 15:30 H3

Magnetische Eigenschaften und magnetoelastisches Verhalten eines $CoFe_2O_4$-basierten Ferrogels im homogenen Magnetfeld — •Stefan Monz, Andreas Tschöpe und Rainer Birringer — Universität des Saarlandes, F.R. 7.3 Technische Physik, Geb. D 2.2, D-66123 Saarbrücken

Aus einem $CoFe_2O_4$-basierten Ferrofluid wurde durch chemische Vernetzung von gelöstem Polyvinylalkohol und Glutardialdehyd ein Ferrogel hergestellt. Die magnetfeldsensitiven viskoelastischen Eigenschaften der so erhaltenen Körper einerseits und der Einfluss der Matrix auf die magnetischen Eigenschaften andererseits wurden untersucht. Durch das Anlegen eines homogenen Magnetfeldes während der Vernetzung besteht die Möglichkeit, die makroskopische Gelprobe magnetisch zu texturieren. Des Weiteren wurde gezeigt, dass sich ein solches Ferrogel auf Grund dieser magnetischen Textur und seiner besonderen elastischen Eigenschaften im homogenen Feld deformiert; je nach den gewählten Randbedingungen kommt es zu einer Rotation oder zu einer Torsion des Ferrogels. Zusätzlich wird ein einfaches Modell vorgestellt, mit dessen Hilfe man mittels magnetischer Messungen Zugang zu den elastischen Eigenschaften der weichen Matrix erhält.

DY 30: Poster II

Time: Thursday 16:00–18:00 Location: Poster D

DY 30.1 Thu 16:00 Poster D

Giant Diffusion in many particle systems — •Olga Zvyagolskaya[1], Stefan Bleil[1], Peter Reimann[2], and Clemens Bechinger[1] — [1]2. Physikalisches Institut, Universität Stuttgart, Germany — [2]Fakultät für Physik, Universität Bielefeld, Germany

The diffusion coefficient of a single particle in thermal equilibrium is reduced by the presence of an external (periodic) potential. When an additional constant driving force f is applied, the diffusion coefficient has been predicted to be largely enhanced and displays a maximum as a function vs. f. We have experimentally investigated this so-called giant diffusion by exposing a colloidal particle to a tilted periodic potential being created by means of optical tweezers. When measuring the diffusion coefficient with video microscopy we find good agreement with theoretical predictions. In addition to single particles, we also investigated the situation where many particles with repulsive interactions are present. We observe a strong enhancement of the diffusion coefficient as a function of the particle interaction strength for constant potential depth and driving force. In addition we observe the diffusion coefficient to depend on the ratio of particles and potential minima in the system.

P. Reimann, C. Van den Broeck, H. Linke, P. Hänggi, J.M. Rubi, and A. Pérez-Madrid; PRL 87, 010602 (2006)

DY 30.2 Thu 16:00 Poster D

Extending the Boltzmann equation to non-equilibrium: A novel method to determine external potentials. — •Valentin Blickle[1], Thomas Speck[2], Udo Seifert[2], and Clemens Bechinger[1] — [1]2. Physikalisches Institut, Universität Stuttgart — [2]II. Institut für Theoretische Physik, Universität Stuttgart

In tilted potentials the motion of a colloidal particle is an interplay between thermal diffusion and drift. Due to this superimposed motion the diffusion coefficient and the average particle velocity become non trivial functions of the driving force f. In our experiment we drive a colloidal particle along a toroidal three-dimensional laser trap using scanning optical laser tweezers. We use an electrooptical modulator to additionally impose a static laser potential V along the torus. To characterize the laser potential we introduce a novel method, based on a steady state non-equilibrium measurement. The method uses a modified Boltzmann equation which additionally considers the stationary current. We show that this method is independent of the driving force f und thus allows to determine the static potential V. Being not restricted to equilibrium fluctuations we can characterize potential depths up to several 100 k_BT.

DY 30.3 Thu 16:00 Poster D

Quantum Monte Carlo Investigation of Quantum Phase Transitions of Mixed Heisenberg Spin Chains — •Rainer Bischof[1], Peter Crompton[2], and Wolfhard Janke[1] — [1]Institut für Theoretische Physik, Universität Leipzig, Germany — [2]Center for Theoretical Physics, Massachusetts Institute of Technology, USA

By means of quantum Monte Carlo simulations at low temperatures, the quantum phase transitions in antiferromagnetic Heisenberg spin chains consisting of two different kinds of spin, S_a and S_b, that appear alternatingly in pairs, are investigated for the cases $S_\mathrm{a} = 1/2$ and $S_\mathrm{b} = 1$, $S_\mathrm{a} = 1/2$ and $S_\mathrm{b} = 3/2$ as well as $S_\mathrm{a} = 1$ and $S_\mathrm{b} = 3/2$. Transitions between qualitatively different ground states (quantum phases) are induced by varying the parameter α which is the relative coupling between unlike and like spins. In particular, the so-called twist order parameter as well as spatial and imaginary temporal correlation lengths are measured and analysed. Critical values of α, critical exponents and leading correction terms are extracted by finite-size scaling analysis.

DY 30.4 Thu 16:00 Poster D

Pore scale model for carbonate rocks — •Bibudhananda Biswal[1], Paul-Eric Oren[2], Rudolf Held[3], Stig Bakke[2], and Rudolf Hilfer[1] — [1]ICP, Universitaet Stuttgart, Pfaffenwaldring 27, 70569 Stuttgart, Germany — [2]Numerical Rocks AS, N-7041 Trondheim, Norway — [3]Statoil ASA, N-7005 Trondheim, Norway

A stochastic geometrical model for the diagenesis of carbonate rocks is proposed. It incorporates many crucial features of real carbonates: correlations with the primordial depositional textures, scale dependent intergranular porosity over many decades, vuggy porosity, a percolating pore space, a fully connected matrix space, strong dependence on the process of discretization and wide variability in the permeabilities etc. The continuum representation allows discretization of the microstructure at arbitrary resolutions. Pore scale geometries of two generic carbonate textures are successfully reconstructed using this model. Petrophysical parameters are measured on the discretized samples and compared with real samples. The model can be easily adapted to reconstruct the pore scale of a wide variety of carbonate rocks.

DY 30.5 Thu 16:00 Poster D

Voter model on lattices with a single antiferromagnetic bond — •Konstantin Klemm[1] and Takuya Yamano[2] — [1]Bioinformatics, Leipzig University, Haertelstr. 16-18, D-04107 Leipzig, Germany — [2]International Christian University, Social Science Research Institute, 3-10-2, Osawa, Mitaka-shi, Tokyo, 181-8585, Japan

Among the simplest types of spin kinetics is the voter model: In each update a pair (i, j) of neighboring sites is chosen and site i adopts the state of site j. Here we consider a version of the model where one of the lattice bonds is antiferromagetic and thus transmits the reverse spin state. Due to the lack of absorbing configurations the dynamics is vastly different from the original model. The density of interfaces shows a bimodal distribution, i.e. the system spends most of the time in strongly ordered and strongly disordered configurations while the time for switching between the two situations is short. The time-averaged density of interfaces decays algebraically with distance from the lattice defect, with an exponent $\approx 1/3$ in dimension $d = 2$. These numerical observations are in sharp contrast to the results for the Ising model on the same kind of perturbed lattice.

DY 30.6 Thu 16:00 Poster D

Colloidal Crystals in 2D: elasticity, structures and phase transitions — •Kerstin Franzrahe and Peter Nielaba — Department of Physics, University of Konstanz, 78457 Konstanz, Germany

Thin films on a substrate can be modelled by two dimensional colloidal systems. The influence of the substrate can be varied by adjusting e.g. the amplitude of an additional external laser field. We investigate the elastic and structural properties of such systems via Monte-Carlo simulations. Our model system consists of particles interacting via a hard-disk potential. For the field free case the influence of quenched impurities on the elastic properties of a mono-disperse system [1] is examined, while in the study of bi-disperse systems our focus is on the stability of crystalline structures for various size and mixing ratios. Modelling the effect of the substrate on the two dimensional crystal, we study the influence of a commensurable, spatially periodic, external laser field on a bi-disperse $S_1(AB)$ crystal. We observe laser induced freezing (LIF).

The fluctuations of the microscopic strains in a solid contain information on the elastic properties of the system. Generalising the approach by S. Sengupta et.al.[2], we analyse the strain correlation functions of a harmonic two dimensional system. The analysis shows that these correlations are highly anisotropic in the solid.

[1] K. Franzrahe et. al., Comp. Phys. Commun. **169**,pp 197-202 (2005)
[2] S. Sengupta, P. Nielaba, M. Rao and K. Binder,Phys. Rev. E **61**, pp. 1072 (2000)

DY 30.7 Thu 16:00 Poster D

An information distance and classical no-cloning theorem — •Takuya Yamano — International Christian University, SSRI, 3-10-2 Osawa, Mitaka-shi, Tokyo 181-8585, Japan

The conservation of the Kullback-Leibler (KL) information measure under the Liouville dynamics provides a classical counterpart of a quantum impossible process, i.e. the no-cloning theorem. We present the degree of the conflict in the distances of initial and final states in the copying process which is comprised of a tripartite (source, machine, and target) system whose probablity functions are factorized. We use a generalized KL measure obtained by operating the Jackson's symmetric q-derivative to a parametrized *overlap*. Some metrics (KL, Fubini-Study, and Wooters) on the Hilbert space provide equivalent values to the Euclidean one for two infinitesimally displaced states up to the second order in the shift. By investigating the metrics up to

higher oder, we study the difference among these metrics and intend to get insights into the theorem.

DY 30.8 Thu 16:00 Poster D

Implications of mean field and non-mean field effects for a system of interacting particles — •Radha Banhatti, Klaus Funke, and Andreas Heuer — Universität Münster, Institut für Physikalische Chemie und SFB 458, Corrensstrasse 30, D-48149 Münster

Recently, a simple harmonic model (SHM) was formulated for an equilibrated system of mutually interacting N +1 particles to study the relaxation following the jump of a central particle at time t=0 [M. Kunow and A. Heuer, J. Chem. Phys. 119, 2338 (2003)]. The relaxation of the central particle (single-particle route) and that of the other N particles (multi-particle route) were cast in the form of rate equations. The SHM formalism was an attempt to enquire into the general validity of the rate equations formulated within jump relaxation models to understand the frequency-dependent conductivity in different classes of disordered materials including ionic crystals, conductors, inorganic glasses and ionic liquids. Using the formalism of the SHM, we show that it is possible to explicitly examine the effect of mean field (collective response) and non-mean field (distance-dependent response) nature of the neighborhood interactions with the central particle. The change in the shape of the trajectory of the central particle (the single-particle route) yields, for example, a direct correlation to the abrupt change of shape of the ion-conductivity spectra of a supercooled melt, calcium potassium nitrate of composition $0.4Ca(NO_3)_2 \cdot 0.6KNO_3$, around T = 375 K [K.Funke and R. D. Banhatti, Solid State Ionics, 177, 1551 (2006)]. A coherent description for the ion conduction in this regime is discussed.

DY 30.9 Thu 16:00 Poster D

Anomalous transport in disordered iterated maps — •Andreas Fichtner and Günter Radons — D-09107 Chemnitz, Germany

Anomalous transport is not only a phenomenon of systems with stochastic environmental forces. Also random walks in random environments can show such a behaviour. Sinai diffusion [1] characterises a class of random walks for which the so called Golosov phenomenon [2] was proven rigorously. We extend the Sinai model to random walks whose transitions are not restricted to nearest-neighbours. Thereby a vanishing global bias is guaranteed by a generalisation of binary disorder. [3,4]

For Sinai disorder exact results exist for the disorder averaged mean square displacement, the density of states of the propagator, and the size-dependence of the escape rate, or, the mean first passage time, respectively. For each of these quantities a characteristic exponent can be definded. We could show numerically that the characteristic exponents also exist for our extended model. At least for relatively small systems the characteristic exponents show a non-trivial dependence on system size and coincide. Perturbation theory, which is exact in the Sinai case, enables us to calculate escape rates for significantly larger systems. For our model we find as function of system size a transition from a large preasymptotic regime to the asymptotic behaviour.

[1] Ya.G.Sinai, Theor. Prob. Appl. 27 (1982) 247.
[2] A.Golosov, Commun. Math. Phys. 92 (1984) 491.
[3] A.Fichtner and G.Radons, New J. Phys. 7 (2005) 30.
[4] G.Radons, Physica D 187 (2004) 3.

DY 30.10 Thu 16:00 Poster D

Surface diffusion in potential landscapes — •Stephan Zschiegner[1,2], Stefanie Russ[3], Armin Bunde[1], Jörg Kärger[2], and Rustem Valiullin[2] — [1]Theoretische Physik III, JLU Giessen — [2]Experimentelle Physik, Universität Leipzig — [3]Theoretische Physik, FU Berlin

We study 2D surface diffusion with different types of potential landscapes. As test potentials we use Gaussian and power-law distributions with or without correlations. For these model surfaces we investigate diffusion properties that are the basis of understanding the inverse problem: Getting potential lanscapes from surface diffusion measurements. For this purpose, we determine a possible basis of potentials and their diffusion properties for a direct transformation from the experimental results to the underlying potential within the pore.

DY 30.11 Thu 16:00 Poster D

Nonlinear integral equations for the thermodynamics of the Uimin-Sutherland model — •Jens Damerau and Andreas Kluemper — Fachbereich C – Physik, Bergische Universität Wuppertal, 42097 Wuppertal, Germany

We investigate the thermodynamical properties of integrable one-dimensional spin-chains of Uimin-Sutherland type. This class includes several interesting models like the spin-1/2 Heisenberg model, the $t-J$ model, the $SU(4)$-symmetric spin-orbital model and certain spin-ladder systems. We derive well-posed finite sets of nonlinear integral equations (NLIE) which allow for the numerical evaluation at arbitrary finite temperature. Analytical solutions are possible in the high- and low-temperature limits. In the low-temperature regime, we find divergences of the magnetic susceptibilities at critical fields and logarithmic singularities for zero magnetic field. In comparison to other recently derived NLIE, the evaluation at low temperature poses no problem in our formulation.

DY 30.12 Thu 16:00 Poster D

The target decay on irregular networks — •mircea galiceanu and alexander blumen — Theoretische Polymerphysik, Universität Freiburg, Hermann-Herder-Straße 3, D-79104 Freiburg, Germany

We investigate the survival probability of immobile targets, which get annihilated by random walkers at first encounter. As irregular lattices we focus on scale free networks [1] and on small world networks [1], [2]. For scale free networks we consider two kinds of degree distributions (number of nearest neighbors) with long time-tails. In the first case we start the degree distribution from degree 1, while in the second case from degree 2. It turns out that the survival probability and the quality of its description through the average number of distinct sites visited, S_n, depend on the details of the degree distribution: networks which are more ramified (the first situation) have survival probabilities which are more regular, whereas the scale free networks with long chain-like segments (the second case) display decay laws similar to those of small world networks, where a description only in terms of S_n is rather poor.

[1] Galiceanu M and Blumen A, *J. Phys. A*, in press
[2] Jasch F and Blumen A *J. Chem. Phys.* **117**, 2474, (2002)

DY 30.13 Thu 16:00 Poster D

Evolution of Canalizing Boolean Networks — •Agnes Szejka and Barbara Drossel — Institut für Festkörperphysik, Technische Universität Darmstadt, Deutschland

Canalizing Boolean networks are used to model gene regulatory networks. To get insight into how evolutionary forces may shape such structures, we simulate the evolution of a canalizing Boolean network by means of an adaptive walk. The mutations considered concern the functions and the connections of the nodes. The fitness criterion is robustness against small perturbations. As the adaptive walk leads to a local maximum in the fitness landscape it can deliver insight into the fitness landscape of a system. We find that all networks always reach maximum fitness and that there is a huge neutral plateau at this value that allows for further evolution. The evolved networks, although robust, show many properties characteristic for chaotic networks.

DY 30.14 Thu 16:00 Poster D

Multicomponent reaction-diffusion processes on complex networks — •Sebastian Weber and Markus Porto — Institut für Festkörperphysik, Technische Universität Darmstadt, Hochschulstr. 8, 64289 Darmstadt, Germany

We study the reaction-diffusion process $A + B \to \emptyset$ on uncorrelated scale-free networks analytically [1]. By a mean-field ansatz we derive analytical expressions for the particle pair-correlations and the particle density. Expressing the time evolution of the particle density in terms of the instantaneous particle pair-correlations, we determine analytically the 'jamming' effect which arises in the case of multicomponent, pair-wise reactions. Comparing the relevant terms within the differential equation for the particle density, we find that the 'jamming' effect diminishes in the long-time, low-density limit. This even holds true for the hubs of the network, despite that the hubs dynamically attract the particles.

[1] S. Weber and M. Porto, Phys. Rev. E **74**, 046108 (2006).

DY 30.15 Thu 16:00 Poster D

Random Boolean Networks with noise — •Christoph Fretter and Barbara Drossel — Institut für Festkörperphysik, Technische Universität Darmstadt, Deutschland

Boolean networks are used as a model for gene regulation networks, where stochastic fluctuations are ubiquitous due to small molecule concentrations. We investigate the influence of stochastic noise on the dynamics of Boolean networks. Noise is implemented in terms of a "temperature", i.e., a probability that a node is assigned a random

state instead of following the deterministic update rule. We measure the robustness of the network dynamics against noise by evaluating the probability of returning to the same attractor after the noise has acted for a finite time. The parameters to be varied are the noise strength, the network size and network topology, and the set of update functions used. We show that under weak noise even simple networks display nontrivial behaviour. We use the theory of relevant components to extrapolate the results to large networks. The methods used are numerical simulations as well as analytical calculations.

DY 30.16 Thu 16:00 Poster D

Ising model on hierarchical scale-free networks — •Sebastian Komosa and Janusz Hołyst — Faculty of Physics and Center of Excellence for Complex Systems Research, Warsaw University of Technology, Koszykowa 75, 00-662 Warsaw, Poland

We studied behavior of a Ising spin model on different hierarchical scale-free networks using Monte Carlo simulations. We observed a phase transition from ferromagnetism to paramagnetism and a power-law behavior of critical temperature with network size. Two different order parameters were used: a standard average network spin and a weighted average network spin. The critical temperature is a power-law function of the ratio $\langle k^2\rangle/\langle k\rangle$.

DY 30.17 Thu 16:00 Poster D

Topographical Stability of Self-Organizing Neural Maps: The case of nonlinear Concave/Convex learning — Fabien Molle[1,2] and •Jens Christian Claussen[2] — [1]Theoretical Physics, Göteborg Universitetet, Sweden — [2]Theoretical Physics, Univ. Kiel, Germany

The apparant self-organizing dynamics of biological topographic feature maps has, apart from the biological modeling, provided various methods of Neural Vector Quantizers as Kohonen's Self-Organizing Map and Martinetz' Neural Gas. The invariant density of the attractor states has been studied extensively the last two decades. In most cases the neural output density adapts the input data density by a power law, which in many cases can be calculated analytically, and even be influenced systematically by modifications in the learning rule [1,2]. Here, we consider a nonlinear learning rule investigated in [2], which is capable to generate information-theoretically optimal maps at least in the 1D case [2]. However, much less is known for the learning dynamics. We introduce a simple crossproduct based stability measure to detect topological defects of the representation when the learning rate is increased [3]. The stability border shows a similar shape for all considered cases, but with different maximal learning rate. The exploration of these stability properties is relevant for applications of neural vector quantizers.

[1] J.C.Claussen, Complexity 8(4),15(2003); Neural Computation 17,996(2005), Claussen & T.Villmann, Neurocomputing 63,124(2005)
[2] T. Villmann & J.C.Claussen, Neural Computation 18, 446 (2006)
[3] F. Molle & J.C. Claussen, Lect. Notes Comp. Sci. 4131, 208 (2006)

DY 30.18 Thu 16:00 Poster D

Resilience of public transport networks against attacks — •Christian von Ferber[1,2], Taras Holovatch[3], Yurij Holovatch[4,5], and Vasyl Palchykov[4] — [1]Applied Mathematics Research Centre, Coventry University, UK — [2]Theoretische Polymerphysik, Universität Freiburg — [3]Ivan Franko University of Lviv, Ukraine — [4]Institute for Condensed Matter Physics, National Academy of Sciences Ukraine, Lviv — [5]Institut für Theoretische Physik, Universität Linz, Österreich

In a recent study of metropolis public transport networks (PTN) we show that these - like many other complex networks - may exhibit scale free behavior [physics/0608125]. In particular, the number of neighboring stations k of a given station is often found to be distributed as $P(k) \sim k^{-\lambda}$, For ideal scale free networks the exponent λ determines the percolation properties, i.e. if $\lambda < 3$ no percolation threshold exists and a giant connected component persists no matter how many nodes are removed. Here, we analyse a number of PTNs of metropolitan areas and extract correlations between the resilience threshold against targeted attacks and their architecture as measured by network characteristics that we find to vary considerably among cities. We develop and simulate an evolutionary model of PTNs that reproduces their key features.

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DY 30.19 Thu 16:00 Poster D

Topological self-organization and critical dynamics of input-driven threshold networks — •Thimo Rohlf — Santa Fe Institute, 1399 Hyde Park Road, Santa Fe, NM 87501, USA

Based on a simple model of network self-organization by local rewiring rules [1], we study topological evolution of input-driven neural threshold networks. In addition to the original system, a subset of network nodes is driven by external input signals with a spiking rate ρ_{in}, that serves as a convenient new control parameter. Depending on $\rho_{in} > 0$, we find a much faster convergence towards topological and dynamical criticality [2] than in the original model (which has $\rho_{in} = 0$).

In particular, our extensive numerical simulations indicate that, at a critical driving rate $\rho_{in}^c(N)$, networks become self-organized critical even for finite numbers N of nodes. Several dynamical order parameters exhibit pronounced power-law scaling, long-range correlations and $1/f$ noise (including, e.g., the distribution of asymptotic Hamming distances of initially nearby system states).

Finally, we discuss possible applications of this model to problems in two fields: control of neural activity in the brain, and the evolution of signal processing by gene regulatory networks in biological cells.

[1] S. Bornholdt and T. Rohlf, *Phys. Rev. Lett.* **84**, 6114 (2000)
[2] T. Rohlf and S. Bornholdt, *Physica A* **310**, 245-259 (2002)

DY 30.20 Thu 16:00 Poster D

Microcanonical Analysis of Polymer Aggregation — •Christoph Junghans, Michael Bachmann, and Wolfhard Janke — Institut für Theoretische Physik, Universität Leipzig

We propose the use of microcanonical analyses for heteropolymer aggregation transitions [1,2]. Performing multicanonical Monte Carlo simulations of a simple hydrophobic-polar continuum model for interacting heteropolymers of finite length, we find a first-order-like behavior in the transition region between the phases of fragmented and aggregated configurations.

[1] C. Junghans, Diploma Thesis, Universität Leipzig (2006).
[2] C. Junghans, M. Bachmann, and W. Janke, Phys. Rev. Lett. **97**, 218103 (2006).

DY 30.21 Thu 16:00 Poster D

Self-driven particle and dynamic disorder — •Holger Grzeschik and Ludger Santen — Saarland University, Theoretical Physics, D-66041 Saarbrücken, Germany

We theoretically investigate self-driven particles, moving on an one dimensional lattice or track. The track is embedded in a cylinder, where the particles move diffusively. The self-driven particles can attach to and detach from the track such that the path length of the particles on the track is finite. At a given point in time the attach rates of the self-driven particles can be reduced due to the presence of a second type of particle, which is unable to perform a directed motion on the filament. This model is motivated by axonal transport, if one relates the self-driven particles to motor-proteins and the immobile particles to tau-proteins. For axons it is known that an excess of tau-proteins may cause a dysfunction of the neuron.

DY 30.22 Thu 16:00 Poster D

Vortex formation in Daphnia swarms — •Jürgen Vollmer, Bruno Eckhardt, and Christoph Lange — Fachbereich Physik, Philipps Universität, 35032 Marburg, Germany

We propose a self-propelled particle model for the swarming of Daphnia, which takes into account propulsion of the swimmers, mutual avoidance of close encounters and attraction to a centre. Various key parameters are identified in order to arrive at a phase diagram for qualitatively different steady-state motions. We find that a vertex is formed only in a finite range of propulsions, and analyse its transitions to other states. Hydrodynamic interaction between the swimmers can stabilise the vortex and change its velocity profile.

DY 30.23 Thu 16:00 Poster D

Collective motion of active brownian particles — •Jessica Strefler[1], Udo Erdmann[2], and Lutz Schimansky-Geier[1] — [1]Humboldt-Universität zu Berlin, Newtonstr. 15, 12489 Berlin — [2]Helmholtz Gemeinschaft, Anna-Louisa-Karsch-Str. 2, 10178 Berlin

In nature complex collective dynamics within swarms of individual animals, e.g. fish can be observed. The swarming behavior originates from interactions between the indiviuals. The most common modes of motion are a coherent translation and a collective rotation. Motivated by this observations, we discuss a model of active Brownian particles in three dimensions interacting via a Morse-type potential. This model qualitativly reproduces the biological behavior. Numer-

ical simulations show either a coherent translatory or an incoherent rotating state. Depending on the number of particles and the noise intensity, phase transitions between the two states are observed.

DY 30.24 Thu 16:00 Poster D

Solvent dependence of protein secondary structures — •Hendrik Hansen-Goos[1,2], Roland Roth[1,2], Klaus Mecke[3], and Siegfried Dietrich[1,2] — [1]Max-Planck-Institut für Metallforschung, Heisenbergstr. 3, 70569 Stuttgart — [2]ITAP, Universität Stuttgart, Pfaffenwaldring 57, 70569 Stuttgart — [3]ITP, Universität Erlangen-Nürnberg, Staudtstr. 7, 91058 Erlangen

Predicting the native state of a protein from a given sequence of amino acids is a task which has not been solved satisfactorily so far. An understanding of the mechanisms involved in protein folding is highly desirable as the 3D structure of a protein determines its function. Many approaches focus on energetic contributions from interaction between the amino acids and interaction with the solvent. There is, however, a contribution to the solvation free energy arising from the solvent entropy which varies for different protein configurations. We calculate solvent entropies for a protein represented in the simple tube model. Using the so-called morphometric approach, which makes calculations very efficient, we are able to scan over a large range of solvent configurations. For the particular case of a hard-sphere solvent, we discern regions where either a tightly packed helix, a sheetlike structure, or some unwinded helix minimizes the solvation free energy. Extensions to more realistic solvents and hydrophilic and hydrophobic interactions are presented.

DY 30.25 Thu 16:00 Poster D

Phase transitions in 2D colloidal crystals in presence of a 1D periodic potential — •Florian Bürzle and Peter Nielaba — Department of Physics, University of Konstanz, 78457 Konstanz, Germany

2D melting transitions for model colloids in presence of a 1D external periodic potential are investigated using Monte Carlo simulation, thereby extending former studies [1]. We modelled the colloidal dispersions by hard disks in the canonical ensemble. In particular, we explore a hard disk system with commensurability ratio $p = \sqrt{3}a_s/2d = 2$, where a_s is the mean distance between the disks and d the period of the external potential. In this system one expects from theoretical considerations [2] a novel 'locked smectic' phase between the well known locked floating solid and the modulated liquid. This new phase, which was also observed in a recent experimental study [3], has been verified in our simulations. Furthermore, we used various statistical quantities like order parameters, their cumulants and response functions, to obtain a phase diagram for the transitions between the three phases.

[1] W. Strepp, S. Sengupta, P. Nielaba, Phys. Rev. E **63**, 046106 (2001)
[2] L. Radzihovsky, E. Frey, D. R. Nelson, Phys. Rev. E **63**, 031503 (2001)
[3] J. Baumgartl, M. Brunner, C. Bechinger, Phys. Rev. Lett. **93**, 168301 (2004)

DY 30.26 Thu 16:00 Poster D

Bubble dynamics on laser excited nanoparticles — •Anton Plech[1], Vassilios Kotaidis[1], Michael Wulff[2], Gero von Plessen[3], and Christian Dahmen[3] — [1]Fachbereich Physik, Uni Konstanz, Universitätsstr. 10, D-78457 Konstanz — [2]ESRF, BP 220, F-38043 Grenoble — [3]I. Physikalisches Institut der RWTH Aachen, Huyskensweg, D-52074 Aachen

Strong nonequilibrium exitation of gold nanoparticles can be achieved by femtosecond laser heating. The nanoscale provides cooling rates of 10^{13} K/sec in aqueous suspension. Consequently the phase transition in the adjacent water layer is of explosive nature with strong supersaturation. We have employed a pump-probe technique using femtosecond laser pulses as heat stimulus and pulsed x-rays as probe for the nanoscale structure relaxations. By a combination of x-ray techniques it was possible to measure the particle temperature, pressure transients in the water phase, vapor bubble morphology and particle shape. Bubbles forming around 9 nm particles expand to sizes in the 20 nm range before they recollapse within a subnanosecond interval. The bubble dynamics can be modelled by macroscopic fluid dynamics (Rayleigh Plesset equation) [1]. We found a supersaturation of the water phase to 85

[1] V. Kotaidis, A. Plech: Cavitation dynamics on the nanoscale, Appl. Phys. Lett., 84 (2005) 213102.
[2] V. Kotaidis, C. Dahmen, G. von Plessen, F. Springer, A. Plech: Excitation of nanoscale vapor bubbles at the surface of gold nanoparticles in water, J. Chem. Phys., 124, (2006) 184702.

DY 30.27 Thu 16:00 Poster D

Bubble dynamics on laser excited nanoparticles — •Anton Plech[1], Vassilios Kotaidis[1], Michael Wulff[2], Gero von Plessen[3], and Christian Dahmen[3] — [1]Fachbereich Physik, Uni Konstanz, Universitätsstr. 10, D-78457 Konstanz — [2]ESRF, BP 220, F-38043 Grenoble — [3]I. Physikalisches Institut der RWTH Aachen, Huyskensweg, D-52074 Aachen

Strong nonequilibrium exitation of gold nanoparticles can be achieved by femtosecond laser heating. The nanoscale provides cooling rates of 10^{13} K/sec in aqueous suspension. Consequently the phase transition in the adjacent water layer is of explosive nature with strong supersaturation. We have employed a pump-probe technique using femtosecond laser pulses as heat stimulus and pulsed x-rays as probe for the nanoscale structure relaxations. By a combination of x-ray techniques it was possible to measure the particle temperature, pressure transients in the water phase, vapor bubble morphology and particle shape. Bubbles expand to sizes in the nanometer range before they recollapse within a subnanosecond interval. The bubble dynamics can be modelled by macroscopic fluid dynamics (Rayleigh Plesset equation) [1]. We found a supersaturation of the water phase to 85 % of the critical temperature [2] as threshold process.

[1] V. Kotaidis, A. Plech: Cavitation dynamics on the nanoscale, Appl. Phys. Lett., 84 (2005) 213102.
[2] V. Kotaidis, C. Dahmen, G. von Plessen, F. Springer, A. Plech: Excitation of nanoscale vapor bubbles at the surface of gold nanoparticles in water, J. Chem. Phys., 124, (2006) 184702.

DY 30.28 Thu 16:00 Poster D

Excess free energy and Casimir forces in slabs with periodic boundary conditions at and above the bulk critical temperature — •Daniel Grüneberg and Hans Werner Diehl — Universität Duisburg-Essen (Campus Duisburg), Fachbereich Physik, D-47048 Duisburg, Germany

We consider systems that are describable by n-component short-range ϕ^4 models in a $\infty^{d-1} \times L$ slab geometry of finite thickness L with periodic boundary conditions along the finite dimension. Within these models the excess free energy and the thermodynamic Casimir force are evaluated at and above the bulk critical temperature $T_{c,\infty}$ using the renormalization-group improved perturbation theory in $d = 4 - \epsilon$ dimensions. This theory has recently been re-examined in Ref. [1], and is found to be ill-defined beyond two-loop order when the boundary conditions (bc) are such that the free propagator involves a zero-energy mode. This applies to periodic bc and special-special ones, and leads to a non-analyticity of the free energy for $L < \infty$ at the bulk critical point (bcp). The remedy is a reorganization of the field theory with regard to a proper treatment of the zero-energy mode [1]. This reorganized field theory is employed to derive the finite-size scaling functions of the excess free energy and the Casimir force. Their values at the bcp are related to the critical Casimir amplitude $\Delta_{\rm per}$, whose small-ϵ expansion is found to involve—besides integers powers of ϵ—fractional powers $\epsilon^{k/2}$ with $k \geq 3$, and powers of $\log \epsilon$. We present explicit results for $\Delta_{\rm per}$ to order $\epsilon^{3/2}$, which are used to estimate its value at $d = 3$.

[1] H. W. Diehl *et al.*, Europhys. Lett. **75**, 241 (2006)

DY 30.29 Thu 16:00 Poster D

Fractal dimension of domain walls in two-dimensional Ising spin glasses — •Oliver Melchert and Alexander K. Hartmann — Institut für Theoretische Physik, Georg-August-Universität Göttingen

We study the problem of finding domain-wall excitations on 2d Ising spin glasses in terms of a shortest-path problem. Purpose of this ground-state study is to shed light on the fractal dimension d_f of domain walls, where d_f describes the scaling of the mean domain wall length with the system size L, i.e. $\langle \ell \rangle \propto L^{d_f}$. Exploring systems up to $L = 300$ we yield $d_f = 1.271(1)$ for the case of gaussian disorder, in support of previous findings. The case of bimodal disorder exhibits a high degeneracy of ground states and thus allows for numerous domain walls with minimal energy. Here, we are able to give a true lower and an estimate for the upper bound of the fractal dimension: $d_f^{low} = 1.097(1)$ and $d_f^{up} = 1.396(10)$.

DY 30.30 Thu 16:00 Poster D

Reduction of surface coverage of finite systems due to ge-

ometrical steps — •Klaus Morawetz[1,2], Carsten Olbrich[3], Sibylle Gemming[4], and Michael Schreiber[1] — [1]Institute of Physics, Chemnitz University of Technology, 09107 Chemnitz, Germany — [2]Max Planck Institute for the Physics of Complex Systems, Nöthnitzer Str. 38, 01187 Dresden, Germany — [3]School of Engineering and Science, Jacobs University Bremen, 28725 Bremen, Germany — [4]Forschungszentrum Rossendorf, PF 51 01 19, 01314 Dresden, Germany

The coverage of vicinal, stepped surfaces with molecules is simulated with the help of a two-dimensional Ising model including local distortions and an Ehrlich-Schwoebel barrier term at the steps. An effective two-spin model is capable to describe the main properties of this distorted Ising model. It is employed to analyze the behavior of the system close to the critical points. Within a well-defined regime of bonding strengths and Ehrlich-Schwoebel barriers we find a reduction of coverage (magnetization) at low temperatures due to the presence of the surface step. This results in a second, low-temperature transition besides the standard Ising order-disorder transition. The additional transition is characterized by a divergence of the susceptibility as a finite-size effect. Due to the surface step the mean-field specific heat diverges with a power law. [cond-mat/0608013]

DY 30.31 Thu 16:00 Poster D

Boundary field induced first-order transition in the 2D Ising model: numerical study — •Elmar Bittner and Wolfhard Janke — Institut für Theoretische Physik, Universität Leipzig, Postfach 100 920, 04009 Leipzig, Germany

In a recent paper, Clusel and Fortin [J. Phys. A.: Math. Gen. 39 (2006) 995] presented an analytical study of a first-order transition induced by an inhomogeneous boundary magnetic field in the 2D Ising model. They identified the transition that separates the regime where the interface is localized near the boundary from the one where it is propagating inside the bulk. To confirm the analytical results, we performed multimagnetic simulations and measured the probability density of the magnetisation and the spin-spin correlation function to determine the phase transition and the location of the interface. Our results are in very good agreement with the theoretical prediction.

DY 30.32 Thu 16:00 Poster D

Continuous time cluster Monte Carlo algorithm for the spin-boson model — •Andre Winter and Heiko Rieger — Theoretische Physik, Universität des Saarlandes, PF 151150, D-66041 Saarbrücken

A Monte Carlo algorithm to explore the quantum phase transition between localized and delocalized phase of the sub-Ohmic spin-boson model is presented. Its partition function can be written as a path integral over spin-worldlines in imaginary time involving an effective action that contains long-range interaction between spin values at different times. This path integral is evaluated with a continuous (imaginary) time Monte-Carlo algorithm with cluster updates. In this way the usual Trotter-discretization is avoided and results of simulations using this algorithm are expected to be representative for the spin-boson model also in the sub-Ohmic regime. We compute the critical exponents of the phase transition and their dependence on the bath exponent characterizing the low frequency behavoir of the spectral function of the bosonic bath.

DY 30.33 Thu 16:00 Poster D

Effects of dissipation in random quantum magnets — •Heiko Rieger[1] and Gregory Schehr[2] — [1]Theoretische Physik, Universität des Saarlandes, PF 151150, D-66041 Saarbrücken — [2]Laboratoire de Physique Théorique, Université de Paris-Sud, F-91405 Orsay

Quantum phase transitions in a large class of one-dimensional and some higher-dimensional quantum magnets with quenched disorder are described by an infinite randomness fixed point. Unusual scaling laws and the occurence of Griffiths-McCoy singularities away from the critical point characterize theses universality classes, which have been studied with a strong disorder renormalization group (SDRG), exact diagonalization and quantum Mone-Carlo methods. A coupling of the spin degrees of freedom to a dissipative bosonic bath alters this scenario significantly: The sharp quantum phase transition is smeared and the Griffiths-McCoy singularities become dominated by a classical behavior of the susceptibility and specific heat below a crossover temperature T*. By combining the SDRG with a renormalization scheme for the spin-boson-system it became possible to describe this crossover quantitatively in random transverse field Ising systems and possibly also in other quantum spin systems.

DY 30.34 Thu 16:00 Poster D

Self-avoiding walks on fractals: scaling laws — •Viktoria Blavatska[1], Yurij Holovatch[2], and Wolfhard Janke[1] — [1]Institut für Theoretische Physik, Universität Leipzig, Augustusplatz 10/11, 04109 Leipzig, Germany — [2]Institute for Condensed Matter Physics, Svientsitski Str. 1, Lviv 79011, Ukraine

The scaling behaviour of linear polymers in disordered media, modelled by self-avoiding random walks (SAWs) on the backbone of three- and four-dimensional percolation clusters is studied by Monte Carlo simulations. We apply the pruned-enriched Rosenbluth chain-growth method (PERM). Our numerical results bring about the estimates of critical exponents, which characterise disorder averages of end-to-end distance and number of SAWs.

DY 30.35 Thu 16:00 Poster D

Beitrag abgesagt — •XXX XXX —

DY 30.36 Thu 16:00 Poster D

Structural Transitions of Three-dimensional Homopolymers on Regular Lattices — •Thomas Vogel[1], Michael Bachmann[1,2], and Wolfhard Janke[1] — [1]Institute for Theoretical Physics, University Leipzig, PF 100920, 04109 Leipzig, Germany — [2]Complex Systems Division, Lund University, Sweden

We employ recently developed flat histogram extensions [1,2] of the pruned-enriched Rosenbluth method (PERM) [3] to study the freezing collapse of flexible polymers on simple cubic (sc) and face-centered cubic (fcc) lattices at temperatures well below the Θ-transition. We find that the freezing collapse does not scale with the system size in this model, besides some fluctuations due to the underlying lattice. It dominates the thermodynamic behavior of small systems but becomes unimportant in the long-chain limit.

Our work was motivated by a recent study of another related system. The crystallization temperature there depends on the polymer length and coincides with the Θ-transition in the thermodynamic limit [4].

[1] M. Bachmann, W. Janke, Phys. Rev. Lett. **91** (2003) 208 105.
[2] T. Prellberg, J. Krawczyk, Phys. Rev. Lett. **92** (2004) 120 602.
[3] P. Grassberger, Phys. Rev. E **56** (1997) 3682.
[4] F. Rampf, W. Paul, K. Binder, Europhys. Lett. **70** (2005) 628.

DY 30.37 Thu 16:00 Poster D

Ground-state structure and energy landscape of the number partitioning problem — •Alexander Mann and Alexander K. Hartmann — Institut für Theoretische Physik, Georg-August-Universität Göttingen

We study the number partitioning problem (NPP), a basic NP-hard optimization problem which presents a phase transition between a computationally easy phase with an exponential number of zero energy solutions and a computationally hard phase with unique non-zero energy ground states. We apply both exact optimization algorithms and parallel tempering Monte Carlo simulations. To get an impression of the structure of the energy landscape we study the clustering properties in the easy as well as in the hard phase. We also study the finite-size scaling behavior of a temperature driven phase transition and compare it to analytical work and to the results of the random-energy model.

DY 30.38 Thu 16:00 Poster D

Finite-size effects and universality in superfluid films — •Anna Maciolek[1,2,3] and Siegfried Dietrich[1,2] — [1]Max-Planck-Institut für Metallforschung, Heisenbergstr. 3, D-70569 Stuttgart, Germany — [2]Institut für Theoretische und Angewandte Physik, Universität Stuttgart, Pfaffenwaldring 57, D-70569 Stuttgart, Germany — [3]Institute of Physical Chemistry, Polish Academy of Sciences, Kasprzaka 44/52, PL-01-224 Warsaw, Poland

Universal aspects and finite-size scaling of the critical Casimir force f_C and specific heat in wetting films of ^{3}He-^{4}He mixtures near their bulk tricritical point and of pure ^{4}He near λ transition are studied within models of corresponding universality class. For mixtures nonsymmetric boundary conditions impose nontrivial concentration profiles leading to the repulsive force which exhibit a rich crossover behavior between the tricritical point and the line of critical points. The theoretical results agree with published experimental data; for mixtures they emphasize the importance of logarithmic corrections to the scaling function. [1] A. Maciolek and S. Dietrich, Europhys. Lett. **74**, 22 (2006). [2] A. Maciolek and S. Dietrich, unpublished.

DY 30.39 Thu 16:00 Poster D

Theory of Low-Frequency Raman-Spectroscopy in Disordered Solids — •Bernhard Schmid and Walter Schirmacher — Phys.-Dept. E13, Technische Universität München, D-85747 Garching, Germany

Raman spectra of disordered solids in the regime near 50 wavenumbers show very often an intensity maximum ("boson peak"). According to a theory of Shuker and Gammon the intensity is proportional to the vibrational density of states (DOS), divided by the frequency squared. The existing data, however do not agree with DOS data measured e.g. by neutron inelastic scattering. We present a theory of vibrational excitations in disordered solids [1] and their observation by Raman spectroscopy, based on the assumption that the elastic moduli and the opto-elastic coupling constants (Pockels constants) fluctuate in space. Comparing our theory with experimental data gives not only good agreement, but enables us to compare with other related anomalous vibrational properties such as neutron and synchrotron radiation spectra, as well as specific heat and thermal conductivity data.

[1] W. Schirmacher, Europhys. Lett. 73, 892 (2006)

DY 30.40 Thu 16:00 Poster D

Description of redox reaction and nanoparticle formation in glass with a reaction-diffusion system — •Knud Zabrocki[1], Steffen Trimper[1], Manfred Dubiel[1], and Klaus-Dieter Schicke[2] — [1]Institut für Physik, Martin-Luther-Universität Halle-Wittenberg, 06099 Halle (Saale), Deutschland — [2]Experimental Department II, Max-Planck-Institut für Mikrostrukturphysik, Weinberg 2, 06120 Halle (Saale), Deutschland

Nanoparticle formation of precious metals like silver and gold in glass is a current field of investigation because of its technically interesting applications. The size, shape and concentration of the particles and especially the control of these parameters during the formation process of the nanoparticles are of great importance for various applications. Detailed experiments on ion-exchanged glasses (EDX, TEM) build up the basis for our description of the formation process starting with a redox reaction of silver ions and glass containing ferrous ions. We use a system of reaction-diffusion equations to analyze the different concentration profiles of the reactants. Furthermore, the reaction-diffusion fronts are calculated where the particle formation as a clustering process sets in. The influence of the different parameters like reaction rate, diffusion coefficients and boundaries are studied in detail.

DY 30.41 Thu 16:00 Poster D

Lattice Gas Simulation of Liesegang Pattern Formation in Glass — •Lukas Jahnke and Jan Werner Kantelhardt — Institute of Physics, Martin-Luther-Universität Halle-Wittenberg, 06099 Halle (Saale), Germany

Liesegang patterns are a self-organized quasi-periodic structuring that occurs in diffusion-limited chemical reactions with two components. A wide range of mean-field theories based on differential equations exists, and they describe the basic properties of the pattern formation. In recent experiments (Mohr et. al., 2000), where silver nanoparticles in glass are generated behind a moving hydrogen front, Liesegang patterns also emerge. Due to the mesoscopic character of these experiments the mean field approaches do not seem to be fully adequate. Alternatively, the microscopic reaction-diffusion process can be modelled by Monte-Carlo simulations in a lattice gas approach (Chopard et. al., 1994). We present simulation results going beyond the mean field approch for parameters inside and outside the pattern formation regime. We also discuss the stability of the patterns and possible modifications of the process that might help to obtain photonic crystals.

DY 30.42 Thu 16:00 Poster D

The description of ion dynamics in silicate glasses in terms of energy landscapes — •Heiko Lammert and Andreas Heuer — Westfälische Wilhelms-Universität, Institut für Physikalische Chemie, Corrensstr. 30, D-48149 Münster

A hopping picture is widely accepted for the description of ion dynamics in amorphous solids. The underlying energy landscape for ionic motion is highly complex due to the disordered structure of the materials, and also because of the changing Coulomb interactions between the mobile ions.

Computer simulations have shown that the Coulomb interaction is required for a completely correct reproduction of e. g. the Mixed Alkali Effect. Meanwhile many qualitative theories of the ion dynamics neglect the Coulomb interactions and work with independent particles and perfectly random distributions of energies and barriers.

We test these common assumptions using realistic molecular dynamics simulations of alkali silicates. Our method for the identification of individual ionic sites from the trajectories enables a treatment in terms of ion hopping. A new analysis of different contributions to the site energies allows a direct comparison to models using simplified energy landscapes.

The results demonstrate the important role of the Coulomb interaction for the fundamental behavior of the system. However the simple picture of independent particles on a random landscape can be recovered, when vacancies are treated instead of ions.

DY 30.43 Thu 16:00 Poster D

Distribution of cavity fields of a m-component spin glass on a Bethe lattice — •Axel Braun and Timo Aspelmeier — Institut für theoretische Physik, Universität Göttingen

Using an extension of the cavity method to m-component vector spins on a Bethe lattice, we write down a self-consistent equation for the distribution of cavity fields, with m going to infinity. With it, we show that there is a replica-symmetric low-temperature phase. We extend these findings by calculating corrections for a finite number of spin components. The results of a numerical analysis confirm replica symmetry and the finite-size-exponent for the sample-to-sample-fluctuations of the free energy is obtained.

DY 30.44 Thu 16:00 Poster D

Hydrodynamic Lyapunov modes in binary Lennard-Jones fluids — •Christian Drobniewski, Günter Radons, and Hong-Liu Yang — Chemnitz University of Technology, 09107 Chemnitz

In analogy to the microscopic definition of structure factors of molecular hydrodynamics we introduced static and dynamic correlation functions for Lyapunov vectors ([1],[2]). By this it was made possible to identify Lyapunov modes in chaotic many particle systems with soft-core interactions (Lennard-Jones fluids). Binary Lennard-Jones fluids are a well known class of systems, which were thoroughly investigated in the context of the glass transition. For binary systems we generalize these Lyapunov vector correlation functions in analogy to the so-called partial structure factors. With these correlation functions we provide a new tool for the investigation of the Lyapunov instability in binary extended systems. We present results obtained by calculating and investigating these correlation functions and find, for instance, signatures indicating the glass transition taking place in the system.

[1] H.L. Yang and G. Radons, Phys. Rev. E 73, 016202 (2006)
[2] G. Radons and H. L. Yang, arXiv nlin. CD/0404028

DY 30.45 Thu 16:00 Poster D

Quantum mechanical model of the conductivity of alkali glasses — •Joachim Sohns and Michael Schulz — Institut für Theoretische Physik, Universität Ulm, 89069 Ulm, Germany

Our aim is to reproduce the mixed alkali effect and other important properties of the conductivity of alkali glasses in the framework of qunatum mechanics. Our model includes direct interaction between the particles, static interaction between the glass and the ions and the interaction between the ions and phonons in the glass. Because the system is assumed to be out of thermal equilibrium, we use the Keldysh technique and calculate two particles Green's functions. The conductivity of the system follows from the Kubo formula.

DY 30.46 Thu 16:00 Poster D

Mean field theory for relaxation in random dipolar systems — •Hartmut Grille[1], Wolfgang Dieterich[2], Philipp Maass[1], and Michael Schulz[3] — [1]Technische Universität Ilmenau, 98684 Ilmenau, Germany — [2]Universität Konstanz, 78457 Konstanz, Germany — [3]Universität Ulm, 89069 Ulm, Germany

Disordered materials often exhibit nearly frequency-independent dielectric loss spectra. This unique feature is far from being understood. By kinetic Monte Carlo simulations it has recently been shown that a dipolar system with positional randomness can provide a mechanism for that "nearly constant loss"(NCL) response [1]. With respect to analytical theories, the long-range and tensorial character of dipole-dipole interactions clearly are complicating factors. In this work we propose a mean field theory for a disordered, dilute system of dipoles, capable of dealing with these problems [2]. The magnitude of dipole moments and their positions are frozen. We derive an approximate expression for the dielectric loss spectra and evaluate it numerically. Influences of different forms of positional randomness and of the sys-

tem size on the dielectric susceptibility are investigated and compared with the simulations.

[1] For a review, see W. Dieterich, P. Maass, Chem. Phys. **284**, 439 (2002).

[2] M. Schulz, W. Dieterich, P. Maass, Z. Phys. Chem. **218**, 1375 (2004).

DY 30.47 Thu 16:00 Poster D

Non-linear conductivity effects in disordered systems: a theoretical approach — •Lars Lühning and Andreas Heuer — Institut für Physikalische Chemie, Westfälische Wilhelms-Universität Münster, Germany

The nonlinear conductivity effects of thin ionic conductors under the influence of ac- and dc electric fields are studied numerically and analytically using a regular hopping model with a characteristic hopping distance representing the typical distance between adjacent ionic sites.

Here we analyze a single-particle hopping model. The transition rates are deduced from a sequence of randomly distributed trapping sites using periodic boundary conditions. An analytical expression for the stationary current under a constant and periodic force in one dimension is given and verified by numerical calculations. Numerical results for the stationary current in two and three dimensions are also presented. It turns out that the stationary current depends on the sample thickness. Interestingly, the first corrections to the linear response display a non-trivial behavior in the thermodynamic limit.

DY 30.48 Thu 16:00 Poster D

How to model surface diffusion using the phase-field approach — •Klaus Kassner — Institut für Theoretische Physik, Otto-von-Guericke-Universität Magdeburg, Postfach 4120, D-39016 Magdeburg

It is demonstrated that the description of surface diffusion controlled dynamics via the phase-field method is less trivial than appears at first sight. A seemingly straightforward approach previously used in the literature is shown to fail to produce the correct asymptotics, albeit in a subtle manner. An apparently obvious alternative fails for a complementary reason. Finally, a model is constructed that asymptotically approaches known sharp-interface equations without adding undesired constraints. For all the models, linear stability of a planar front is investigated both analytically and numerically, in order to assess their utility in numerical simulations.

DY 30.49 Thu 16:00 Poster D

The Evolution of Stressed Coherent Interfaces — •Michael Fleck and Robert Spatschek — Institut fuer Festkoerperforschung, Forschungszentrum 52425 Juelich

Understanding the influence of elasticity on the evolution of surfaces or interfaces is of great scientific and technological importance, because it is directly related to fracture. Nonequilibrium interface kinetics are driven by a chemical potential which sensitively depends on the elastic state of the system. We present a method how to derive the chemical potential of two coherently connected linear elastic media from fundamental variational principles. It turns out that the coherency conditions, which is the absence of slips and detachments at the interface, has important implications.

We analyze the onset of the Asaro-Tiller-Grinfeld (ATG) instability - i.e. the elastically induced morphological surface instability of a solid body subjected to a uniaxial stress - including effects from dynamic elasticity, surface tension and effects from the modification due to coherency.

The results of the linear stability analysis are compared to numerical results from phase field modelling. In the late stage of the instability this process can lead to fracture.

DY 30.50 Thu 16:00 Poster D

Dendritic melting along a grain boundary — •Claas Hueter, Efim Brener, and Dmitri Temkin — Institut für Festkörperforschung, Forschungszentrum Jülich, D-52425 Jülich, Germany

Dendritic growth is a process which is very important in materials science. It can occur not only in solidification, but also in melting processes. Specifically, we discuss the melting of an overheated crystal along a grain boundary, in the framework of the symmetric model of diffusion-limited growth.

In contrast to the conventional dendritic growth, which requires the consideration of the anisotropy of the surface tension to provide a selection of the characteristic length scale of the appearing pattern and the growth velocity, the situation is here rather different: The presence of the triple junction at the tip allows a steady growth even for isotropic surface tension. This pattern formation problem is solved entirely analytically for specific parameter ranges. To our best knowledge, this is the first case of an entirely analytical solution in dendritic growth. In other cases, the corresponding nonlinear eigenvalue problem is solved numerically.

DY 30.51 Thu 16:00 Poster D

2d barchan dunes made in the lab — •Christopher Groh[1], Christof Krülle[1], Andreas Wierschem[2], Nuri Aksel[2], and Ingo Rehberg[1] — [1]Experimentalphysik V, Universität Bayreuth, D-95440 Bayreuth — [2]Technische Mechanik und Strömungsmechanik, Universität Bayreuth, D-95440 Bayreuth

For a long time people are fascinated by the dynamics of sand dunes. And so it is not surprising that there are a lot of studies outdoors, which give an overview about the facts of the formation of dunes in the desert or at the beach. In recent years scientists looked for theoretical models to give answers to the basic questions of the physical mechanisms of dune formation and migration [1,2]. In our setup we are able to investigate the dynamics of a well defined two-dimensional single barchan dune under the force of a shearing water flow. This allows easily the validation of the existing two-dimensional theoretical models with our experimental data. Beyond that, several unexpected new features have been observed.

[1] B. Andreotti, P. Claudin, and S. Douady, Eur. Phys. J. B 28, 341-352 (2002)

[2] K. Kroy, G. Sauermann and H. J. Herrmann Phys. Rev. E 66, 031302 (2002)

DY 30.52 Thu 16:00 Poster D

Coefficient of restitution: The effect of finite duration of collisions — Thomas Schwager and •Thorsten Poeschel — Charité, Augustenburger Platz 1, 13353 Berlin

The dynamics of a granular systems may be computed by Molecular Dynamics based on the interaction forces or by event-driven Molecular Dynamics using the coefficient of restitution. Knowing the forces the coefficient of restitution can be derived by integrating Newton's equation of motion. The end of a particle collision should be characterized by the time when the repulsive force between the particles conceals. So far, however, for simplicity it was assumed that the collision ends when the distance of the particle exceeds the sum of the radii. We show that the latter assumption leads erroneously to effective attractive forces and, thus, to an overestimation of the coefficient of restitution. Applying the improved condition for the duration of collisions, we derive the coefficient of restitution for the most frequently used particle interaction models. For the case of viscoelastic particles we find a novel dependence of the coefficient of restitution on the impact rate.

DY 30.53 Thu 16:00 Poster D

Granular gas cooling and relaxation to the steady state in regard to the overpopulated tail of the velocity distribution — •Thorsten Poeschel[1], Nikolai Brilliantov[2], and Arno Formella[3] — [1]Charité, Augustenburger Platz, 10439 Berlin — [2]Institut für Physik, Universität Potsdam, Am Neuen Palais 10, 14469 Potsdam — [3]Universidad de Vigo, Department of Computer Science, Edificio Politécnico, 32004 Ourense, Spain

We present a universal description of the velocity distribution function of granular gases, $f(v)$, valid for both, small and intermediate velocities where v is close to the thermal velocity and also for large v where the distribution function reveals an exponentially decaying tail. By means of large-scale Monte Carlo simulations and by kinetic theory we show that the deviation from the Maxwell distribution in the high-energy tail leads to small but detectable variation of the cooling coefficient and to extraordinary large relaxation time.

Reference: T. Pöschel, N. Brilliantov, and A. Formella, Phys. Rev.E 74, 041302 (2006)

DY 30.54 Thu 16:00 Poster D

Bottom-to-Top-Restructuring for the simulation of nanopowders — •Thomas Schwager[1], Thorsten Pöschel[1], and Dietrich E. Wolf[2] — [1]Charite, Augustenburger Platz 1, 13353 Berlin — [2]Fachbereich Physik, Universität Duisburg-Essen, D-47048 Duisburg

When repeatedly redepositing chunks cut out of a two-dimensional packing of adhesive rigid particles one converges to a losely packed assembly whose fractal dimension is close to one. On a system of a few

million particles we studied the structural properties of these packings. We found that the system adopts a universal structure which is determined by the chunk size. Moreover, the short-range structure of these assemblies is independent even of the chunk size. To obtain statistically significant results one has to consider systems of particle numbers far higher than one million particles. Granular systems of such sizes are beyond the capabilities of methods like force-based or event-driven Molecular Dynamics. Instead we applied a generalization of the Bottom-to-Top-Restructuring (Visscher and Bolsterli, Nature 239:504, 1972) which allows the simulation of hundred million particles. The results from this study can be applied to packings of nano-powders.

DY 30.55 Thu 16:00 Poster D

Experimental Study towards Granulates on Planetary — Antje Brucks[1] and •Jürgen Blum[2] — [1]Zentrum für angewandte Raumfahrttechnologie und Mikrogravitation, Am Fallturm, 28359 Bremen — [2]Institut für Geophysik und extraterrestische Physik, Technische Universität zu Braunschweig, Mendelssohnstr. 3, 38106 Braunschweig

We present a study on low-gravity surface flows of granular materials. Planetary surfaces of small solar-system bodies are usually covered by granulates called regolith. We are interested in the static and dynamic characteristics of such granulates under low-gravity conditions prevailing on the surfaces of small bodies in the solar system. We are particularly interested at which lower boundary in g-level particles become dominated by cohesive forces.

We investigated the effect of the reduction of the gravitational acceleration on the granular flow behaviour. The experiments were performed under microgravity conditions in the Bremen Drop Tower and were using a slowly rotating centrifuge for simulating low-gravity environments. Surface flow effects were simulated in two flat (quasi-2D) sand glass experiments, in a rotating tumbler and in an avalanche box. We will present results from 15 microgravity experiments in an acceleration range between 1 g_0 and 0.01 g_0.

DY 30.56 Thu 16:00 Poster D

Horizontal Brazil-nut effect in a binary mixture — •Christian Kröner, Christof Krülle, and Ingo Rehberg — Experimentalphysik V, Universität Bayreuth, D-95440 Bayreuth, Germany

The segregation of one big sphere in a monolayer of spheres rolling on a circularly vibrating table in a circular container is observed. The granular system consists of a binary mixture with size ratio 3 to 2. Depending on the ratio of the particles' material density and size, migration of the large intruder particle occurs either towards center or to the boundary. This is called the horizontal (reverse) Brazil-nut effect (H(R)BNE)[1]. The crossing point between HBNE and HRBNE is determined by varying the intruder's size and maintaining its material density. By varying the proportion of small particles in the binary mixture it was observed that the average particle size is a crucial parameter. For a better understanding of the mechanisms the interaction between the intruder and the binary mixture are studied in detail.

[1] T. Schnautz, R. Brito, C. A. Kruelle, and I. Rehberg, Phys. Rev. Lett. 95, 028001 (2005)

DY 30.57 Thu 16:00 Poster D

Coarsening of segregation patterns in a continuously rotating drum — •Tilo Finger and Ralf Stannarius — Otto-von-Guericke-Universität Magdeburg

The radial and axial segregation of granular mixtures in a long horizontal rotating drum has become one of the standard problems in the investigation of the physics of granular matter. Nevertheless the phenomena are incompletely understood so far. We investigate experimentally the structural properties and long term dynamics of the axial stripe pattern in a cylindrical drum which is initially half filled with a mixture of glass beads of different sizes and filled up with a liquid. The standard system is embedded in water. Rotation rates are chosen at low Froude numbers ($Fr \ll 1$). After starting a constant rotation rate a regular stripe pattern along the cylinder axis appears on the time scale of a few minutes. On a time scale of hours or days, the pattern coarsens by spontaneous dissolving of individual stripes. This was studied by optical and NMR methods [1]. We investigate the influence of viscosity and density of the interstitial fluid on the coarsening process. The relation between the level of segregation and the energy dissipation in the driving process is recorded and analyzed.

[1] T. Finger *et al.*, Phys. Rev. E **74**, 031312 (2006)

DY 30.58 Thu 16:00 Poster D

Rheological properties and the disturbance of the pair correlation function in clusters of oriented dipolar particles — •Stefan Fruhner and Siegfried Hess — Institut für Theoretische Physik, Technische Universität Berlin, D-10623, Germany

Clusters of colloidal dipolar particles are studied with the help of Non Equilibrium Molecular Dynamics (NEMD). This allows to study the local structure and rheological properties in magneto-rheological fluids [1] and in (inverted) ferro-fluids. A surrounding wall potential keeps the particles together. It can be regarded either as effective interactions with the surrounding fluid or as "walls" of a particle trap. The paricles are exposed to a homogeneous shear flow and they are subjected to a Gaussian thermostat. The dipole-dipole interaction and the shear flow render a distortion of the pair correlation function. A more complex anisotropic description for the directional dependence is needed [2]. The pair correlation function can also be approximated by the Maxwell-Stokes relation [3] for small shear rates. With the knowledge of the pair correalation function other quantities can be computed, i.e. the pressure and viscosity. The pressure tensor can also be obtained directly from the simulation, so a comparision of both methods is possible.

[1] M.Kröger, P.Ilg and S. Hess, J. Phys.: Condens. Matter 15(2003) S1403-S1423
[2] H.J.M. Hanley and S.Hess: "Pressure Tensor and Viscosity Coefficients of a Soft Sphere Liquid Under Shear", J. of Thermophysics Vol.4 No.2 (1983)
[3] H.J.M. Hanley, J. C. Rainwater and S. Hess: "Shear-induced angular dependence of the liquid pair correlation function", Phys. Rev. A 6, 1795 - 1802 (1987)

DY 30.59 Thu 16:00 Poster D

Magnetic fields generated in dipolar nematic liquid crystals under shear — •S. Grandner[1], S. Heidenreich[1], P. Ilg[1,2], S.H.L. Klapp[1,3], and S. Hess[1] — [1]Institute for Theoretical Physics, TU Berlin, 10623 Berlin, Germany — [2]Institute for Polymers, ETH Zürich, 8093 Zürich, Switzerland — [3]Stranski-Laboratorium for Physical and Theoretical Chemistry, TU Berlin, 10623 Berlin, Germany

The orientation of a tumbling nematic liquid crystal shows a time dependent response in a stationary Couette flow. This behavior can be described by a nonlinear transport equation for the alignment tensor [1]. Here, we generalize this approach to investigate a liquid crystal consisting of particles with an electric dipole moment [2]. The coupling between the alignment tensor and the electric polarisation is taken into account via an extended Landau-de Gennes potential. For certain ranges of the coupling parameter one can find a macroscopic electric polarisation in the nematic state without shear. The dynamic equations in the presence of shear are solved revealing complex dynamic behavior characterized by different states such as *tumbling*, *wagging* or *chaotic* [3]. According to the inhomogeneous Maxwell equation the time dependence of the electric polarisation yields a magnetic field, which is of measurable strength.

[1] S. Hess, Z. Naturforsch. 30a, 728, 1224 (1975)
[2] S. Grandner, S. Heidenreich, P. Ilg, S.H.L. Klapp and S. Hess - Dynamic electric polarization of nematic liquid crystals subjected to a shear flow (submitted)
[3] G. Rienäcker, M. Kröger and S. Hess, Phys. Rev. E 66, 040702(R) (2002)

DY 30.60 Thu 16:00 Poster D

Viscous behaviour of the nonlinear Maxwell model with a generalization for magnetorheological fluids. — •Bastian Arlt and Siegfried Hess — Institut für Theoretische Physik, Technische Universität Berlin, D-10623, Germany

A generalization of the Maxwell model where the relaxation is associated with a modification of the rheological model introduced by O. Hess, Ch. Goddard and S. Hess [1] is considered. The nonlinear Maxwell model equation involves the derivative of a potential function with respect to the stress tensor. In dependence on [1] where terms up to the 4^{th} order were used, here an alternative potential with terms up to 6^{th} order is studied. Furthermore, in order to treat the behaviour of dense magnetorheological fluids [2] additional terms associated with an applied magnetic field are taken into account [3]. Consequences of the model, in particular the shear stress, the first and second normal stress difference are presented for a plane Couette flow.

[1] O. Hess, Ch. Goddard, S. Hess: *From Shear-Thickening and Periodic Flow Behavior to Rheo-Chaos in Nonlinear Maxwell-Model Fluids*, Physica A (2005), 31-54
[2] H. See and R. Tanner: *Shear rate dependence of the normal force of a magnetorheological suspension*, Rheol. Acta 42 (2003) 166-170
[3] H. M. Laun, C. Gabriel, G. Schmidt: *Primary and secondary normal stress differences of a magnetorheological fluid (MRF) up to magnetic flux densities of 1 Tesla*, to be published

DY 30.61 Thu 16:00 Poster D

Quantitative measurement of directed fluctuations in a fer-

rofluid ratchet — •Christian Müller, Thomas John, and Ralf Stannarius — Universität Magdeburg, ANP, Universitätsplatz 2, 39106 Magdeburg

Ferrofluids as many particle systems stabilized by thermal fluctuations are well suited to compare theoretical model predictions for a nanoscale thermal ratchet [1] with experimental results. We study the influence of the field frequency and wave form on the time-averaged macroscopic torque generated in a ferrofluid volume. Two pairs of Helmholtz coils are used to generate an oscillating (non-rotation) magnetic field. This field induces a ratchet potential for the ferrofluid particles. In combination with thermal fluctuations, this symmetry breaking potential leads to a net rotation of the particles, which is transferred to the sample liquid by viscous forces. The total macroscopic torque is measured and compared with predictions based on a microscopic model [2].

[1] A. Engel et al., PRL 91, 060602 (2003).
[2] A. Engel and Peter Reimann, PRE 70, 051107 (2004).

DY 30.62 Thu 16:00 Poster D

Switching Behavior of Thermoreversible Nematic Gels — •Matthias Müller[1], Andreas Timme[2], Wolfgang Schöpf[1], Günter Lattermann[2], and Ingo Rehberg[1] — [1]Experimentalphysik V, Universität Bayreuth, D-95440 Bayreuth — [2]Makromolekulare Chemie I, Universität Bayreuth, D-95440 Bayreuth

We investigated the physical properties of a thermoreversible (physical) gel consisting of a nematic liquid crystal mixed with an organogelator in the planar configuration. In our sample materials the temperature of the gel-sol transition lies above the clearing point of the liquid crystal. Therefore the director stays aligned, after the gel network has formed. The main interest of this study is the change in the switching behavior between the gel and the pure liquid crystalline material, when applying an electric field. As expected, we found an increase of the threshold voltage for the Fréedericksz transition due to the gel network. Beyond that we experienced hysteresis effects, the are induced by the gelator.

DY 30.63 Thu 16:00 Poster D

Experimental realisation of the Rosensweig instability with ferrogels — •Christian Gollwitzer[1], Marina Krekhova[2], Ingo Rehberg[1], Günter Lattermann[2], and Reinhard Richter[1] — [1]Experimentalphysik V, Universität Bayreuth — [2]Makromolekulare Chemie I, Universität Bayreuth

Ferrogels are an interesting new class of materials that enhance the properties of magnetic fluids by elastic components [1]. The most striking phenomenon in ferrofluids, namely the Rosensweig instability, shows also up in ferrogels under certain conditions. Bohlius et al. [2] predict, that compared to the pure ferrofluid, the critical magnetic field is shifted to higher values due to elastic forces, and the critical wavenumber to remain the same.

We use a thermoreversible ferrogel [3] and expose it to a homogeneous magnetic field. By controlling the temperature we can easily change the elastic modulus over several orders of magnitude. The surface profile of the ferrogel is then recorded using an X-ray technique.

[1] Zrinyi, M., Barsi, L., Szabo, D. & Kilian, H.-G. 1997 *The Journal of Chemical Physics* **106** (13), 5685–5692.
[2]Bohlius, Brand & Pleiner 2006 *Z. Phys. Chem* **220**, 97
[3]Lattermann, G. & Krekhova, M. 2006 *Macromol. Rapid Commun.* **27**, 1373–1379.

DY 30.64 Thu 16:00 Poster D

Response of a ferrofluid to travelling stripe forcing — •Achim Beetz, Reinhard Richter, and Ingo Rehberg — Universität Bayreuth

A travelling stripe forcing excitation is applied for the first time to the surface of magnetic liquids in the advent of the Rosensweig instability. We investigate the response of the ferrofluid, in particular the amplitude of travelling waves, under variation of the magnetic field strength and the driving velocity. If the native propagation velocity v of the ferrofluid corresponds to the driving speed, the amplitude of the travelling waves shows a maximum. By fitting the data with an amplitude equation of a damped forced oscillation, one can obtain the critical Rosensweig field (at $v = 0$) and a part of the dispersion relation at a fixed wavenumber.

DY 30.65 Thu 16:00 Poster D

Transport Behavior of Colloids in Micro-Channels — •Peter Henseler and Peter Nielaba — Fachbereich Physik, Universität Konstanz, D-78457 Konstanz

The transport behavior of a system of gravitationally driven colloidal particles is investigated. The particle interactions are determined by the superparamagnetic behavior of the particles. They can thus be arranged in a hexagonal order by application of an external magnetic field. Therefore the motion of the particles through a narrow channel is governed by this positioning and a layered structure forms parallel to the walls. The arrangement of the particles is perturbed by diffusion and the motion induced by gravity. Due to these combined influences a density gradient forms along the direction of motion of the particles. A reconfiguration of the ordered structure is observed leading to a reduction of the number of layers. Experiments and Brownian dynamics (BD) simulations show that this is due to the density gradient along the channel. Furthermore we present simulation results for various channel geometries and the effect of obstacles within the channel.

[1] M. Köppl, P. Henseler, A. Erbe, P. Nielaba and P. Leiderer, Phys. Rev. Lett. **97**, 208302 (2006)

DY 30.66 Thu 16:00 Poster D

Dynamics in Thin Films of Blockcopolymer — •Peter Fey, Sabine Scherdel, Marcus Böhme, Nicolaus Rehse, and Robert Magerle — Chemische Physik, TU Chemnitz, D-09107 Chemnitz

Thin films of blockopolymer are of scientific interest because their structure can easily be adjusted. Their dynamics can be controlled by solvent vapors. We observe the surfaces of thin films of blockopolymer with tapping mode scanning probe microscopy (TM-SPM). TM-SPM allows in-situ observations of the polymer film under solvent vapor atmosphere and gives information about the topology as well as mechanical properties of the surface. At the given volume ratio of the two blocks typical surface structures include lamellae, perforated lamellae, and cylinders oriented perpendicular or parallel to the surface, depending on film thickness and the solvent vapor pressure.

In our work we mainly focus on cylinders parallel to the surface. These cylinders show characteristic fluctuations close to the phase transition in width and orientation. We examine these fluctuations for typical periodicies using image processing algorithms.

DY 30.67 Thu 16:00 Poster D

Phase diagram of a colloidal adsorbate on a quasicrystalline substrate — •Michael Schmiedeberg and Holger Stark — Max-Planck-Institute for Dynamics and Self-Organization, D-37073 Göttingen, Germany

Using Monte-Carlo simulations, we study the phase behavior of a 2D charged-stabilized colloidal suspension in a potential with decagonal symmetry that can be realized by five interfering laser beams. As one may expect, we find a triangular to liquid phase transition for small potential values and a ten-fold symmetric quasicrystalline phase for high laser intensities. However, in an intermediate regime a quasicrystalline phase exist that only exhibits a 20-fold bond orientational order. It occurs due to the delicate interplay between the interacting colloids and the substrate potential.

DY 30.68 Thu 16:00 Poster D

On the behaviour of short Kratky-Porod chain — •Semjon Stepanow — Universität Halle, Institut für Physik, 06099 Halle

Using the exact computation of a large number of moments of the distribution function of the end-to-end distance G(r,N) of the wormlike chain, we have established the analytical form of the coefficients in Taylor expansions of the moments for short chain lengths N. The knowledge of these coefficients enabled us to resummate the moment expansion of G(r,N) by taking into account consecutively the deviations of the moments from their stiff rod limit. Within this procedure we have derived the short-chain expansion for G(r,N), the scattering function, and the extension-force relation, which take into account the deviations of the moments from their stiff rod limit to the seventh order in N.

DY 30.69 Thu 16:00 Poster D

Collapse and Freezing Transitions of Polymers on Regular Lattices — •Thomas Vogel[1], Michael Bachmann[1,2], and Wolfhard Janke[1] — [1]Institute for Theoretical Physics, University Leipzig, PF 100920, 04109 Leipzig, Germany — [2]Complex Systems Division, Lund University, Sweden

We present simulation results for the thermodynamical behavior of flexible polymers (interacting self-avoiding walks) on simple cubic (sc) and face-centered cubic (fcc) lattices. Beside the well-known collapse

transition, we concentrate ourselves on the freezing transition ocurring at lower temperatures.

We show how this transition, also called crystallization, liquid-solid [1] or globule-groundstate transition [2], is influenced by the lattice and how the transition depends on the system size.

We employ the pruned-enriched Rosenbluth method (PERM) [3] and generalized extensions of it [4,5].

[1] F. Rampf, W. Paul, K. Binder, Europhys. Lett. **70** (2005) 628.
[2] M. Bachmann, W. Janke, J. Chem. Phys. **120** (2004) 6779.
[3] P. Grassberger, Phys. Rev. E **56** (1997) 3682.
[4] M. Bachmann, W. Janke, Phys. Rev. Lett. **91** (2003) 208 105.
[5] T. Prellberg, J. Krawczyk, Phys. Rev. Lett. **92** (2004) 120 602.

DY 31: Granular matter / contact dynamics II

Time: Friday 10:15–13:00 Location: H2

DY 31.1 Fri 10:15 H2

About contact models for granular matter — •Stefan Luding — Particle Technology, Nanostructured Materials, DelftChemTech, TUDelft, Julianalaan 136, 2628 BL Delft, NL

In adhesive granular matter, phenomena like cohesion, agglomeration, sintering, compaction and fracture can be observed. The basic ingredient for the discrete modeling of granular matter is the contact model that enters the Molecular Dynamics like simulation algorithm. A contact model is presented that does not only allow for simulation of rather large granular matter in the milli-meter range, but also for much finer particles in the micro-meter range or even smaller. Besides dissipation and elasticity, the contact model involves plastic deformation, contact-adhesion, tangential friction, and rolling-resistance as well as torque-resistance. Agglomeration, pressure-sintering and tensile tests can now be examined with a single contact model.

DY 31.2 Fri 10:30 H2

Multiscale Simulations of Powder Sintering by Discrete Element Modeling — •Andreas Wonisch, Torsten Kraft, Michael Moseler, and Hermann Riedel — Fraunhofer Institute for Mechanics of Materials, Freiburg, Germany

In powder technology bulk materials are created from a huge number of particles that are first compacted and then bonded together by sintering. Sintering is activated by heating the powder at a high temperature below the melting point and leads to densification and grain growth. The driving force for this phenomenon is the surface energy of the grains. In order to better understand how the structure and dynamics on the grain scale affect macroscopic sintering behavior the discrete element method (DEM) is applied. The simulation scheme is based on a (random) aggregate of particles and takes mesoscopic properties like particle sizes, particle distribution, rotation and rearrangement into account. Appropriate pair forces between particles have been derived to simulate solid-state and liquid-state sintering where an additional liquid phase enhances the densification rate by rearrangement of grains. We show how rearrangement and rotation affects macroscopic sintering properties like densification rate and viscosity. We also demonstrate that certain kinds of particle configurations and boundary conditions lead to crack formation and anisotropic sintering behavior.

DY 31.3 Fri 10:45 H2

Impedance Spectra of Numerically Generated Particle Setups — •Dominik Schwesig and Dietrich Wolf — Universität Duisburg-Essen

We use the Contact Dynamic Method to generate the particle c onfiguration of a cohesive powder in a cylinder for different applied stresses, as done in experiments for nanopowders. We simulate the complex resistance of these configurations with a classic circuit network for a wide range of frequncies and compare these spectra with a simple model for the current network in these powders.

DY 31.4 Fri 11:00 H2

Translation and Rotation are correlated in Granular Gases — •Thorsten Poeschel[1], Nikolai Brilliantov[2], Till Kranz[3], and Annette Zippelius[3] — [1]Charité, Augustenburger Platz 1, 13353 Berlin — [2]Institut für Physik, Universität Potsdam, Am Neuen Palais 10, 14469 Potsdam — [3]Institut für Theoretische Physik, Universität Göttingen, Friedrich-Hund-Platz 1, 37073 Göttingen

In a granular gas of rough spherical particles the axis of rotation of the particles is correlated with the translational velocity of the particles. The average relative orientation of angular and linear velocities depends on the coefficients of restitution which characterize the dissipative nature of the collision. We derive a theory for these correlations and validate it with numerical simulations for a wide range of coefficients of normal and tangential restitution. Surprisingly, even for vanishinlgy small roughness, there are *macroscopic* correlations of the particles. Therefore, granular gases of *almost* smooth particles behave very different from gases of smooth particles, that is, the limit of smooth spheres does not exist.

Reference: cond-mat/0609213

DY 31.5 Fri 11:15 H2

Macroscopic stress and strain distributions in sand piles — •Pradip Roul and Klaus Kassner — Institut für Theoretische Physik, Otto-von-Guericke-Universität Magdeburg, Postfach 4120, D-39016 Magdeburg

The stress distribution under a sand pile sometimes exhibits unusual features. Depending on characteristics such as the size distribution of grains but also the construction history of the aggregate, the pressure distribution may display a minimum or a maximum under the tip of the heap, with the former behaviour appearing counterintuitive. We performed numerical simulations generating two-dimensional "sand piles" from several thousand convex polygonal particles with varying shapes, sizes and corner numbers, using a discrete element approach based on soft particles. The pressure distribution regularly has a minimum under piles poured from a point source but does not show one, if the grains are poured from a line source. Calculations of the macroscopically averaged stress and strain tensors inside granular aggregates will be presented. Stress distributions are compared with the elasto-plastic theory of Cantelaube et al. It turns out that this theory describes the overall behaviour of the simulated sand piles well, if the relative size of the elastic and plastic regions is considered a free parameter. The prediction of this size itself by the theory is inaccurate.

DY 31.6 Fri 11:30 H2

The hopping ball: a common measurement method for the coefficient of restitution revisited — •Thomas Schwager[1], Christof Krülle[2], and Thorsten Pöschel[1] — [1]Charite, Augustenburger Platz 1, 13353 Berlin — [2]Experimentalphysik V, Universität Bayreuth, D-95440 Bayreuth

The coefficient of restitution is the central characteristics of the damping properties of granular material. One common way to measure this coefficient is to let a sphere fall on a rigid plate and measure the time interval between successive collisions. These measurements, however, are afflicted with intense stochastic fluctuations which drastically increase towards lower impact velocities – rendering the results problematic for the most interesting case of slow impact. As an added puzzle the distribution of the variations is non-Gaussian. These experimental results put the use of a deterministic coefficient of restitution in question. We present here a theoretical model of the particles which is in quantitative agreement with the experiment and which allows to shed light on the mechanism causing the stochastic variations. This in turn allows to extract useful information for the case of slow impact. Based on this model we will present a damping model which incorporates the observed statistical properties of the particle collisions. The consequences of this model for the theory of granular gases is discussed.

DY 31.7 Fri 11:45 H2

Axial transport of granular materials in a rotating drum — Khan Zeina S.[1] and •Morris Stephen W.[2] — [1]Max Plank Institute for Dynamics and Self-Organization, Goettingen, Germany — [2]University of Toronto, Department of Physics, Toronto, Canada

Bidisperse granular mixtures rapidly segregate by size when tumbled in a partially filled horizontal rotating drum. The smaller grains move radially towards the axis of rotation and form a buried radial core.

On a longer time scale, modulations of the radial core may grow into axial bands. Using a narrow pulse of the smaller component as an initial condition, we observe that the axial transport of the radial core is a subdiffusive front advencement process. By colouring some of the larger grains, we also find that the mixing and axial transport is subdiffusive. We also report on the effects of changing the relative grain size and drum diameter on the axial transport of grains.

DY 31.8 Fri 12:00 H2

Segregation and convection of granular mixtures in a rotating Hele-Shaw cell at high fill levels — •Frank Rietz and Ralf Stannarius — Otto-von-Guericke Universität Magdeburg, Fakultät für Naturwissenschaften, Institut für Experimentelle Physik, Abteilung Nichtlineare Phänomene

We describe experimentally the segregation and pattern formations in a granular medium that is almost densely packed in a flat container. The experiment is inspired by theoretical work of Awazu [1]. The container is rotated around a horizontal axis at rates of a few rotations per minute. The granulate is a bimodal glass bead mixture. Our experimental results are qualitatively completely different from observations in a loosely packed container, where fluidization of the material leads to the formation of regular segregation stripes, like they are commonly found in rotating drums. Instead, we observe slow convection rolls that are accompanied by and decorated by a segregation of the mixture. 'Conventional' axial stripe patterns are observable for fill levels below 95% tapped volume. At fill levels above 95%, the granulate is nearly jammed and the mobility of particles almost inhibited. Convection modes develop with wave numbers related to cell height. The velocity of these regular convection motion decreases when the initial fill level approaches 100%.

[1] Phys. Rev. Lett. 84, 4585, 2000

DY 31.9 Fri 12:15 H2

Lateral segregation of bidisperse mixtures — •Michael Heckel, Andreas Götzendorfer, Christof Krülle und Ingo Rehberg — Experimentalphysik V, Universität Bayreuth, D-95440 Bayreuth, Germany

The understanding of the behaviour of vibrated granular matter is important because many industrial processes rely on mixed multicomponent substances. In the last years 'granulodynamics', i.e. the physics of granular media, has attracted the interest of physicists as well. In our experiments we study a binary mixture of spheres with different sizes in a circular vibrated environment on an especially designed vibratory conveyor [1]. Above a threshold frequency of the excitation the bigger particles move to the top of the granulate similar to the Brazil-nut effect (BNE). If a second threshold frequency is exceeded another separation begins to dominate which can be seen as well-separated monodisperse domains in the vibrated bed. This reminds to phenomena known for purely horizontally shaken binary granular mixtures [2]. By increasing the shaker frequency even further a final state can be achieved where both particle species are separated completely in two distinct domains.

[1] M. Rouijaa, C. Krülle, I. Rehberg, R. Grochowski und P. Walzel, Transportverhalten und Strukturbildung granularer Materie auf Schwingförderern, Chemie Ingenieur Technik 76, 62 (2004)

[2] P.M. Reis and T. Mullin, Granular segregation as a critical phenomenon, Phys. Rev. Lett. 89, 244301 (2002)

DY 31.10 Fri 12:30 H2

Binary mixtures of inelastic hard spheres — •Wolf Till Kranz, Hildegard Uecker, and Annette Zippelius — Institute of Theoretical Physics, University of Göttingen, Germany

Analyzing the homogeneous cooling state of rarefied binary mixtures of inelastic hard spheres it is found that in general the species' temperatures do *not* evolve towards a common value. Nevertheless the temperature *ratio* becomes stationary within a few collisions per particle. In order to better understand this surprising effect we consider a simple model with a constant coefficient of restitution and derive a kinetic theory for the granular temperatures. The validity of the model is assessed by comparison with MD-Simulations. We present an argument that makes the source of and the conditions for the non-equipartition particularly transparent. Finally we will show how the above results can be generalized to mixtures with an arbitrary number of components in a straight forward manner.

DY 31.11 Fri 12:45 H2

Behaviour of Granular Media under Reduced Gravity — •Antje Brucks[1] and Jürgen Blum[2] — [1]Zentrum für angewandte Raumfahrttechnologie und Mikrogravitation, Am Fallturm, 28359 Bremen — [2]Institut für Geophysik und extraterrestische Physik, Technische Universität zu Braunschweig, Mendelssohnstr. 3, 38106 Braunschweig

Most granular surface flows are driven by gravity. Our understanding of such shear flows is much based on Earth-bound observations. Yet, pictures from Mars for example give rise to discussions on how strong the influence of ambient conditions such as air pressure and liquid lubricants in combination with reduced gravity are on the flow behaviour.

We investigated the effect of the reduction of the gravitational acceleration on the granular flow behaviour. The experiments were performed under microgravity conditions in the Bremen Drop Tower and were using a slowly rotating centrifuge for simulating low-gravity environments.

In our experiments, we used two flat (quasi-2D) sand glasses, a rotating tumbler and a somewhat larger box to resemble different aspects of flowing and avalanching granular materials as a function of g-levels between 1 g_0 and 0.01 g_0. We find that static and dynamic angle of repose increase with decreasing g-level in accordance to former investigations (Klein and White, AIAA J. 28(10),1701-1702 (1988)). However, we also find a lower limit where the cohesive properties start to dominate and prevent flow.

DY 32: Synchronization

Time: Friday 10:15–11:45 Location: H3

DY 32.1 Fri 10:15 H3

Quantum Stochastic Synchronization — •I. Goychuk[1], J. Casado-Pascual[2], M. Morillo[2], J. Lehmann[3], and P. Hanggi[1] — [1]Universität Augsburg, Germany — [2]Universidad de Sevilla, Spain — [3]Universität Basel, Switzerland

We study, within the spin-boson dynamics, the synchronization of a quantum tunneling system with an external, time-periodic driving signal [1]. As a main result we find that at a sufficiently large system-bath coupling strength (i.e. for a friction strength $\alpha > 1$) the thermal noise plays a constructive role in yielding forced synchronization. This noise-induced synchronization can occur when the driving frequency is larger than the zero-temperature tunneling rate. As an application evidencing the effect, we consider the charge transfer dynamics in molecular complexes.

[1] I. Goychuk, J. Casado-Pascual, M. Morillo, J. Lehmann, P. Hänggi, Phys. Rev. Lett. 97, 210601 (2006).

DY 32.2 Fri 10:30 H3

Sublattice synchronization of chaotic networks with delayed couplings — •Wolfgang Kinzel and Johannes Kestler — Theoretische Physik, Universität Würzburg

Chaotic systems, mutually coupled by their delayed variables, can synchronize to a common chaotic trajectory. This phenomenon may lead to interesting applications for secret communication with chaotic semiconductor lasers. We investigate networks of delay-coupled chaotic units which can be decomposed into two interconnected sublattices. For some values of the couplings we find sublattice synchronization: Each sublattice has a common chaotic trajectory, but the two sublattices are not synchronized. Although each sublattice is causing the synchronization of the other one, the sublattices are only correlated but not synchronized, not even in the meaning of generalized synchronization. Phase diagrams and spectra of Lyapunov exponents are calculated analytically for networks of iterated Bernoulli maps with delayed feedback and couplings.

DY 32.3 Fri 10:45 H3

Spatially localized desynchronization in weakly disordered lattices of phase oscillators — •Michael Zaks — Institut für Physik, Humboldt-Universität zu Berlin

If the coupling in a lattice of diffusively coupled non-identical phase oscillators is strong enough, a synchronized state appears in which all elements rotate with the same rate. I restrict myself to the case where the distribution of frequencies along the lattice is weakly disordered (the binary Thue-Morse lattice serves as an example). It turns out that the stable synchronized state is not necessarily a global attractor and may coexist with other nontrivial regimes. In such states, nearly the whole ensemble is synchronized whereas a few elements do not obey the common dynamics and rotate with different frequencies. Phase differences between such oscillators and the rest of the ensemble grow linearly in time. In spite of unbounded temporal growth, these phase defects do not propagate in space: they stay localized.

DY 32.4 Fri 11:00 H3

Synchronization of a hierarchical ensemble of coupled excitable oscillators — •Cornelia Petrovic and Rudolf Friedrich — Institut für Theoretische Physik, Westfälische Wilhelms-Universität Münster

In our work we investigate a model for an ensemble of globally coupled excitable oscillators. These oscillators are relaxation oscillators with hierarchically ordered frequencies and show several kinds of synchronization phenomena - from partial up to global synchronization - which can be detected in selfaffine features in the temporal evolution of the system. In our contribution we shall present some details of analytical and numerical analysis of the given system.

Our model was motivated by an experiment concerning the exothermic CO-oxidation on palladium supported catalyst (C.Ballandis, P.J.Plath, Journal of Non-Equilibrium Thermodynamics 25 3/4, 301 (2000)).

DY 32.5 Fri 11:15 H3

Synchronization in acoustical systems by the example of organ pipes — •Markus Abel[1], Karsten Ahnert[2], and Steffen Bergweiler[1] — [1]UP Transfer GmbH an der Universität Potsdam, Am Neuen Palais 10, 14469 Potsdam — [2]Institut für Physik, Universität Potsdam, Am Neuen Palais 10, 14469 Potsdam

From measurements on organ pipes, it is known since a long time, that phase-locking can lead to a mutual influence of organ pipes by each other. The same holds for external driving of pipes by acoustical sources of well-defined frequencies. We explain the theoretical background from nonlinear vibrational theory and apply it to measurements of the synchronization between an organ pipe and a loudspeaker. In the experiment we observe an Arnold tongue over a range of 60 dB, i.e. about 3 decades. With nonlinear, nonparametric embedding we are able to determine effective equations for the system in terms of a driven nonlinear oscillator.

DY 32.6 Fri 11:30 H3

Corticothalamic Projections control Synchronization in Ensembles of Bistable Thalamic Oscillators — •Jörg Mayer[1], Heinz Georg Schuster[1], Jens Christian Claussen[1], and Mathias Mölle[2] — [1]Institut für Theoretische Physik und Astrophysik, Christian-Albrechts Universität, Olshausenstraße 40, 24098 Kiel — [2]Department of Neuroendocrinology, University of Lübeck, Ratzeburger Allee 160, 23538 Lübeck

Thalamic circuits are able to generate state dependent oscillations of different frequencies and degrees of synchronization. Experimental findings suggest, that the simultaneous occurrence of spindle oscillations over widespread territories of the thalamus is due to the corticothalamic projections. Synchrony is lost in the decorticated thalamus. Here we introduce a generic model of a thalamic oscillator and study the influence of corticothalamic projections on the degree of synchrony in a network of such coupled oscillators. For this purpose we feed our model with slow wave stimuli. We uncover the underlying control mechanism, an compare our results with experimental observations. This leads to a control method which is applicable to a wide range of stochastically driven excitable units.

DY 33: Nonlinear dynamics and pattern formation

Time: Friday 12:00–13:15 Location: H3

DY 33.1 Fri 12:00 H3

Electro-optics and pattern formation of a bent-core nematic phase — •Jana Heuer[1], Maria-Gabriela Tamba[2], Alexey Eremin[1], and Ralf Stannarius[1] — [1]Otto-von-Guericke-Universität Magdeburg, Institut für Experimentelle Physik — [2]Martin-Luther-Universität Halle, Institut für Physikalische Chemie

Nematic phases of bent-core liquid crystals behave basically different from common rodlike (calamitic) nematics concerning the electro-optics.

We study a twin mesogen consisting of a bent-core unit and a covalently bound rod-like part. This substance is studied in the classical splay Freedericksz geometry. The sample is sandwiched in a transparent cell with planar alignment and observed with polarizing microscopy while we apply an electric AC field.

Above a certain threshold voltage (splay Freedericksz transition) Bloch-Leger-Walls occur. From the large anisotropy of these walls with respect to the director easy axis one can determine the ratio between the bend and twist elastic constant of the substance, which is substantially larger than in common calamitic nematics.

A second issue concerns the formation of periodic structures above a second threshold voltage. This stripe pattern is similar to standard electroconvection of nematics with negative dielectric anisotropy and positive conductivity anisotropy except one fundamental property: The alignment of the rolls is parallel to the director easy axis instead of a perpendicular orientation. A characterization of these structures gives insight in the basic pattern forming mechanism.

DY 33.2 Fri 12:15 H3

Pattern Formation in Unidirectional Coupled Nonlinear Optical Systems — Guido Krüger and •Rudolf Friedrich — Institute for Theoretical Physics, University of Münster, Wilhelm-Klemm-Str. 9, 48149 Münster

We present theoretical and numerical studies of two unidirectional coupled optical single feedback mirror systems. A single optical single feedback mirror system (OSFMS) can exhibit various structures such as 8-fold quasipatterns, hexagons, squares or solitary structures. In our work we consider two unidirectional coupled OSFMS and study the emerging patterns in the second cell. Our main focus in this talk will be on the interaction of solitary objects and the interplay of solitary objects with 8-fold quasipatterns. The coupling of these patterns allows the creation of various new patterns, that do not exist in a single OSFMS.

DY 33.3 Fri 12:30 H3

Localized Subharmonic Waves in a Circularly Vibrated Granular Bed — •Andreas Götzendorfer[1], Daniel Svenšek[2], Christof Kruelle[1], and Ingo Rehberg[1] — [1]Experimentalphysik V, Universität Bayreuth — [2]Department of Physics, University of Ljubljana, Slovenia

Localized period doubling waves arise in circularly shaken granular beds contained in an annular channel. These solitary wave packets are accompanied by a locally increased particle density. The width and velocity of the granular wave pulse are measured as a function of the amount of material in the container. A continuum model for the material distribution, based on the measured granular transport velocity as a function of the bed thickness, captures the essence of the experimental findings.

DY 33.4 Fri 12:45 H3

Controlling the stability transfer between oppositely traveling waves and standing waves by inversion symmetry breaking perturbations — •Alexander Pinter, Manfred Lücke, and Christian Hoffmann — Institut für Theoretische Physik, Universität des Saarlandes, Postfach 15 11 50, D-66041 Saarbrücken

The effect of an externally applied flow on symmetry degenerated

waves propagating into opposite directions and standing waves that exchange stability with the traveling waves via mixed states is analyzed. Wave structures that consist of spiral vortices in the counter rotating Taylor-Couette system are investigated by full numerical simulations and explained quantitatively by amplitude equations containing quintic coupling terms. The latter are appropriate to describe the influence of inversion symmetry breaking perturbations on many oscillatory instabilities with O(2) symmetry.

DY 33.5 Fri 13:00 H3

Ising and Bloch fronts in lattices of coupled forced oscillators. — •Ernesto Nicola[1] and Diego Pazó[2] — [1]Max-Planck-Institut für Physik komplexer Systeme, Noethnitzer Str. 38, D-01187 Dresden, Germany — [2]Instituto de Física de Cantabria (CSIC-UC), E-39005 Santander, Spain

The parametrically forced complex Ginzburg-Landau equation has been intensively studied since the seminal work by Coullet and coworkers [1]. This equation, which models a spatially extended medium, is bistable and admits fronts separating both states. These fronts can be of two types: Ising and Bloch. The Ising fronts are stationary and the Bloch fronts move with constant velocity. A transition between both fronts is observed as the intensity of the forcing is changed.

Systems in nature are very often discrete. Some examples of these kind of systems are arrays of coupled oscillators, spin systems and diverse biophysical systems. Here, we analyse the parametrically coupled Ginzburg-Landau equation on the lattice. Numerical simulations of this equation show a large variety of front types. Some of them are not present in the continuum case. We show that the dynamics and transitions between all these fronts can be captured by a normal form consisting of two ordinary differential equations.

[1] P. Coullet et al., Phys. Rev. Lett. 65, 1352 (1990).