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

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Overview of Invited Talks and Sessions

(lecture rooms MA 001, MA 004, A 053, A 060, EB 407; Poster C)

Prize Talk

The prize talk (Max Born-Prize) by Prof. Hagen Kleinert takes place Friday, 9:15, H 0105. See the plenary section for the abstract.

Invited Talks

DY 1.1	Mon	10:00–10:30	MA 004	**The Thermodynamic Casimir Effect: Monte Carlo Results** — •Alfred Hucht
DY 2.9	Mon	12:30–13:00	MA 001	**New Results on Water in Bulk, Nanoconfined, and Biological Environments** — •H. Eugene Stanley
DY 4.1	Mon	14:00–14:30	MA 004	**Entropic particle transport** — •Gerhard Schmid, P. Sekhar Burada, Peter Hänggi
DY 11.1	Tue	9:30–10:00	EB 407	**Glass freezing in confined geometries studied by DMA** — •Wilfried Schranz, Johannes Koppensteiner, Madalina-Roxana Puica
DY 14.1	Tue	14:00–14:30	MA 004	**When it helps to be purely Hamiltonian: Acceleration of rare events, enhanced particle and energy transport** — •Dirk Hennig, Lutz Schimansky-Geier, Peter Hänggi
DY 18.1	Wed	14:00–14:30	MA 001	**Rate Dependence and Role of Disorder in Linearly Sheared Two-Dimensional Foams.** — •Martin Van Hecke, Gijs Katgert, Matthias Moebius
DY 23.1	Thu	9:30–10:00	MA 001	**From the phase-space representation of optical microcavities to an improved ray dynamics** — •Martina Hentschel
DY 25.5	Thu	12:30–13:00	MA 001	**State space properties of linearly stable flows - How does flow in a pipe become turbulent?** — •Tobias M. Schneider
DY 26.1	Thu	14:00–14:30	MA 001	**Statistical physics of atmospheric clouds** — •Raymond A. Shaw

DY10 Symposium "Controlling Dirty bosons: Disorder effects on BECs"

Organization: A. Pelster (Universität Duisburg-Essen)

DY 10.1	Tue	9:30–10:00	MA 001	**Localization of interacting ultra cold atoms in a disordered potential** — •Alain Aspect, David Clément, Pierre Lugan, Philippe Bouyer, Gora Shlyapnikov, Laurent Sanchez-Palencia
DY 10.2	Tue	10:00–10:25	MA 001	**Coherent backscattering of Bose-Einstein condensates from 2D disorder potentials** — •Peter Schlagheck
DY 10.3	Tue	10:25–10:55	MA 001	**Ultracold atoms near nanofabricated surfaces** — •Jozsef Fortagh
DY 10.4	Tue	10:55–11:20	MA 001	**Collective Excitations in a Trapped Bose-Einstein Condensate with Weak Quenched Disorder** — •Gianmaria Falco, Axel Pelster, Robert Graham
DY 10.5	Tue	11:20–11:50	MA 001	**Disorder in ultracold Fermi-Bose quantum gas mixtures** — •Klaus Sengstock
DY 10.6	Tue	11:50–12:15	MA 001	**DMRG Studies of Disordered Bosons** — •Ulrich Schollwöck

Invited Talks of joint symposia with other Divisions

Symposium: "Quantum phase transitions (SYPT)"

See SYPT for the full program of the Symposium.

SYPT 1.1	Mon	14:00–14:35	H 0105	**Dark order in the metallic state** — •Andrew John Schofield
SYPT 1.2	Mon	14:35–15:10	H 0105	**Quantum criticality in $YbRh_2Si_2$** — •Philipp Gegenwart
SYPT 1.3	Mon	15:10–15:45	H 0105	**Elementary Excitations in Quantum Critical Antiferromagnets** — •Christian Ruegg
SYPT 1.4	Mon	16:00–16:35	H 0105	**How to have fun with frustrated ferromagnets** — •Nic Shannon, Tsutomu Momoi, Philippe Sindzingre
SYPT 1.5	Mon	16:35–17:10	H 0105	**Towards Quantum Magnetism with Ultracold Quantum Gases in Optical Lattices** — •Immanuel Bloch
SYPT 1.6	Mon	17:10–17:45	H 0105	**Correlated inhomogeneous systems: from trapped atoms to heterostructures** — •Achim Rosch

Symposium: "Single molecules (SYSM)"

See SYSM for the full program of the Symposium.

SYSM 1.1	Tue	14:00–14:30	H 0105	**Two-Focus Fluorescence Correlation Spectroscopy: A versatile tool for precise measurements of molecular diffusion** — •Jörg Enderlein, Anastasia Loman, Thomas Dertinger, Iris von der Hocht, Bernd Müller, Victor Pacheco, Konstantin Komolov, Karl-Wilhelm Koch, Ingo Gregor
SYSM 1.2	Tue	14:30–15:00	H 0105	**Tracking and Manipulating Single Molecule Diffusion in Liquids** — •Frank Cichos
SYSM 1.3	Tue	15:00–15:30	H 0105	**Single Molecule Studies on Myosin Motors** — •Claudia Veigel
SYSM 1.4	Tue	16:00–16:30	H 0105	**Real-time observation of bacteriophage T4 gp41 helicase reveals unwinding mechanism** — M. Manosa, T. Lionnet, M. M. Spiering, S. J. Benkovic, D. Bensimon, •V. Croquette
SYSM 1.5	Tue	16:30–17:00	H 0105	**From valleys to ridges: Exploring the dynamic energy landscape of single membrane proteins** — •Daniel Müller

Max Planck Symposium

On the occasion of Max Planck's 150. birthday a Symposium takes place Wednesday, 14:30, H 0105. See the corresponding section SYGP for the list of speakers.

Symposium: "Computational soft matter physics (SYMP)"

See SYMP for the full program of the Symposium.

SYMP 1.1	Thu	9:30–10:00	H 0105	**Hydrodynamic cooperativity in active fluids** — •Ignacio Pagonabarraga
SYMP 1.2	Thu	10:00–10:30	H 0105	**Hydrodynamic Effects on Molecular Motion** — •Raymond Kapral
SYMP 1.5	Thu	11:15–11:45	H 0105	**Proton transport through water-filled narrow pores** — •Christoph Dellago
SYMP 1.6	Thu	11:45–12:15	H 0105	**Role of fluctuations in the selectivity mechanism for the KcsA potassium channel** — •Michael E. Paulaitis, Dilip Asthagiri, Lawrence R. Pratt
SYMP 2.1	Thu	14:00–14:30	H 0105	**DNA mechanics and dynamics** — •Richard Lavery
SYMP 2.2	Thu	14:30–15:00	H 0105	**Charge mobility of discotic mesophases of polyaromatic hydrocarbons: a multiscale quantum/classical study** — •Denis Andrienko
SYMP 2.4	Thu	15:30–16:00	H 0105	**Simulation of coarse-grained membrane models** — •Marcus Müller
SYMP 2.5	Thu	16:00–16:30	H 0105	**Fragments of a computational cell: mesoscopic simulations of soft matter** — •Julian C. Shillcock

Symposium: "Game theory in dynamical systems (SYDN)"

See SYDN for the full program of the Symposium.

SYDN 1.1	Fri	10:10–10:50	H 0105	**Volunteering and Punishment in Public Goods games** — •Christoph Hauert
SYDN 1.8	Fri	12:20–13:00	H 0105	**Inequity Concerns in Social Networks** — •Pablo Branas-Garza

Sessions

DY 1.1–1.7	Mon	10:00–12:00	MA 004	**Critical phenomena and phase transitions**
DY 2.1–2.9	Mon	10:30–13:00	MA 001	**Statistical physics I (general)**
DY 3.1–3.8	Mon	10:30–12:30	A 053	**Statistical physics of complex networks I**
DY 4.1–4.11	Mon	14:00–17:00	MA 004	**Brownian motion and transport**
DY 5.1–5.9	Mon	14:30–16:45	MA 001	**Statistical physics in biological systems (joint session DY/BP)**
DY 6.1–6.4	Mon	14:30–15:30	A 053	**Ferrofluids**
DY 7.1–7.7	Mon	16:30–18:15	A 053	**Time-delayed feedback and neural networks**
DY 8.1–8.6	Mon	17:00–18:30	MA 001	**Superfluidity and Bose Einstein Condensation**
DY 9.1–9.6	Mon	17:00–18:30	MA 004	**Nonlinear dynamics, synchronization and chaos I**
DY 10.1–10.6	Tue	9:30–12:15	MA 001	**Internal Symposium: Controlling Dirty Bosons: Disorder Effects on BECs**
DY 11.1–11.10	Tue	9:30–12:15	EB 407	**Glasses I (joint session DF/DY)**
DY 12.1–12.5	Tue	10:00–11:15	MA 004	**Nonlinear dynamics, synchronization and chaos II**
DY 13.1–13.6	Tue	11:30–13:00	MA 004	**Cardiac dynamics and reaction-diffusion systems**
DY 14.1–14.7	Tue	14:00–16:00	MA 004	**Statistical physics II (general)**
DY 15.1–15.9	Tue	14:30–16:45	MA 001	**Controlling Dirty Bosons: Disorder Effects on BECs**
DY 16.1–16.7	Tue	14:30–16:15	EB 407	**Glasses II (joint session DF/DY)**
DY 17.1–17.59	Tue	16:00–18:00	Poster C	**Poster I**
DY 18.1–18.9	Wed	14:00–16:30	MA 001	**Soft matter**
DY 19.1–19.8	Wed	14:30–16:30	MA 004	**Granular matter I**
DY 20.1–20.7	Wed	14:30–16:15	EB 407	**Glasses III (joint session DF/DY)**
DY 21.1–21.5	Wed	16:45–18:00	MA 001	**Nonlinear dynamics, synchronization and chaos III**
DY 22.1–22.7	Wed	16:45–18:30	MA 004	**Statistical physics of complex networks II**
DY 23.1–23.6	Thu	9:30–11:15	MA 001	**Quantum chaos I**
DY 24.1–24.10	Thu	10:00–12:30	MA 004	**Granular matter II**
DY 25.1–25.5	Thu	11:30–13:00	MA 001	**Fluid dynamics I**
DY 26.1–26.11	Thu	14:00–17:00	MA 001	**Fluid dynamics II**
DY 27.1–27.10	Thu	14:30–17:00	MA 004	**Quantum chaos II**
DY 28.1–28.6	Thu	14:30–16:00	A 060	**Statistical physics far from thermal equilibrium**
DY 29.1–29.72	Thu	16:00–18:00	Poster C	**Poster II**
DY 30.1–30.11	Fri	10:15–13:00	MA 001	**Nonlinear stochastic systems**
DY 31.1–31.11	Fri	10:15–13:00	MA 004	**Quantum dynamics, decoherence and quantum information**

Annual General Meeting of the Dynamics and Statistical Physics Division

Thursday 18:30–19:30 MA 004

Tagesordnung:

- Bericht des Fachverbandsleiters
- Tagungsnachlese
- Verschiedenes

DY 1: Critical phenomena and phase transitions

Time: Monday 10:00–12:00 Location: MA 004

Invited Talk DY 1.1 Mon 10:00 MA 004

The Thermodynamic Casimir Effect: Monte Carlo Results — •Alfred Hucht — Theoretische Physik, Universität Duisburg-Essen, 47048 Duisburg

The thermodynamic Casimir effect describes a force between the boundaries of thin films mediated through long-range fluctuations of the order parameter near a continuous phase transition. This force is universal for a given universality class and boundary condition, and can be attractive or repulsive.

The universal finite size scaling function of the critical Casimir force for the three dimensional XY and Ising universality class with different boundary conditions is determined using Monte Carlo simulations [1]. The results are in excellent agreement with recent experiments on ^{4}He Films at the superfluid transition [2] and with experiments on binary liquid mixtures [3].

[1] A. Hucht, Phys. Rev. Lett. 99, 185301 (2007).
[2] R. Garcia and M. H. W. Chan, Phys. Rev. Lett. 83, 1187 (1999).
[3] M. Fukuto *et al.*, Phys. Rev. Lett. 94, 135702 (2005).

DY 1.2 Mon 10:30 MA 004

Autocorrelation times and the parallel tempering algorithm — •Elmar Bittner, Andreas Nussbaumer, and Wolfhard Janke — Institut für Theoretische Physik, Universität Leipzig, Postfach 100 920, 04009 Leipzig, Germany

We introduce a new update schema for systematically improving the efficiency of parallel tempering Monte Carlo simulations by taking the temperature dependence of autocorrelation times into account. In contrast to previous attempts the temperature is fixed and chosen in such a way that the acceptance rate for all adjacent replica is about 50%. We show that by adopting the numbers of local updates between the parallel tempering moves, the round-trip times of a replica between the lowest and the highest temperatures is significantly increased, and therefore, the efficiency of the parallel tempering algorithm is considerably improved. As examples we show results for the two-dimensional Ising model and the three-dimensional Edwards-Anderson spin glass.

DY 1.3 Mon 10:45 MA 004

Spin-1/2 XX chain with three-site interactions: Dynamic properties — •Joachim Stolze[1], Oleg Derzhko[2], Taras Krokhmalskii[2], and Taras Verkholyak[2] — [1]Institut für Physik, TU Dortmund, Germany — [2]Institute for Condensed Matter Physics, L'viv, Ukraine

We consider a spin-1/2 XX chain in a transverse (z) field with (XZX+YZY)-type three-site interactions. After performing the Jordan-Wigner transformation to spinless fermions, these interactions induce only a (real) next-nearest-neighbor hopping of spinless fermions preserving the exact solvability of the problem. We focus on dynamic properties of the model in its various ground-state phases. We report a closed-form expression for the zz dynamic structure factor and for some other dynamic structure factors all of which are governed by a two-fermion (particle-hole) excitation continuum. We examine the properties of the two-fermion excitation continuum (boundaries, soft modes, van Hove singularities). The xx dynamic structure factor is governed by many-fermion excitations. We report both analytical (in the high-temperature limit and in the zero-temperature strong-field regime) and numerical results for this dynamic structure factor. Throughout our study we discuss in some detail those features of the dynamic structure factors which indicate the presence of the three-site interactions.

This research was supported by a NATO collaborative linkage grant (CBP.NUKR.CLG 982540, project "Dynamic Probes of Low-Dimensional Quantum Magnets").

DY 1.4 Mon 11:00 MA 004

Negative-weight percolation — •Oliver Melchert and Alexander K. Hartmann — Institut für Physik, Universität Oldenburg, 26111 Oldenburg

We describe a percolation problem on lattices, with edge weights drawn from disorder distributions that allow for weights of either sign, i.e. including negative weights. We are interested whether there are spanning paths or loops of total negative weight. This kind of percolation problem is fundamentally different from conventional percolation problems, e.g. it does not exhibit transitivity, hence no simple definition of clusters, and several spanning paths/loops might coexist in the percolation regime at the same time. To study this percolation problem numerically, one has to perform a non-trivial transformation of the original graph and apply sophisticated matching algorithms.

Here, we study the corresponding percolation transitions on large square and cubic lattices for two types of disorder distributions and determine the critical exponents. The results show that negative-weight percolation is in a different universality class compared to conventional bond/site percolation. On the other hand, negative-weight percolation seems to be related to the ferromagnet/spin-glass transition of random-bond Ising systems, at least in two dimensions.

DY 1.5 Mon 11:15 MA 004

Multifractality of self-avoiding random walks on percolation cluster — •Viktoriya Blavatska[1,2] and Wolfhard Janke[2] — [1]Institute for Condensed Matter Physics of the National Academy of Sciences of Ukraine, Lviv, Ukraine — [2]Institut für Theoretische Physik, Universität Leipzig, Leipzig, Germany

The model of self-avoiding walks (SAWs) on disordered lattice perfectly describes the universal properties of long flexible polymer chains in porous media. In our study, disordered lattice is exactly at the percolation threshold. Applying the pruned-enriched Rosenbluth chain-growth method (PERM), we perform numerical simulations of SAWs on the backbone of the incipient percolation cluster in two, three and four dimensions. Considering higher order correlations of SAWs, we study the multifractal properties of the model. Our results bring about the estimates of critical exponents, governing the scaling laws of configurational properties of SAWs.

DY 1.6 Mon 11:30 MA 004

Molecular Dynamics simulations of the phase separation of polymer solutions in thin film geometry — •Katarzyna Bucior, Leonid Yelash, and Kurt Binder — Institute of Physics, Johannes-Gutenberg University of Mainz, Mainz, Germany

We use a coarse-grained model of hexadecane dissolved in supercritical carbon dioxide to simulate the phase separation, initiated by quenching a system into an unstable region of the phase diagram, e.g. by temperature or pressure jumps. The parameters of the model are fitted to reproduce critical parameters of hexadecane and carbon dioxide. The study is performed in slit like pores, formed by two infinite parallel walls consisting of spherical particles.

We present the typical results for the observed time evolutions during phase separation for this model, structure factors, snapshot pictures, density profiles, density distributions. Since the behavior of the system depends on the distance from the wall, we calculate some properties in layers parallel to the walls. The time dependence of the characteristic domain size is also discussed.

DY 1.7 Mon 11:45 MA 004

Investigation of adsorption of star polymers in the framework of massive field theory approach — •Zoryana Usatenko — Leibniz Institute for Polymer Research Dresden e.V., 01069 Dresden, Germany — Institute for Condensed Matter Physics, NAS Ukraine, 79011 Lviv, Ukraine

Adsorption on a planar repulsive and "inert" wall of a star polymer with f arms with the same length immersed in a good solvent are studied on the basis of renormalization group field theoretical approach directly in d=3 dimensions for one-loop order. The performed scaling analysis is based on formal analogy between the polymer adsorption problem and the equivalent problem of critical phenomena in the semi-infinite n-vector model (in the limit $n \to 0$) with a planar boundary. The case of a center adsorbed star and star polymer with two adsorbed arm ends are considered. We have calculated the configuration-number exponents $\gamma(f)$ for center adsorbed star and $\gamma_{II}(f)$ for two ends adsorbed star polymer. The obtained results for critical exponents are compared with results obtained in the framework of ϵ - expansions. We also calculated the mean force between free star polymer and surface.

DY 2: Statistical physics I (general)

Time: Monday 10:30–13:00 Location: MA 001

DY 2.1 Mon 10:30 MA 001

Variational Resummation of Effective Potential in Φ^4-Theory with Proper Goldstone Modes — •Sonja Overesch[1], Axel Pelster[2], and Hagen Kleinert[1] — [1]Fachbereich Physik, Freie Universität Berlin, Arnimallee 14, 14195 Berlin, Germany — [2]Fachbereich Physik, Universität Duisburg-Essen, Lotharstraße 1, 47048 Duisburg, Germany

The Hartree-Fock-Bogoliubov approximation, which is very good for electrons, cannot be applied to a Bose gas in the condensed phase since it makes Goldstone modes massive. We investigate this problem within $O(N)$-symmetric Φ^4-Theory by performing a resummation of the renormalized two-loop effective potential in $D = 3$ dimensions by *Variational Perturbation Theory* (VPT). Using both a longitudinal and a transversal mass as two independent variational parameters, we obtain a resummed effective potential which preserves the Goldstone theorem. Since it takes simultaneously Hartree-, Fock-, and Bogoliubov channels into account, VPT can be regarded as a proper generalization of the Hubbard-Stratonovich transformation to all values of N.

DY 2.2 Mon 10:45 MA 001

Dynamics of the Bose-Einstein condensation: analogy with the collapse dynamics of a classical self-gravitating Brownian gas — •Julien Sopik[1], Clément Sire[2], and Pierre-Henri Chavanis[2] — [1]Jacobs University, Bremen, Germany — [2]Laboratoire de Physique Théorique, Toulouse, France

We investigate the dynamical properties in momentum space of the condensation of a gas of free bosons strongly coupled with a thermal bath. Since the temperature is kept fixed, we describe the Bose-Einstein condensation in the canonical ensemble. The dynamics of this condensation process exhibits striking analogies with the collapse dynamics of a self-gravitating Brownian system. We discuss these similarities and we compare our results with those of other works.

DY 2.3 Mon 11:00 MA 001

Comparison of arbitrary orthogonal, unitarily and unitary-symplectic invariant random matrix ensembles and supersymmetry — •Mario Kieburg and Thomas Guhr — University Duisburg-Essen, Faculty Physics, Theoretical Physics, research group Guhr

Supersymmetry is nowadays an indispensable tool for studies of models in mesoscopic physics and of random matrix models. It has been shown recently in [J.Phys. A39 (2006) 13191-13224] that the supersymmetry method can be generalized to arbitrary unitarily invariant random matrix ensembles. In this presentation we will extend this approach to the models of orthogonal and unitary-symplectic invariance. Connections and differences to the method of superbosonization presented in [arXiv:0707.2929v1, math-ph (2007)] will be discussed.

DY 2.4 Mon 11:15 MA 001

Untersuchungen über die inverse verallgemeinerte Mittag-Leffler-Funktion — •Thomas Müller[1] und Rudolf Hilfer[1,2] — [1]ICP, Universität Stuttgart, 70569 Stuttgart, Germany — [2]Institut für Physik, Universität Mainz, 55099 Mainz, Germany

Fraktionale Differenzialgleichungen gewinnen in der Physik zunehmend an Bedeutung, beispielsweise bei der Beschreibung von Relaxationsprozessen glasartiger Stoffe [1] oder in anomalen Diffusionsprozessen [2]. Hierbei spielt die verallgemeinerte Mittag-Leffler-Funktion eine herausragende Rolle, ähnlich der der Exponentialfunktion bei herkömmlichen Differenzialgleichungen. Sie wurde bereits in der Vergangenheit eingehend beschrieben und numerisch berechnet [3]. Nun wurde zum ersten Mal die inverse verallgemeinerte Mittag-Leffler-Funktion in der komplexen Ebene für verschiedene Parameter ausführlich untersucht, beschrieben und visualisiert. Es wurden die Haupt- und Nebenzweige sowie deren Schnitte und Verzweigungspunkte definiert.

[1] R. Hilfer, Chem. Phys., **284**, 399 (2002)
[2] R. Hilfer und L. Anton, Phys. Rev. E, **51**, 848 (1995)
[3] R. Hilfer und H.J. Seybold, Integral Transforms and Special Functions, **17**, 637 (2006)

DY 2.5 Mon 11:30 MA 001

The effect of shear flow on conductivity of polymer-carbon nanotube composites: an anisotropic percolation theory — •Fedor Semeriyanov, Marina Grenzer, and Gert Heinrich — Leibniz-Institut für Polymerforschung, Hohe Str. 6, D-01069 Dresden, Germany

In explaining the conductivity properties of carbon-nanotube (CNT) polymer composites the percolation approach looks the most suitable. The objective of the study is to investigate the effect of shear flow on formation of the percolating cluster of CNTs that spans in the direction of the preferred orientation. We consider a system of rods dispersed in a homogenous media in which the orientational order is induced by the shear flow. The problem is theoretically approached by a random contact model making use of a shear-dependent excluded volume per rod. The anisotropic percolation probability is calculated on Husimi cactus, an infinitely ramified fractal lattice. A detailed comparison of the results for conductivity to those for viscosity as a function of shear rate near percolation threshold is done, providing an insight into the role of orientational order.

DY 2.6 Mon 11:45 MA 001

Temperature-dependent self-avoiding walks on Sierpinski carpets — •Miriam Fritsche[1], H. Eduardo Roman[2], and Markus Porto[1] — [1]Institut für Festköperphysik, Technische Universität Darmstadt, Hochschulstr. 8, 64289 Darmstadt, Germany — [2]Dipartimento di Fisica, Universitá di Milano - Bicocca, Piazza della Scienza 3, 20126 Milano, Italia

Self-avoiding walks (SAWs) on fractal structures constitute a valuable model of polymers absorbed on a disordered surface and give intriguing insights in their statistical properties. We study the temperature-dependent structural behaviour of self-avoiding walks on two-dimensional Sierpienski carpets [1]. Thereby, the Sierpinski carpet defines two types of sites with energy 0 and $\epsilon > 0$, respectively, yielding a deterministic fractal energy landscape with 'infinite ramification'. In the limiting cases of temperature $T \to 0$ and $T \to \infty$, the known behaviours of SAWs on Sierpinsky carpets and on regular square lattices, respectively, are recovered. For finite temperatures, the structural behaviour is found to be intermediate between the two limiting cases. The characteristic exponents, however, display a non-trivial dependence on temperature.

[1] M. Fritsche, H.E. Roman, and M. Porto, Phys. Rev. E (in print)

DY 2.7 Mon 12:00 MA 001

Phase transitions from saddle points of the potential energy landscape — •Michael Kastner — Physikalisches Institut, Universität Bayreuth, 95440 Bayreuth

The relation between saddle points of the potentials of classical many-particle systems and the analyticity properties of thermodynamic functions is studied. For finite systems, each saddle point is found to cause a nonanalyticity in the entropy, and the functional form of this nonanalytic term can be derived explicitly. With increasing system size, the order of the nonanalytic term grows unboundedly, leading to an increasing differentiability of the entropy. Nonetheless, a distribution of an unboundedly growing number of saddle points may cause a phase transition in the thermodynamic limit. Analyzing the contribution of the saddle points to the density of states in the thermodynamic limit, conditions on the distribution of saddle points and their curvatures are derived which are necessary for a phase transition to occur. For several spin models, the absence or presence of a phase transition is predicted from saddle points and their local curvatures in microscopic(!) configuration space.

DY 2.8 Mon 12:15 MA 001

Adjusting dynamic material properties by a thermostat — •Christoph Junghans, Matej Praprotnik, and Kurt Kremer — Max-Planck-Institut für Polymerforschung, Ackermannweg 10, D-55128 Mainz, Germany

An advanced thermostat for molecular dynamics is proposed, which on the one side keeps the stabilizing and hydrodynamic properties, but on the other side allows to control the dynamic properties of the system. This extension of the dissipative particle dynamics thermostat [1] treats the friction for the transversal and longitudinal components of the relative velocities of interacting pairs separately and enables to adjust diffusion constant and shear viscosity to the desired value. Numerical studies on Lennard-Jones fluid and the TIP3P water model show a very sensitive dependency of the viscosity and diffusion constant on the strength of the friction [2].

[1] T. Soddemann, B. Dünweg and K. Kremer, *Phys. Rev. E* **68**, 046702 (2003).
[2] C. Junghans, M. Praprotnik and K. Kremer, *Soft Matter* 2008, DOI:10.1039/b713568h.

Invited Talk DY 2.9 Mon 12:30 MA 001

New Results on Water in Bulk, Nanoconfined, and Biological Environments — •H. Eugene Stanley — Department of Physics, Boston University, Boston, MA 02215 USA

This talk will introduce some of the 63 unsolved mysteries of water, and will demonstrate some recent progress in solving them combining information provided by water in bulk, nanoconfined, and biological environments. In particular, we will present evidence from experiments designed to test the hypothesis that water displays "polymorphism" in that it can exist in two different phases. The concept of liquid polymorphism is also proving useful in understanding some of the anomalies of other liquids with local tetrahedral symmetry, such as silicon, silica, and carbon.

In particular, the talk will discuss changes in dynamic transport properties [1], and water in biological environments, including a possible physical explanation for the phenomenon known as the protein glass transition [2].

[1] P. Kumar, S. V. Buldyrev, S. L. Becker, P. H. Poole, F. W. Starr, and H. E. Stanley, "Relation between the Widom line and the Breakdown of the Stokes–Einstein Relation in Supercooled Water," Proc. Natl. Acad. Sci. USA 104, 9575-9579 (2007).
[2] P. Kumar, Z. Yan, L. Xu, M. G. Mazza, S. V. Buldyrev, S.-H. Chen. S. Sastry, and H. E. Stanley, "Glass Transition in Biomolecules and the Liquid-Liquid Critical Point of Water," Phys. Rev. Lett. 97, 177802 (2006).

DY 3: Statistical physics of complex networks I

Time: Monday 10:30–12:30 Location: A 053

DY 3.1 Mon 10:30 A 053

Global Ownership: Unveiling the Structures of Real-World Complex Networks — •James Glattfelder, Stefano Battiston, and Frank Schweitzer — Chair of Systems Design, ETH Zurich, Switzerland

The empirical analysis of complex networks is often limited to the case of undirected graphs. However, there is a richer structure to be discovered by incorporating additional knowledge of the network under study, namely the orientation and weights of edges next to state variables associated with the vertices, serving as proxies for real-world quantities. The networks of shareholding relationships of quoted companies in selected countries serve as an example of how topological and weighted observables show different statistical properties. In addition to the generalization of standard network measures, new statistical quantities are introduced which heavily rely on the aforementioned hallmarks. The empirical analysis presented here yields fine-grained insights into real-world networks, where edges and vertices carry auxiliary information.

DY 3.2 Mon 10:45 A 053

The Phase Diagram of Random Threshold Networks — •Agnes Szejka, Tamara Mihaljev, and Barbara Drossel — Institut für Festkörperphysik, TU Darmstadt, Hochschulstrasse 6, 64289 Darmstadt, Germany

Threshold networks are used as models for neural or gene regulatory networks. They show a rich dynamical behavior with a transition between a frozen and a chaotic phase. We investigate the phase diagram of randomly connected threshold networks with real-valued thresholds h and a fixed number of input nodes per node. The nodes are updated according to the same rules as in a model of the cell-cycle network of *Saccharomyces cereviseae* [PNAS **101**, 4781 (2004)], which successfully reproduces the overall dynamical properties of the real network. Using the annealed approximation, we derive expressions for the time evolution of the proportion of active nodes in the network and for the average sensitivity of nodes to changes of the states of their input nodes. The results are compared with simulations of quenched networks. We find that the fact that with this update schema nodes do not change their state when the sum of their inputs is equal to the threshold value, leads to deviations of the dynamical behavior of quenched systems from the one predicted by the annealed approximation.

DY 3.3 Mon 11:00 A 053

The Critical Line in Random Threshold Networks with Inhomogeneous Thresholds — •Thimo Rohlf — Santa Fe Institute, 1399 Hyde Park Road, Santa Fe, NM 87501, USA — Max-Planck Institute for Mathematics in the Sciences, Inselstrasse 22, D-04103 Leipzig

We calculate analytically the critical connectivity K_c of Random Threshold Networks (RTN) for homogeneous and inhomogeneous thresholds, and confirm the results by numerical simulations. We find a super-linear increase of K_c with the (average) absolute threshold $|h|$, which approaches $K_c(|h|) \sim h^2/(2\ln|h|)$ for large $|h|$, and show that this asymptotic scaling is universal for RTN with Poissonian distributed connectivity and threshold distributions with a variance that grows slower than h^2. Interestingly, we find that inhomogeneous distribution of thresholds leads to increased propagation of perturbations for sparsely connected networks, while for densely connected networks damage is reduced; the cross-over point yields a novel, characteristic connectivity K_d. Further, damage propagation in RTN with in-degree distributions that exhibit a scale-free tail k_{in}^{γ} is studied; we find that a decrease of γ can lead to a transition from supercritical (chaotic) to subcritical (ordered) dynamics. Last, local correlations between node thresholds and in-degree are introduced. Here, numerical simulations show that even weak (anti-)correlations can lead to a transition from ordered to chaotic dynamics, and vice versa. Interestingly, in this case the annealed approximation fails to predict the dynamical behavior for sparse connectivities $\bar{K}$, even for large networks with $N > 10^4$ nodes.

DY 3.4 Mon 11:15 A 053

Asynchronous Random Boolean Networks — •Florian Greil and Barbara Drossel — Institut für Festkörperphysik, Technische Universität Darmstadt

Random Boolean networks (RBNs) were introduced by Stuart Kauffman nearly 40 years ago as a simple model for gene regulation. The dynamics of such systems is characterized by attractors, the properties of which can be best understood when the nodes are classified into frozen, nonfrozen and relevant nodes. The latter are arranged in relevant components which determine the dynamics. This talk shows that the properties of the attractors depend on the way how the nodes are updated. We discuss deterministic asynchronous and stochastic updating schemes for critical RBNs. Compared to synchronous parallel update, asynchronous updating schemes generally reduce the attractor numbers, while the number of states belonging to an attractor usually increases.

DY 3.5 Mon 11:30 A 053

Long-term Evolution of Boolean Network Populations — •Tamara Mihaljev and Barbara Drossel — Institut für Festkörperphysik, Technische Universität Darmstadt, Hochschulstraße 6, 64289 Darmstadt

We investigate the evolution of populations of Random Boolean Networks under the influence of a selection pressure for higher robustness (i.e., a higher probability to return to the same attractor after perturbing one node), and of random mutations (addition and deletion of links, change of update functions). We find that already after a short time the populations reach a state of high fitness. When the population is evolved for much longer times, the mean fitness decreases slowly, and so does the proportion of networks with highest fitness, although the selection pressure remains the same. We ascribe such long-term changes to the fact that even after reaching a state of high fitness evolution slowly drives the populations into regions of network space that are far away from those reached first.

DY 3.6 Mon 11:45 A 053

Modelling Paradigms for Random Movements on com-

plex networks: How "anti-hubs"control dispersa — •Vasily Yu. Zaburdaev[1,2], Marc Timme[2,3], and Dirk Brockmann[2,4] — [1]Technische Universit"at, Berlin — [2]Max-Planck-Institute for Dynamics and Self-Organization, Göttingen — [3]Bernstein Center for Computational Neuroscience, Göttingen — [4]Northwestern University, Evanston IL, USA

Recently a huge number of studies focused on dynamical properties of stochastic processes evolving on networks of complex topology. Very often, researchers strive to understand whether, how and why highly connected nodes (hubs) in scale free networks accelerate relaxation and change the dynamics qualitatively. In all models of physical dispersal phenomena, the topology of the network as defined by a weight matrix w_{ij} is translated into transition probability rates $p_{ij} = w_{ij}/\sum_i w_{ij}$ that define the random process such that waiting times are independent of node degree (system A).

This relationship between topology and dynamics, appealing as it may seem, is by no means unique. In fact for a number of physical systems it is appropriate to interpret weights directly as probability rates, i.e. $p_{ij} = w_{ij}$ (system B). Here we show that both systems exhibit drastically different dynamical properties: Contrary to the common notion that hubs are the key players in dispersal facilitation, nodes with few connections determine the relaxation properties more strongly, an effect that generically arises in type B systems.

DY 3.7 Mon 12:00 A 053

A Monte Carlo method for generation of random graphs — •Bartlomiej Waclaw[1], Leszek Bogacz[2], Zdzislaw Burda[2], and Wolfhard Janke[1] — [1]Institut für Theoretische Physik, Universität Leipzig, Vor dem Hospitaltore 1, 04103 Leipzig, Germany — [2]Faculty of Physics, Astronomy and Applied Informatics, Jagellonian University, Reymonta 4, 30-059 Krakow, Poland

Random graphs are widely used for modeling the Internet, transportation, biological or social networks. Many models, based on some simple rules for growth and rewiring of links, have been proposed to explain their specific structural features as for instance power-law degree distribution and small diameter. However, to study dynamical phenomena taking place on networks with a given structure, it is desirable to have a general algorithm which produces a variety of random graphs. The method presented here is based on a random walk in the space of graphs. By ascribing to each graph a certain statistical weight we can set up a sort of Markovian process that generates networks with the desired probability. One can change their typical properties by tuning the weight function and thus to generate networks of different types. The method works for both growing and maximal-entropy graphs, that is graphs which are maximally random for a given constraint. Various properties, like power-law degree distribution, degree-degree correlations or higher clustering can be easily obtained. The method is very flexible and allows for further improvement, e.g. multicanonical simulations.

DY 3.8 Mon 12:15 A 053

(Un)detectable cluster structure in sparse networks — •Jörg Reichardt[1] and Michele Leone[2] — [1]Universität Würzburg, Institut f. Theoretische Physik — [2]ISI Foundation, Torino, Italy

We study the problem of recovering a known cluster structure in a sparse network, also known as the planted partitioning problem, by means of statistical mechanics. We find a sharp transition from unrecoverable to recoverable structure as a function of the *separation* of the clusters. For multivariate data, such transitions have been observed frequently, but always as a function of the *number of data points* provided, i.e. given a large enough data set, two point clouds can always be recognized as different clusters, as long as their separation is non-zero. In contrast, for the sparse networks studied here, a cluster structure remains undetectable even in an infinitely large network if a critical separation is not exceeded. We give analytic formulas for this critical separation as a function of the degree distribution of the network and calculate the shape of the recoverability-transition. Our findings have implications for unsupervised learning and data-mining in relational data bases and provide bounds on the achievable performance of graph clustering algorithms.
Ref.: pre-print: http://arxiv.org/abs/0711.1452

DY 4: Brownian motion and transport

Time: Monday 14:00–17:00 Location: MA 004

Invited Talk DY 4.1 Mon 14:00 MA 004

Entropic particle transport — •Gerhard Schmid, P. Sekhar Burada, and Peter Hänggi — Institut für Physik, Universität Augsburg, D-86135 Augsburg

We show that transport in the presence of entropic barriers exhibits peculiar characteristics which makes it distinctly different from that occurring through energy barriers. The constrained dynamics yields a scaling regime for the particle current and the diffusion coefficient in terms of the ratio between the work done to the particles and available thermal energy [1]. The problem is analyzed under the perspective of the Fick-Jacobs equation which accounts for the effect of the lateral confinement by introducing an entropic barrier in a one dimensional diffusion. The validity of this approximation, being based on the assumption of an instantaneous equilibration of the particle distribution in the cross-section of the structure, is analyzed by comparing the different time scales that characterize the problem. A validity criterion is established in terms of the shape of the structure and of the applied force [2].

[1] D. Reguera, G. Schmid, P. S. Burada, J. M. Rubi, P. Reimann, and P. Hänggi, Phys. Rev. Lett. **96**, 130603 (2006)
[2] P. S. Burada, G. Schmid, D. Reguera, J. M. Rubi, and P. Hänggi, Phys. Rev. E **75**, 051111 (2007)

DY 4.2 Mon 14:30 MA 004

Active Brownian particles and Nosé-Hoover thermostats — •Rainer Klages — School of Mathematical Sciences, Queen Mary, University of London, UK

Active Brownian particles refer to a theory that is used in order to model the self-propelled motion of biological entities such as, for example, cells migrating on substrates. For this purpose the friction coefficient of ordinary Langevin dynamics is assumed to be velocity dependent, representing the take-up of energy from some external reservoir and its conversion into kinetic energy. Other well-known generalizations of Langevin equations are deterministic thermal reservoirs for which the Nosé-Hoover thermostat is a simple example. I will show that these two seemingly different concepts are quite related to each other. Particularly, I will focus onto the origin of crater-like velocity distributions, which are produced by both types of generalized Langevin dynamics. Starting from Nosé-Hoover thermostats, I will argue that the crater-like shapes can be understood in terms of a combination of canonical with microcanonical distributions.

Ref.: R.Klages, Microscopic chaos, fractals and transport in nonequilibrium statistical mechanics (World Scientific, Singapore, 2007), Chapter 16.

DY 4.3 Mon 14:45 MA 004

Conformational Subdiffusion in Peptides — •Thomas Neusius[1], Igor M. Sokolov[2], and Jeremy C. Smith[3] — [1]Interdisziplinäres Zentrum für wissenschaftliches Rechnen (IWR), Ruprecht-Karls-Universität Heidelberg, Im Neuenheimer Feld 368, D-69120 Heidelberg — [2]Institut für Physik, Humboldt-Universität zu Berlin, Newtonstraße 15, D-12489 Berlin — [3]Center for Molecular Biophysics, Oak Ridge National Laboratory, P.O. Box 2008, Oak Ridge TN 37831-6164, USA

There has been recent interest in the dynamics of both folding and folded proteins and the relation of protein dynamics to biological function. Among the dynamical aspects of biomolecules anomalous conformational diffusion, in particular subdiffusion, has attracted a lot of attention both in experimental [1] and theoretical [2] works. Subdiffusion can be seen in relativly small molecules such as peptides. Molecular dynamics simulation of peptides extending to several microseconds can provide the basis for a better understanding of conformational subdiffusion and the underlying mechanisms.

[1] S. C. Kou and X. Sunney Xie, Phys. Rev. Lett. **93**, 180603 (2004); W. Min, G. Luo, B. J. Cherayil, S. C. Kou, and X. Sunney Xie, Phys. Rev. Lett. **94**, 198302 (2005); G. Luo, I. Andricioaeli, X. Sunney Xie and M. Karplus, J. Phys. Chem. B **110**, 9363 (2006).

[2] G. R. Kneller and K. Hinsen, J. Chem. Phys. **121**, 10278 (2004); G. R. Kneller, PCCP **7**, 2641 (2005); R. Granek and J. Klafter, Phys. Rev. Lett. **95**, 098106 (2005).

DY 4.4 Mon 15:00 MA 004

The diffusion coefficient of nonlinear Brownian motion — •Benjamin Lindner — Max-Planck-Institute for the Physics of Complex Systems, Dresden, Germany

Nonequilibrium biological systems like moving cells or bacteria have been phenomenologically described by Langevin equations of Brownian motion in which the friction function depends on the particle's velocity in a nonlinear way. In my talk I present an exact result for the diffusion coefficient of such a nonlinear Brownian motion for simple cases (Rayleigh friction, SET model, and powerlaw friction). I discuss under which conditions the diffusion can be minimized at a finite noise intensity. REFS: Lindner New J. Phys. 9 , 136 (2007); Lindner J. Stat. Phys. (in press, 2007)

DY 4.5 Mon 15:15 MA 004

Random walks with random velocities — •Vasily Zaburdaev, Michael Schmiedeberg, and Holger Stark — Institut für Theoretische Physik, Technische Universität Berlin, Hardenbergstr. 36, D-10623 Berlin, Germany

We consider a random walk model that takes into account the velocity distribution of random walkers. Random motion with alternating velocities is inherent to various physical and biological systems. Despite the obvious importance and potential applications, such a model has not been considered before. Here, we derive transport equations describing the dispersal process in the model and solve them analytically. The asymptotic properties of solutions are presented in the form of a phase diagram that shows all possible scaling regimes, including superdiffusive, ballistic and superballistic motion. Theoretical results of this work are in excellent agreement with accompanying numerical simulations.

DY 4.6 Mon 15:30 MA 004

Branched Flow and Caustics in Random Media — •Jakob J. Metzger, Ragnar Fleischmann, and Theo Geisel — Max-Planck-Institute for Dynamics and Self-Organization, Göttingen, Germany

Classical particles as well as quantum mechanical waves exhibit complex behaviour when propagating through random media. One of the surprising features of the dynamics in correlated, weak disorder potentials is the appearance of branches in the flow. This can be observed in several physical systems, most notably in the electron flow in two-dimensional electron gases [1].

We show that the branching is due to the formation of caustics and present advances in the theoretical understanding and numerical simulation of the caustics. We compare our results to existing theoretical models. In particular, we study the statistics of the first appearance of a caustic along a trajectory.

[1] e.g. Topinka, M. A. et. al. Nature, 2001, 410, 183-186; Jura, M. P. et. al. Nat Phys, advanced online publication, Nov. 2007

DY 4.7 Mon 15:45 MA 004

Diffusive Processes on Fractals — •Janett Prehl[1], Do H. N. Anh[1], Karl Heinz Hoffmann[1], and Sujata Tarafdar[2] — [1]Institut für Physik, Technische Universität Chemnitz, D-09107 Chemnitz — [2]Condensed Matter Physics Research Center, Jadaypur University, Kolkata 700 032, India

Anomalous diffusion processes are of great interest in natural science as well as in many applications, like diffusion in disordered media such as porous rocks, cements, or biological tissues. In order to model anomalous diffusion random walks on regular fractals or the master equation approach are usually used. Describing diffusion phenomena in porous material the complex structure of these media has to be taken into account. As an appropriate model for the observed material structure we apply Sierpinski carpets with finite iteration depth [1] and we attempt to capture the randomness of the material by mixing Sierpinski carpet generators randomly [2,3]. Besides we consider biased diffusion of charged particles in an external field in such models. Analyzing the diffusive process 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)
[3] D. Anh, et al., *J. Phys. A: Math. Theor.*, **40**, 11453 (2007)

DY 4.8 Mon 16:00 MA 004

Anomalous escape kinetics due to thermal 1/f noise — •Igor Goychuk and Peter Hänggi — Institut für Physik, Universität Augsburg, Germany

We present an analytic study for subdiffusive escape of overdamped particles out of a cusp-shaped parabolic potential well which are driven by thermal, fractional Gaussian noise with a $1/\omega^{1-\alpha}$ power spectrum. This long-standing challenge becomes mathematically tractable by use of a generalized Langevin dynamics via its corresponding non-Markovian, time-convolutionless master equation: We find [1] that the escape is governed asymptotically by a power law whose exponent depends *exponentially* on the ratio of barrier height and temperature. This result is in distinct contrast to a description with a corresponding subdiffusive fractional Fokker-Planck approach; thus providing experimentalists an amenable testbed to differentiate between the two escape scenarios.

[1]I. Goychuk and P. Hänggi, Phys. Rev. Lett. **99**, 200601 (2007).

DY 4.9 Mon 16:15 MA 004

Realization of a Brownian ratchet based on a ferrofluid sample — •Thomas John and Ralf Stannarius — Otto-von-Guericke-Universität Magdeburg

We demonstrate an experimental ratchet system where thermal fluctuations plays a necessary role. The system is a suspension of nano-sized ferrite particles (ferrofluid) in a time dependent magnetic field. We use the sensitivity of this suspension to magnetic fields and construct a system where the ratchet is a time periodic, orientational asymmetric magnetic potential. This potential rectifies the stochastic motion of the ferrite particles. Depending on the shape of the potential a macroscopic torque is measured on the sample. Results of our measurements are compared with a microscopic model (Engel et al.).

[1] A. Engel et al., PRL 91, 060602 (2003).
[2] A. Engel and Peter Reimann, PRE 70, 051107 (2004).

DY 4.10 Mon 16:30 MA 004

Ratchet effect caused by internal degree of freedom — •Sebastian von Gehlen, Mykhaylo Evstigneev, and Peter Reimann — Universität Bielefeld, Universitätsstraße 25, 33615 Bielefeld

A dimer consisting of two dissimilar components is considered. It is assumed that the two dimer components are in contact with the same heat bath and find themselves in periodic potentials of the same wavelength but different amplitudes modulated synchronously in time. It is shown that this model exhibits the ratchet effect, i.e., directed transport in the absence of any external bias. An accurate analytic approximation for the dimer's velocity and diffusion coefficient is obtained. The system exhibits phenomena similar to stochastic resonance and resonant activation: its velocity is maximized by adding an optimal amount of noise and by tuning the driving frequency to an optimal value. Furthermore, there exists an optimal coupling strength at which the velocity is the largest.

DY 4.11 Mon 16:45 MA 004

Deterministic Relativistic Josephson vortex ratchet: new results — •Edward Goldobin, Reinhold Kleiner, and Dieter Koelle — Physikalisches Institut – Experimentalphysik II and Center for Collective Quantum Phenomena, University of Tübingen, Auf der Morgenstelle 14, D-72076 Tübingen, Germany

We investigate a deterministic relativistic Josephson vortex ratchet[1,2] — a fluxon in an asymmetric periodic potential driven by a deterministic force with zero time average. Our previous experiments[3] showed that such a ratchet exhibits several non-adiabatic effects such as quantized rectification, fractional dynamics, and voltage reversal. We also observed an anomalously high average fluxon velocity which, up to now, could not be explained theoretically.

In this talk we present new results in the non-adiabatic regime and also investigate efficiency and loading capability of this kind of deterministic relativistic Josephson vortex ratchet.

[1] E. Goldobin et al. Phys. Rev. E **63**, 031111 (2001).
[2] G. Carapella, Phys. Rev. B **63**, 54515 (2001).
[3] M. Beck et al., Phys. Rev. Lett. **95**, 090603 (2005).

DY 5: Statistical physics in biological systems (joint session DY/BP)

Time: Monday 14:30–16:45 Location: MA 001

DY 5.1 Mon 14:30 MA 001

Point Mutations Effects on Charge Transport Properties of the Tumor-Suppressor Gene p53 — •Rudolf A. Roemer[1], Chi-Tin Shih[2], and Stpehan Roche[3] — [1]Department of Physics and Centre for Scientific Computing, University of Warwick, Gibbet Hill Road, Coventry, CV4 7AL, UK — [2]Department of Physics, Tunghai University, 40704 Taichung, Taiwan — [3]CEA/DSM/DRFMC/SPSMS, 17 avenue des Martyrs, 38054 Grenoble, France

We report on a theoretical study of point mutations effects on charge transfer properties in the DNA sequence of the tumor-suppressor p53 gene. On the basis of effective tight-binding models which simulate hole propagation along the DNA, a statistical analysis of mutation-induced charge transfer modifications is performed. In contrast to non-cancerous mutations, mutation hotspots tend to result in significantly weaker changes of transmission properties. This suggests that charge transport could play a significant role for DNA-repairing deficiency yielding carcinogenesis.

DY 5.2 Mon 14:45 MA 001

A simple model for spike timing dependent plasticity — Heinz Georg Schuster and •Jörg Mayer — Institute of Theoretical Physics and Astrophysics University of Kiel, D-24098 Kiel, Germany

Several experimental results indicate that the strength of cortical synaptic connections varies in dependence of the relative timing of pre- and postsynaptic spikes. We introduce a simple time discrete model of spike timing dependent plasticity. In our model the strength of synapses is increased if the timing of pre and postsynaptic spikes occur causal and decreased if they occur anti-causal. For reasons of convergence we further introduce a leakage term in the dynamics of the synapses. We find that stochastic independent input leads to a phase transition and further observe coherence resonance in dependence of the amplitude of the input noise. Further we derive the equations of motion for the mean field activity analytically.

DY 5.3 Mon 15:00 MA 001

Self-organized critical control in human behavior — •Felix Patzelt, Markus Riegel, Udo Ernst, and Klaus Pawelzik — Institute of Theoretical Neurophysics, University of Bremen, Bremen, Germany

When humans perform closed loop control tasks like in upright standing or while balancing a stick, their behavior exhibits non-Gaussian fluctuations with long-tailed distributions. We investigated if they might be caused by self-organized critical noise amplification which emerges in control systems when an unstable dynamics becomes stabilized by an adaptive controller that has finite memory. We generalized the basic model of self-organized critical control and compared it with experimental data from human control behavior. Our results suggest, that the nervous system involved in closed loop motor control nearly optimally estimates system parameters on-line from very short epochs of past observations. We discuss possible microscopic implementations of this principle in neuronal networks and multi-agent models which reveal its potential for explaining power law behavior in other physical systems.

DY 5.4 Mon 15:15 MA 001

Panic reactions and global disease dynamics — •Rafael Brune[1], Christian Thiemann[1], Bernd Blasius[2], Theo Geisel[1,4], and Dirk Brockmann[1,3] — [1]Max-Planck-Institute for Dynamics and Self-Organization, Göttingen — [2]Georg-August-University, Göttingen — [3]ICBM, Oldenburg — [4]Northwestern University, Evanston IL, USA

We analyze spatially extended disease dynamics in a system in which individuals change their dispersal characteristics in response to the local infection level. The key question is to what extent infectious wave front dynamics and the time course of the global infection change in response to host awareness and individuals trying to avoid infection by increased dispersal. We investigate two qualitatively different responses to the local degree of infection. In one system (panic reaction) the local diffusion coefficient increases with the concentration of infecteds, in the other system (directed reaction) indivuals drift proportional to infection level gradients. For both systems we develop a mean field model. Although one expects that the invididual rationale of avoiding an epidemic wave mitigates disease dynamics we find extended parameter regimes in which this rationale actually facilitates epidemic spread. Finally we investigate the dynamics of a fully stochatic system in which the effects prevail but which also show an increased extinction probability of the epidemic as a function of increasing dispersal response.

DY 5.5 Mon 15:30 MA 001

Drift reversal in asymmetric coevolutionary conflicts: Influence of the microscopic processes and the population size — •Jens Christian Claussen — Theoret. Phys. & Astrophys., Univ. Kiel

Coevolutionary dynamics in finite populations is investigated in chemical catalysis, biological evolution, social and economic systems; often formulated within the unifying framework of evolutionary game theory. From a payoff matrix characterizing the elementary interactions, traditionally evolutionary game theory proeceeds with the (deterministic) replicator equation ansatz tacitly assuming an infinite population size, In contrary, in finite populations the dynamics is inherently stochastic which can lead to new effects. In asymmetric conflicts between two populations with a cyclic dominance, a finite-size dependent drift reversal recently was demonstrated, depending on underlying microscopic process of the evolutionary update. Cyclic dynamics appears widely in biological coevolution, be it within a homogeneous population, or be it between disjunct populations (asymmetric conflicts) as female and male. Here the average drift is calculated analytically for the frequency-dependent Moran process and for different pairwise comparison processes. It is explicitely shown that the drift reversal cannot occur if the process relies on payoff differences between pairs of individuals. Further, also a linear comparison with the average payoff does not lead to a drift towards the internal fixed point. Hence the nonlinear comparison function of the frequency-dependent Moran process, together with its usage of nonlocal information via the average payoff, is essential for the (meta)stability of the internal fixed point.

DY 5.6 Mon 15:45 MA 001

Bilateral interactions in disease dynamics - Decreasing epidemic thresholds with facilitated contact rates — •Alejandro Morales Gallardo[1], Dirk Brockmann[1,3], and Theo Geisel[1,2] — [1]Max-Planck-Institute for Dynamics and Self-Organization, Göttingen — [2]Georg-August-University , Göttingen — [3]Northwestern University, Evanston IL, USA

Compartmental epidemiological models are very successful modeling paradigms in epidemiology. Typically, they are used for quantitative assessments of key parameters such as the basic reproduction number R_0. These models rest on two key assumptions: 1.) a population is well mixed 2.) transmission is triggered by a population averaged contact rate. However, experimental evidence shows that contact rates vary substantially, and it has been hypothesized that this variability can change the dynamics of population relevant disease dynamics. However, for inhomogeneous populations the translation of distributed contact rates into effective disease transmission events is non-trivial. Transmission may either depend only on the contact rate of the transmitting individual alone (unilateral transmission), or on the contact rates of transmitting and receiving individual (bilateral transmission). In the SIS model we show that in either systems the endemic state of a disease can be stable for values of $R_0 < 1$ unlike homogeneous systems with a critical value $R_0 = 1$. Furthermore, bilateral contact dynamics entail parameter regimes in which a stable endemic state can cease to exist if the mean contact rate is increased, an unexpected effect absent in homogeneous populations.

DY 5.7 Mon 16:00 MA 001

Continuous description of a contact diffusion spread: complete separation of variables and the approximate analytical solution — •Eugene Postnikov[1], Uta Naether[2], and Igor Sokolov[2] — [1]Lehrstuhl für Theoretische Physik, Staatliche Universität Kursk, Russland — [2]Institut für Physik, Humboldt - Universität zu Berlin, Deutschland

Despite of a century of thorough work, the problem of mathematical description of spread of an epidemic is still an actual question. In the present contribution we present the analytical considerations on the PDE system describing an SIR epidemic spread reproducing the realistic asymmetric Kendall waves of infection as well as to verify the analytical solution by stochastic simulations. The model system as comprises three kinds of individuals (or cells with the perfect mixing of individuals inside) which are the susceptible (S), the infected (I), and the removed (R) ones. The probability for a cell to be infected can only change in case the cell is susceptible and depends on the number of its infected nearest-neighbors.

We show that the corresponding system of PDEs allows for a complete separation of variables. Moreover the solutions for I and R are given in a closed form if the solution for S is known. The autonomous equation for S admits the approximate analytical solutions for a wide range of parameters including the regions of a strong non-linearity.

The results of our analytical treatment are compared with direct Monte-Carlo simulations as well as with real epidemiological data on the epidemic among the harbor seals in Wadden Sea and Baltic Sea.

DY 5.8 Mon 16:15 MA 001

The effects of bidirectional host movements on infectious disease dynamics — •Vitaly Belik[1], Benjamin Schwenker[1], Theo Geisel[1,2], and Dirk Brockmann[1,3] — [1]MPI for Dynamics and Self-Organization, Göttingen — [2]Georg-August-University, Göttingen — [3]Northwestern University, Evanston IL, USA

Reaction-Diffusion equations such of the Fisher-Kolmogorov-Petrovsky-Piskunov (FKPP) type are widely applied in the context of spatial dynamics of directly transmitted diseases. This ansatz assumes that host individuals perform random walks or diffuse in space. Although this approach may find applications for animal host systems, its validity must be questioned for human infectious diseases. Although humans visit various places, they subsequently return to their abode thus performing bidirection movements on starlike topologies. Ordinary reaction and diffusion models are therefore not adequate for description of human spatial disease dynamics. We propose a stochastic model in which individuals can travel between their home and distant locations. We establish a link between explicit travel behavior of individuals and effective coupling among populations. We derive and analyze corresponding mean-field equations for the epidemic spread, which are structurally different from FKPP equation, e.g. diffusion and reaction are no longer uncoupled. The dependence of the front speed of the epidemic wave on the travelling rate is bounded from above, contrary to the common reaction-diffusion case, where it can attain any value. Our analysis is supported by agent based simulation of the full stochastic model.

DY 5.9 Mon 16:30 MA 001

From Cannibalism to Active Motion — •Pawel Romanczuk and Lutz Schimansky-Geier — Humboldt Universität zu Berlin, Newtonstr. 15, 12489 Berlin

The detailed mechanisms leading to collective dynamics in animal and insects groups are still poorly understood. A recent study by Simpson et. al. suggests cannibalism as a driving mechanism for coordinated migration of mormon crickets [1].

Based on this result we propose a simple generic model of brownian particles interacting by asymmetric, non-conservative collisions accounting for the cannibalistic behaviour and the corresponding avoidance strategy. We discuss our model in one and two dimensions and show that a certain type of collisions drives the system out of equilibrium and leads to coordinated active motion of groups.

[1] Stephen J. Simpson, Gregory A. Sword, Patrick D. Lorch and Iain D. Couzin: *Cannibal crickets on a forced march for protein and salt*, PNAS, 103:4152-4156, 2006

DY 6: Ferrofluids

Time: Monday 14:30–15:30 Location: A 053

DY 6.1 Mon 14:30 A 053

The Rosensweig instability in thermoreversible 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]. According to Bohlius et al. [2], the famous Rosensweig instability should also be possible in ferrogels. Compared to the pure ferrofluid, the critical magnetic field is shifted to higher values due to elastic forces, and the critical wavenumber remains 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 6.2 Mon 14:45 A 053

Ground state structures in ferrofluid monolayers: theory and simulations — •Sofia Kantorovich[1,2], Taisiya Prokop'eva[2], Victor Danilov[2], and Christian Holm[1,3] — [1]MPI-P, Ackermannweg 10, D-55128, Mainz, Germany — [2]USU, Lenin av. 51, 620083, Ekaterinburg, Russia — [3]FIAS, Ruth-Moufang-Str 1, D-60438, Frankfurt am Main, Germany

A combination of analytical calculations and Monte Carlo simulations was used to find the ground state structures in ferrofluid monolayers. Taking into account the magnetic dipole-dipole interaction between all particles in the system, and treating ferroparticles as hard spheres, we found different topological structures that were probable for low temperatures. It turned out that among the most energetically advantageous are rings, double rings and vortex structures. However, we have shown a single ideal ring to be the most probable ground state structure for a ferrofluid monolayer. We compared extensively theoretical predictions to the results of computer simulations and found them to be in a very nice agreement.

DY 6.3 Mon 15:00 A 053

Reorientation of a Ferrofluidic Torsional Pendulum Observed in an Oscillating Magnetic Field — •Harald Brendel[1], Reinhard Richter[1], Ingo Rehberg[1], and Mark Shliomis[2] — [1]Experimentalphysik V, Universität Bayreuth, D-95444 Bayreuth — [2]Ben Gurion University of the Negev, Beer Sheva, Israel

Recently a new type of torsional pendulum was proposed [1] which we realize by suspending a disc shaped container in a Helmholtz pair of coils driven by an alternating sinusoidal current. The container is suspended with its long axis in line with the fiber. In contrast to a spherical pendulum [2,3] the orientation of the disc is sensitive both to the field direction and the field frequency: It should expose its edge to the field vector of low oscillating field and its broad side to the field vector of high frequency. Unfortunately, this reorientation (FLIP) can hardly be realized for available ferrofluids because of their polydispersity. But with help of an additional constant magnetic field, which is orientated perpendicular to the oscillating one, the FLIP of the pendulum can be observed. In this case one is able to tune the FLIP frequency by varying the amplitude of the help field. This effect is a physical mechanism in principal, which should occur in electrical polarized matter, too.

[1] M.I. Shliomis, M.A. Zaks, *Phys. Rev. E*, **73**, 066208 (2006).
[2] A. Engel, H.W. Müller, P. Reimann, and A. Jung, *Phys. Rev. Lett.* **91**, 060602 (2003).
[3] M.I. Shliomis, M.A. Zaks, *Phys. Rev. Lett.*, **93**, 047202 (2004).

DY 6.4 Mon 15:15 A 053

Rolling ferrofluid drop on the surface of a liquid — •Verena Sterr[1], Konstantin Morozov[2], and Andreas Engel[1] — [1]Institut für Physik, Carl von Ossietzky Universität Oldenburg, 26111 Oldenburg — [2]Institute of Continuous Media Mechanics, 1 Korolev Street, 614013 Perm, Russia

A ferrofluid drop ($\varnothing \sim$ mm) floats on the surface of a viscous non-magnetic liquid. Due to the properties of ferrofluids, an external magnetic field, whose vector rotates in a plane orthogonal to the fluid surface, makes the drop rotate and "roll"over the surface with velocity $\mathbf{v}_{\rm drop}$. This drift velocity is determined by use of a simplifying model which treats the ferrofluid drop either as a solid sphere (a) or as a liquid half-sphere (b). The velocity fields are expanded in vector spherical harmonics and the result $\mathbf{v}(r, \vartheta, \varphi)$ for $r \to \infty$ gives $\mathbf{v}_{\rm drop}$ in terms of experimental parameters.

In case a), the usual no-slip boundary condition is employed at the sphere surface which leads to a logarithmically diverging viscous torque, so that the last boundary condition cannot be used. In order to relieve the singularity, the Navier slip condition is applied, which allows for a finite velocity at the sphere surface and leads to a result for the drop speed which, however, depends on an unknown parameter, the slip length. Calculations for case b) are more complex, but the result does not depend on any unknown parameters.

Considering the simplifications of this model, the agreement with experimental data is surprisingly accurate.

DY 7: Time-delayed feedback and neural networks

Time: Monday 16:30–18:15 Location: A 053

DY 7.1 Mon 16:30 A 053

Stabilizing continuous-wave output in semiconductor lasers by time-delayed feedback methods — •Thomas Dahms, Philipp Hövel, and Eckehard Schöll — Institut f. Theor. Physik, Sekr. EW 7-1, Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin, Germany

Time-delayed feedback methods have been widely used to control unstable dynamics in a huge variety of different fields ranging from chemical to optical systems. In the latter case, the time-delayed feedback can be realized experimentally by an optical resonator [1]. We present an application of a multiple time-delayed feedback scheme to a semiconductor laser system with undamped relaxation oscillations implemented as a model of Lang-Kobayashi type. We show that the control method is able to enhance the range of local stability of the lasing fixed point leading to continuous-wave operation by suppression of unwanted intensity pulsations. This local enhancement matches our findings on a generic normal-form model [2], but due to the self-feedback, multistable behavior can also occur in the form of delay-induced limit cycles and fixed points for certain choices of the control parameters.

[1] S. Schikora, P. Hövel, H. J. Wünsche, E. Schöll, and F. Henneberger: *All-optical noninvasive control of unstable steady states in a semiconductor laser*, Phys. Rev. Lett. **97**, 213902 (2006).
[2] T. Dahms, P. Hövel, and E. Schöll: *Control of unstable steady states by extended time-delayed feedback*, Phys. Rev. E **76**, 056201 (2007).

DY 7.2 Mon 16:45 A 053

Controlling noise–induced oscillations by time–delayed feedback — •Clemens von Loewenich and Hartmut Benner — Institut für Festkörperphysik, Technische Universität Darmstadt, Germany

Noise-induced oscillations have been observed in an electronic van der Pol oscillator just below the Hopf bifurcation, where the noisefree system still has a stable fixed point. In previous investigations it was shown both analytically and numerically that these oscillations can be controlled by time-delayed feedback, which allows to maximize their correlation time on variation of delay time, feedback strength and noise intensity [1,2].

The experimental implementation of this model turned out to be a rather delicate problem, in particular, to achieve a variation of the noise level over several orders of magnitude. Nevertheless we were able to confirm the main theoretical predictions: Correlation time and power spectrum were measured for different delay times and feedback strengths over a noise intensity range of about 30 dB. The power spectrum of the delayed-feedback circuit exhibits the typical multi-peak structure predicted. The correlation time, in fact, shows a dramatic feedback-induced increase which fits the theory even quantitatively.

[1] N. B. Janson et al., Phys. Rev. Lett. **93**, 010601 (2004)
[2] J. Pomplun et al., Europhys. Lett. **71**, 366 (2005)

DY 7.3 Mon 17:00 A 053

Suppression of pulses in excitable media by delayed nonlocal coupling — •Felix M. Schneider, Markus A. Dahlem, and Eckehard Schöll — Institut f. Theor. Physik, Sekr. EW 7-1, Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin, Germany

We investigate a FitzHugh-Nagumo system with diffusion in 1D close to the excitation limit. This serves a model of spatio-temporal neural excitation patterns in the cortex emerging from pathological pathways, e.g. during migraine, seizure, or stroke. We apply a range of control algorithms based on time-delayed feedback transmitted spatially along nonlocal connectivity patterns. We show through simulations that for different control schemes activity can be restricted to the pathological part of the network. Some control schemes reflect the nature of interneuronal cortical connections, where on short distances connections from inhibitory interneurons dominate, while on an intermediate range excitatory, lateral connections prevail.

DY 7.4 Mon 17:15 A 053

Observing global properties of time-delayed feedback control with an unstable controller — •Hiroyuki Shirahama[1,2], Klaus Höhne[1], Hartmut Benner[1], and Wolfram Just[3] — [1]Institut für Festkörperphysik, TU Darmstadt,, 64289 Darmstadt, Germany — [2]Faculty of Education, Ehime University, Matsuyama 790-8577, Japan — [3]Queen Mary/University of London, School of Mathematical Sciences, London E1 4NS, UK

Time-delayed feedback control is a simple, robust and efficient tool to stabilize unstable periodic orbits embedded in strange attractors of chaotic systems. Early analytical investigations indicated that unstable orbits with an odd number of real unstable modes cannot be stabilized by this method [1]. To overcome this limitation the counterintuitive idea of an unstable control loop has been proposed [2]. By including an additional unstable mode into the control loop one artificially enlarges the set of real multipliers greater than unity to an even number. We demonstrate the feasibility of an unstable control loop to stabilize such torsion-free orbits in an electronic circuit experiment. Analytical normal form calculations and numerical simulations reveal a severe dependence of the control performance on the coupling scheme of the control force. These predictions are confirmed by the experiment and emphasize the importance of the coupling scheme for the global control performance [3].

[1] H. Nagajima, Phys. Lett. A **232**, 207 (1997)
[2] K. Pyragas, Phys. Rev. Lett. **86**, 2265 (2001)
[3] K. Höhne et al., Phys. Rev. Lett. **98**, 214102 (2007)

DY 7.5 Mon 17:30 A 053

Control of neural dynamics by extended time-delayed feedback — •Philipp Hövel, Markus A. Dahlem, and Eckehard Schöll — Institut f. Theo. Physik, Sekr. EW 7-1, Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin, Germany

We investigate the cooperative dynamics of two muually coupled neural populations represented by two FitzHugh-Nagumo systems. Both populations are prepared at parameter values at which no self-sustained oscillations occur, and both are subject to independent sources of Gaussian white noise. In order to influence the cooperative dynamics measured, for instance, by quantities like the coherence, ratio of average interspike intervals, and synchronization, we apply a local, external stimulation modelled as extended time-delayed feedback. This method was originally proposed to stabilize unstable periodic orbits of deterministic systems and generates a feedback signal from the differences of multiple time delays. Depending on the control parameters such as time delay, feedback strength, and memory parameter, we expect stronger effects on the coherence, time scales, and synchronization of coupled neural oscillators compared to control schemes with only a single time delay.

DY 7.6 Mon 17:45 A 053

Delay sustained pattern formation in subexcitable media — •Martin Gassel, Erik Glatt, and Friedemann Kaiser — Institute of Applied Physics, TU Darmstadt, Germany

In the last decades a lot of investigations on the dynamics of nonlinear systems and their control have been done. Many of them focus on time-delayed feedback control, a widely used method to achieve a qualitative change in the system dynamics. Pyragas introduced a feedback control scheme to stabilize an unstable orbit of a chaotic attractor to control deterministic chaos. In other investigations time-delayed feedback is used to control the coherence of noise-induced oscillations or to suppress limit cycle oscillations (amplitude death). In the present contribution the influence of time-delayed feedback on pattern formation in subexcitable media represented by a net of FitzHugh-Nagumo elements is studied. Without feedback wave fronts, which are either induced by special initial conditions or by additive noise, die out after a short propagation length (subexcitable net dynamics). Applying time-delayed feedback with appropriate feedback parameters pattern formation is sustained and the wave fronts may propagate through the whole net. The coherence of the patterns and the life time of the wave fronts are investigated dependent on the feedback strength and the delay time. It is shown that both the coherence of the patterns and the life time of the wave fronts are significantly larger, if feedback with appropriate parameters is applied.

DY 7.7 Mon 18:00 A 053

Control of delay-induced oscillatory firing patterns — •Gerald Hiller, Sebastian Brandstetter, Philipp Hövel, Markus A. Dahlem, and Eckehard Schöll — Institut für Theoretische Physik, Technische Universität Berlin

Using the FitzHugh-Nagumo model as a prototypical example of an excitable system, we investigate the emergence of oscillatory firing patterns as a result of delayed coupling between two units. The compound system becomes a bistable system being either at rest or in a state of sustained mutually driven oscillation.

We apply Pyragas' delayed feedback method to control the delay-induced bifurcation that renders the compound system oscillatory. We also investigate the robustness of the oscillator to white noise as well as colored noise and examine the possibility of using either noise or control to trigger the transition between the rest state and the oscillatory state.

DY 8: Superfluidity and Bose Einstein Condensation

Time: Monday 17:00–18:30 Location: MA 001

DY 8.1 Mon 17:00 MA 001

Systematic Semiclassical Approximations for Harmonically Trapped Ideal Bose Gases — •Ben Klünder, Axel Pelster, and Robert Graham — Fachbereich Physik, Universität Duisburg-Essen, Lotharstraße 1, 47048 Duisburg, Germany

Based on the field-theoretic effective action approach, we systematically generalize the usual semiclassical approximation in such a way that its range of applicability is essentially extended. With this we can calculate analytically thermodynamic properties of harmonically confined non-interacting Bose gases in the grand-canonical ensemble also for small particle numbers. Furthermore, it becomes now possible to determine the critical temperature as well as the temperature dependence of heat capacity and condensate fraction in low-dimensional traps, where the standard semiclassical approximation is not applicable.

DY 8.2 Mon 17:15 MA 001

Phase diagram for interacting Bose gases — •Michael Männel[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

From the many-body T-matrix we obtain the condition for a medium-dependent bound state in a Bose gas with contact interaction. This condition, i.e. the phase diagram, is derived from the medium-dependent scattering length and scattering phase as well as from the pole of the T-matrix. Also the binding energy is calculated. By separating the Bose pole from the distribution function the influence of a Bose condensate is measured too.

DY 8.3 Mon 17:30 MA 001

Functional renormalization group analysis of the interacting Bose gas in the symmetry broken phase — •Andreas Sinner, Nils Hasselmann, and Peter Kopietz — Institut für Theoretische Physik, Universität Frankfurt, Max-von-Laue Str.1, 60438 Frankfurt

We investigate the small frequency and momentum structure of the weakly interacting Bose gas in $1 \leq D \leq 3$ within a functional renormalization group approach. Using a variant of the local potential approximation, the $U(1)$ symmetry is automatically obeyed and our approach allows to go beyond the Bogoliubov theory in a consistent manner. The flow equations are derived within a derivative approximation of the effective action up to second order in spatial and temporal variables and investigated numerically. We present further an approach which goes beyond the derivative approximation of the functional renormalization group. It allows to calculate corrections to the Bogoliubov spectrum and to investigate the damping of quasiparticles also at finite momenta.

DY 8.4 Mon 17:45 MA 001

Green's Function Approach to the Bose-Hubbard Model for Finite Temperatures — Henrik Enoksen[1], •Alexander Hoffmann[2], Matthias Ohliger[3], and Axel Pelster[4] — [1]Department of Physics, Norwegian University of Science and Technology, N-7491 Trondheim, Norway — [2]Arnold Sommerfeld Center for Theoretical Physics, Theresienstr. 37, Department Physik, Universität München, 80333 München, Germany — [3]Fachbereich Physik, Freie Universität Berlin, Arnimallee 14, 14195 Berlin, Germany — [4]Fachbereich Physik, Universität Duisburg-Essen, Lotharstraße 1, 47048 Duisburg, Germany

The Green's function for bosons in an optical lattice is determined in the Mott phase within a finite-temperature hopping expansion up to the second order in the tunnel matrix element. This allows us to reconstruct in a qualitative way the time-of-flight absorption pictures, which are taken after the optical lattice is switched off. Furthermore, investigating the divergence of the Green's function, we can locate the boundary between the superfluid and the Mott phase for finite temperatures. Whereas the first-order calculation reproduces the seminal mean-field result, the second order goes beyond and shifts the phase boundary in the immediate vicinity of the critical parameters determined by Monte-Carlo simulations of the Bose-Hubbard model.

DY 8.5 Mon 18:00 MA 001

The chemical potential for the inhomogeneous electron liquid in terms of its kinetic and potential parts with special consideration of the surface potential step and BCS-BEC crossover — •Klaus Morawetz[1,2], Norman H. March[3,4,5], and Richard H. Squire[6] — [1]Institute of Physics, Chemnitz University of Technology, 09107 Chemnitz, Germany — [2]Max Planck Institute for the Physics of Complex Systems, Noethnitzer Str. 38, 01187 Dresden, Germany — [3]Department of Physics, University of Antwerp, Belgium — [4]Oxford University, Oxford, England — [5]Abdus Salam International Centre for Theoretical Physics, Trieste, Italy — [6]Department of Chemistry, West Virginia University, Montgomery, WV25136, USA

The chemical potential μ of a many-body system is valuable since it carries fingerprints of phase changes. Here, we summarize results for μ for a three-dimensional electron liquid in terms of average kinetic and potential energies per particle. The difference between μ and the energy per particle is found to be exactly the electrostatic potential step at the surface. We also present calculations for an integrable one-dimensional many-body system with delta function interactions, exhibiting a BCS-BEC crossover. It is shown that in the BCS regime the chemical potential can be expressed solely in terms of the ground-state energy per particle. A brief discussion is also included of the strong coupling BEC limit.
Physics Letters A, In Press,
http://dx.doi.org/10.1016/j.physleta.2007.10.025

DY 8.6 Mon 18:15 MA 001

Functional renormalization group approach to the Anderson impurity model: partial bosonization in two competing channels — •Jose Juan Ramos Cardenas and Peter Kopietz — Institut für Theoretische Physik, Universität Frankfurt, Germany

We take into account the dominant singularities in two competing interaction channels of strongly interacting Fermi systems via a generalization of the collective field functional renormalization group approach developed by Schütz, Bartosch and Kopietz [Phys. Rev. B **72**, 035107 (2005)]. Our method is based on the introduction of two independent bosonic Hubbard-Stratonovich fields describing competing collective fluctuations of the underlying Fermi system. As an application, we study the Anderson impurity model where the interference between the spin-singlet particle-hole and particle-particle channels is essential to correctly describe the strong-coupling crossover to the Fermi-liquid regime at energy scales below the Kondo temperature.

DY 9: Nonlinear dynamics, synchronization and chaos I

Time: Monday 17:00–18:30 Location: MA 004

DY 9.1 Mon 17:00 MA 004

Self-induced oscillations in an optomechanical system — •Clemens Neuenhahn[1,2], Maximilian Ludwig[1,2], Constanze Metzger[3], Alexander Ortlieb[2], Ivan Favero[4], Khaled Karrai[2], and Florian Marquardt[1,2] — [1]Arnold-Sommerfeld Center for Theoretical Physics — [2]Center for Nanoscience and Departement of Physics, Ludwig-Maximilians Universität München, Munich, Germany — [3]Boston University, Electrical and Computer Engineering, Boston, MA 02215, USA — [4]Université Paris Diderot, Laboratoire Matériaux et Phénomènes Quantiques, Bâtiment Condorcet, 75205 Paris CEDEX 13

We have explored the nonlinear dynamics of an optomechanical system consisting of an illuminated Fabry-Perot cavity, one of whose end-mirrors is attached to a vibrating cantilever. Such a system can experience negative light-induced damping and enter a regime of self-induced oscillations. We present a systematic experimental and theoretical study of the ensuing attractor diagram in an experimental setup where the oscillation amplitude becomes large, and the mirror motion is influenced by several optical modes. A theory has been developed that yields detailed quantitative agreement with experimental results. This includes the observation of a regime where two mechanical modes of the cantilever are excited simultaneously.

DY 9.2 Mon 17:15 MA 004

Synchronization and Desynchronization in Chaotic Map Networks — •Mirko Schäfer[1] and Martin Greiner[2] — [1]Frankfurt Institute for Advanced Studies (FIAS), Ruth-Moufang-Straße 1, 60438 Frankfurt am Main, Germany — [2]Corporate Technology, Information Communications, Siemens AG, 81730 München

We study the dynamics of coupled Tchebycheff maps on networks as a function of the coupling parameter. Various network topologies are considered. We are interested in a characterization of the respective coupling regimes where maximum synchronization or desynchronization is reached. The latter case may have some relevance to the standard model of elementary particles.

DY 9.3 Mon 17:30 MA 004

Multivariate Characterisation of Spatially Heterogeneous Phase Synchronisation — •Reik Donner — TU Dresden, Andreas-Schubert-Str. 23, 01062 Dresden, Germany

Over the last decades, the emergence of synchronisation phenomena in complex networks has attracted considerable interest. In particular, phase synchronisation phenomena of coupled oscillators have be observed in a variety of systems. In this contribution, we discuss how phase synchronisation can be properly detected in the case of multi-component systems. Whereas the traditional approach has exclusively considered averages of bivariate synchronisation measures, in the recent years, different approaches to synchronisation cluster analysis have been proposed. Some of these methods are reviewed and thoroughly compared. In particular, we discuss the potential importance of different eigenvalue statistics obtained from matrices of pairwise phase coherence measures for the characterisation of spatially heterogeneous or clustered phase synchronisation. Our results are illustrated for networks of phase oscillators as well as the problem of self-organised material flows on networks.

DY 9.4 Mon 17:45 MA 004

Modelling of oscillatory phase separation of binary mixtures under continuous cooling — •Yumino Hayase, Günter K. Auernhammer, and Doris Vollmer — Max Planck Institute for Polymer Research, Mainz, Germany

We investigate the phase separation of binary mixtures under continuously ramping temperature using the Cahn-Hilliard equation including gravity. Our model is motivated by the experimental observation that for a broad range of composition and cooling rates binary mixtures may show pronounced oscillation in the turbidity, i.e. the transition to the biphasic state happens via a cascade of nucleation waves. The number of oscillations and their frequency depend on the choice of the components and the cooling rate [1]. Typically either the upper or the lower phase oscillates and hardly both. To understand the mechanism of oscillation instability we investigate the kinetics of phase separation under continuous cooling using the Cahn-Hilliard equation, the most widely studied model equation for the description of phase separation. To account for sedimentation we have added a mechanism to the C-H equation taking gravity into account. Numerically, we observe oscillatory wave of droplet formation. Depending on the composition and shape of the phase diagram, either both or only one phase oscillates. The oscillation period and the cooling rate have a power law relation. Experimental results support the numerical results very well.

[1] G.K. Auernhammer, D. Vollmer, and J. Vollmer, J. Chem. Phys., 123, 134511 (2005)

DY 9.5 Mon 18:00 MA 004

From Unstable Attractors to Heteroclinic Switching — •Christoph Kirst[1,2,3,4] and Marc Timme[1,2] — [1]Network Dynamics Group, Max Planck Institute for Dynamics and Self-Organization (MPIDS) — [2]Bernstein Center for Computational Neuroscience (BCCN) Göttingen, 37073 Göttingen, Germany — [3]Fakultät für Physik, Georg-August-Universität Göttingen, Germany — [4]DAMTP, Centre for Mathematical Sciences, Cambridge University, Cambridge CB3 0WA, UK

We report the first example of a dynamical system that naturally exhibits two unstable (Milnor) attractors that are completely enclosed by each others basin volume. This counter-intuitive phenomenon occurs in networks of pulse-coupled oscillators with delayed interactions. We analytically and numerically investigate this phenomenon and clarify the mechanism underlying it [1]: Upon continuously removing the non-invertibility of the system, the set of two unstable attractors becomes a set of two non-attracting saddle states that are heteroclinically connected to each other. This transition from a network of unstable attractors to a heteroclinic cycle constitutes a new type of bifurcation in dynamical systems.

[1] C. Kirst and M. Timme, arXiv:0709.3432 (2007)

DY 9.6 Mon 18:15 MA 004

Relaxation oscillations and chaos in the torsional Quincke pendulum — •Michael Zaks[1] and Mark Shliomis[2] — [1]Institut für Physik, Humboldt-Universität zu Berlin — [2]Ben-Gurion University, Beer Sheva, Israel

Let a constant electric field act upon an insulating body suspended into a liquid with low conductivity. If the field is sufficiently strong, the body starts to rotate; this phenomenon is known under the name of Quincke effect. Dynamics of this torsional motion has been recently shown to obey the Lorenz equations, provided the elasticity of suspension is discarded: depending on the field strength, the Quincke rotor exhibits stationary and chaotic rotations. We take elasticity into account and demonstrate that in a certain range of the field intensity the rotor should perform relaxational oscillations with large amplitude. Explicit expressions relate the amplitude and period of oscillations to physical parameters of the problem: intensity of the field, viscosity of the liquid and elasticity of the suspension. In stronger fields the regime of large-scale relaxational oscillations breaks down abruptly and is replaced by minor erratic fluctuations of the pendulum. We explain this transition in terms of the global bifurcations in the Lorenz equations.

DY 10: Internal Symposium: Controlling Dirty Bosons: Disorder Effects on BECs

Time: Tuesday 9:30–12:15 Location: MA 001

Invited Talk DY 10.1 Tue 9:30 MA 001

Localization of interacting ultra cold atoms in a disordered potential — •Alain Aspect[1], David Clément[1], Pierre Lugan[1], Philippe Bouyer[2], Gora Shlyapnikov[1], and Laurent Sanchez-Palencia[1] — [1]Institut d'Optique, Palaiseau, France — [2]LPTMS, Orsay, France

Ultra cold atoms can be placed in disordered potentials produced by laser speckle. Such a correlated potential is very well mastered on the experimental side, and perfectly characterized so that relevant theoretical treatments can be developped. It is a useful toy model to study Anderson localization, and test the influence of interactions.

We will present experimental and theoretical results on 1D localization for a Bose Einstein Condensate placed in a laser speckle disordered potential, as a function of relevant parameters: amplitude and correlation length of the disordered potential, healing length of the BEC...

DY 10.2 Tue 10:00 MA 001

Coherent backscattering of Bose-Einstein condensates from 2D disorder potentials — •Peter Schlagheck — Institut für Theoretische Physik, Universität Regensburg, 93040 Regensburg, Germany

We investigate the quasi-stationary transport of Bose-Einstein condensates through two-dimensional disorder potentials of finite thickness. Our numerical approach is based on the integration of the Gross-Pitaevskii equation in presence of a source term that simulates the continuous injection of matter waves onto the disorder potential. For noninteracting atoms, the constructive interference between reflected semiclassical paths and their time-reversed counterparts leads to a weak localization phenomenon, namely the enhanced backreflection of atoms into the direction that is opposite to the incident beam. We show that this peak of coherent backscattering is inverted and transformed into a dip by the presence of a weak interaction between the atoms. This anti-localization phenomenon is reproduced by analytical calculations of the transport process and can be related to similar nonlinear effects in the scattering of light through disordered atomic media.

Invited Talk DY 10.3 Tue 10:25 MA 001

Ultracold atoms near nanofabricated surfaces — •Jozsef Fortagh — Physikalisches Institut der Universität Tübingen, Auf der Morgenstelle 14, 72076 Tübingen

The research field of ultracold atomic quantum gases in microscopic traps has seen enormous advances within the last few years. State of the art chip fabrication technology is used to realize trapping potentials of various geometries for cold atoms, to control the distance between atoms and a solid surface with high precision, and to construct model potentials for degenerate Bose and Fermi gases. Imperfect fabrication of the field generating elements enters as a disorder in the trapping potential. This may offer novel experimental access to the physics of disordered systems. At the same time, fundamental electromagnetic interactions between atoms and the chip surface become manifest in the attractive Casimir-Polder force between atoms and the surface, and decoherence of atomic spins. These effects have been observed in experiments. I will review experimental techniques on manipulating cold atoms at nanofabricated surfaces, recent experiments on atom-surface interactions, and model experiments on atom interferometry.

Reference:
"Magnetic Microtraps for Ultracold Atoms", J. Fortágh and C. Zimmermann, Rev. Mod. Phys. 79, 235 (2007).

DY 10.4 Tue 10:55 MA 001

Collective Excitations in a Trapped Bose-Einstein Condensate with Weak Quenched Disorder — •Gianmaria Falco[1], Axel Pelster[2], and Robert Graham[2] — [1]Department of Physics, Cologne University, Zülpicher Straße 77, 50937 Köln, Germany — [2]Fachbereich Physik, Universität Duisburg-Essen, Lotharstraße 1, 47048 Duisburg, Germany

We study how the collective mode frequencies of a condensate in a harmonic trap are shifted by the presence of additional weak quenched disorder. To this end we apply the Huang-Meng theory [1,2] to an inhomogeneous condensate in the Thomas-Fermi approximation [3]. This approach describes how local condensates in the minima interfere with the superfluid property of the condensate. We work out in detail the consequences for the hydrodynamic equations. In case of a Gaussian correlated disorder correlation we find that the negative shifts of the collective frequencies for the monopole and the dipole mode decrease rapidly with increasing correlation length. Thus, our theory makes it possible to experimentally test the predictions of the Huang-Meng theory.

[1] K. Huang and H.F. Meng, Phys. Rev. Lett. **69**, 644 (1992)
[2] G.M. Falco, A. Pelster, and R. Graham, Phys. Rev. A **75**, 063619 (2007)
[3] G.M. Falco, A. Pelster, and R. Graham, Phys. Rev. A **76**, 013624 (2007)

Invited Talk DY 10.5 Tue 11:20 MA 001

Disorder in ultracold Fermi-Bose quantum gas mixtures — •Klaus Sengstock — Institut für Laserphysik, Universität Hamburg, Luruper Chaussee 149, 22761 Hamburg

The physics of ultracold gases and Bose-Einstein condensates allows various connections to other fields of physics. Especially the physics of degenerate quantum gases in optical lattices shows similarities to condensed matter systems. Prominent examples are the Mott-insulator transition and e.g. the ferromagnetic and polar phases of Bose Einstein condensates in lattices as well as effects of disorder.

This talk will give an overview on quantum gas physics in optical lattices and focus on the simultaneous trapping of mixtures of fermionic and bosonic atoms in optical lattice potential. We observe e.g. a strong influence of a small concentration of fermionic Potassium atoms on the coherence properties of bosonic Rubidium atoms in a 3D-optical lattice.

DY 10.6 Tue 11:50 MA 001

DMRG Studies of Disordered Bosons — •Ulrich Schollwöck — Institut für Theoretische Physik C, RWTH Aachen

The DMRG method has emerged as a very powerful tool to characterize the phase diagrams of strongly interacting one-dimensional systems with disorder, namely in the case of bosons. In this talk I will present various complementary approaches to study disorder effects in bosonic systems and discuss the phase diagram of a disordered Bose-Hubbard model with a box distribution as well as new results related to other forms of disorder distributions.

DY 11: Glasses I (joint session DF/DY)

Time: Tuesday 9:30–12:15 Location: EB 407

Invited Talk DY 11.1 Tue 9:30 EB 407

Glass freezing in confined geometries studied by DMA — •Wilfried Schranz, Johannes Koppensteiner, and Madalina-Roxana Puica — Faculty of Physics, University of Vienna, Boltzmanngasse 5, A-1090 Wien, Austria

Dynamics in confined surroundings appears in many fields, i.e. in chemistry, physics, biology, material science, etc. Using a dynamic mechanical analyser (DMA) we measured [1] the low frequency elastic response of the glass former salol confined in silica based nanoporous media of various pore sizes (2.5nm to 7.5 nm). In addition to the glass transition of the bulk material of salol we find a second freezing process, showing up in the real and imaginary parts of the complex elastic response. This is explained by a radial distribution of Vogel-Fulcher temperatures inside the pores, an assumption which is consistent with recent computer simulations [2] showing an increase of the molecular relaxation time with decreasing distance from rough pore surfaces. The observed glass transition temperatures decrease with decreasing pore size. The mechanism of the glass transition reduction will be discussed. Acknowledgements: Support by the Austrian FWF (P19284-N20) and the University of Vienna (IK 1022-N) is gratefully acknowledged.

[1] W. Schranz, M.R. Puica, H. Kabelka and A.V. Kityk. Europhys. Lett. 79, 36003 (2007) [2] P. Scheidler, W. Kob and K. Binder, Europhys. Lett. 59, 701 (2002).

DY 11.2 Tue 10:00 EB 407

Confined glass formers in nanoporous materials studied by ^{31}P NMR — •Sabine Gradmann[1], Gilberte Dosseh[2], Christiane Alba Simionesco[2], and Ernst Rössler[1] — [1]Experimentalphysik II, Universität Bayreuth, 95440 Bayreuth, Germany — [2]Laboratoire de Chimie Physique, CNRS-UMR 8000, Bâtiment 349, Université de Paris-Sud, 91405 Orsay, France

We investigate the dynamics of the glass former m-tricresylphosphate (mTCP) confined in the nanoporous matrices CPG, SBA15, MCM41 with different pore sizes, varying in diameter from 4nm up to 300nm, within a temperature range above the glass transition temperature (from 210 K up to 370 K). The performed ^{31}P NMR experiments demonstrate a great change in the relaxation times (T1 and T2) reflecting a significant slowing down of the dynamics for small pore systems in comparison with the bulk. Additionally, a detailed analysis of 1D spectra reveals pronounced dynamic heterogeneities, which we describe by a distribution of correlation times. The width of the latter decreases gradually while approaching the bulk limit. Furthermore, exploiting the large dynamic window of ^{31}P NMR, 2D exchange NMR is applied in order to establish whether the dynamic heterogeneities are of static or transient nature.

DY 11.3 Tue 10:15 EB 407

On the nature of the high-frequency relaxation in a molecular glass former: A joint study of glycerol by field cycling NMR, dielectric spectroscopy and light scattering — •Catalin Gainaru[1], Oliver Lips[2], Anna Troshagina[1], Robert Kahlau[1], Alexander Brodin[1], Franz Fujara[2], and Ernst A. Rössler[1] — [1]Experimentalphysik II, Universität Bayreuth, D-95444 Bayreuth — [2]Inst. f. Festkörperphysik, TU Darmstadt, Hochschulstraße 6, D-64289 Darmstadt

Recently we introduced a new approach to disentangle α-peak and excess wing (EW) contributions in the dielectric spectra of glass formers, assuming that the α-process obeys frequency-temperature superposition (FTS) in the full temperature range above the glass transition temperature T_g. Based on this scenario, a comparison between the orientational correlation functions of rank $l = 1$ (probed by dielectric spectroscopy – DS) and $l = 2$ (probed for the first time over a broad frequency range by field cycling NMR and light scattering – LS) is carried out. For the glass former glycerol DS, NMR and LS spectra are scaled according to FTS over 15 decades in frequency. Significant differences in the spectral shape of the susceptibilities of different ranks are recognized on both sides of the relaxation peak, while the time constants turn out to be the same. Regarding the systematic differences observed at high frequencies, they are explained by assuming that the fast dynamics (EW) proceeds via small angles. Below T_g, NMR and DS reflect the same dynamics down to cryogenic temperatures.

DY 11.4 Tue 10:30 EB 407

Dielectric polarization noise near the glass transition — •Sandra Jenewein, Andreas Fleischmann, Gernot Kasper, Andreas Reiser, and Christian Enss — Kirchhoff-Institut für Physik, Universität Heidelberg, Im Neuenheimer Feld 227, 69120 Heidelberg

Dielectric polarization noise can reveal fundamental information on relaxation processes in glass forming liquids or glasses. We measured the voltage and current noise spectral density in the organic glass former tri-propylene glycol in the vicinity of the glass transition. A home built electrometer amplifier was used to measure the voltage fluctuations of a capacitor filled with the sample. Using a custom built current-to-voltage converter we measured the current fluctuations of the sample. From the noise spectra we determined the dynamic glass transition. Using the fluctuation-dissipation theorem a comparison to frequency domain dielectric spectroscopy will be given.

DY 11.5 Tue 10:45 EB 407

Glassy dynamics in the mono-, di- and trimer of glass-forming propylene glycol — •Melanie Köhler, Robert Wehn, Peter Lunkenheimer, and Alois Loidl — Experimental Physics V, Center for Electronic Correlations and Magnetism, University of Augsburg, 86135 Augsburg

We report broadband dielectric spectra on glass-forming propylene glycol and its di- and trimer. Aside of the α-relaxation, we focus on the dynamics at higher frequencies, which is believed to play an important role for the glass transition. While the monomer of propylene glycol has a well-developed excess wing, a characteristic spectral feature of glassy dynamics beyond the α-relaxation [1], the di-and trimers show a Johari-Goldstein β-relaxation [2]. Interestingly, as revealed by long-time aging experiments performed in our group [1], the excess wing in propylene glycol also can be described as signature of a β-relaxation. The data is analysed in the framework of different models, as the coupling model and the minimal model [3, 4]. In addition we treat the relation between the Cole-Cole peak, recently suggested within an extended version of mode coupling theory [5], and the spectral properties of the experimentally detected β-relaxation in these glass formers. Also first results in the region beyond GHz frequencies, where additional fast processes are expected, are provided. [1] K.L. Ngai *et al.*, J. Chem. Phys. **115**, 1405 (2001). [2] K. Grzybowska *et al.*, J. Chem. Phys. **125**, 044904 (2006). [3] K. L. Ngai, Comments Solid State Phys. 9, 127 (1979). [4] J. C. Dyre, N. B. Olsen, Phys. Rev. Lett. **91**, 155703 (2003). [5] W. Götze and M. Sperl, Phys. Rev. Lett. **92**, 105701 (2004).

DY 11.6 Tue 11:00 EB 407

The high frequency wing of the α-process as probed by depolarized light scattering — •Nikolaus Petzold, Alexander Brodin, and E. A. Rössler — Universität Bayreuth

We show that the "intermediate power law"recently observed in optical Kerr effect (OKE) measurements is equivalent with the excess wing from frequency-domain data long since known from dielectric spectroscopy (DS), and is an equally common feature in depolarised light scattering (DLS). From the OKE representation we find that the wing from OKE and DS data has a temperature independent exponent γ. Based on this behavior, we build a mastercurve from the literature OKE data and transform it into DLS representation. The mastercurve obtained that way fits nicely our DLS data. We are able to obtain a model independent crossover temperature for several liquids (benzophenone BZP, propylene carbonate (PC), glycerol (GY), propylene glycol (PG), ortho-terphenyl (OTP), decahydroisoquinolin (DHIQ)), at which temperature the onset of the wing first appears and which corresponds to a characteristic relaxation time of $\tau_x \approx$ 10ns. In the high temperature range, where no wing is observable, the apparent width of the α-peak correlates with the relaxation strength of the fast dynamics and anticorrelates with fragility opposite to common wisdom.

DY 11.7 Tue 11:15 EB 407

Secondary relaxations in molecular glasses and polymers studied by 2D ^{2}H NMR — •Björn Micko[1], Dieter Bingemann[2], and Ernst Rössler[1] — [1]Experimentalphysik II, Universität Bayreuth, 95440 Bayreuth, Germany — [2]Department of Chemistry, Williams College, Williamstown, MA 01267, USA

We present a two-dimensional (2D) ^{2}H exchange NMR study, attempting to clarify the geometry of the molecular motion involved in the secondary relaxation (β-process) of three glass formers: PMMA, polybutadiene and a mixture of decaline and chlorobenzene. Stimulated echo measurements of the orientational correlation function circumscribe the temperature range, in which the β-process is expected to dominate the spectra. In this range we will show by comparison with the spectra of o-terphenyl, which does not show a pronounced β-process, that the β-process is also clearly observable in the 2D NMR spectra below and somewhat above T_g, until upon further heating the structural relaxation (α-process) enters the time window of the experiment and gives rise to a convergence of the spectra. Whilst the time constants for the studied systems (obtained from dielectric spectrocopy) are very similar on the reduced temperature scale T_g/T, the dielectric relaxation strength differs for each system. In contrast the 2D NMR spectra turn out to be practically identical on the T_g/T scale - which implies strong similarities concerning time scale and underlying geometry of the motion. To get further insight on the reorientation angles involved, simple motional models will be compared against the spectra.

DY 11.8 Tue 11:30 EB 407

Raman scattering in glasses and the boson peak — •Bernhard Schmid[1] and Walter Schirmacher[2] — [1]FB Physik, Univ. Mainz — [2]Phys.-Dept. TU München

Vibrational spectra of glasses as measured e.g. by inelastic neutron scattering exhibit at low frequencies (∼ 1THz) an enhancement over Debye's ω^2 law ("boson peak"). Using a theory of light scattering from disordered materials developed recently [1,2], we show that the anomalous low-frequency Raman spectra observed in this frequency regime are *not* proportional to the density of states (as was widely believed) but are related to the disorder-induced self-energy function. The latter, in turn, can be related to the width of the Brillouin line in the same frequency regime.

[1] B. Schmid, Diploma thesis, TU München, 2007
[2] B. Schmid and W. Schirmacher, to be published

DY 11.9 Tue 11:45 EB 407

Fractional approaches in dielectric broadband spectroscopy — •Simon Candelaresi[1] and Rudolf Hilfer[1,2] — [1]ICP, Universität Stuttgart, 70569 Stuttgart, Germany — [2]Institut für Physik, Universität Mainz, 55099 Mainz, Germany

A fractional approach is used to describe data from dielectric spectroscopy for several glassy materials. Using composite fractional time evolution propagators [1] a modified law for relaxation in glasses [2] is found that describes the experimental data for broadband dielectric spectroscopy [3]. Properties and solutions of some particular fractional differential equations (fDEQs) are investigated both for rational and irrational order. The laws of Debye, Kohlrausch, Cole-Cole, Cole-Davidson and Havriliak-Negami are compared with this new approach in frequency and time space.

[1] R. Hilfer; Time, Quantum and Information, L.Castell and O.Ischebeck (Eds.); Springer-Verlag Berlin 2003 p.235
[2] R. Hilfer Chemical Physics, **284**, 399 (2002)
[3] U. Schneider et al., Phys. Rev. E, **59**, 6924 (1999)

DY 11.10 Tue 12:00 EB 407

Collective atomic dynamics and relaxation processes in Al_2O_3 melt — •Sandro Jahn[1] and Paul A. Madden[2] — [1]GeoForschungsZentrum Potsdam, Telegrafenberg, 14473 Potsdam — [2]Chemistry Department, University of Edinburgh, Edinburgh EH9 3JJ, UK

The atomic dynamics of Al_2O_3 melt are studied by molecular dynamics simulation. The particle interactions are described by an advanced ionic interaction model that includes polarization effects and ionic shape deformations. The model has been shown to reproduce accurately the static structure factors $S(Q)$ from neutron and x-ray diffraction and the dynamic structure factor $S(Q,\omega)$ from inelastic x-ray scattering. Analysis of the partial dynamic structure factors show inelastic features in the spectra up to momentum transfers, Q, close to the principal peaks of partial static structure factors. The broadening of the Brillouin line widths is discussed in terms of a frequency dependent viscosity $\eta(\omega)$.

DY 12: Nonlinear dynamics, synchronization and chaos II

Time: Tuesday 10:00–11:15 Location: MA 004

DY 12.1 Tue 10:00 MA 004

Decelerating microdynamics accelerates macrodynamics in the voter model — Hans-Ulrich Stark, Claudio Juan Tessone, and •Frank Schweitzer — Chair of Systems Design,ETH Zurich, Switzerland

We study an extension to the standard voter model, in which voters have an individual inertia to change their state. We assume that this inertia increases with the time a voter has been in its current state. Increasing the level of inertia in the system decelerates the microscopic dynamics. Counter-intuitively, we find that the time to reach a macroscopic ordered state can be accelerated for intermediate levels of inertia. This is true for different network topologies, including fully-connected ones. We derive a mean-field approach that shows that the origin of this phenomenon is the break of the magnetization conservation because of the evolving inertia. We find that the dynamics near the ordered state is governed by two competing processes, which stabilize either the majority or the minority of voters. If the first one dominates, it accelerates the ordering of the system.

DY 12.2 Tue 10:15 MA 004

Tunable Fermi acceleration in the driven elliptical billiard — •Florian Lenz[1], Fotis K. Diakonos[2], and Peter Schmelcher[1,3] — [1]Physikalisches Institut, University of Heidelberg, Philosophenweg 12, 69120 Heidelberg, Germany — [2]Department of Physics, University of Athens, GR-15771 Athens, Greece — [3]Theoretische Chemie, Physikalisch-Chemisches Institut, University of Heidelberg, Im Neuenheimer Feld 229, 69120 Heidelberg, Germany

We explore the dynamical evolution of an ensemble of non-interacting particles propagating freely in an elliptical billiard with harmonically driven boundaries. The existence of Fermi acceleration is shown thereby refuting the established assumption that smoothly driven billiards whose static counterparts are integrable do not exhibit acceleration dynamics. The underlying mechanism based on intermittent phases of laminar and stochastic behavior of the strongly correlated angular momentum and velocity motion is identified and studied with varying parameters. The diffusion process in velocity space is shown to be anomalous and we find that the corresponding characteristic exponent depends monotonically on the breathing amplitude of the billiard boundaries. Thus it is possible to tune the acceleration law in a straightforwardly controllable manner.

DY 12.3 Tue 10:30 MA 004

Deterministic escape of a dimer over an anharmonic potential barrier — •Simon Fugmann, Dirk Hennig, and Lutz Schimansky-Geier — Institut für Physik, Humboldt-Universität Berlin, Newtonstrasse 15, 12489 Berlin, Germany

We consider the deterministic escape dynamics of a dimer from a metastable state over an anharmonic potential barrier. The underlying dynamics is conservative and noiseless. The dimer consists of two particles coupled through a spring. Its motion takes place in a two-dimensional plane. Each of the constituents for itself is unable to escape, but as the outcome of the coupled dynamics the system is eventually enabled to exit the domain of attraction, it is initially put in. Related to escape, we present the critical dimer configurations and the corresponding activation energies. It is found that, there exists a range of optimal coupling for escape to take place. Interestingly, out of this range the system shows Fermi resonance, which completely inhibits the process of overcoming the barrier.

DY 12.4 Tue 10:45 MA 004

Simulating Classical Particles in Random Potentials — •Kai Bröking[1], Stephan Kramer[2], Ragnar Fleischmann[1], and Theo Geisel[1] — [1]Max-Planck-Institut für Dynamik und Selbstorganisation, 37073 Göttingen — [2]Institut für Theoretische Physik, 37077 Göttingen

The propagation of classical trajectories in systems with chaotic dynamics or in the presence of weak correlated disorder often makes high demands in accuracy and speed on the ODE solver employed; in either case the conservation of integrals of motion is a valuable indicator whether the correct physics is being reproduced by the simulation.

This becomes even more important when the analysis of the physics of the problem requires extensive post-processing of the numerical results, e.g. aiming at finding small effects which depend on the correct simulation of an ensemble of particles. In the latter case, the solver must treat the problem accurately and with greatest possible efficiency to allow the simulation of a large number of trajectories. This is crucial when simulating ballistic transport effects in the presence of weak disorder which leads to a branching of the electron flow [1][2].

We study the abidance of conservation laws by solvers of the DOPRI family [3] with regard to motion on unstable periodic orbits, and to the simulation of an ensemble of electrons in weak disordered potentials.

[1] Topinka et al., Coherent branched flow in a two-dimensional electron gas, Nature 410 (2002)
[2] Jura et al., Unexpected features of branched flow through a high-mobility 2DEG, Nature Physics, doi:10.1038/nphys756
[3] Hairer et al., Solving ODEs Vol. I, Springer 2000

DY 12.5 Tue 11:00 MA 004

How does God play dice? — •Jan Nagler — Institute for Nonlinear Dynamics, University of Bremen — Max Planck Institute for Dynamics und Self-Organization, Göttingen

A dice throw is commonly considered a paradigm for chance. However tossing the dice has little to do with fortuitousness. We show how deterministic classical dynamics make a dice throw to a fairly good random number generator, and under which conditions the outcome is rather predictable. In order to keep things simple, we focus on the simplest possible dice throw model: a barbell with two marked masses at each end that is thrown with initial rotation and eventually comes to rest when the bounces have consumed all energy. The two possible final configuration types of the masses define then the outcome of the throw. We analyze the pseudorandom nature of a dice roll studying the dependence of the outcomes on initial energy, position, momenta and friction strength.

DY 13: Cardiac dynamics and reaction-diffusion systems

Time: Tuesday 11:30–13:00 Location: MA 004

DY 13.1 Tue 11:30 MA 004

Different forms of alternans in the modified Beeler-Reuter model for cardiac dynamics and chaotic media — Georg Röder[1], Blas Echebarria[2], Jörn Davidsen[3], Steffen Bauer[4], and •Markus Bär[4] — [1]MPIPKS Dresden — [2]UPC Barcelona, Spain — [3]University of Calgary, Canada — [4]PTB Berlin

We investigate the phenomena of spatial period doubling and alternans of by numerical simulations and stability analysis of one-dimensional coherent structures in reaction-diffusion models. In general, the onset of alternans in different media can be related to a linear instability of periodic waves that is either a period doubling or a Hopf bifurcation. In chaotic media a period doubling of wavetrains is found, while in the modified Beeler-Reuter model of cardiac tissue period doubled wave trains stemming from a non-monotonous dispersion curve as well as Hopf bifurcations leading to temporary modulations of wave trains are observed. Period doubling bifurcations of wavetrains are related to real eigenvalues and lead to alternant wavetrains, whereas Hopf bifurcations correspond to purely imaginary eigenvalues displaying a frequency that is roughly half of the temporal frequency of the original wave train and produce . Implications for structures in higher dimensions are briefly discussed.

DY 13.2 Tue 11:45 MA 004

Pattern control in a two-dimensional model of cardiac tissue — •Philip Bittihn[1], Ulrich Parlitz[1], and Stefan Luther[2] — [1]Drittes Physikalisches Institut, Georg-August-Universität Göttingen, Germany — [2]Max-Planck-Institut für Dynamik und Selbstorganisation, Göttingen, Germany

Characteristic spatio-temporal patterns in cardiac tissue are plane waves and spiral waves. Spiral wave breakup may occur leading the system into defect mediated turbulence. In the heart, this transition may lead to a lethal electro-mechanical malfunction of the organ and sudden cardiac death. We demonstrate in a two dimensional numerical simulation that this chaotic spatio-temporal dynamics can be controlled and turned into a state of periodic activation using multiple delay feedback. The application of this approach to experiments and possible limitations will be discussed.

DY 13.3 Tue 12:00 MA 004

Inhibition of Tachyarrhythmic Activity by Local Pacing — •Ekaterina Zhuchkova and Harald Engel — Institute of Theoretical Physics, Technical University of Berlin, Berlin, Germany

Any abnormalities in the electrical activity of the heart are arrhythmias. Termination of arrhythmias occurring in the ventricles, particularly ventricular tachyarrhythmias, remains one of the most attractive research topics in view of application of physics and engineering to cardiology. Ventricular tachyarrhythmias are induced by rotation of a single or multiple re-entrant waves, which have spiral (in 2D) or scroll (in 3D) shapes.

Using the simplified ionic Fenton-Karma model of excitation in the heart we resolve the problem of termination of such dangerous reentrant activity by local pacing of monophasic and biphasic waveforms. Although suppression efficiency nonlinearly depends on a number of parameters, in clinical context the local termination of spiral-wave dynamics would have an advantage: It would need low power of the stimulation and could be readily implemented with existing hardware - implantable cardioverter defibrillators.

DY 13.4 Tue 12:15 MA 004

Kinematical theory of rigidly rotating spiral waves — •Vladimir Zykov — TU Berlin, Hardenbergstr. 36, 10623 Berlin, Germany

A simplified kinematical description of a rigidly rotating spiral induced in a generic two-component reaction-diffusion medium is elaborated by application of a free-boundary approach. It is shown that all characteristics of a rigidly rotating spiral (including its rotation period) are determined by the value of the slow component near the spiral front. On the other hand, the same value determines the period of a periodic wave train. Since the rotation period represents simultaneously the period of the wave train generated by a spiral wave, a selected value of the rotation frequency is uniquely determined as a solution of a system of algebraic equations. The results obtained in the framework of the proposed approach are compared to asymptotics derived earlier in the limits of weak and high excitability.

DY 13.5 Tue 12:30 MA 004

Hysteresis in the selection of rotating wave patterns — •Hartmut Lentz, Vladimir Zykov, and Harald Engel — Institut für Theoretische Physik, TU Berlin, Hardenbergstr. 36, D-10623 BERLIN

We study rotating wave patterns in an annular channel as spiral waves, rotating wave segments and boundary spots. Usually, a unique rotation period and wave shape are selected for given channel geometry and parameters of the medium. Within a modified kinematic approach that takes into account a boundary layer in the wave front, we derive a nonlinear eikonal equation with an unstable branch. Based on this equation we describe the transformation of rotating segments pinned to the inner boundary into a freely rotating spiral wave. Additionally, we specify a regime with hysteresis of the rotation frequency under variation of the inner radius. We conclude, that dispersion effects are not the crucial factor for the hysteresis in the rotation period. The theoretical predictions are compared with results obtained by numerical simulation of the underlying reaction-diffusion equations.

[1] G. Bordyugov and H. Engel: Continuation of spiral waves. 2007.
[2] A. Pertsov et. al.: Rotating spiral waves in a modified fitzhugh-nagumo-model, 1984.
[3] V. Zykov: Selection mechanism for rotating patterns in weakly excitable media, 2007.

DY 13.6 Tue 12:45 MA 004

Percolation effects in front propagation — •Sergio Alonso[1], Karin John[2], Raymond Kapral[3], and Markus Baer[1] — [1]Physikalisch-Technische Bundesanstalt, Berlin, Germany — [2]Université J. Fourier, Grenoble, France — [3]University of Toronto, Toronto, Canada

Waves and fronts propagate in nonlinear spatially extended systems. Normally extended systems present heterogeneities and deformations which hinder the stable propagation and which cannot be avoided. Numerical models do not usually consider any type of defects and they study homogeneous models. Here we study the propagation of a front in a bistable media for two different types of defects: some sites of the numerical grid do not propagate the front (site percolation), or some connections between the sites do not propagate (bond percolation). We calculate the velocity of both situations for different density of defects, and compare the results with an effective medium theory.

DY 14: Statistical physics II (general)

Time: Tuesday 14:00–16:00 Location: MA 004

Invited Talk DY 14.1 Tue 14:00 MA 004
When it helps to be purely Hamiltonian: Acceleration of rare events, enhanced particle and energy transport — •Dirk Hennig[1], Lutz Schimansky-Geier[1], and Peter Hänggi[2] — [1]Institut für Physik, Humboldt Universität zu Berlin, Newtonstr. 15, 12489 Berlin — [2]Insitut für Physik, Universität Augsburg, Universitätsstr. 1, 86135 Augsburg

In the first part we present a deterministic escape of chains of interacting units from a metastable state over an anharmonic potential barrier. The underlying dynamics is conservative and noise-free. The mutual interplay between nonlinearity and interaction causes that an initially uniform lattice state becomes unstable, leading to energy redistribution with strong localization. As a result a spontaneously emerging localized mode grows into a critical nucleus. By surpassing this transition state, the nonlinear chain manages a self-organized, deterministic barrier crossing. Most strikingly, these noise-free, collective nonlinear escape events proceed generally by far faster than the transitions assisted by thermal noise when the ratio between the average energy supplied per unit in the chain and the potential barrier energy assumes small values.

In the second part we discuss the formation of directed transport in driven Hamiltonian systems. Most crucially,the overall system dynamics is unbiased in the sense that the force averaged over time and space vanishes. Nevertheless we demonstrate that for adiabatic time-periodic modulations of the tilt of a symmetric and spatially periodic potential a giant transient directed current is induced.

DY 14.2 Tue 14:30 MA 004
Memory effects in the particles' clustering in the Mean Field Hamiltonian model — •Angelo Facchini[1], Hiroko Koyama[2], and Stefano Ruffo[3] — [1]Center for the Study of Complex Systems, University of Siena, Italy — [2]Department of Physics, Nagoya University, Nagoya 464-8602, Japan — [3]Dipartimento di Energetica "S. Stecco", University of Florence, INFN and CSDC, Italy

We investigate the memory effects in the dynamics of cluster in the Hamiltonian Mean Field model. In a preliminary paper, Koyama and Ruffo found that the life times, i.e. the time interval for which all the particles are trapped in the cluster, were distributed according to a power law. Here we extend this preliminar result investigating the power law distribution for energies ranging from $U = 0.3$ to $U = 0.65$ and particle number $N = 8, 16, 32, 64, 128, 256, 512$. For a given N, we have computed the scaling index of the life-time distribution at different energies, showing that the phenomenon depends on both N and U. Furthermore, for a fixed N, Ruffo and Antoni [PRE,52,2361, 1995] showed that in the interval $U = 0-0.75$, there is a specific value, $U = 0.3$, for which the cluster begins to melt. Increasing U, the cluster continues to melt and the liquid phase disappears for $U_c = 0.75$, the critical transition energy. By means of simulations in the microcanonical ensemble, we show that in the interval $U = 0.3 - 0.75$, there is an energy range $0.3 - U_{pl}$ for which the power law exists.

We show that this is a non thermodynamic effect, retraceble in the dynamics of the long range interaction between a small number of particles.

DY 14.3 Tue 14:45 MA 004
Estimating fixed points of complex dynamical systems - with an application to wind energy research — •Julia Gottschall and Joachim Peinke — Institut für Physik, Carl von Ossietzky Universität Oldenburg, 26111 Oldenburg

We present a method to estimate the fixed points of complex dynamical systems and show its robustness against different sources of noise. Assuming that the considered process can be described by a Langevin or Fokker-Planck equation, Friedrich et al. [1] proposed some years ago a procedure how to reconstruct its deterministic and stochastic dynamics, separately, directly from the data. Recently, it has been investigated how the reconstruction is affected by measurement noise as well as by a finite sampling frequency of the data, and more or less complex corrections have been suggested [2].

We have studied the reconstruction of the deterministic dynamics and the influence of the proposed corrections in more detail. In particular, we could show that a reliable estimation of the characteristic points is still possible with the uncorrected procedure, even when the system is spoilt by different kinds of noise. Therewith, we have a very efficient method to estimate the fixed points of a complex system.

This conclusion allows to apply the method to a variety of fields of interest. We present an application to wind energy research, namely the estimation of power performance curves for wind turbines.

[1] R. Friedrich et al., Physics Letters A 271 (2000), 217-222
[2] F. Böttcher et al., Physical Review Letters 97, 090603 (2006)

DY 14.4 Tue 15:00 MA 004
Numerical estimation of Baxter-Wu critical amplitudes — •Wolfhard Janke[1] and Lev N. Shchur[2] — [1]Institut für Theoretische Physik, Universität Leipzig, Postfach 100 920, 04009 Leipzig, Germany — [2]Landau Institute for Theoretical Physics, 142432 Chernogolovka, Russia

We report a Monte Carlo simulation study of the critical and off-critical behaviour of the Baxter-Wu model. The critical temperature window is estimated by using known exact results for the specific heat and magnetization. This helps us to extract the universal ratio Γ_+/Γ_- of the susceptibility amplitudes. Such ratios have recently been determined numerically for the 2D q-state Potts model with $q = 2$, 3, and 4, where deviations from the theoretical predictions by Delfino and Cardy were found for $q = 4$. It was speculated that this deviation could be explained by the relatively strong multiplicative logarithmic corrections to the leading scaling behaviour. Since the Baxter-Wu model belongs to the same universality class as the 4-state Potts model, but does *not* exhibit logarithmic corrections, our results for the ratio Γ_+/Γ_- of the Baxter-Wu model shed some new light on this puzzle.

DY 14.5 Tue 15:15 MA 004
Critical Adsorption and Critical Casimir Force at Geometrically Structured Substrates — •Matthias Tröndle[1,2], Ludger Harnau[1,2], and Siegfried Dietrich[1,2] — [1]Max-Planck-Institut für Metallforschung, Heisenbergstr. 3, 70569 Stuttgart — [2]Universität Stuttgart, Institut für Theoretische und Angewandte Physik, Pfaffenwaldring 57, 70569 Stuttgart

We study the behavior of fluids close to geometrically structured substrates upon approaching a critical point at $T = T_C$ in their bulk phase diagram. The substrate surfaces are modeled by periodic arrays of wedges and ridges.

Guided by general scaling considerations we calculate, within the mean field approximation, the order parameter profiles of a fluid close to a single structured substrate for $T > T_C$, $T = T_C$, and $T < T_C$. Universal amplitudes for a suitably defined excess adsorption are discussed.

Universal scaling functions for forces between geometrically structured substrates mediated by critical fluids are calculated within mean field theory. Normal forces between flat and structured substrates as well as lateral forces between two identically structured substrates are studied.

DY 14.6 Tue 15:30 MA 004
Free energy barriers of spin glasses — Andreas Nussbaumer, •Elmar Bittner, and Wolfhard Janke — Institut für Theoretische Physik, Universität Leipzig, Postfach 100 920, 04009 Leipzig, Germany

The Ising spin glass in the Sherrington-Kirkpatrick (SK) mean-field and the Edwards-Anderson (EA) nearest-neighbour formulations are investigated by means of Monte Carlo simulations. To this end, we employ a combination of the multioverlap algorithm with the parallel tempering method. We investigate the finite-size scaling behaviour of the free-energy barriers which are visible in the probability density of the Parisi overlap parameter. Assuming that the mean barrier height diverges with the number of spins N as N^α, our data for the SK model show good agreement with the theoretical value $\alpha = 1/3$. We compare the scaling behaviour to the data from the EA model.

DY 14.7 Tue 15:45 MA 004
Non-Fermi liquid regime in the 2D Hubbard model at weak-to-moderate coupling — •Hermann Freire[1], Eberth Correa[2], and Alvaro Ferraz[2] — [1]Max-Planck-Institute for Solid State Research, D-70569 Stuttgart, Germany — [2]International Center for Condensed Matter Physics, Universidade de Brasilia, Caixa Postal 04667, 70910-900 Brasilia-DF, Brazil

We analyze the two-dimensional Hubbard model on a square lattice at weak-to-moderate coupling by implementing the functional field-theoretical renormalization group (RG) up to two-loop order. This approach is essential to evaluate the effect of the anomalous dimension induced by interactions on the low-energy single-particle excitations. As a result, we find evidence of a non-Fermi liquid (NFL) regime near half-filling before the $d_{x^2-y^2}$-wave singlet superconducting instability becomes dominant. To characterize the nature of this NFL phase, we perform a systematic two-loop RG study of several susceptibilities of interest in the model.

DY 15: Controlling Dirty Bosons: Disorder Effects on BECs

Time: Tuesday 14:30–16:45 Location: MA 001

DY 15.1 Tue 14:30 MA 001

Bose-Einstein Condensates in Strongly Disordered Traps — •Thomas Nattermann[1] and Valery Pokrovsky[2] — [1]Institut für theoretische Physik der Universität zu Köln — [2]Department of Physics, Texas A&M University, USA

A Bose-Einstein condensate in an external potential consisting of a superposition of a harmonic and a random potential is considered theoretically. From a semi-quantitative analysis we find the size, shape and excitation energy as a function of the disorder strength. For positive scattering length and sufficiently strong disorder the condensate decays into fragments each of the size of the Larkin length L. This state is stable over a large range of particle numbers. The frequency of the breathing mode scales as 1/L^2. For negative scattering length a condensate of size L may exist as a metastable state. These findings are generalized to anisotropic traps.

DY 15.2 Tue 14:45 MA 001

Ultracold bosons in lattices with disorder created by "heavy" impurities — Konstantin V. Krutitsky[1], Michael Thorwart[2], Reinhold Egger[2], and •Robert Graham[1] — [1]Fachbereich Physik, Universität Duisburg-Essen, Lotharstraße 1, 47048 Duisburg, Germany — [2]Institut für Theoretische Physik IV, Heinrich-Heine-Universität Düsseldorf, Germany

Quantum phases of ultracold bosons with repulsive interactions in optical lattices in the presence of disorder are investigated. The disorder is assumed to be caused by the interaction of the bosons with impurity atoms having a large effective mass. The system is described by the Bose-Hubbard Hamiltonian with on-site energies which have a discrete probability distribution. The phase diagram at zero temperature is calculated using several methods like a strong-coupling expansion, an exact numerical diagonalization, a Bose-Fermi mapping, as well as two different versions of a mean-field theory.

DY 15.3 Tue 15:00 MA 001

Dipole Oscillations of a Bose-Einstein Condensate in Presence of Defects and Disorder — •Tobias Paul, Mathias Albert, Nicolas Pavloff, and Patricio Leboeuf — Laboratoire de Physique Théorique et Modèles Statistiques, Universite Paris Sud

We study the dipole oscillations of a weakly interacting BEC, confined in a harmonic cigar-shaped trap with a tight transverse confinement but a shallow axial trapping frequency in presence of an external defect or random potential. Our main result is a new, global picture characterizing the dynamical properties of the dipole oscillations, where different regimes of condensate dynamics are observed: For small-amplitude dipole oscillations we demonstrate that the BEC-flow is superfluid and the dipole oscillations are almost undamped, but the external potential induces a small shift of the oscillations frequency. When the center of mass motion reaches a critical velocity the superfluid behavior breaks down and one enters a regime of dissipative dynamics characterized by a strong damping of the dipole oscillations. We show that the onset of this domain is marked by the emergence of gray solitons. For large-amplitude oscillations a regime of quasi-dissipationless transport is found where the creation of elementary excitations is strongly oppressed. We discuss our findings in the context of recent experimental observation [1,2,3] and address the question under which circumstances Anderson localization is of relevance for these systems.

[1] C. Fort et al., Phys. Rev. Lett. 95, 170410 (2005)
[2] J. E. Lye et al., Phys. Rev. A 75, 061603 (2007)
[3] P. Engels and C. Atherton, Phys. Rev. Lett. 99, 160405 (2007

DY 15.4 Tue 15:15 MA 001

Disorder physics in atomic mixtures — •Oleksandr Fialko and Klaus Ziegler — Universität Augsburg

Mixtures of different atomic species represent complex quantum systems with competing degrees of freedom. They can be created either by filling two types atoms in an optical lattice [1,2] or by allowing an atomic cloud to form molecules due to attractive interatomic interaction [3,4]. The competing degrees of freedom can lead to competing quantum phases, phase transitions, phase separation, and correlation induced disorder. We discuss various systems with elastic and inelastic scattering, quantum phases, and the possibility of Anderson localization.

[1] C. Ates and K. Ziegler, Phys. Rev. A 71, 063610 (2005)
[2] K. Ziegler, Nucl. Phys. A 790, 718c (2007)
[3] K. Ziegler, Laser Physics 15, 650 (2005)
[4] O. Fialko, Ch. Moseley and K. Ziegler, Phys. Rev. A 75, 053616 (2007)

DY 15.5 Tue 15:30 MA 001

Tracking Bogoliubov excitations in correlated disorder — •Cord A. Müller and Christopher Gaul — Physikalisches Institut, Universität Bayreuth, 95440 Bayreuth, Germany

In order to study the interplay of interaction and disorder in atomic BECs, we investigate the transport properties of Bogoliubov excitations in the presence of correlated spatial potential fluctuations [1]. In two dimensions, we find that the scattering cross-section of Bogoliubov excitations by an elementary obstacle has a node, which can be explained analytically in the hydrodynamic description. We further explore the consequences for the multiple-scattering regime in a correlated disordered potential by calculating relevant transport lengths.

[1] R.C. Kuhn et al, New J. Phys. 9, 161 (2007)

DY 15.6 Tue 15:45 MA 001

Critical Temperature of Dirty Bosons — •Ben Klünder, Axel Pelster, and Robert Graham — Fachbereich Physik, Universität Duisburg-Essen, Lotharstraße 1, 47048 Duisburg, Germany

We consider a dilute Bose gas moving in a harmonic trap with a superimposed frozen random potential which arises in experiments either artifically with laser speckles or naturally in wire traps. The critical temperature, which characterizes the onset of Bose-Einstein condensation, depends on the disorder realization within the ensemble. Therefore, we introduce an effective grand-canonical potential from which we determine perturbatively the disorder averages of both the first and second moment of the critical temperature in leading order. We discuss our results for a finite number of particles by assuming a Gaussian spatial correlation for the quenched disorder potential.

DY 15.7 Tue 16:00 MA 001

Many-body diffusion in disordered potentials — •Sandro Wimberger — Institut für Theoretische Physik, Universität Heidelberg, D-69120 Heidelberg

Ongoing experiments with Bose-Einstein condensates are studying the quantum transport of ultracold atoms in disordered potentials. Going beyond the currently investigated regimes, we predict a crossover between regular and quantum chaotic dynamics as a function of the disorder strength. Our spectral approach is based on the Bose-Hubbard model describing the motion of strongly interacting bosonic atoms in deep potentials. Our statistical predictions on the spectral properties are readily observable by monitoring the evolution of typical experimental initial states.

DY 15.8 Tue 16:15 MA 001

The Bose-Fermi-Hubbard model as a step to the disordered Bose-Hubbard-Model — •Alexander Mering and Michael Fleischhauer — Fachbereich Physik, Technische Universitaet Kaiserslautern

The influence of disorder on the ground-state phase diagram of the

Bose-Hubbard model (BHM) is of long standing experimental and theoretical interest and yet not completely understood. We present analytical and numerical results for the Bose-Hubbard model with a binary disorder distribution resulting from the admixture of a heavy fermionic species as quasi-static impurities to the system. We find that for quenched and annealed disorder the phase diagram can be understood in terms of compressible, partial-compressible and incompressible phases. Numerical calculations using the density matrix renormalization group show that the partially compressible phases have a Bose-glass character. We also discuss the Bose-Fermi-Hubbard model in the limit of fast fermions where a finite lattice size leads to effects reminiscent of the BHM with a boxed disorder distribution.

DY 15.9 Tue 16:30 MA 001

Stochatical Mean Field Theory for the Disordered Bose Hubbard Model — •Ulf Bissbort and Walter Hofstetter — Institut für Theoretische Physik, JWG Universität Frankfurt am Main

We develop a systematic extension of the usual site decoupling mean field theory for the disordered Bose Hubbard model, extending the self-consistency condition to account for disorder induced inhomogeneity of the mean field parameter, by using a probability distribution. This method is capable of describing the Bose glass in the thermodynamic limit at T=0 and recovers the usual MFT in the limit of vanishing disorder, as well as the arithmetically averaged MFT in the limit of infinite dimensions, where the Bose glass border shifts to JZ=0. Phase diagrams are presented for a box disorder distribution and the limit of strong disorder is discussed.

DY 16: Glasses II (joint session DF/DY)

Time: Tuesday 14:30–16:15 Location: EB 407

DY 16.1 Tue 14:30 EB 407

Glassy Solution-Space Structure of Optimization Problems — Alexander Mann[1], Wolfgang Radenbach[2], and •Alexander Hartmann[3] — [1]Institute for Theoretical Physics, University of Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen, Germany — [2]University of Göttingen, Platz der Göttinger Sieben 5, 37073 Göttingen, Germany — [3]Institute for Physics, University of Oldenburg, 26111 Oldenburg, Germany

We study numerically the glassy solution-space cluster of random ensembles of two NP-hard optimization problems originating in computational complexity, the vertex-cover problem and the number partitioning problem. We use branch-and-bound type algorithms to obtain exact solutions of these problems for moderate system sizes. Using two methods, direct neighborhood-based clustering and hierarchical clustering, we investigate the structure of the solution space. The main result is that the correspondence between solution structure and the phase diagrams of the problems is not unique. Namely, for vertex cover we observe a drastic change of the solution space from large single clusters to multiple nested levels of clusters. In contrast, for the number-partitioning problem, the phase space looks always very simple, similar to a random distribution of the lowest-energy configurations. This holds in the "easy"/solvable phase as well as in the "hard"/unsolvable phase.

DY 16.2 Tue 14:45 EB 407

A Gaussian model for the energy landscape of supercooled liquids and its implications — •Andreas Heuer — Inst. f. Phys. Chemie, Corrensstr. 30, 48149 Münster

From the previous analysis [1,2] of the potential energy landscape of molten silica and of a binary Lennard-Jones system a simple picture has emerged for the properties of the potential energy landscape as well as the relation between the energy and the dynamics. Formulating these observations in a general framework one can make specific predictions about the behaviour of supercooled liquids. This involves the dependence of fragility to non-exponentiality, the invalidation of the Stokes-Einstein relation and the relation between thermodynamic and kinetic fragility.

[1] B. Doliwa, A. Heuer, Phys. Rev. Lett. 91, 235501 (2003). [2] A. Saksaengwijit, J. Reinisch, A. Heuer, Phys. Rev. Lett. 93, 235701 (2004).

DY 16.3 Tue 15:00 EB 407

Fluorescence lifetime fluctuations and molecular reorientation of single molecules as observables of the dynamics in supercooled poly(methyl acrylate) — Renaud Vallée[2], •Gerald Hinze[1], Taoufik Rohand[2], Noel Boens[2], Wim Dehaen[2], and Thomas T. Basché[1] — [1]Institute of Physical Chemistry, Johannes-Gutenberg University, Mainz, Germany — [2]Department of Chemistry , Katholieke Universiteit Leuven, 3001 Leuven, Belgium

The dynamics of supercooled poly(methyl acrylate) has been explored on a nanoscale by tracking single fluorescing molecules as local reporter. We could follow the molecular orientation and the fluctuating fluorescence lifetime of single dyes in time. To meet the requirements of high photostability and a very high quantum yield, custom-built BODIPY dyes have been used. Experiments were performed in bulk sample to prevent interface effects.

While the rotational dynamics of the dyes strongly depends on the interaction between matrix and the probe molecules, the fluorescence lifetime could alter solely by matrix fluctuations without structural dynamics of the dye. We have analyzed the fluctuations by means of correlation functions and discuss their relationship to the dynamics of the supercooled matrix.

DY 16.4 Tue 15:15 EB 407

Properties of the Incoherent Scattering Function as derived from a Continuous Time Random Walk Analysis — •Oliver Rubner and Andreas Heuer — Institut für Physikalische Chemie der Universität Münster

We have shown in previous work that it is possible to describe the dynamics of a binary mixture Lennard-Jones (BMLJ65) model system above the glass transition in terms of a continuous time random walk (CTRW). Here we focus on the connection to experimentally accessible quantities. Approximating the incoherent intermediate scattering function $F(q,t)$ as a stretched exponential function $\exp(-\left(\frac{t}{t_0}\right)^{\beta})$ we have been able to derive analytical expressions for the q-dependence of the two parameters $t_0(q)$ and $\beta(q)$. These expressions are well reproduced by simulations of the BMLJ65 system.

We analyse the behaviour of the resulting equations in different q-regimes and are able to interpret their physical content exhibiting close connections to existing work, e.g. on facilitated spin systems. Furthermore system size effects are discussed.

DY 16.5 Tue 15:30 EB 407

Finite size corrections in mean-field spin glasses — •Timo Aspelmeier[1], Alain Billoire[2], Enzo Marinari[3], and Michael A. Moore[4] — [1]Max-Planck-Institut für Dynamik und Selbstorganisation, Göttingen — [2]Service de physique théorique, CEA Saclay, 91191 Gif-sur-Yvette, France — [3]Dipartimento di Fisica, INFM and INFN, Sapienza Università di Roma, P. A. Moro 2, 00185 Roma, Italy — [4]School of Physics and Astronomy, University of Manchester, Manchester, M13 9PL, UK

Finite size corrections in mean-field spin glasses are poorly understood theoretically because calculation of the loop expansion beyond Gaussian order is practically impossible. Here we present arguments and simulations to show that a system of finite size N is stabilized by a finite number of replica symmetry breaking steps K as opposed to the infinite replica symmetry breaking found in the thermodynamic limit. The number K is shown to be proportional to $N^{1/6}$. Using this correspondence between K and N we calculate the finite size dependences of internal energy, free energy, Edwards-Anderson order parameter and sample-to-sample fluctuations of the free energy.

DY 16.6 Tue 15:45 EB 407

The critical behavior of 3D Ising spin glass models: universality and scaling corrections — •Martin Hasenbusch[1], Andrea Pelissetto[2], and Ettore Vicari[3] — [1]Institut für theoretische Physik, Universität Leipzig, Postfach 100920, 04009 Leipzig, Deutschland — [2]Dipartimento di Fisica dell'Universita di Roma I and I.N.F.N., I-00185 Roma, Italy — [3]Dipartimento di Fisica dell'Universita di Pisa and I.N.F.N., I-56127 Pisa, Italy

We perform high-statistics Monte Carlo simulations of three three-dimensional Ising spin glass models: the +-J Ising model for two values of the disorder parameter p, p=1/2 and p=0.7, and the bond-diluted +-J model for bond-occupation probability p_b = 0.45. A finite-size scaling analysis of the quartic cumulants at the critical point shows conclusively that these models belong to the same universality class and allows us to estimate the scaling-correction exponent omega related to the leading irrelevant operator, omega=1.0(1). We also determine the critical exponents nu and eta. Taking into account the scaling corrections, we obtain nu=2.53(8) and eta=-0.384(9).

DY 16.7 Tue 16:00 EB 407

The m-component spin glass on a Bethe lattice — •Axel Braun[1] and Timo Aspelmeier[2] — [1]Institut für theoretische Physik, Universität Göttingen — [2]Max-Planck-Institut für Dynamik und Selbstorganisation, Göttingen

Using an extension of the cavity method to m-component vector spins on a Bethe lattice, we have derived a self-consistent equation of cavity fields, with $m \to \infty$. We have improved these findings by calculating corrections for a finite number of spin components and used these self consistent field equations to investigate the distribution of cavity fields in the low temperature phase. We provide numerical evidence that the RS distribution is unstable for finite m slightly below the critical temperature, indicating a second transition to a RSB state.

DY 17: Poster I

Time: Tuesday 16:00–18:00 Location: Poster C

DY 17.1 Tue 16:00 Poster C

Temporal flooding of regular islands — 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. We demonstrate this effect for the standard map. The saturation values vary from torus to torus with a maximum value corresponding to a uniform distribution of the wave packet. The complete transition can be quantitatively described in a universal way employing a random matrix model and regular-to-chaotic tunneling rates.

DY 17.2 Tue 16:00 Poster C

Effects of point-like perturbations in billiards — •Timur Tudorovskiy, Ruven Höhmann, Ulrich Kuhl, and Hans-Jürgen Stöckmann — Fachbereich Physik, Philipps-Universität Marburg, Renthof 5, D-35032 Marburg, Germany

We study two-dimensional cavities with antennas and scatterers, where they are treated as point-like perturbations. Using this approach we construct a scattering theory for cavities with one or more open transversal channels and several antennas. In the framework of this approach we were able to reproduce observable "wavefunctions" of the cavity with exactly degenerated state as well as with nearly degenerated states in the presence of one and two antennas [1]. The comparison with experimental data from microwave cavities shows a good agreement. The same idea allowed us to consider cavities with loops, where some antennas are connected. With time dependent point-like perturbations Floquet systems can be realized. We apply this theory for the periodically driven cavities.

[1] U. Kuhl, E. Persson, M. Barth, and H.-J. Stöckmann. Eur. Phys. J. B 17, 253 (2000).

DY 17.3 Tue 16:00 Poster C

Investigation of three-dimensional wave dynamical systems — •Stefan Bittner, Barbara Dietz, Thomas Friedrich, Maksim Miski-Oglu, Pedro Oria Iriarte, Achim Richter, and Florian Schäfer — Institut für Kernphysik, Darmstadt

Two different three-dimensional systems are studied. The first system is investigated experimentally. It consists of a flat, circular dielectric microwave resonator, an enlarged version of the resonators commonly used for microdisk lasers. The aim is to validate the principle of effective index of refraction as a simplified means to calculate the resonance frequencies of microdisk lasers. For this, the resonance frequencies of a flat microwave resonator made of Teflon were measured and compared with effective index of refraction calculations. Significant deviations between the measured and computed frequencies were found.

The second system is investigated theroretically. It is a 3D stadium billiard, which consists of two quarter cylinders that are rotated with respect to each other by 90 degrees. Its classical dynamics is chaotic and exhibits a few nongeneric periodic orbits. We introduce an analytic method for their treatment. Small deviations of the spectral properties from random matrix theory led to the discovery of stable orbits. We theoretically investigated the effect of the breaking of the symmetry existent for equal radii on spectral properties of the quantum billiard. It is shown that the classically abrupt change of the symmetry properties of the system is accompanied by a gradual change of the spectral properties of the quantum billiard.

DY 17.4 Tue 16:00 Poster C

The random phase hypothesis and the circular ensembles — •Rudolf A. Roemer[1] and Hermann Schulz-Baldes[2] — [1]Department of Physics and Centre for Scientific Computing, University of Warwick, Gibbet Hill Road, Coventry, CV4 7AL, UK — [2]Institut für Mathematik, Universität Erlangen-Nürnberg, Bismarkstrasse 1 1/2, 91054 Erlangen, Deutschland

A new type of a random phase hypothesis for multi-channel disordered wires is presented, stating that the random action of the symplectic transfer matrices on the Lagrangian planes has an isotropic invariant measure on the elliptic channels of the wire. When the Lagrangian planes are identified with the unitary matrices via the stereographic projection, these isotropic invariant measures become precisely those of Dyson's circular ensembles. This is numerically shown to hold at weak disorder regime in both metallic and localized regime of various physical models belonging to different universality classes.

DY 17.5 Tue 16:00 Poster C

Experimental results on open microwave 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

Scattering properties, time evolution and diffraction patterns are investigated in different open microwave billiards. In an open circular billiard with an attached waveguide the survival probability is computed by means of a method proposed by Hannay, Dittes and Müller. Also the famous single and double slit experiments are performed in a microwave billiard on the basis of future experiments with regular and chaotic dynamics. In another experiment presented we test the random matrix description of spectral fluctuations and show that this analysis serves as a tool to learn about the dynamics of a system in the regime of overlapping resonances. Finally, we report on the decay for short times of open mushroom billiards, which we investigated for both the classical and quantum.

DY 17.6 Tue 16:00 Poster C

New methods for determining Poincaré recurrence times — Roland Ketzmerick and •Matthias Michler — Institut für Theoretische Physik, Technische Universität Dresden, 01062 Dresden, Germany

The distribution of Poincaré recurrence times in Hamiltonian systems typically shows a power-law decay. This is due to the self-similar phase-space structure at the interface of regular and chaotic regions. It is still an open question if at large times this decay has a universal exponent and further numerical investigations are needed. The standard numerical approaches, however, waste most of the computing effort on the short time behaviour. We present two new methods for determining the Poincaré recurrence time statistics, which circumvent this disadvantage.

DY 17.7 Tue 16:00 Poster C

Critical parameters for the disorder-induced metal-insulator

transition in FCC and BCC lattices — Andrzej Eilmes[1], •Andrea M. Fischer[2], and Rudolf A. Roemer[2] — [1]Department of Computational Methods in Chemistry, Jagiellonian University, Krakow, Poland — [2]Department of Physics and Centre for Scientific Computing, University of Warwick, Coventry CV4 7AL, UK

We use a transfer matrix method to study the disorder-induced metal-insulator transition. We take isotropic nearest neighbour hopping and an onsite potential with uniformly distributed disorder. Following previous work done on the simple cubic lattice, we perform numerical calculations for the face centred cubic (FCC) and body centred cubic (BCC) lattices, which are more common in nature. We obtain the localisation length from calculated Lyapunov exponents for different system sizes. This data is analysed using finite size scaling to find the critical parameters. We create an energy-disorder phase diagram for both lattice types, noting that it is symmetric about the band centre for the BCC lattice, but not for the FCC lattice. We find a critical exponent of approximately 1.5 to 1.6 for both lattice types for transitions occurring either at fixed energy or at fixed disorder, agreeing with results previously obtained for other systems belonging to the same orthogonal universality class. We notice an increase in critical disorder with the number of nearest neighbours, which agrees with intuition.

DY 17.8 Tue 16:00 Poster C

Spin Relaxation and Decoherence through Chaotic Coupling — •Marcus V. S. Bonança and Klaus Richter — Institut für Theoretische Physik, Universität Regensburg, D-93040, Germany

We present numerical results and also the strategy for analytical calculations of the dynamics of a spin 1/2 (or a two-level system) coupled to two degrees of freedom which classical dynamics is chaotic. The chaotic system plays the role of an environment for the spin. It has been shown in the literature that such low-dimensional chaotic systems can induce relaxation and decoherence processes in simple systems coupled to them. The motivation behind such works is to understand better the role played by the dynamics in those irreversible phenomena. Our goal is to investigate a relation between the origin of the spin relaxation and decoherence and the chaoticity even when quantum effects are taken into account in the environment dynamics. Starting from a product initial state for the whole system, we study the spin effective dynamics numerically and analytically. Path integral calculations in close analogy to the spin-boson model are performed. Semiclassical methods are used to incorporate quantum effects in the correlation functions of the chaotic system.

DY 17.9 Tue 16:00 Poster C

Multifractal Analysis of the Metal to Insulator Transition in the Three-Dimensional Anderson Model — Louella J. Vasquez[1], Alberto Rodriguez[1,2], and •Rudolf A. Roemer[1] — [1]Department of Physics and Centre for Scientific Computing, University of Warwick, CV47AL United Kingdom — [2]Departamento de Fisica Fundamental, Universidad de Salamanca, 37008 Salamanca, Spain

The wavefunctions at the metal to insulator transition (MIT) of a disordered system within the Anderson model of localization have been shown to be of multifractal nature. In this paper we use a multifractal analysis to compute for the singularity spectra of very large wavefunctions at the band center. We will show that the singularity spectrum at the MIT is independent of the system size. We compare our results with recent findings and the Wegener prediction.

DY 17.10 Tue 16:00 Poster C

Mesoscopic Coulomb Supersolid — Alexei Filinov[1], •Jens Böning[1], Michael Bonitz[1], and Yurii Lozovik[2] — [1]Institut für Theoretische Physik und Astrophysik, Christian-Albrechts-Universität, Kiel, Germany — [2]Institute of Spectroscopy of the Russian Academy of Sciences, Troitsk, Russia

When a few tens of charged particles are trapped in a spherical electrostatic potential at low temperature they form concentric shells resembling atoms. These "artificial atoms" can be easily controlled by varying the confinement strength. We analyze such systems for the case that the particles are bosons and find superfluid behavior which even persists in the solid state. We show that while in the liquid phase the superfluid fractions on different shells are similar, in the radially ordered, but orientationally disordered state, the shells contribute very differently. For clusters with hexagonal symmetry which have the highest stability against intershell rotation, the superfluid fraction in the core region is reduced and superfluidity may persist only at the boundary, as known from, e.g., crystal grains [1] and parahydrogen clusters [2]. In contrast, pronounced concentration of superfluidity in the cluster core is observed for $N = 21-23, 30-32$, and $N = 39-42$. This novel state of matter is a mesoscopic supersolid [3].

[1] S. Sasaki *et al.*, Science **313**, 1098 (2006)
[2] S. A. Khairallah *et al.*, Phys. Rev. Lett. **98**, 183401 (2007)
[3] A. Filinov, J. Böning, M. Bonitz and Yu E. Lozovik, arXiv:0711.1255

DY 17.11 Tue 16:00 Poster C

Decoherence in the central spin model (Gaudin model) — Michael Bortz[1], •Christian Schneider[2], Joachim Stolze[2], and Robert Stübner[2] — [1]Fachbereich Physik, TU Kaiserslautern, Germany — [2]Institut für Physik, TU Dortmund, Germany

The Gaudin (or central spin) model consists of a single spin-1/2 coupled to a bath of independent spins-1/2 by exchange interactions. The model may be used to describe the decoherence of an electron spin quantum bit in a quantum dot which is coupled to many nuclear spins by hyperfine interactions. In general the interactions are inhomogeneous, I.e. each bath spin couples to the central spin with a different strength. For isotropic (Heisenberg-like) couplings the energy eigenstates and eigenvalues may be determined by the Bethe Ansatz (BA). A general formula for the time dependence of the central spin polarization can be derived from the BA. In the special case of homogeneous couplings the model may be diagonalized directly (I.e. without the BA) even for uniaxially anisotropic (XXZ-type) couplings. We develop strategies for finding the necessary BA quantum numbers numerically. Then we discuss the behavior of the central spin for homogeneous and inhomogeneous couplings. We also consider different types of initial states, varying in spin polarization and degree of entanglement.

DY 17.12 Tue 16:00 Poster C

Quantum transport on small-world networks: A continuous-time quantum walk approach — Oliver Mülken, •Volker Pernice, and Alexander Blumen — Theoretische Polymerphysik, Universität Freiburg, D-79104 Freiburg

We consider the quantum mechanical transport of (coherent) excitons on small-world networks (SWN). The SWN are built from a one-dimensional ring of N nodes by randomly introducing B shortcuts in the form of additional bonds between them.

The exciton dynamics is modeled by continuous-time quantum walks, a quantum mechanical analog of continuous-time random walks. We evaluate numerically the ensemble averaged transition probability to reach any node of the network from the initially excited one. We observe that already a few connections obliterate the pattern of quantum carpets that is present for transport on a ring.

For sufficiently large B we find that the quantum mechanical transport through the SWN is, first, very fast, given that a limiting distribution of the transition probabilities is reached very quickly; second, that in contrast to the classical case, where the limiting value is $1/N$ for all nodes, the transport does not lead to equipartition, given that on average the exciton is most likely to be found at the initial node. The reason for this is to be found in the network's eigenstates, which are localized at the band edges, whereas inside the band they are quite delocalized, similar to the undisturbed network [1].

[1] O.Mülken, V.Pernice, A.Blumen, Phys. Rev. E (2007) in press

DY 17.13 Tue 16:00 Poster C

Quantum Dynamics of Nanomechanical Resonator Arrays — •Max Ludwig and Florian Marquardt — Arnold-Sommerfeld Center for Theoretical Physics, Center for NanoScience and Department of Physics, Ludwig-Maximilians Universiät München, Munich, Germany

We investigate the nonequilibrium quantum dynamics of arrays of coupled nanoresonators, where the coupling constants can be tuned in a time-dependent manner. In our numerical simulations, we take into account dissipation effects via a Lindblad master equation approach, and discuss the influence of different initial state preparations. We visualize the dynamics in terms of the Wigner density evolution of the individual resonators.

DY 17.14 Tue 16:00 Poster C

Phase transition of the sub-Ohmic spin-boson model — •Andre Winter and Heiko Rieger — Theoretische Physik, Universität des Saarlandes, PF 151150, D-66041 Saarbrücken

We study the spin-boson model in the sub-Ohmic case via path integral Monte Carlo methods. An algorithm in continuous imaginary time is applied, which avoids the usual Trotter-discretization, that is supposed to violate the quantum-classical mapping to the long-range Ising spin chain with algebraically decaying interaction. The phase transition between localized and delocalized phase is investigated by finite size scaling procedures, which take the corrections to scaling incoming due to long-range interaction into account. Critical Exponents are determined in both the mean-field and the non-classical regime, divided by the bath exponent of the spectral function.

DY 17.15 Tue 16:00 Poster C

Decoherence of the electron spin of NV-centers in Diamond — •Florian Rempp, Philipp Neumann, Torsten Gaebel, Fedor Jelezko, and Jörg Wrachtup — 3. Physikalisches Institut, Universität Stuttgart, Germany

Nitrogen-vacancy color centers (NV-center) in diamond with proximal C13 nuclear spins are one of the promising candidates for solid state quantum computers. One of the main assets of the NV-center is the optical accessibility of single spins while showing long T2 times due to low residual spin density.

We compute the decoherence the electron spin of NV-centers in diamond for various configurations of nitrogen and C13 atoms in the surroundings of the center. By characterising the effects of the those finite environments we hope to achieve better understanding of the experimental reality. It may thus be possible to estimate natural limits to the usage of NV-centers as quantum processors and memory.

DY 17.16 Tue 16:00 Poster C

Coherence properties of photons emitted by single defect centers in diamond — •Anton Batalov, Christian Zierl, Petr Siyushev, Torsten Gaebel, Fedor Jelezko, and Jörg Wrachtup — 3. Physikalisches Institut, Pfaffenwaldring 57, D-70550 Stuttgart

Photon interference among distant quantum emitters is a promising method to generate large scale quantum networks. Interference is best achieved when photons show long coherence times. The nitrogen-vacancy (NV) defect center in diamond can be used as a source of single indistinguishable photons. Optically induced Rabi oscillations indicate a close to Fourier transform (i.e. lifetime) limited width of photons emitted even when averaged over minutes. The projected contrast of two-photon interference (0.8) is high enough to envisage the applications in quantum information processing. The time resolved two-photon interference (experiment in preparation) will allow one to describe the photons, emitted by a single NV, in a more direct manner.

DY 17.17 Tue 16:00 Poster C

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

Diffusive transport is not only a phenomenon arising from stochastic environmental forces, which act e.g. on a heavy particle. While this picture requires many degrees of freedom, one can find normal and, more interestingly, anomalous diffusion already in low dimensional systems such as random walks in quenched random environments. A class of recurrent random walks, for which properties of the so called Golosov-phenomenon had been proven, is known under the heading of Sinai diffusion. In our work we extend the discrete Sinai model to random walks with next-nearest neighbour transitions. Thereby a generalization of binary disorder guarantees recurrence [1].

For Sinai disorder the known results concern quantities such as the disorder averaged mean square displacement, the density of states of the propagator, and the size-dependence of the escape rate. For each of them one can define a characteristic exponent. We show numerically for our generalized model that these exponents exist likewise and seem to coincide [2]. Perturbation theory, which is exact in the Sinai case, enables calculating escape rates for significant larger systems. For our model we find as function of system size a transition from a large preasymptotic regime to the asymptotic behaviour in dependence on the system parameters.

[1] G. Radons Physica D **187** (2004) 3.
[2] A. Fichtner, G. Radons New J. Phys. **7** (2005) 30.

DY 17.18 Tue 16:00 Poster C

Absolute negative mobility of an inertial Brownian particle — •David Speer[1], Joachim Nagel[2], Tobias Gaber[2], Ralf Eichhorn[1], Peter Reimann[1], Reinhold Kleiner[2], and Dieter Koelle[2] — [1]Universität Bielefeld, Fakultät für Physik, 33615 Bielefeld, Germany — [2]Universität Tübingen, Physikalisches Institut - Experimentalpysik II, 72076 Tübingen, Germany

We consider a single inertial Brownian particle in a symmetric periodic potential. Recently [1,2], it was shown that such a system is likely to exhibit absolute negative mobility (ANM), once thermal equilibrium is broken by a time-periodic force. E.g. the particle climbs uphill against a static tilt of the potential. The effect is due to noisy chaos in the model. We give an intuitive explanation, explain related effects, explore the the parameter region associated with ANM and consider generalizations of the model. Recent experiments [3] with Josephson Junctions show very good agreement with our predictions.

[1] L. Machura et al., Phys. Rev. Lett. 98, 040601 (2007).
[2] D. Speer et al., Europhys. Lett. 79, 10005 (2007), D. Speer et al., Phys. Rev. E 76, 051110 (2007).
[3] J. Nagel et al., in preparation.

DY 17.19 Tue 16:00 Poster C

Stochastic dynamics in a continuous disordered potential — •Steffen Röthel — Westfälische Wilhelms-Universität Münster, Institut für Theoretische Physik, Wilhelm-Klemm-Str. 9, 48149 Münster

We consider the behavior of an overdamped charged particle moving in a disordered potential in the presence of an external electric field under the influence of a Gaussian white noise. By applying periodic boundary conditions for the disordered potential a Fokker-Planck treatment of the corresponding Langevin equation allows to determine the the current density for various temperatures. The current depends on the electric field as well as on the statistical characteristics of the disordered potential in form of the potential increment. The experimental determination of the current-voltage relation can be used to identify properties of the disordered potential, and, in turn, to characterize the spatial structure of the material probe.

DY 17.20 Tue 16:00 Poster C

Correlations in the Sequence of Residence Times — •Benjamin Lindner[1] and Tilo Schwalger[2] — [1]Max-Planck-Institute for the Physics of Complex Systems, Dresden, Germany — [2]Humboldt-Universitaet Berlin, Berlin, Germany

Sequences of residence times (RTs) associated with the escape from metastable states are observed in many fields. Here, we study analytically and numerically the correlations among RTs for a bistable stochastic system driven by dichotomous noise. Our theory predicts an oscillatory behavior of the correlations with respect to the lag between RTs. Correlations vanish at all lags if the switching rate matches the hopping rate of the unperturbed system. It is also shown that RT correlations may reveal features of the driving which are not present in the single-RT statistics.

DY 17.21 Tue 16:00 Poster C

Interspike Interval Distribution of a Neuron Driven by Colored Noise — Tilo Schwalger[1,2], •Jessica Strefler[1], and Lutz Schimansky-Geier[1] — [1]Humboldt-Universität zu Berlin, Newtonstr. 15, 12489 Berlin — [2]RIKEN Brain Science Institute, Hirosawa 2-1, Wako, Saitama 351-0198, Japan

The interspike interval (ISI) density of the leaky integrate-and-fire neuron model driven by exponentially correlated Gaussian noise exhibits a dominant peak at small bursting intervals and a slow power-law decay of long interburst intervals. Due to this power-law decay, extreme ISIs have a large effect on the ISI statistics. This leads to a coefficient of variation which diverges as $t^{1/2}$ and an unexpected suppression of ISI correlations. This is in clear contrast to the colored noise effect in simpler neuron models, where the effect of noise correlations appeared in higher order statistical measures. Additionally, we study the impact of a dichotomous driving force.

DY 17.22 Tue 16:00 Poster C

Effect of noise and delay near a global bifurcation in superlattices — •Johanne Hizanidis and Eckehard Schöll — Institut f. Theor. Physik, Sekr. EW 7-1, Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin, Germany

We investigate the effect of time-delayed feedback control and Gaussian white noise on a semiconductor superlattice. Superlattices are spatially extended systems with complex dynamics of interacting fronts. The system is prepared in a regime where the deterministic dynamics is characterized by a global bifurcation, namely a saddle-node bifurcation on a limit cycle (*SNIPER*). Physically such a bifurcation governs the transition from stationary to traveling field domains through the device. The *SNIPER* is associated with excitability and therefore the phenomenon of coherence resonance can be verified in the addition of noise below the bifurcation: Noise forces stationary fronts to move and at an optimal noise intensity the regularity of the front motion exhibits a maximum. The possibility to control the noise-induced motion through time-delayed feedback comes into question next. But first the effect of delay without noise is considered. We are able to show that delay induces a homoclinic bifurcation. This result is in agreement to a generic model for the *SNIPER* with delay. Finally, with both noise and delay, we show how one is able to manipulate characteristic time scales of the system and enhance or deteriorate the coherene resonance effect.

DY 17.23 Tue 16:00 Poster C

Multiple time-delayed feedback control of stochastic dynamics in a resonant tunneling diode — •Niels Majer and Eckehard Schöll — Institut für Theoretische Physik, Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin, Germany

We study multiple time-delayed feedback control of noise-induced spatio-temporal oscillations in a double barrier resonant tunneling diode. The system is modeled by a set of partial differential equations of reaction-diffusion type with global coupling.

Below a Hopf bifurcation, Gaussian white noise sources and a multiple time-delayed feedback control force are applied to the system. Correlation times and timescales of the resulting noise-induced oscillations are investigated under variation of the control parameters. The obtained results are explained using the stability properties of the deterministic system.

DY 17.24 Tue 16:00 Poster C

Nonlinear hopping conduction in open channels — •Martin Körner[1], Mario Einax[1], Philipp Maass[1], and Abraham Nitzan[2] — [1]Institut für Physik, Technische Universität Ilmenau, 98684 Ilmenau, Germany — [2]School of Chemistry, The Sackler University of Science, Tel Aviv University, Tel Aviv 69978, Israel

The nonlinear conduction under the influence of strong static and oscillating electric fields is investigated based on an open channel model. In the model thermally activated hopping is considered on a linear chain connected to two particle reservoirs with different electrochemical potentials. An analytical expression for the stationary current is derived and tested against numerical calculations. In particular we discuss the behaviour of the nonlinear dc-current in the thermodynamic limit. A systematic scheme for analyzing the response to strong oscillating fields is presented and numerical results for frequency-dependent nonlinear conductivities are compared to measurements on thin-film glassy electrolytes.

DY 17.25 Tue 16:00 Poster C

Erzeugung von dynamischen Verkehrszustandsgrenzen für Online-Verkehrssimulationen — •Florian Mazur, Thomas Zaksek, Johannes Brügmann und Michael Schreckenberg — Universität Duisburg-Essen, Physik von Transport und Verkehr, Lotharstr. 1, D-47057 Duisburg, Germany

Die bisherige Einteilung der Verkehrszustände anhand der Anzahl Fahrzeuge und anhand ihrer Geschwindigkeiten in 4 Verkehrszustände ist nach der MARZ statisch auf eine Richtgeschwindigkeit von 130 km/h ausgelegt. Eine besondere Bedeutung innerhalb des Algorithmus hat die Geschwindigkeit 80 km/h. Ein Verkehrsaufkommen von 40 Fahrzeugen mit durchschnittlicher Geschwindigkeit von 79 km/h entspricht zähfließendem Verkehr. Bei einer Durchschnittsgeschwindigkeit von 81 km/h entspricht dieser dichtem Verkehr. Besonders in Bereichen mit niedrigeren Höchstgeschwindigkeiten, wie zum Beispiel im Bereich von Baustellen oder auf Autobahnen mit Verkehrsbeeinflussungsanlagen, führt diese Einteilung schnell zu nicht plausiblen Ergebnissen.

Dieses Poster zeigt einen Algorithmus, mit dem die Verkehrszustände auf Streckenabschnitten mit bestehenden statischen Geschwindigkeitsbeschränkungen genauer, d. h. realitätskonformer abgebildet werden können.

DY 17.26 Tue 16:00 Poster C

Entwicklung von Standardganglinien im Bereich von Baustellen für Online-Verkehrssimulationen — •Thomas Zaksek, Florian Mazur, Johannes Brügmann und Michael Schreckenberg — Universität Duisburg-Essen, Physik von Transport und Verkehr, Lotharstr. 1, D-47057 Duisburg, Germany

Im Bereich von Baustellen ist es schwierig, genaue Informationen über den Verkehrszustand auf diesem Abschnitt zu erhalten. Meist sind die automatischen Erfassungsanlagen abgeschaltet und nur sehr selten Ersatzdetektionsgeräte aufgestellt. Besonders in diesen Bereichen ist jedoch eine zuverlässige Information über den Verkehrszustand besonders interessant, da die Stauwahrscheinlichkeit an Engpässen ansteigt. Hierzu wurden Ersatzganglinien aus historischen Daten der vergangenen Jahre entwickelt, die die Topologie der Baustelle und die Spurführung berücksichtigen. Kombiniert mit den Verkehrsinformationen vor und nach dem Bereich der Baustelle können deutlich genauere Verkehrsinformationen für die Baustelle selbst erzeugt werden.

Dieses Poster zeigt die Erstellung von Ersatzganglinien und die Systematik, die für die Auswahl der richtigen Ersatzganglinie angewendet wird.

DY 17.27 Tue 16:00 Poster C

Stationary Turing Patterns in the Diffusive Bazykin System — •Oliver Strebel — Handjerystr. 31 12159 Berlin

Recently McGehee et. al. [1] demonstrated the existence of Turing patterns in the diffusive Bazykin System within the framework of linear stabilty analysis. Time series from numerical integration of the parabolic Bazykin system underpinned this finding. In this study stationary Turing patterns of the time-independent elliptic Bazykin systemare calculated using fixed point methods.

The stability of various spatial modes is determined in the linear approximation. The stable modes emanating from the constant solution are continuated using numerical continuation methods [2]. They exhibit in course of the continuation gradually more anharmonic bahaviour. Numerical criteria for detecting tangent, pitchfork and Hopf bifurcations are employed [3]. These bifurcation points in turn are continuated numerically, giving a description of the systems behaviour in the parameter space.

[1] E. A. McGehee et al., Phys. Lett. A342 90 (2005) [2] E. L. Allgower and K. Georg, Numerical Continuation Methods, Springer (1990). [3] Yu. A. Kuznetsov, Elements of Applied Bifurcation Theory (3rd ed.), Springer AMS (2004).

DY 17.28 Tue 16:00 Poster C

Patterns of Chaos Synchronization — •Johannes Kestler, Anja Englert, and Wolfgang Kinzel — Theoretische Physik III, Universität Würzburg

Small networks of chaotic units which are coupled by their time-delayed variables, are investigated. In spite of the time delay, the units can synchronize isochronally, i.e. without time shift. Moreover, networks can not only synchronize completely, but can also split into different synchronized sublattices. These synchronization patterns are stable attractors of the network dynamics. In this contribution we present different networks with their associated behaviors and synchronization patterns.

DY 17.29 Tue 16:00 Poster C

Lyapunov spectral gap and branch splitting of Lyapunov modes in a "diatomic" system — •Hong-liu Yang and Günter Radons — Institute of Physics, Chemnitz University of Technology, D-09107 Chemnitz, Germany

Lyapunov instability of a "diatomic" system of coupled map lattices is studied and the dynamics of Lyapunov modes (LMs) is compared with phonon dynamics. Similar to the phonon case mass differences between neighbouring sites induce gaps in the Lyapunov spectrum and LMs split into two types correspondingly. An unexpected finding [1] is that contrary to the phonon case a nontrivial threshold value for the mass difference is required for the occurrence of the spectral gap and the splitting of LMs. A possible origin of such a nontrivial threshold value of mass differences is suggested.

[1] Hong-liu Yang and Günter Radons, Phys. Rev. Lett. 99, 164101 (2007).

DY 17.30 Tue 16:00 Poster C

When can one observe good hydrodynamic Lyapunov modes? — •Hong-liu Yang and Günter Radons — Institute of Physics, Chemnitz University of Technology, D-09107 Chemnitz, Germany

Inspired by recent results on differences in fluctuations of finite-time Lyapunov exponents between hard-core and soft-potential systems we surmise that partial domination of the Oseledec splitting (DOS) with respect to subspaces associated with near-zero Lyapunov exponents is essential for observing good hydrodynamic Lyapunov modes (HLMs). Numerical results for coupled map lattices are presented to show the importance of DOS for observing good HLMs. This is achieved by relating splitting parameters to the maximum value of the Lyapunov mode structure factor.

DY 17.31 Tue 16:00 Poster C

Hydrodynamic Lyapunov modes and strong stochasticity threshold in the dynamic XY model: an alternative scenario — •Hong-liu Yang and Günter Radons — Institute of Physics, Chemnitz University of Technology, D-09107 Chemnitz, Germany

Crossover from weak to strong chaos in high-dimensional Hamiltonian systems at the strong stochasticity threshold (SST) was anticipated manifesting a global transition in the geometric structure of the phase space. Our recent study of Fermi-Pasta-Ulam (FPU) models showed that corresponding to the transition of the system dynamics at the SST the scaling of the energy density dependence of all Lyapunov exponents exhibits a similar change as the largest one. Also the profiles of change of all Lyapunov exponents are identical apart from an energy density independent scaling factor. The current investigation of the dynamic XY model discovers an alternative scenario of change of the system dynamics at SSTs. Although the tendency of change of all Lyapunov exponents is similar the detailed profiles are different from each other except in the near-harmonic regime. Such a finding restricts the use of only crude indices such as the largest Lyapunov exponent and the Ricci curvatures to characterize the global transition in dynamics of high-dimensional Hamiltonian systems. Moreover, numerical simulations demonstrate the existence of HLMs in the dynamic XY model and show that there is a smooth transition in the energy density dependence of significance measures of HLMs corresponding to the crossover in Lyapunov exponents.

DY 17.32 Tue 16:00 Poster C

Hydrodynamic Lyapunov modes in binary 1D-Lennard-Jones fluids — •Christian Drobniewski and Günter Radons — TU-Chemnitz 09107

Corresponding to the partial structure factors of molecular hydrodynamics we defined static and dynamic correlation functions of the Lyapunov vectors ([1],[2]). By this it was made possible to identify Lyapunov modes in chaotic many particle systems with softcore interactions (Lennard-Jones fluids). Lennard-Jones fluids are a well know and widely treated class of systems which are often investigated in the context of the glass transition. With these correlation functions we open new investigation possibilities. For instance, the frequency properties for the Lyapunov modes allow the connection to the known properties of fluid or glasseous systems. We present results for a binary 1D-Lennard-Jones fluid with alternating masses. Special focus lies on the distinct properties shared with simpler model systems such as the linear chain or couple map lattices with alternating masses ([3]). To recognize differences in the behaviour of the particle sorts we splitted the above correlations functions for each of them. [1] Hong-liu Yang and Günter Radons, Hydrodynamic Lyapunov modes in coupled map lattices, Phys. Rev. E 73, 016202 (2006) [2] G. Radons and H. L. Yang, Static and Dynamic Correlations in Many-Particle Lyapunov Vectors, arXiv nlin. CD/0404028 [3] H.L. Yang, G. Radons, Lyapunov Spectral Gap and Branch Splitting of Lyapunov Modes in a Diatomic System, Phys. Rev. Lett. 99, 164101 (2007)

DY 17.33 Tue 16:00 Poster C

Dimensional collapse and fractal properties of simple maps with fluctuating delay times — •Jian Wang, Hong-liu Yang, and Günter Radons — Institute of Physics, Chemnitz University of Technology, D-09107 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. A characteristic feature of such systems is that the dimension of the system dynamics collapses due to the fluctuation of the delay times. This implies infinite contraction rates therby leading to diverging Lyapunov exponents. The consequences of the latter for the fractal attractor dimensions are discussed.

DY 17.34 Tue 16:00 Poster C

Dynamical characterization of Markov processes with varying order — •Michael Bauer and Günter Radons — Chemnitz University of Technology, 09107 Chemnitz, Germany

Our objective is to characterize the behavior of discrete-time Markov processes with randomly fluctuating order in a finite state space. Such processes may arise e.g. in the symbolic dynamics of dynamical systems with varying memory length. Changing the order leads to different transition matrices, resulting for the evaluation of block probabilities in random products of matrices with different ranks, which have to be applied to the initial state. We calculate numerically the Lyapunov exponents of the random matrix product and the Kolmogorov-Sinai entropy for a sequence of symbols generated by such a time-variant Markov chain. In special cases this can be done analytically. We also provide results for the distribution of the state probabilities of such a non-stationary process. A connection is made to special hidden Markov models thereby providing results also for the latter.

DY 17.35 Tue 16:00 Poster C

Hamiltonian dynamics in a one-dimensional, spatially quenched random potential — •Ines Hartwig — Technische Universität Chemnitz

The Chirikov-Taylor standard map is modified by introducing a one-dimensional quenched random – yet analytic – potential. Besides having Gaussian autocorrelation, the potential also is Gaussian distributed. In order to define a fundamental cell in Hamiltonian phase space, the potential is made periodic. Finite-size effects created by this periodicity are considered.

The dependence of phase space structures and transport properties both on the period of the potential and the perturbation strength of the map are investigated. Diffusion exponents for transport in the momentum as well as the spatial coordinate are determined and compared to the standard map under corresponding perturbation. Enhanced transport for the random case is shown.

Crude estimates for the critical perturbation strenghts for the destruction of the last KAM-curve are found. Their frequency distribution over many realizations of the random potential is presented.

DY 17.36 Tue 16:00 Poster C

Nonlinear Dynamics of Coupled Hysteretic Transducers of Preisach-Type — •Andreas Zienert and Günter Radons — Chemnitz University of Technology, D-09107 Chemnitz

Hysteresis plays an important role in science and engineering. Many physical and technical systems such as ferromagnetic materials, shape memory alloys, or certain friction models are characterized by hysteretic behavior, implying e.g. a complex dependence on previous input events. The Preisach-model has proven to be an application independent tool for describing such systems.

We investigate the behavior of a series connection $y_n(t) = (\Gamma^n x)(t)$ of Preisach-hysteresis transducers Γ. We show that the outputs $y_n(t)$ for $n \to \infty$ always converge to multi-step functions jumping between two different values. In general $y_\infty(t)$ depends on the given input $x(t)$ and the special form of the Preisach-transducer Γ. A simple geometric method can be used to predict whether for a given Γ the limit output function $y_\infty(t)$ is input dependent. If this is not the case, the method can be used to determine $y_\infty(t)$ from $x(t)$.

DY 17.37 Tue 16:00 Poster C

Investigation of atrial fibrillation generating mechanisms — •Claudia Hamann, Mario Einax, and Philipp Maass — Institut für Physik, Technische Universität Ilmenau, Deutschland

Atrial fibrillation (AF) is the most common arrhythmia of the heart in the industrial countries. Different theories with respect to the generating mechanism of the fibrillatory state in the atria are discussed in the literature [1]: Single or multiple reentrant waves, stable or meandering spirals, action potentials circulating around tissue inhomogeneities, or the interference of a stable spiral in the left atrium with regular waves coming from the sinus node in the right atrium.
To probe these mechanisms we study the interplay between travelling action potentials and spatial inhomogeneities ("obstacles") on the basis of the FitzHugh-Nagumo-model [2]. Dependent on the form and characteristics of the obstacle various behaviours occur, for example, spiral waves can be bound to the obstacle, or they detach and meander through the system. We determine a phase diagram that differentiates the dynamical patterns with respect to the parameters characterising the extent and the physiological features of the obstacle.

[1] S. Nattel, Nature **415**, 219 (2002).

[2] R. FitzHugh, J. Gen. Physiol. **43**, 867 (1960).

DY 17.38 Tue 16:00 Poster C

Synchronization of a hierarchical ensemble of globally cou-

pled excitable oscillators — •Cornelia Petrovic and Rudolf Friedrich — Institut für Theoretische Physik, Westfälische Wilhelms-Universität Münster

The presented work is motivated by the dynamics of the exothermic CO-oxidation on Palladium-supported catalyst [1]. In this experiment one can detect self-affine features in the temporal evolution of the system which are characterized by break-downs of the CO-conversion rate, due to break-downs of parts of the catalyst. We will present a model of an ensemble of globally coupled relaxation oscillators which is able to reproduce the most important characteristics which were experimentally observed. According to the model, these characteristics crucially originate from kind of synchronization phenomena.

[1] C.Ballandis, P.J.Plath, Journal of Non-Equilibrium Thermodynamics 25 3/4, 301 (2001)

DY 17.39 Tue 16:00 Poster C

Weather Roulette—Game Theoretical Concepts For Evaluating Forecasts — •Jochen Bröcker[1], Mark Roulston[2], and Leonard Smith[3] — [1]Max Planck Institute for the Physics of Complex Systems, Dresden, Germany — [2]London School of Economics, London, United Kingdom — [3]Met Office, Exeter, United Kingdom

Probabilistic forecasts are (at least in principle) superior to deterministic forecasts, as the former allow for a better assessment of potential risks. In weather and climate for example, probabilistic forecasts have therefore been a longstanding aim. In these sectors, the use of ensembles to convey probabilistic information has become more and more common.

Different from deterministic forecasts, probabilistic forecasts (ensemble forecasts or other) cannot simply be evaluated by just how far they missed truth. But how do we know then if our probabilistic forecast is "good"? In this contribution, concepts for evaluating probabilistic forecasts are discussed. Using a game theoretic approach, we investigate the income stream the forecast would generate in a lottery–like setup named "weather roulette". Thus the value of the forecast is measured directly in terms of money.

We discuss to what extend a good performance in weather roulette portends general virtues of a forecast. It turns out that, when implemented correctly, weather roulette does not encourage hedging. Numerical results are presented using ensemble weather forecasts for temperature and pressure at several locations.

DY 17.40 Tue 16:00 Poster C

Understanding Oscillatory Zoning in binary solid solution — •Tanja Mues and Andreas Heuer — Institut für physikalische Chemie, Universität Münster, 48149 Münster

Oscillatory Zoning (OZ) is a phenomenon common to many geologically formed crystals. A model of OZ in a binary solid solution grown from an aqueous solution can be described by a system of nonlinear partial differential equations, which were analysed in one dimension in the past. It combines species diffusion in the solution, particle adsorption, surface diffusion and subsequent desorption and incorporation into the crystal. We expand this scheme to two dimensions and check whether the growth behavior displays new characteristics as compared to the 1D case. In particular we elucidate whether the growth pattern is homogeneous, i.e. does not display concentration fluctuations along the surface and whether the limits of stability, obtained for the 1D case, still hold. This is checked via a linear stability analysis as well as a numerical simulation of the partial differential equations.

DY 17.41 Tue 16:00 Poster C

External noises effects on the spatiotemporal characterization of ensemble prediction systems — •Jorge Revelli, Miguel Rodriguez, and Horacio Wio — Instituto de FIsica de Cantabria, Santander, Spain

We investigate the effects of an external noise applied to anextended chaotic system. The chosen model is the Lorenz '96. The system is subjected to temporal and spatiotemporal perturbations. To approach to climate problems the studied system is characterized by three main components. A control, ensemble and reality trajectories. Ensemble trajectories are the result of applying perturbations on the initial conditions to the control. The reality evolution is independent of the control trajectory.

We analyze the fluctuations obtained as differences between each member of the ensemble and the control trajectory and between control and reality trajectories. We use the MVL (Mean Variance of Logarithms) diagrams to represent the interplay and evolution of the fluctuations moments.

With the Talagrand diagram we check where the evolution of a given trajectory usually falls with respect to the ensemble data ordered in a predetermined way.

In this work we study the similarities and differences between these two methods of characterize spatiotemporal evolutions in systems subjected to different ways of applying the external noise to the system. The aim is to establish correspondences between them.

DY 17.42 Tue 16:00 Poster C

Migraine symptoms modeled as transient particle-like waves — Markus A. Dahlem, •M. Hannelore Frank, Gerald Hiller, and Eckehard Schöll — Institut f. Theor. Physik, Sekr. EW 7-1, Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin, Germany

In two-dimensional reaction-diffusion systems, the evolution of waves depends on their form (length and shape). For each set of parameters a specific particle-like wave form exists. When this form is perturbed the momentarily excited area either grows or dies after a transient time. This defines a size limit for excitation spread of particular wave shapes. We show that close to this limit the reaction-diffusion model can be used to describe spatio-temporal patterns of pathological activity during migraine. Patients' symptom reports suggest that pathological activity breaks away from one side of a pathological core and vanishes after it has spread a certain distance. We model this by wave propagation initiated from a circular core region with a cut out wedge. We perform numerical simulations of transient waves breaking away from the core and match their evolution with data of affected cortical tissue obtained from the patients' symptom reports. In the model, we observe curvature effects arising due to the fact that the initial shape of the wave segments is higher curved than the natural form of particle-like waves. We investigate under what circumstances cortical geometry can cause a curvature-induced transition to non-excitable dynamics explaining not only the confined spread but also the partial excitation block at the opposite side of the pathological core.

DY 17.43 Tue 16:00 Poster C

Three-dimensional wave propagation in thin layers of a photo-sensitive BZ-medium — •Peter A. Kolski, Hermann Brandtstädter, and Harald Engel — Institut für Theoretische Physik, TU Berlin, Hardenbergstr. 36, D-10623 BERLIN

We study the dynamics of excitation waves in thin gel layers of the light-sensitive Belousov-Zhabotinsky (BZ) medium in the presence of an excitability gradient transverse to the direction of propagation. Due to Beer-Lamberts law the effective light intensity decreases exponentially with the depth into the layer. Three-dimensional numerical simulations of the underlying reaction-diffusion equations were performed to reveal experimentally observed complex pattern. Calculations were carried out using the Oregonator model modified to describe the photosensitive BZ reaction. The results provide insight into the mechanism of reflective wave collision close to the transition between excitable and oscillatory local kinetics. Inhibiting only parts of the layer leads to the formation of scroll waves and allows for the study of their dynamics in this constraint geometry.

DY 17.44 Tue 16:00 Poster C

Stabilized spiral waves between two excitability limits — •Jan Schlesner, Vladimir S. Zykov, and Harald Engel — Institut für Theoretische Physik, Technische Universität Berlin, Hardenbergstrasse 36, 10623 Berlin, Germany

Taking the FitzHugh-Nagumo as an representative example, rigidly rotating spiral waves are studied over the whole excitability range where spiral waves are supported. By external feedback control we inhibit the instability of rigid rotation and the transition to meandering motion. Under the feedback we determine the rotation frequency, the core radius and other characteristics of rigid rotation in a broad excitability range that includes the meander regime where rigid rotation is unstable. These numerical results are compared to theoretical predictions obtained within the framework of a kinematical approach. Up to now the agreement is encouraging: Both the scaling laws valid for weakly and strongly excitable media as well as the range of intermediate excitability values are reproduced fairly good.

DY 17.45 Tue 16:00 Poster C

Travelling and breathing dissipative solitons in a three-component reaction-diffusion system — •Svetlana V. Gurevich[1], Shalva Amiranashvili[2], Hans-Georg Purwins[3], and

Rudolf Friedrich[1] — [1]Institute for Theoretical Physics, WWU Münster, 48149 Münster, Germany — [2]Weierstrass Institut for Applied Analysis and Stochastics, 10117 Berlin, Germany — [3]Institute of Applied Physics, WWU Münster, 48149 Münster, Germany

We are interested in stability of the localized solutions in a three component reaction-diffusion system with one activator and two inhibitors, which is considered as phenomenological model of the planar dc gas-discharge system with high-ohmic electrode operating in the glow mode. Here we consider the situation, where two critical modes become unstable simultaneously. In this case two control parameters are to be changed, so one can speak about codim=2 bifurcation point. This situation is analyzed performing a two-time-scale expansion in the vicinity of the bifurcation point. Also numerical simulations are carried out showing good agreement with the analytical predictions.

DY 17.46 Tue 16:00 Poster C

Hopf-bifurcations in systems with conserved quantities — •Markus Hilt and Walter Zimmermann — Theoretische Physik I, Universität Bayreuth, 95440 Bayreuth, Germany

A cubic Ginzburg-Landau equation is presented, which describes the universal properties of a Hopf-bifurcation in a system with conserved quantities. It is a universal feature of the equation that all traveling wave solutions are linear unstable. In finite systems with periodic boundary conditions only the solution with the longest possible wavelength is stable in some parameter range. This is different from the behavior of a Hopf-bifurcation in systems with an unconserved order parameter.

We present four typical solution scenarios of this universal equation. In addition we show that the typical nonlinear coarsening behavior in such systems may be suppressed by temporal forcing whereby a wavelength range is selected which depends on the forcing frequency.

DY 17.47 Tue 16:00 Poster C

Implementation of a microscopic simulation model for urban traffic — •Daniel Weber and Michael Schreckenberg — Physik von Transport und Verkehr, Universität Duisburg-Essen

We present a microscopic traffic flow model derived from the Nagel-Schreckenberg cellular automaton. This model is implemented for a realistic urban traffic topology, featuring multiple lanes, varying speed limits and junctions with and without traffic signals. Local flow and velocity measurements are used as input or the simulation to compute travel-times and level-of-service for the whole network. We show results of the calibration and validation of the simulation using data of detectors and test drives.

DY 17.48 Tue 16:00 Poster C

On multiplicative forcing effects in the Cahn-Hilliard model — •Christian Feller, Alexei Krekhov, and Walter Zimmermann — Theoretische Physik I, Universität Bayreuth, 95440 Bayreuth, Germany

Phase separation in the presence of spatially periodic temperature modulation has been investigated theoretically in terms of a generalized Cahn-Hilliard model, where the temperature modulation is described by a spatially periodic modulation $G\cos(Qx)$ of the control parameter.

One obtains for harmonic and subharmonic solutions with respect to the modulation of the control parameter different thresholds for the bifurcation from the basic state. The threshold for the harmonic solutions is always lower. Beyond the threshold there exists a discrete set of periodic solutions characterized by the wave number Q/m (with integer m) which become stable only beyond a certain second threshold. In the nonlinear regime numerical simulations of the phase separation dynamics in one and two dimensions are compared with the results of linear stability analysis.

DY 17.49 Tue 16:00 Poster C

Conversion of Stability in Systems close to a Hopf Bifurcation by Time-delayed Coupling — Chol-ung Choe[1,2], Valentin Flunkert[2], •Philipp Hövel[2], Hartmut Benner[3], and Eckehard Schöll[2] — [1]Department of Physics, University of Science, Unjong-District, Pyongyang, DPR Korea — [2]Institut f. Theo. Physik, Sekr. EW 7-1, Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin, Germany — [3]Institut für Festkörperphysik, Technische Universität Darmstadt, 64289 Darmstadt, Germany

We propose a control method with time delayed coupling which makes it possible to convert the stability features of systems close to a Hopf bifurcation. We consider two delay-coupled normal forms for Hopf bifurcation and demonstrate the conversion of stability, i.e., an interchange between the sub- and supercritical Hopf bifurcation. [1] The control system provides us with an unified method for stabilizing both the unstable periodic orbit and the unstable steady state and reveals typical effects like amplitude death and phase locking. The main method and the results are applicable to a wide class of systems showing Hopf bifurcations, for example, the Van der Pol oscillator. The analytical theory is supported by numerical simulations of two delay-coupled Van der Pol oscillators, which show good agreement with the theory.

[1] C.-U. Choe *et al.*, Phys. Rev. E **75**, 046206 (2007).

DY 17.50 Tue 16:00 Poster C

Synfire chains in Integrate-and-fire networks with unreliable synapses — •Johannes Friedrich and Wolfgang Kinzel — Institute of Theoretical Physics and Astrophysics, University of Würzburg, Am Hubland, Würzburg, Germany

There is experimental evidence that synapses transmit an incoming spike not deterministically but with some probability which may be as low as a few percent. We investigated the properties of a network of identical integrate-and-fire neurons with unreliable inhibitory synapses which transmit with a delay time.

Without temporal delay, the network relaxes to a state of high attention: Most of the neurons collect just below threshold and are prepared to react immediately to an incoming excitation.

With time delay the network relaxes to a state with clusters, or synfire chains. The whole network consists of clusters of identical size which are stable, instead of the probabilistic nature of the synapses. The number of clusters does not depend on the probability p of synaptic transmission, but their survival time decreases with decreasing p. The number of possible configurations of synfire chains increases exponentially with the size of the network.

Ref: Wolfgang Kinzel, J Comput Neurosci
DOI 10.1007/s10827-007-0049-3

DY 17.51 Tue 16:00 Poster C

Stabilizing odd-number orbits close to a saddle-node bifurcation by time-delayed feedback control — •Valentin Flunkert[1], Bernold Fiedler[1], Philipp Hövel[2], Marc Georgi[2], and Eckehard Schöll[1] — [1]Institut für Theoretische Physik, Technische Universität, Berlin — [2]Institut für Mathematik I, Freie Universität, Berlin

We demonstrate by a simple normal form model that an unstable periodic orbit generated by a saddle-node bifurcation can be stabilized using time-delayed feedback control.

This furnishes a further example, besides the subcritical Hopf bifurcation [1], that the alleged "odd number limitation theorem", which states that orbits with an odd number of positive Floquet multipliers greater than unity cannot be stabilized by Pyragas time-delayed feedback, does not hold.

We analyse the stability regions of our model in the parameters space and investigate the mechanism of stabilization.

[1] B. Fiedler, V. Flunkert, M. Georgi, P. Hövel, and E. Schöll, Phys. Rev. Lett. **98**, 114101 (2007).

DY 17.52 Tue 16:00 Poster C

Influence of noise on time-delayed feedback control — Tine Brülle, •Klaus Höhne, Markus Appel, and Hartmut Benner — Institut für Festkörperphysik, TU Darmstadt

Time-delayed feedback control is a convenient tool to control chaos in dynamical systems. While the control mechanism is meanwhile well understood and even the role of global properties is presently discussed, the influence of noise on the control performance has still remained an open question. To fill this gap we made control experiments on the diode resonator, which previously has been used as a paradigm to study time-delayed feedback control techniques. Applying different types of noise (additive and multiplicative noise in the controlled system and multiplicative noise in the control loop) we probed the size of the control interval with increasing noise level. The controlled system turned out to be very robust and the control regime was decreased only by very strong noise. Our experimental results were supported by numerical simulations, underlining their general relevance.

DY 17.53 Tue 16:00 Poster C

Mechanisms of the reflection of water jets on superhydrophobic surfaces — •Michael Scharnberg[1], Sören Kaps[2], Vladimir Zaporojtchenko[1], Srdjan Milenkovic[3], Achim Wal-

ter Hassel[3], Franz Faupel[1], and Rainer Adelung[2] — [1]Lehrstuhl für Materialverbunde, Institut für Materialwissenschaft, CAU Kiel — [2]Funktionelle Nanomaterialien, Institut für Materialwissenschaft, CAU Kiel — [3]Max-Planck-Institut für Eisenforschung, Düsseldorf

After impinging onto biological and artificial superhydrophobic surfaces water jets are observed to flow across the surface for a distance equal to several jet diameters before they are reflected off the surface as coherent jets under an angle that is close to or smaller than the angle of incidence. The influence of the water jet's velocity and angle of incidence on this intriguing phenomenon was examined in order to further the understanding of the physics involved. Based on the experimental data a simple theoretical model was derived which will be discussed as well as possible applications in microfluidics.

DY 17.54 Tue 16:00 Poster C

Lagrangian statistics in forced two-dimensional turbulence — •Oliver Kamps and Rudolf Friedrich — Institute for Theoretical Physics, University of Muenster

In recent years the Lagrangian description of turbulent flows has attracted much interest from the experimental point of view and as well is in the focus of numerical and analytical investigations. We present detailed numerical investigations of Lagrangian tracer particles in the inverse energy cascade of two-dimensional turbulence. In the first part we focus on the shape and scaling properties of the probability distribution functions for the velocity increments and compare them to the Eulerian case and the increment statistics in three dimensions. Motivated by our observations we address the important question of translating increment statistics from one frame of reference to the other [1]. To reveal the underlying physical mechanism we determine numerically the involved transition probabilities. In this way we shed light on the source of Lagrangian intermittency.

[1] R. Friedrich, R. Grauer, H. Hohmann, O. Kamps, A Corrsin type approximation for Lagrangian fluid Turbulence , arXiv:0705.3132

DY 17.55 Tue 16:00 Poster C

Anomalous transport in turbulent systems — •Holger Zimmermann[1], Rudolf Friedrich[1], and Frank Jenko[2] — [1]Institut für Theoretische Phyisk, WWU Münster, Germany — [2]Max-Planck-Institut für Plasmaphysik, 85748 Garching, Germany

Patterns and coherent structures in self-organizing turbulent systems have considerable impact on the transport properties of particles. We investigate a simple model to describe pattern formation in plasma core turbulence. It shows the basic patterns observed in plasma turbulence. These are zonal flows, for the case of ion temperature gradient (ITG) driven turbulence, respectively streamers for electron temperature gradient (ETG) driven turbulence. For the sake of simplicity, a two dimensional model, consisting of two coupled partial differential equations, is considered. In addition, the transport of test particles is also computed for the random forced Burgers equation, which serves as a simple model system for fluid turbulence. Comparable to the coherent structures in the plasma system, this system shows the formation of shocks.

DY 17.56 Tue 16:00 Poster C

Structure of the offshore wind profile of the boundary layer. — •Allan Morales and Joachim Peinke — Physhics Institute, Oldenburg University

From high frequency (1-50Hz) wind and temperature offshore measurements from the research platform in the north sea FINO I , it is possible to get a better understanding of the complexity of wind fields. We analyze these data with respect to high frequency instabilities. As a characteristic parameter we calculate the instantaneous thermal stability of the meteorological boundary layer by means of the Richardsons number. We use these results to get a better, more detailed description of the mean wind profile of the boundary layer. In particular we consider the 10 min. wind profile as a nonstationary superposition of different wind profile situations.

DY 17.57 Tue 16:00 Poster C

A Comparison of Turbulent and Random Fields — •Michael Wilczek[1], Holger Homann[2], Rainer Grauer[2], and Rudolf Friedrich[1] — [1]Institute for Theoretical Physics, Westfälische Wilhelms-Universität Münster, Germany — [2]Institute for Theoretical Physics I, Ruhr-Universität Bochum, Germany

Fully developed turbulence is dominated by a complex tangle of vortex filaments. During their complicated interaction they produce an almost Gaussian velocity field and an energy spectrum according to Kolmogorov's classical prediction. By a randomization procedure we construct random, incoherent fields, which maintain these properties but lack of any signatures of coherent structures. Regarding Eulerian statistics a comparison of the coherent and incoherent fields reveals significant differences in one-point statistics like the pdf of vorticity, velocity and acceleration. An investigation of the statistical alignment of these fields confirms the picture of turbulence as an ensemble of tubular coherent structures. A comparison of the Eulerian structure function gives further insight to the relation between coherent structures and intermittency. Additionally we study the advection of tracer particles, focusing on Lagrangian structure functions. We find that the scaling properties significantly differ in both cases, consistent with the observations in the Eulerian frame.

DY 17.58 Tue 16:00 Poster C

Buoyancy-driven hydrodynamic instabilities of chemical reaction fronts — •Lenka Šebestíková and Marcus J. B. Hauser — Otto von Guericke Universität Magdeburg, Institut für Experimentelle Physik, Abteilung Biophysik, Magdeburg

Experimental results on buoyancy-driven hydrodynamic instabilities taking place in a liquid system made of two miscible fluids that are separated by a traveling reaction front are presented. The experiments have been performed in a rectangular-shaped channel, whose top was open to air, allowing for gas/liquid interfaces. The reaction fronts propagate with a certain speed through the channel showing a dependence of the liquid depth on the speed of a propagating reaction front. The liquid depth also affects the dynamics of the system leading to a new type of pattern formation, reminiscent of turbulence patterns. A critical liquid depth for the development of the new type of patterns was determined. We will discuss a possible relationship of the turbulence-like pattern formation and the development of hydrodynamic convection rolls accompanying the traveling reaction front.

DY 17.59 Tue 16:00 Poster C

Semiclassical Local Densities in One-Dimensional Systems — •Jerome Roccia and Matthias Brack — Institut für Theoretische Physik, Universität Regensburg, 93040 Regensburg, Germany

We investigate the local densities for non-interacting fermions in one dimensional potentials at zero temperature. Using the semiclassical Green's function, we study the particle and kinetic-energy densities close to the minimum of the potential. Without any knowledge of individual wave functions, we find a universal behavior as function of the position which depends only on the non periodic trajectories of the system. We give also a simple analytical formula for symmetric potentials.

DY 18: Soft matter

Time: Wednesday 14:00–16:30 Location: MA 001

Invited Talk DY 18.1 Wed 14:00 MA 001

Rate Dependence and Role of Disorder in Linearly Sheared Two-Dimensional Foams. — •Martin Van Hecke, Gijs Katgert, and Matthias Moebius — Kamerlingh Onnes Lab, PObox 9504 2300 RA Leiden, the Netherlands

We experimentally probe the rheology of two dimensional foams sandwiched between the fluid phase and a top-plate, and find that these flows depend crucially on both the applied strain rate and the degree of disorder of the foam: (1) Disordered, bidisperse foams exhibit rate dependent flow profiles, which become increasingly shear-banded for large shear rates. (2) Ordered, monodisperse foams exhibit rate independent flows.

These findings are captured in a model in which the averaged drag forces between bubble and top plate are balanced by the inter-bubble drag forces. We show that nonlinear scaling of these forces and rate dependent flows are intimately connected.

The fact that disorder plays such a crucial role for the foam flow, evidences that the translation from individual inter-bubble drag forces to the average inter-bubble drag forces is nontrivial. We find that for disordered foams the average inter-bubble drag forces scale differently from the individual inter-bubble drag forces. This is consistent with earlier suggestions that the averaged viscous drags are enhanced over what might be expected from the local interactions, due to disordered, non-affine, bubble motion. We discuss how anomalous scaling of bulk properties caused by non-affine motion at the micro scale appears to be a general feature of disordered systems close to jamming.

DY 18.2 Wed 14:30 MA 001

Mesoscale, particle-based simulations of binary mixtures and microemulsions — •Thomas Ihle and Daniel Kroll — Department of Physics, North Dakota State University, Fargo, ND, 58105, USA

An appealing algorithm for complex fluids introduced by Malevanets and Kapral, often called Stochastic Rotation Dynamics (SRD), describes a fluid by means of particles which undergo efficient multi-particle collisions. The algorithm has been successfully applied to study the behavior of polymers, colloids and vesicles.

Here, we use a recent generalization of this algorithm for binary mixtures [1,2]. We present results for the demixing of a mixture such as the phase diagram, interface fluctuations and the surface tension of a droplet. We show how Ginzburg-Landau free energy functionals including gradient terms can be derived from the microscopic collision rules. Expressions for the equation of state and the phase diagram are shown to be in excellent agreement with numerical results.

To describe microemulsions, a third phase of surfactant molecules is introduced which consists of rigid objects. We show how objects of arbitrary shape can be efficiently embedded in the SRD-fluid. The phase diagram and results for emulsification will be presented.

[1] T. Ihle, E. Tuzel, D.M. Kroll, Europhys. Lett. 73 (2006) 664.

[2] E. Tuzel, G. Pan, T. Ihle and D. M. Kroll, Europhys. Lett. 80 (2007) 40010.

DY 18.3 Wed 14:45 MA 001

Effective Interactions in Like-Charged Colloidal Mixtures and Cluster Formation — •A. V. Anil Kumar[1] and Juergen Horbach[2] — [1]Institut für Physik, Universität Mainz, Staudinger Weg 7, 55099 Mainz — [2]Institut für Materialphysik im Weltraum, Deutsches Zentrum für Luft- und Raumfahrt, 51170 Köln

We consider binary mixtures of like-charged colloidal particles of large size disparity. Using molecular dynamics simulations, the depletion interaction between the big colloidal particles mediated by a fluid of small particles is calulated. Attention is given to the region in parameter space where there is an effective attractive interaction between the large spheres. Our results indicate that indeed there exists an attractive force between two large spheres when the interaction between the large and small spheres are non-additive and highly repulsive. This attractive interaction is due to the overlap of depletion regions around two big spheres formed due to the high repulsion between large and small spheres. The strength of this effective attraction depends on the strength of large-small repulsion and also on the number ratio between the large and small particles. In this attractive region, we simulated a bulk system, where we observed cluster formation among the big particles. The cluster size distribution decays exponentially with cluster size, which is in agreement with experimental observations. At higher volume fractions, the cluster size distribution develops a two peak structure. This may be seen as a precursor to phase separation. The detailed results of molecular dynamics simulations and their connection with experimental observations will be discussed.

DY 18.4 Wed 15:00 MA 001

Dynamical Simulations Of Colloids In Optical Tweezers — •Rudolf Weeber and Jens Harting — Institute For Computational Physics, University Of Stuttgart, Pfaffenwaldring 27, D-70569 Stuttgart

Dynamical Simulations Of Colloids In Optical Tweezers Optical tweezers are important tools in the study of colloidal suspensions outside of equilibrium, because they make it possible to perturb the system in a controlled manner. We present simulations of a colloid dragged through both, a colloidal crystal and a polymer suspension using an optical tweezer modeled as a moving parabolic potential. From the behavior of the dragged particle within the trap and the surrounding crystal, dynamical properties like drag forces and the rearrangement of surrounding particles in the suspension are obtained. The simulations for both systems are compared to experiments. For the polymer suspension, we find a linear velocity-force relation. At high polymer concentrations, we find a significant accumulation of polymers in front of the dragged colloid. This leads to an increased drag force, that cannot be explained by the Stokes-Einstein-Relation. For the colloidal crystal, the drag force is non-linear with respect to velocity. Also, the details of the inter-colloid potential play an important role in the velocity-force relation. We also compare two simulation techniques - namely Brownian Dynamics and Stochastic Rotation Dynamics - to evaluate the impact of complex hydrodynamic interactions on these experiments.

DY 18.5 Wed 15:15 MA 001

From soliton staircases to strain density waves: Monte Carlo simulations of surface-induced deformation of soft colloidal crystals — David Yu-Hang Chui[1], •Surijit Sengupta[2], and Kurt Binder[1] — [1]Institut für Physik, Johannes-Gutenberg-Universitüt, Staudingerweg 7, 55099 Mainz, Germany — [2]S. N. Bose National Centre for Basic Sciences, Block JD, Sector III, Salt Lake, Kolkata 700098, India

Two dimensional colloidal crystal interacting with an inverse power law potential was studied using Monte Carlo simulations. Two structured walls, which are created by choosing two rows of particles fixed in the positions of the triangular lattice, provide the confinement to the system. By varying the distance between two walls, the deformation of the two dimensional colloid is induced and typical soliton staircase can be observed. The strain in the system was also calculated and the strain density wave superstructure was found in the different thicknesses of the strips.

DY 18.6 Wed 15:30 MA 001

Ground-state properties of thick flexible polymers — •Thomas Vogel[1], Thomas Neuhaus[2], Michael Bachmann[1], and Wolfhard Janke[1] — [1]Institute for Theoretical Physics, University of Leipzig, PF 100 920, 04009 Leipzig — [2]John von Neumann Institute for Computing, Forschungszentrum Jülich, 52425 Jülich

We investigate ground-state properties of a simple model for flexible polymers, where the steric influence of monomeric side-chains is effectively introduced by a thickness constraint [1]. Thickness is defined via the global radius of curvature [2]. From parallel tempering and flat-histogram computer simulations, we find a strong thickness dependence of the conformational topology of the ground-state structures. A systematic analysis for short polymers allows for a thickness-dependent classification of the dominant ground-state topologies. It turns out that helical structures, strands, rings, and coils are natural, intrinsic geometries of such linelike objects.

[1] T. Neuhaus, O. Zimmermann, and U.H.E. Hansmann, Phys. Rev. E 75, 051803 (2007).

[2] O. Gonzalez and J. Maddocks, Proc. Natl. Acad. Sci. USA 96, 4769 (1999).

DY 18.7 Wed 15:45 MA 001

Conformational transitions of flexible polymers — •Stefan Schnabel, Michael Bachmann, and Wolfhard Janke — Institut für Theorethische Physik Universität Leipzig

We investigate collapse and crystallization of flexible homopolymers by means of multicanonical computer simulations of a simple off-lattice bead-spring polymer model with FENE (finitely extensible nonlinear elastic) bond potential [1] and intramonomeric Lennard–Jones interaction.

Beside the well known Theta transition we also observe another transition at lower temperatures which is expected to be the liquid-solid transition. This is indicated by sharp energetic fluctuations as signalized by the specific heat. The crystallized polymer structures possess similarities to ground states of pure Lennard-Jones clusters. From our results, we also conclude that crystallization and collapse transition remain well separated in the thermodynamic limit [2].

[1] R. B. Bird, C. F. Curtiss, R. C. Armstrong and O. Hassager, Dynamics of Polymeric Liquids, 2nd ed., 2 vols. (Wiley, New York, 1987). [2] D. F. Parsons and D. R. M. Williams, J. Chem. Phys 124, 221103 (2006)

DY 18.8 Wed 16:00 MA 001

Steric molecular recognition: Selecting Components of Hard Rod Mixtures — •Thomas Gruhn and Andreas Richter — Max Planck Institute for Colloids and Interfaces, Science Park Golm, 14424 Potsdam, Germany

The mechanisms of molecular recognition are of great relevance for the development of specific pharmaceutical agents. One important selection method is based on the geometrical matching of the receptor and the molecule of interest. A large molecule cannot enter a small cavity, but, at first sight, a molecule cannot be too small to enter a large cavity. However, we have found that suitably shaped cavities in a substrate can select molecules of a specific size from a polydisperse system by purely steric interactions. We have performed Monte Carlo simulations of a system of hard rods with a length polydispersity in contact with a hard substrate. The planar substrate has rectangular cavities, that match geometrically to one rod component of the mixture. The simulations show that the corresponding rod component can be successfully selected from the system of rods. A direct usage of this effect is the preparation of colloidal rod systems with a narrow length distribution.

DY 18.9 Wed 16:15 MA 001

Adaptive molecular resolution via a continuous change of the phase-space dimensionality: Theory and Application — •Luigi Delle Site, Matej Praprotnik, and Kurt Kremer — Max-Planck Institute for Polymer Research, Mainz

For the study of complex synthetic and biological molecular systems by computer simulations one is still restricted to simple model systems or to by far too small time scales. To overcome this problem multiscale techniques are being developed. However in almost all cases, the regions treated at different level of resolution are kept fixed and do not allow for a free exchange. We here present a robust computational method and a basic theoretical framework for an efficient and flexible coupling of the different regimes. The approach leads to the concept of "geometry induced phase transition" and to a counterpart of the equipartition theorem for fractional degrees of freedom. The efficiency of the presented approach is illustrated by the application to several systems.

DY 19: Granular matter I

Time: Wednesday 14:30–16:30 Location: MA 004

DY 19.1 Wed 14:30 MA 004

Formation of sand ripples in weakly turbulent flows — •Christof Krülle[1], Mustapha Rouijaa[2], Tobias Edtbauer[1,2], and Nuri Aksel[2] — [1]Experimentalphysik V, Universität Bayreuth, D-95440 Bayreuth — [2]Technische Mechanik und Strömungsmechanik, Universität Bayreuth, D-95440 Bayreuth

One of the most fascinating examples of pattern formation in nature are the dunes and ripples formed in sand, caused either by wind or by shear flows in water. Laboratory studies have focused mainly on the surface profile of the granular layer, describing the ripples and their instability in terms of global parameters. Here, we present an experimental study of ripple generation in an annular channel at rather low Reynolds numbers in weakly turbulent flow. We characterize the fluid velocity field at the onset of ripple generation by utilizing a laser doppler anemometer. These experimental studies show that the local rapid increase of velocity fluctuations close to the sandy bottom initiate the motion of particles and thus will finally lead to the formation of ripple patterns with finite amplitude.

DY 19.2 Wed 14:45 MA 004

A unified hydrodynamic model for dilute and dense granular flow — •Arnulf Latz and Sebastian Schmidt — Fraunhofer Institut für Techno- und Wirtschaftsmathematik, Kaiserslautern

A continuum model for granular flow is presented, which covers the regime of fast dilute flow as well as slow dense flow up to vanishing velocity. Our model is at small and intermediate densities equivalent to a kinetic model of granular flow. The existence of an inherent instability in the kinetic model due to the vanishing kinetic pressure for small granular temperatures requires a cross over from a kinetic pressure to an athermal yield pressure at densities close to random close packing. The viscosity diverges for small temperatures analogous to the diverging viscosities of liquids close to the glass transition. The model is able to recover many features of granular flow. As examples we show simulations of sandpiles with predictable slopes, Hopper simulations with mass and core flow and angle dependent critical sand heights in granular flow down an inclined plane. We solve the system of the strongly nonlinear singular hydrodynamic equations with the help of a newly developed nonlinear time stepping algorithm together with a finite volume space discretisation. The numerical algorithm is implemented using a finite volume solver framework developed by the authors which allows discretisation on cell-centred bricks in arbitrary domains.

DY 19.3 Wed 15:00 MA 004

2D barchan dunes made in the lab — •Christopher Groh[1], Andreas Wierschem[2], Nuri Aksel[2], Ingo Rehberg[1], and Christof Krülle[1] — [1]Experimentalphysik V, Universität Bayreuth, D-95440 Bayreuth, Germany — [2]Technische Mechanik und Strömungsmechanik, Universität Bayreuth, D-95440 Bayreuth, Germany

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 field studies, 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.

In our setup we are able to investigate a well defined two-dimensional single barchan dune under the force of a shearing water flow. Thus we have a basic access to the dynamic of a barchan dune. This allows easily the validation of the existing two-dimensional theoretical models with our experimental data.

DY 19.4 Wed 15:15 MA 004

Rheological Transition in Granular Media — •Zahra Shojaaee, Lothar Brendel, and Dietrich E. Wolf — Department of Physics, University of Duisburg-Essen, 47048 Duisburg, Germany

The **C**ontact **D**ynamics method is being applied to investigate a two-dimensional non-cohesive granular material. The particles are hard discs, and Coulomb friction and volume exclusion forces are the only forces being exerted. The particles are confined between two parallel walls at the top and the bottom. The walls are being pushed inwards by the same perpendicular forces. They move horizontally with the same constant velocity in opposite directions.

The velocity profile is being studied. In the case of a bidisperse system the flow as function of the shear velocity shows characteristics comparable to a *phase transition*. The key quantities are the velocity of the center of mass of the system as well as its fluctuations. A *finite size analysis* suggests that it is a discontinuous *"phase transition"*. At high shear velocity the symmetry between the upper and lower wall is not spontaneously broken, whereas at slow shear rate the granular material has different slip at the two walls. For large systems the *ergodic time* seems to diverge exponentially below the critical shear velocity.

DY 19.5 Wed 15:30 MA 004

Impact Compaction of a Cohesive Granular Medium — Jens Boberski, •Lothar Brendel, and Dietrich Wolf — Computational Physics, Universität Duisburg-Essen, Deutschland

The collision between a slab of cohesive granular media and an impacting plate is investigated, focussing on the emerging compaction front. The propagation of the latter is analytically derived, taking into account a constitutive law which relates the powder's volume fraction and stability algebraically. The results are compared to Contact Dynamic simulations of the collision, which confirm the constitutive law and which agree well with the analytic treatment.

DY 19.6 Wed 15:45 MA 004

In-situ investigation of the mechanical and electrical properties of nanosized Silicon powders during compaction — •Ingo Plümel[1,2], Hartmut Wiggers[2], and Axel Lorke[1] — [1]Experimental Physics and CeNIDE, Universität Duisburg-Essen, Duisburg, Germany — [2]Institute of Combustion and Gas Dynamics, Universität of Duisburg-Essen, Duisburg, Germany

Nominally doped and undoped nano- and microsized Silicon powders were characterized by determining in-situ the conductance, impedance, and the change of porosity while applying a uniaxial mechanical pressure ranging from 7.5 to 750 MPa. The conductance shows an exponential dependence on the applied pressure for nanosized particles and a power law for microsized particles. Simple scaling considerations with respect to the particle size cannot explain this fundamentally different behavior. A slow time dependent change in conductance together with a decrease in porosity was observed while applying a constant pressure, suggesting friction-limited compaction of the powder. For a constant external force, the comparison of samples with different particle size leads to a clear power law dependence between the conductance of pressed samples and their mean particle diameter. This size effect spans seven orders of magnitude in conductance while the particle size changes by only a factor of ten. The conductance clearly exceeds any influence of the doping concentration and the variation of the sample mass. In agreement with the observed compaction of the powder, impedance spectra show a strong increase of the sample capacitance and conductance as a function of the applied pressure.

DY 19.7 Wed 16:00 MA 004

Asymptotic Structure of Nanopowders — Thomas Schwager[1], Dietrich E. Wolf[2], and •Thorsten Pöschel[3] — [1]Charité Berlin, Institut für Unfallchirurgie — [2]Universität Duisburg-Essen, Fachbereich Physik — [3]Universität Bayreuth, Physikalisches Institut

We investigate the asymptotic structure of a nano-powder as it evolves as a result of a repeated break-and-deposition process. By means of numerical simulations we found that a two-dimensional packing of adhesive rigid particles converges to a loosely packed structure whose properties are determined by the fragment size. We characterize the asymptotic structure and the relaxation to the final state by means of the density, correlation function, coordination number and fractal dimension. Surprisingly, it was found that a) the final packing density is independent of the initialization, b) the short-range correlation function is independent of the fragment size, and c) the fractal dimension of the asymptotic structure is close the one, in agreement with a scaling argument.

DY 19.8 Wed 16:15 MA 004

Three dimensional model reconstruction from two dimensional micrographs — •Bibudhananda Biswal[1], Vikaran Khanna[1], Thomas Zauner[1], and Rudolf Hilfer[1,2] — [1]ICP, Universität Stuttgart, Pfaffenwaldring 27, 70569 Stuttgart, Germany — [2]Institut für Physik, Universität Mainz, 55099 Mainz, Germany

A novel and practical method for reconstructing pore scale microstructure of multiscale porous media is presented. The method combines crystallite information from two dimensional high resolution micrographs with primordial crystallite correlations from three dimensional low resolution μ–CT to produce models with calibrated porosity, correlation and transport properties. A laboratory scale model of carbonate rock is generated and synthetic μ–CT discretizations of the reconstructed model are compared with experimental μ–CT models at different resolutions. This reconstruction method has possible application across many disciplines where three dimensional macroscopic reconstruction from insufficient microscopic information is necessary.

DY 20: Glasses III (joint session DF/DY)

Time: Wednesday 14:30–16:15 Location: EB 407

DY 20.1 Wed 14:30 EB 407

Impedance- and IR-spectroscopy on sputtered borate glasses — •Gerd-Hendrik Greiwe and Guido Schmitz — Institut für Materialphysik, WWU Münster, Wilhelm-Klemm-Str. 10, D-48149 Münster

Ion-conducting oxide glasses are considered as components of thin film batteries. In our study, glass films of the compositions $x\ Li_2O \cdot (1-x)\ B_2O_3$ with $x = 0.15$, 0.20, 0.25, 0.30, and 0.35 are prepared by ion beam sputtering in a thickness range between 100 and 1000 nm. TEM cross section investigations show a homogeneous, amorphous structure of the films, while the correspondence of their chemical composition with the glass targets is proved by EELS analysis. The specific dc-conductivity of the glass films is determined by temperature-dependent impedance spectroscopy and found to be up to three orders of magnitude higher compared to the conductiviy of the corresponding bulk glasses prepared from the melt. This conductivity increase is explained by a modification of the network structure of the thin glass films. The concentration of the Non-Bridging Oxygen atoms of the network is assumed to be increased by the sputter process. This increase is expected to be the main reason for the observed conductivity enhancement. IR-spectroscopy is used to determine the content of the Non-Bridging Oxyges atoms of the network, to correlate structural and electrical properties of the thin film glasses.

DY 20.2 Wed 14:45 EB 407

Decoupling of Atomic Diffusion in Glass-Forming Mixtures — •Thomas Voigtmann and Jürgen Horbach — Institut für Materialphysik im Weltraum, Deutsches Zentrum für Luft- und Raumfahrt (DLR), 51170 Köln

The diffusion in dense binary soft-sphere mixtures with disparate sizes is studied. While the system approaches a glass transition, only the transport of large particles ceases, while small particles are still able to diffuse through the almost frozen background formed by the large ones, leading to an order-of-magnitude decoupling in the respective transport coefficients. This mechanism qualitatively describes the phenomenology of ion-conducting melts such as sodium silicate mixtures. Upon further increasing the density, the small-particle mean-squared displacement shows an increasing regime of anomalous power-law-like diffusion, which is interpreted as the precursor of a second localization transition following the glass transition in this system.

DY 20.3 Wed 15:00 EB 407

In-situ study of dynamics in hydrous silicate melts with quasielastic neutron scattering — •fan yang[1], andreas meyer[2], tobias unruh[3], and josef kaplonski[1] — [1]Physik-Department E13, TU München, 85748 Garching, Germany — [2]Institut für Materialphysik im Weltraum, Deutsches Zentrum für Luft- und Raumfahrt, 51147 Köln, Germany — [3]Forschungsneutronenquelle Heinz Maier-Leibnitz (FRM II), TU München, 85748 Garching, Germany

Dissolved water in silicate melts and glasses is of great interest in geoscience as well as in technical applications. We investigate water dynamics in silicate melts and the correlation between macroscopic properties like viscosity and the microscopic structure. With the intrinsic q resolution of quasielastic neutron scattering diffusion can be studied in great detail. Diffusion of water in sodium trisilicate melt was studied in-situ at different temperatures under a pressure of 200 MPa. The temperature dependence of the H diffusion coefficient obeys an Arrhenius law with an activation energy of about 0.36 eV.

DY 20.4 Wed 15:15 EB 407

Conductivity of Alkali Glasses in Quantum Statistics — •Joachim Sohns and Michael Schulz — University of Ulm

Our aim is to find an analytically solvable model of the conductivity of mixed alkali glasses. Our starting point is the schroedinger equation of the multy particle wave function of the system. As a consequence of the structural and dynamical disorder the system is irreversible in time. The dynamics of the system is given by the matrix greens functions of the keldysh technique. The linear response of the system to an external electrical field may be calculated within the kubo formalism. In addition to the usual paramagnetic and diamagnetic current we find an other contribution to the current which is caused by the finite life times of the states. The dependence of the conductivity on the concentration of alkali ions, on the temperature and on the frequency of the external electrical field are calculated. The mixed alkali effect is reproduced by our model.

DY 20.5 Wed 15:30 EB 407

Barium diffusion in mixed cation glasses — •Michael Grofmeier, Frank Natrup, and Hartmut Bracht — Institute of Materials Physics, University of Münster, Germany

Diffusion of barium in mixed cation glasses of the composition xNa_2O*(3*x)BaO*4SiO_2 with x = 0.0, 0.1, 0.3 and 1.0 and 0.4K_2O*2.6BaO*4SiO_2 was investigated by means of the radiotracer diffusion technique below the respective glass transition temperatures. In accord with our previous results of calcium diffusion in soda-lime silicate glasses, the mobility of alkaline-earth ions increases with the alkali content in all analyzed glass systems with no decrease in the diffusion activation enthalpy, but a raise in the pre-exponential factor. A distinct dependency of the activation enthalpy of alkaline-earth ions on the type and content of the alkali ions in the glass is observed. The results provide evidence for elastic and electrostatic contributions to cation diffusion in glasses and support the formation of dissimilar cation pairs, that were derived from nuclear magnetic resonance investigations of soda-lime silicate glasses and glasses containing sodium and barium. Finally, a striking correlation between the pre-exponential factor of alkaline-earth ion diffusion in soda-lime and potassium barium glasses is found whose origin remains unsolved.

DY 20.6 Wed 15:45 EB 407

Ion Dynamics in Room Temperature Ionic Liquids — Monika Mutke, •Radha Dilip Banhatti, and Klaus Funke — Institut für Physikalische Chemie und SFB 458, Universität Münster, Corrensstr. 30, D-48149 Münster

Room temperature ionic liquids (RTIL) are molten salts consisting of a bulky organic cation such as 1-butyl-3-methyl-imidazolium (BMIM) and anions such as BF_4^- and PF_6^-. Above T_G, RTILs exhibit non-Arrhenius type DC conductivities and are classified as of intermediate fragility. Earlier, the broadband conductivity spectra of a fragile ionic melt [1] and of a polymer electrolyte [2] were modelled providing a link between the short-time and the long-time dynamics of the ions, via the dispersive features of the spectra. We could thus obtain the activation energy of the elementary displacive step, E^*. In this contribution, we present and analyse the conductivity spectra of $BMIMBF_4$ from 1 mHz up to about 6 GHz in the temperature range 193 K - 353 K. We show that $BMIMBF_4$ exhibits spectral features similar to those of the polymer electrolyte, indicating the importance of structure mediated ion-ion interactions. Moreover, both for $BMIMPF_6$ and $BMIMBF_4$, E^* is found to be about 0.18 eV, which is similar to the conformational reorientation energy of the cation [3].

[1] P. Singh, R.D. Banhatti and K. Funke, Phys. Chem. Glasses **46**, 241 (2005).
[2] S.J. Pas, R.D. Banhatti and K. Funke, Solid State Ionics **177**, 3135 (2006).
[3] A. Rivera and E. Rössler, Phys. Rev. B **73**, 212201 (2006).

DY 20.7 Wed 16:00 EB 407

Crystal precursor nucleation: A connection between crystallization and vitrification. — •Hans Joachim Schöpe[1], Gary Bryant[2], and William van Megen[2] — [1]Johannes Gutenberg-Universität Mainz, Institut für Physik, Staudinger Weg 7, 55099 Mainz, Deutschland — [2]Department of Applied Physics, Royal Melbourne Institute of Technology, GPO Box 2476V, Melbourne 3001, Australia

A complete understanding of the solidification process (crystallization, vitrification) is one of the long-standing problems in condensed matter physics. The use of colloidal model systems provides an ideal controlled experimental system to reduce this lack of knowledge. We investigated the solidification scenario in suspensions of colloidal hard spheres for three polydispersities between 4.8% and 5.8%, from near freezing to near the glass transition. We identify four stages in the crystallization process: (i) an induction stage where large numbers of precursor structures are observed; (ii) a conversion stage as precursors are converted to close packed structures; (iii) a second nucleation stage; and (iv) a ripening stage. Near the glass transition the crystallization process is entirely frustrated, and the sample is locked into a compressed crystal precursor structure. Interestingly neither polydispersity nor volume fraction significantly influence the precursor stage, suggesting that the crystal precursors are present in all solidifying samples. We speculate that these precursors are related to the dynamical heterogeneities observed in a number of dynamical studies linking the two processes of crystallization and vitrification. JCP 127, 084505 (2007)

DY 21: Nonlinear dynamics, synchronization and chaos III

Time: Wednesday 16:45–18:00 Location: MA 001

DY 21.1 Wed 16:45 MA 001

Soliton ratchets in inhomogeneous sine-Gordon systems — •Vera Stehr, Patric Müller, and Franz G. Mertens — Physikalisches Institut, Universität Bayreuth, 95440 Bayreuth

In recent years the particle ratchet effect has been generalised to extended systems where solitons play the role of particles. Unidirectional motion of solitons can take place although the applied force $f(t)$ has zero average in time. In this talk we consider a damped and driven sine-Gordon-system with an additive inhomogeneity: $\phi_{tt} - \phi_{xx} + \sin\phi = -\beta\phi_t + f(t) + g(x)$. The periodically repeated function $g(x)$ consists of positive and negative boxes with zero spatial average. This inhomogeneity causes the spatial asymmetry which allows for the ratchet effect. We examine the ratchet transport in this system using a collective coordinate approach and analyse the influence of different collective coordinates on the dynamics of the soliton. The results are fully confirmed by simulations.

DY 21.2 Wed 17:00 MA 001

Absolute negative resistance in Josephson junctions — •Joachim Nagel[1], Tobias Gaber[1], David Speer[2], Ralf Eichhorn[2], Peter Reimann[2], Reinhold Kleiner[1], and Dieter Koelle[1] — [1]Universität Tübingen, Physikalisches Institut – Experimentalpysik II — [2]Universität Bielefeld, Fakultät für Physik

It has been predicted [1,2] that an underdamped Brownian particle, moving in a periodic 1D potential under the influence of both, a dc and ac driving force, can show absolute negative mobility (ANM), i. e., the particle moves opposite to the dc drive. Here, we present the experimental realization of this effect, using underdamped $Nb - AlO_x - Nb$ Josephson junctions, irradiated with microwaves up to $\sim 40\,\mathrm{GHz}$. In this system, described by the resistively and capacitively shunted junction model, the particle coordinate, its average velocity and the driving forces correspond to the Josephson phase, a dc voltage V, and applied dc and ac currents, respectively. Measuring the dc $I - V$ curves at 4.2 K, we demonstrate the appearance of ANM, or in our system, of absolute negative resistance (ANR) and determine its dependence on amplitude and frequency of the ac drive. As pointed out in [1], there are two basically different physical mechanism giving rise to ANM: one is governed by transient chaos [1], while the other essentially amounts to a noise induced effect [2]. Comparison of the experimental data with numerical simulations shows very good agreement and implies that the basic physical mechanism from [1] is at work in the present system.

[1] Speer *et al.*, Europhys. Lett. **79**, 10005; Phys. Rev. E **76**, 051110 (2007). [2] L. Machura *et al.*, Phys. Rev. Lett. **98**, 040601 (2007).

DY 21.3 Wed 17:15 MA 001

Analysing sliding and depinning drops using efficient time-integration and path-following — •Philippe Beltrame[1,2], Peter Talkner[2], Peter Haenggi[2], and Uwe Thiele[1,3] — [1]Max-Planck-Institut für Physik komplexer Systeme, Nöthnitzer Strasse 38, D-01187 Dresden — [2]Theoretische Physik I, Uni. Augsburg, Universitätsstr. 1, D-86159 Augsburg — [3]School of Math., Loughborough University, Loughborough, LE11 3TU, UK

Pattern formation in thin liquid films represents a highly nonlinear phenomenon far from equilibrium. Its study requires a numerical treatment of the fully nonlinear system allowing for time integration of the dynamics and path-following to directly track equilibria. We present a code unifying both tasks for lubrication-type equations in analogy to a similar approach for the Navier-Stokes equations. We show that time-stepping based on an *exponentiation propagation* scheme is much better adapted to the lubrication equation than the classically used semi-implicit scheme, especially for the automatic adaptation of the timestep. The developed common numerical framework is applied to the three-dimensional phenomena of (1) Stable sliding drops on an inclined homogeneous substrate and the transition to sliding drops that emit secondary droplets (time integration); (2) Depinning scenarios and stick-slip motion of ridges and drops on a heteregeneous (striped) substrate (path-following and time-integration).

We acknowledge support by the EU and DFG under grants MRTN-CT-2004-005728 and SFB 486 B13.

DY 21.4 Wed 17:30 MA 001

Measuring interaction complexity — Thomas Kahle, •Eckehard Olbrich, Nihat Ay, and Jürgen Jost — Max Planck

Institute for Mathematics in the Sciences, Leipzig, Germany

We introduce a new vector valued complexity measure, which we will call interaction complexity, whose components quantify the complexity in terms of k-th order statistical dependencies that cannot be explained by interactions between $k-1$ units. Formally the measure $I := (I_1, \ldots, I_N)$ is defined in terms of Kullback-Leibler distances to exponential families of k-interactions for $k = 1, ..., N$. By applying this measure on probability distributions generated by dynamical systems such as coupled map lattices and cellular automata, we demonstrate that these measure allows a refined analysis of complex dynamical regimes. We discuss possible applications for biological data, such as genomic sequences or multielectrode recordings in neural systems.

DY 21.5 Wed 17:45 MA 001

Multivariate Phase Rectified Signal Averaging - A tool for studying complex interrelated time series — •Aicko Y. Schumann, Jan W. Kantelhardt, and Fabian Gans — Institut für Physik Theorie, Martin-Luther University Halle-Wittenberg

Many natural systems generate periodicities on different time scales because some of their components form closed regulation loops in addition to causal linear control chains, e.g., cardio-respiratory rhythms in physiology or the El-Niño phenomenon in geophysics. In most cases non-stationary and noisy data from several simultaneously recorded signals is available for a multivariate analysis. In order to understand the underlying control chains and loops an time series analysis tool capable of identifying periodicities and the direction of causal relations in the presence of non-stationarities and noise is needed. In a previous work [1,2,3] we have therefor introduced the (monovariate) phase-rectified signal averaging technique (PRSA), which can distinguish effects caused by acceleration and deceleration of a signal in the signal itself. Further developing this approach for the study of two related signals, we propose the multivariate-PRSA method (MPRSA), which is capable of detecting and quantifying related quasi-periodic oscillations as well as causal interrelations in two signals masked by non-stationarities and noise.

[1] Bauer, A. et. al. Physica A, 2006,**364**, 423–434
[2] Bauer, A. et. al. The Lancet, 2006 **367**, 1674
[3] Kantelhardt, J.W. et. al. CHAOS, 2007 **17**(1), 015112

DY 22: Statistical physics of complex networks II

Time: Wednesday 16:45–18:30 Location: MA 004

DY 22.1 Wed 16:45 MA 004

Thermodynamic forces, flows, and Onsager coefficients in complex networks — Agata Fronczak, Piotr Fronczak, and •Janusz Holyst — Faculty of Physics, Warsaw University of Technology, Koszykowa 75, 00-662 Warsaw, Poland

We present Onsager formalism applied to random networks with arbitrary degree distribution. Using the well-known methods of non-equilibrium thermodynamics we identify thermodynamic forces and their conjugated flows induced in networks as a result of single node degree perturbation. The forces and the flows can be understood as a response of the system to events, such as random removal of nodes or intentional attacks on them. Finally, we show that cross effects (such as thermodiffusion, or thermoelectric phenomena), in which one force may not only give rise to its own corresponding flow, but to many other flows, can be observed also in complex networks.

DY 22.2 Wed 17:00 MA 004

Dynamical Clustering in Reaction-Dispersal Processes on Complex Networks — •Vincent David[1], Marc Timme[1,4], Theo Geisel[1,2,4], and Dirk Brockmann[1,3] — [1]Max-Planck-Institute for Dynamics and Self-Organization, Göttingen — [2]Georg-August-Universität, Göttingen — [3]Northwestern University, Evanston — [4]Bernstein Center for Computational Neuroscience, Göttingen

We investigate nonlinear annihilation processes (e.g., $A + A \to \emptyset$) of particles that perform random walks on complex networks. In well mixed populations (mean field) this process exhibits t^{-1} decay behavior in the total number of particles. Additional dispersal of particles adds a second time scale and drastically changes the decay behavior.

Here we study these changes for two types of hopping processes. First, if particles independently select one of the possible exit channels at each node their exit rates are given by the sum of all outgoing weights such that the waiting times are degree-dependent. We compare this to the popular ansatz of a uniform waiting time process.

Derived mean field equations show that for large numbers of particles per node both processes exhibit nearly identical relaxation properties. However, below a critical particle number the processes deviate not only from mean field predictions but, more importantly, by orders of magnitude from one another. We attribute this to dynamical clustering effects in the uniform waiting time model, that is absent in the independent channel dynamics. We conclude that the prediction of dynamical properties of reaction-diffusion processes on complex networks drastically depend on the appropriate choice of model.

DY 22.3 Wed 17:15 MA 004

Pattern Formation and Efficiency of Reaction-Diffusion Processes on Complex Networks — •Sebastian Weber[1], Marc-Thorsten Hütt[2], and Markus Porto[1] — [1]Institut für Festkörrperphysik, Technische Universität Darmstadt, Germany — [2]Computational Systems Biology, School of Engineering and Science, Jacobs University Bremen, Germany

To understand how the topology of a network influences a given dynamic taking place on it, is a major challenge in many fields of science. We address part of this challenge by studying the impact of topological correlations in complex networks on the pattern formation and the efficiency of the reaction-diffusion process $A + B \to \emptyset$ [1], the latter serving as a generic dynamic capturing the essentials of many real world examples. We show how to properly compare the states of the dynamics taken place on different ensembles of networks, which allows us to isolate the impact of topological correlations from other effects. The major result is that (i) the pattern formation can by characterized by a single scalar observable directly related to the amount of topological correlations and that (ii) a large amount of pattern formation does not necessarily mean a small efficiency, in contrast to regular d dimensional lattices.

[1] S. Weber, M.-Th. Hütt, and M. Porto, submitted

DY 22.4 Wed 17:30 MA 004

Decorrelation of networked communication flow via load-dependent routing weights — •Jan Scholz[1] and Martin Greiner[2] — [1]Frankfurt Institute for Advanced Studies, Johann Wolfgang Goethe Universität, Frankfurt am Main, Germany — [2]Corporate Research and Technology, Information & Communications, Siemens AG, München, Germany

Clever assignments of link weights are able to change the routes in communication networks in such a way that loads are distributed almost evenly across the network. This is achieved by weight assignments based on link load. As demonstrated for scale-free as well as synthetic Internet networks they decorrelate the loads of the nodes and links from the network structure and increase the transport capacity of the network. For various Internet scans the increase of transport capacity amounts to a factor of around five when compared to shortest-path routing.

DY 22.5 Wed 17:45 MA 004

Effects of load fluctuations on the robustness of networks — •Dominik Heide[1], Mirko Schäfer[1], and Martin Greiner[2] — [1]Frankfurt Institute for Advanced Studies (FIAS), Ruth-Moufang-Str. 1, 60438 Frankfurt am Main — [2]Corporate Technology, Information Communications, Siemens AG, 81730 München

On previously studied heterogeneously loaded networks [1], we analyze the effect of load fluctuations on the network's robustness. We find that on each vertex the distribution of the resulting load can be described using parameters analytically derived from the network flow paths. Based on this analysis, we propose a capacity layout where the probabilities for the number of overloaded vertices due to load fluctuations is known. Furthermore, we analyze the robustness of the network against cascades of overload failures. The findings are of relevance for critical infrastructures like communication, transportation, and power networks.

[1] A. Motter, and Y.C. Lai, Phys. Rev. E **66**, 065102(R) (2002)

DY 22.6 Wed 18:00 MA 004

Frustration from Fat Graphs — •Martin Weigel[1] and Des Johnston[2] — [1]Institut für Physik, KOMET 331, Johannes-Gutenberg-Universität* Mainz, Staudinger Weg 7, 55099 Mainz, Germany — [2]Department of Mathematics and the Maxwell Institute for Mathematical Sciences, Heriot-Watt University, Edinburgh, EH14 4AS, UK

We consider the effect of geometric frustration induced by the random distribution of loop lengths in the "fat" graphs of the dynamical triangulations model on coupled antiferromagnets. While the influence of such connectivity disorder is rather mild for ferromagnets in that an ordered phase persists and only the properties of the phase transition are substantially changed in some cases, any finite-temperature transition is wiped out due to frustration for some of the antiferromagnetic models. A wealth of different phenomena is observed: while for the annealed average of quantum gravity some graphs can adapt dynamically to allow the emergence of a Néel ordered phase, this is not possible for the quenched average, where a zero-temperature spin-glass phase appears instead. We relate the latter to the behaviour of conventional spin-glass models coupled to random graphs.

[1] M. Weigel and D. Johnston, Phys. Rev. B **76** (2007) 054408.

DY 22.7 Wed 18:15 MA 004

Spin Dynamics on Complex Networks — Filippo Radicchi[1], Yong-Yeol Ahn[2], and •Hildegard Meyer-Ortmanns[3] — [1]CNNL., ISI Foundation, 10133 Torino, Italy — [2]Korea Adv.Inst.Science and Technology, Daejeon 305-701, Korea — [3]SES, Jacobs University, 28725 Bremen, Germany

In the first part we consider Ising spin dynamics as it can be used to describe the approach to a state of social balance. We shall map this dynamics along with the associated algorithm to the process of solving a satisfiability problem of computer science. The network is varied from an all-to-all topology, to a random one with different degrees of dilution, and to regular topologies. As it turns out, the stationary states and the time of finding a solution depend on the topology as well as on the dilution parameter and the propensity parameter which characterizes the tendency to reduce frustration in the system. Even if an optimal solution exists it depends on the parameter choice whether the local stochastic algorithm is able to find it. In the second part we systematically interpolate between synchronous and asynchronous update of a chain of Ising spins. As a function of the interpolation parameter we identify a phase transition between the stationary states that belongs to the universality class of parity conservation. For fully synchronous update of the ferromagnetic Ising chain the stationary state becomes antiferromagnetic. Moreover, strongly asynchronous update for Boolean threshold dynamics considerably changes the phase space that is supposed to model the yeast cell cycle.

DY 23: Quantum chaos I

Time: Thursday 9:30–11:15 Location: MA 001

Invited Talk DY 23.1 Thu 9:30 MA 001

From the phase-space representation of optical microcavities to an improved ray dynamics — •Martina Hentschel — Max-Planck-Institut für Physik komplexer Systeme, Nöthnitzer Straße 38, D-01187 Dresden

Optical microcavities are open billiards for light in which electromagnetic waves can, however, be confined by total internal reflection at dielectric boundaries. These resonators enrich the class of model systems in the field of quantum chaos and are an ideal testing ground for the correspondence of ray and wave dynamics that, typically, is taken for granted. Using phase-space methods we show that this assumption has to be corrected towards the long-wavelength limit. We first generalize the concept of Husimi functions to dielectric interfaces where both the wave function and its derivative are non-zero. We then show that curved interfaces require a semiclassical correction of Fresnel's law due to an interference effect called Goos-Hänchen shift. It is accompanied by the so-called Fresnel filtering which, in turn, corrects Snell's law. These two contributions are especially important near the critical angle. They are of similar magnitude and correspond to ray displacements in independent phase-space directions. Implementing both effects into the ray model improves the agreement with wave optics by about one order of magnitude. We discuss the phase-space dynamics of light in this amended ray-optics picture and show that the Poincaré surface of section can be significantly modified.

Further reading: M. Hentschel *et al.*, Europhys. Lett. **62**, 636 (2003); H. Schomerus and M. Hentschel, Phys. Rev. Lett. **96**, 243903 (2006).

DY 23.2 Thu 10:00 MA 001

Semiclassical calculation for the survival probability — Daniel Waltner[1], •Martha Gutierrez[1], Klaus Richter[1], and Arseni Goussev[2] — [1]Institut für Theoretische Physik, Universität Regensburg, 93053 Regensburg — [2]Department of Mathematics, University of Bristol, Bristol

In open chaotic systems the classical decay rate is exponential in time, however it is well known that there are quantum corrections at time scales of the order of the Heisenberg time [1]. We calculate semiclassically the leading order correction to the survival probability of a wave packet inside an open chaotic quantum dot. In order to reproduce Random Matrix Theory predictions, we need to calculate, beyond the diagonal approximation, the contribution of a new type of loop - like diagramms, which until now did not have to be taken into account. We discuss implications of this result in the semiclassical approximation for the conductivity in linear response.

[1] K. Frahm, PRE 56, R6237, 1997.

DY 23.3 Thu 10:15 MA 001

Resonance widths in open microwave cavities studied by harmonic inversion — •Ulrich Kuhl[1], Ruven Höhmann[1], Jörg Main[2], and Hans-Jürgen Stöckmann[1] — [1]Fachbereich Physik, Philipps-Universität Marburg, Renthof 5, — [2]Institut für Theoretische Physik und Synergetik, Universität Stuttgart,

From the measurement of a reflection spectrum of an open microwave cavity the poles of the scattering matrix in the complex plane have been determined [1]. The resonances have been extracted by means of the harmonic inversion method [2]. By this it became possible to resolve the resonances in a regime where the line widths exceed the mean level spacing up to a factor of 10, a value inaccessible in experiments up to now. The obtained experimental distributions of line widths were found to be in good agreement with predictions from random matrix theory [3].

[1] arXiv:0711.1828v1
[2] J. Main, Phys. Rep. **316**, 233 (1999).
[3] H. J. Sommers, Y. V. Fyodorov, and M. Titov, J. Phys. A **32**, L77 (1999).

DY 23.4 Thu 10:30 MA 001

Conservation of energy in coherent backscattering of light — •Susanne Fiebig[1], Christof M. Aegerter[1], Wolfgang Bührer[1], Eric Akkermans[2], Gilles Montambaux[3], and Georg Maret[1] — [1]Universität Konstanz, Konstanz, Germany — [2]Technion Israel Institute of Technology, Haifa, Israel — [3]Universite Paris-Sud, Orsay, France

Although conservation of energy is fundamental in physics, its principles seem to be violated in the field of wave propagation in turbid media by the energy enhancement of the coherent backscattering cone. We present experimental data which show that the energy enhancement of the cone is balanced by an energy cutback at all scattering angles. Moreover, we give a theoretical description, which is in good agreement with these data. The additional terms needed to enforce energy conservation in this description result from an interference effect between incident and multiply scattered waves, which is reminiscent of the optical theorem in single scattering.

DY 23.5 Thu 10:45 MA 001

Emission through Chaotic Transports in Chaotic Microcavities — •Jeong-Bo Shim[1], Sang-Bum Lee[2], Soo Young Lee[2], Juhee Yang[2], Songky Moon[2], Sang Wook Kim[3], Jai-Hyung Lee[2], and Kyungwon An[2] — [1]Max Planck Institute for the Physics of Complex Systems, Dresden, Germany — [2]School of Physics and Astronomy, Seoul National University, Seoul, Korea — [3]Department of Physics Education, Pusan National University, Busan, Korea

The idea of chaotic deformed microcavities has been suggested to make a directional emission with keeping the cavity-Q factor higher than conventional cavities. We realized the chaotic deformed microcavity with a liquid jet system, and analyzed the directional emission of it numerically and theoretically. In this work, we present a experimental and numerical evidence of the turnstile process which is realized in the double peak of the deformed microcavity emission. Interestingly, this characteristic emission is not consistently explained by the classical turnstile process in the whole regimes of a chaotic transition. Accordingly, we suggest the distinguished emission mechanism depending on the action transport in the classical phase space.

DY 23.6 Thu 11:00 MA 001

Algebraic fidelity decay for local perturbations — •Ruven Höhmann, Ulrich Kuhl, and Hans-Jürgen Stöckmann — Fachbereich Physik, Philipps-Universität Marburg, Renthof 5,

From a reflection measurement in a rectangular microwave billiard with an arrangement of randomly distributed scatterers the scattering fidelity was studied with the position of one of the scatterers as the perturbation parameter. Such perturbations have been termed "local"by us since the wave function is influenced only locally [1]. This is in contrast of previous studies of our group where the fidelity decay had been studied as a function of one billiard wall [2]. Using Berry's random plane wave conjecture, an analytic expression for the fidelity decay due to the shift of one scatterer has been obtained, yielding an algebraic 1/t decay for long times. A perfect agreement between experiment and theory has been obtained, including a predicted scaling behavior concerning the dependence of the fidelity decay on the shift distance. The only free parameter has been determined independently from the variance of the level velocities. From the spectrum the ordinary fidelity amplitude could be determined also, and was found to be in good agreement with the scattering fidelity.

[1] M. Barth, U. Kuhl, and H.-J. Stöckmann, Phys. Rev. Lett. **82**, 2026 (1999).
[2] R. Schäfer, H.-J. Stöckmann, T. Gorin, and T. H. Seligman, Phys. Rev. Lett. **95**, 184102 (2005).

DY 24: Granular matter II

Time: Thursday 10:00–12:30 Location: MA 004

DY 24.1 Thu 10:00 MA 004

Experimental study of the freely cooling granular gas — •Corinna Maass, Nathan Isert, Christof Aegerter, and Georg Maret — Fachbereich Physik, Universität Konstanz, Universitätstrasse 10, 78457 Konstanz

In the study of granular gases, the cooling state has considerable importance as the ground state of the driven system. Theoretical studies of this state consist of Haff's cooling law for the isotropic case and modifications including inhomogeneous clustering or speed-dependent restitution coefficients. In our experiment, we diamagnetically levitate granular gases consisting of 50 – 100 bismuth shots. The particles are excited in two different ways by either periodically changing the levitation field or by mechanical vibration with a loudspeaker. The resulting velocity distributions are recorded using video microscopy and particle tracking. With this setup we have done an experimental investigation of Haff's cooling law using a variation of Haff's law incorporating a time-dependent number density, as well as a comparative study of the small velocity range of velocity distributions for different types of heating.

DY 24.2 Thu 10:15 MA 004

Phase separation in driven granular systems — •Nathan Isert, Corinna Maass, Christof Aegerter, and Georg Maret — Universität Konstanz, Germany

Granular matter can show counterintuitive behavior, such as a separation induced by undirected shaking, a phenomenon known as Maxwell's demon. In the theoretical description of this effect, gravity plays an important role for the prediction of the observed bifurcation. Here, we investigate this role of gravity directly, by altered gravity up to a microgravity environment using diamagnetic levitation of grains. Our results show profound differences in the gravity dependence when compared to the predicted bifurcations, thereby strongly suggesting a modification of the present theoretical approach.

DY 24.3 Thu 10:30 MA 004

Model for pattern formation of granular matter on vibratory conveyors — •Michael Grevenstette and Stefan Jakob Linz — Institut für Theoretische Physik, WWU Münster, Wilhelm-Klemm-Straße 9, D-48149 Münster, Germany

Recently, Götzendorfer et al. [Powders and Grains '05, 1181 (2005)] have observed subharmonic propagating surface wave patterns if granular material on a trough is subject to a combination of vertical *and* horizontal periodic driving. The observed structures are nonstationary in space, drift with a constant mean velocity along the trough and oscillate subharmonically with half the driving frequency. We present a phenomenological model [1] for the surface evolution of the granular material that qualitatively reproduces and explains important aspects of the experimentally observed patterns.

[1] Grevenstette M, Linz SJ, Model for pattern formation on a vibratory conveyor, Chaos, Solitons & Fractals (2007), doi:10.1016/j.chaos.2007.06.101

DY 24.4 Thu 10:45 MA 004

Granular convection, stripe pattern segregation and collective dynamics observed in a single experimental setup — •Frank Rietz and Ralf Stannarius — Otto-von-Guericke-Universität Magdeburg, Abteilung für Nichtlineare Phänomene

Pattern formation in continuously driven granulates has been studied extensively in recent years, but the observed phenomena are far from being well understood. In loosely packed (fluidized) granulates, dynamics of axially segregated stripes have been investigated in horizontally rotating mixers. Convection rolls have been found in vibrated containers. The fluid-like mobility of individual granular particles is restricted at dense pack, one observes a collective motion (dynamic glass transition) instead.

All these phenomena are found in combination in a single experiment, which is introduced here [1]. A flat container (Hele-Shaw cell) is filled with a granular mixture and afterwards rotated continuously about its horizontal long axis. The filling fraction is crucial for the observed effects. At partial filling, a pattern of axially segregated stripes appears, which undergoes slow coarsening. Periodically travelling stripes are observed, too. In an almost densely packed container regular convection rolls appear instead. The densely packed granulate moves in collective clusters and a serpent like segregation pattern appears.

[1] F. Rietz & R. Stannarius: On the brink of jamming: Granular convection in densely filled containers; *Phys. Rev. Lett.*; submitted

DY 24.5 Thu 11:00 MA 004

Granular Hydrodynamics and Pattern Formation in Vertically Oscillated Granular Disk Layers — •José A. Carrillo[1], Thorsten Pöschel[2], and Clara Salueña[3] — [1]ICREA (Institució Catalana de Recerca i Estudis Avançats) and Departament de Matemàtiques, Universitat Autònoma de Barcelona, Bellaterra, Spain — [2]Universität Bayreuth, Physikalisches Institut, Germany — [3]Departament de Enginyeria Mecànica-ETSEQ, Universitat Rovira i Virgili, Tarragona, Spain

The hydrodynamic simulation of granular flows is challenging, particularly in systems where dilute and dense regions occur at the same time and interact with each other. We demonstrate that hydrodynamic approaches, derived from inelastic kinetic theory, give fairly good descriptions of rapid granular flows even if they are way beyond their supposed validity limits. A numerical hydrodynamic solver is presented for a vibrated granular bed in 2D. It is based on a highly accurate Shock Capturing scheme applied to a compressible Navier-Stokes system for granular flow. As a benchmark experiment we investigate the formation of Faraday waves in a 2D thin layer exposed to vertical vibration in the presence of gravity. The results of the hydrodynamic simulations agree quantitatively with those of event-driven Molecular Dynamics. To our knowledge, these are the first hydrodynamic re-

sults for Faraday waves in 2D granular beds that accurately predict the wavelengths of the standing waves as a function of the excitation amplitude.
[1] J. A.Carrillo, T. Pöschel, and C. Salueña, arXiv:cond-mat/0612276, J. Fluid Mech. (in press)

DY 24.6 Thu 11:15 MA 004

Wet granulates under shear — •Seyed Habibollah Ebrahimnazhad, Martin Brinkmann, Jürgen Vollmer, and Stephan Herminghaus — MPI for Dynamics and Self-Organization, 37073 Göttingen

Small amounts of a wetting liquid render sand a stiff and moldable material. Cohesion between wet grains is caused by the presence of capillary bridges formed at the points of contact. The finite strength of these liquid bonds is responsible for a transition from a quiescent to a fluidized state under applied shear stress. This fluidization transition is studied in a MD-type simulation in a two dimensional assembly of bidisperse discs under the action of a spatially heterogeneous external force. Capillary interaction is modeled as a short ranged but hysteretic attractive force between discs with soft core repulsion. Besides the fluidization threshold we studied the spatial and temporal distribution of granular temperature, shear rate, stress, local packing fraction, and density of capillary bridges in both the fluidized and the quiescent state. The local viscosity η of the fluidized state is dominated by the local packing fraction ρ and diverges as $\eta \propto (\rho_c - \rho)^{-1.1}$ upon approaching random close packing ($\rho_c \approx 0.85$).

DY 24.7 Thu 11:30 MA 004

The phase diagram of static granular media — •Matthias Schröter[1], Trey Suntrup[1], Charles Radin[2], and Harry L. Swinney[1] — [1]CNLD, UT Austin, Texas — [2]Math, UT Austin, Texas

The idea of an ensemble approach to static granular media was first discussed by Edwards & Oakeshott in 1989 (Physica A **157**, 1080). However, the difficulty to control the underlying state variables of pressure p and volume fraction ϕ hampered experimental tests of this idea until recently. We show that the preparation of granular samples with flow pulses in a fluidized bed allows an independent control of ϕ and p. The so determined phase diagram is the test case for the still developing statistical mechanics of static granular media.

DY 24.8 Thu 11:45 MA 004

Macroscopic stress and displacement response functions of static granular layers — •Pradip Roul and Klaus Kassner — Institute für Theoretische Physik,Otto-Von-Guericke-Universität,Magdeburg,Postfach-4120,D-39106,Magdeburg

We investigated numerically the averaged stress and displacement response functions to a local force perturbation of assemblies of grains that have been constructed by a layer-wise deposition of particles. We apply a load to a single grain of the top layer of the granular packing with a force small enough to not cause any rearrangement of the layer structure. This study has been done by use of a DEM numerical simulation generating granular packings with different packing order consisting of soft convex polygonal sand particles. The simulation was performed in two-dimensional systems. The shape of the vertical normal stress response function depends upon the packing order of the granular aggregate. Mono-disperse packings of round particles show double peak shapes underneath the point where the external force is applied, a behaviour predicted for hyperbolic continuum equations. For bidisperse packings, double peaks are also present, but much less pronounced, whereas there is only asingle peak present packings of pentagonal particles. Stress responses are compared qualitatively with experimental results by Junfei Geng et al. of photo elastic material. Our simulation results show good agreement with these experiments. Moreover, the calculation of the macroscopically averaged displacement response functions inside the granular aggregates will be presented.

DY 24.9 Thu 12:00 MA 004

Grain coarsening effects in granular statics and dynamics — •Claas Bierwisch and Michael Moseler — Fraunhofer-Institut für Werkstoffmechanik IWM, Wöhlerstraße 11, 79108 Freiburg, Germany

The influence of grain coarsening on static and dynamic properties of frictional and cohesive grains has been studied using discrete element simulations. Volume fraction, coordination number and angle of repose have been studied as static fingerprints of the systems while the outflow rate through an orifice reflects dynamic behavior. The effect of coarsening dependend model parameters is analyzed. Surface and boundary effects in both static and dynamic regimes are highlighted and quantified. Furthermore, similarities between complex shaped particles and spheres without rotational freedom are discussed.

DY 24.10 Thu 12:15 MA 004

Stress-birefringence for granular particles in three dimensions — Andreas Wandert and •Matthias Sperl — Institut für Materialphysik im Weltraum, DLR, Köln

It has been shown repeatedly how stress-birefringence can be used to analyze forces in granular packings in two dimensions [see e.g. Majmudar/Sperl/Luding/Behringer, Phys. Rev. Lett. 98, 058001 (2007)]. In this contribution it is shown how this method can be extended to three dimensions.

DY 25: Fluid dynamics I

Time: Thursday 11:30–13:00 Location: MA 001

DY 25.1 Thu 11:30 MA 001

Highly resolved measurements of temperature fluctuations in turbulent flows — •Achim Kittel and Florian Heidemann — Energy and Semiconductor Research Laboratory, University of Oldenburg,

We present high frequency, highly spatially resolved temperature measurement taken with a sub-micrometer thermocouple developed in our group gained from two different experimental setups. The first setup is a water free-jet in water. Here a heated water jet is injected into a cold basin. The presented measurements are taken at high injection velocities and, therefore, the temperature has no impact on the flow — it can be considered as a passive scalar. The temperature fluctuations are taken at different positions and analyzed with different methods. With our sensor we are able to resolve temperature fluctuations up to 30kHz under these conditions. The changes on characteristic features of the inertial range are investigated under variation of the sensors position. The second experiment is a large scale convection experiment — the barrel of Ilmenau. Here the mean temperature and the temperature fluctuations are measured as a function in distance to the cooling plate at the top lid of the experiment. We achieved a special resolution of a micrometer in separation from the lid. The results are discussed by means of finite element simulation.

DY 25.2 Thu 11:45 MA 001

Spiral vortices in perturbed circular Couette flow — •Jan Abshagen — Institute of Experimental and Applied Physics, University of Kiel, 24098 Kiel, Germany

Circular Couette flow is well-known for its centrifugal instability that results in the formation of either Taylor or spiral vortices depending on the rate of differential rotation of the two cylinders that confine the viscous fluid in radial direction. Due to the presence of axial end plates as often used in experimental systems the circular Couette profile is deformed. This results in a secondary circulation, the so-called Ekman vortices. The role of axial end plates for the onset of Taylor vortices in the 'classical' Taylor-Couette setup with non-rotating outer cylinder has been studied in depth and recently finite-length effects have been found at the onset of spiral vortices in counter-rotating Taylor-Couette flow. Here, the role of the secondary circulation for the appearance and the properties of spiral vortices in perturbed circular Couette flow is investigated. Focus is given to the case of co-rotating cylinders which has been considered so far as a prototype for the appearance of Taylor vortices due to centrifugal instability.

DY 25.3 Thu 12:00 MA 001

Complexity in small aspect ratio Taylor-Couette flow — •Ole Staack, Matti Heise, Jan Abshagen, and Gerd Pfister — Institute of Experimental and Applied Physics, Kiel, Germany

Taylor-Couette flow, i.e. a viscous fluid in the gap between two concentric rotating cylinders, is one of the classical hydrodynamic systems for investigating bifurcation events and nonlinear dynamics. For small aspect ratios the multiplicity of steady solutions is small. However, complex dynamical behavior, that appears abruptly from time dependent flow, can be observed at higher Reynolds numbers. Our present study is focused on the origin of this complexity. Therefore the underlying bifurcation structure has been investigated in an extended parameter space, unfolded by the rotation of the rigid end plates.

A rich diversity of time dependent modes and mode coupling has been observed. One example is a rotating wave with an azimuthal wave number $m = 2$ rotating either in the same or the opposite azimuthal direction to the rotating inner cylinder. This direction reversion scenario includes frequency locking between the rotating wave and the stationary as well as the slowly rotating 'imperfect' end plates.

DY 25.4 Thu 12:15 MA 001

The Wake of a Magnetic Obstacle — Evgeny Votyakov and •Egbert Zienicke — Institut für Physik, Technische Universität Ilmenau, 98684 Ilmenau, Germany

When a liquid metal moves relative to a localized magnetic field — a magnetic obstacle — the induced eddy currents produce a Lorentz force retarding the flow according to Lenz's rule and, moreover, creating vorticity. Whereas the flow pattern around a mechanical obstacle, such as for example a circular cylinder, is well documented the structure of the wake of a magnetic obstacle is poorly understood even in the seemingly simple steady state.

We demonstrate [1] that the stationary flow pattern is considerably more complex than in the wake behind an ordinary body. The steady flow is shown to undergo two bifurcations (rather than one) and to involve up to six (rather than just two) vortices. We find that the first bifurcation leads to the formation of a pair of vortices within the region of magnetic field that we call *inner magnetic vortices*, whereas a second bifurcation gives rise to a pair of *attached vortices* that are linked to the inner vortices by *connecting vortices*.

[1] E.V. Votyakov, Yu. Kolesnikov, O. Andreev, E. Zienicke, A. Thess, Phys. Rev. Lett. **98** (2007) 144504.

Invited Talk DY 25.5 Thu 12:30 MA 001

State space properties of linearly stable flows - How does flow in a pipe become turbulent? — •Tobias M. Schneider — Fachbereich Physik, Philipps-Universität Marburg, D-35032 Marburg, Germany

According to most textbooks flow down a straight circular pipe becomes turbulent near a Reynolds number of 2000. However, despite research since 1883 when Reynolds performed his famous experiments, details of the transition mechanism are still not completely understood. This has primarily to do with the absence of a linear instability of the laminar profile for any flow rate, thus making the transition fundamentally different from the ones in the well studied cases of fluids heated from below (Rayleigh-Benard) or between rotating cylinders (Taylor-Couette). The transition in pipe flow is not mediated by any intermediate simple states but rather jumps to a complex flow state immediately. The flow rates at which the onset of transition has been observed vary over a wide range, and there are indications that the turbulent state is not permanent but can decay spontaneously. All these observations are compatible with the formation of a strange chaotic saddle in the system's state space. We will summarize evidence for the existence of this saddle, discuss the properties of the turbulent state and analyze the 'edge of chaos' that separates laminar and turbulent dynamics.

DY 26: Fluid dynamics II

Time: Thursday 14:00–17:00 Location: MA 001

Invited Talk DY 26.1 Thu 14:00 MA 001

Statistical physics of atmospheric clouds — •Raymond A. Shaw — Leibniz-Institute for Tropospheric Research, Leipzig, DE — Department of Physics, Michigan Technological University, Houghton, USA

Atmospheric clouds, a crucial piece of the climate change problem, are iconic as visualizations of turbulence. The ubiquity of random turbulence in clouds, over a large range of spatial and temporal scales, suggests that statistical physics is a useful approach for obtaining simplified representations of such complex systems. Some of the many aspects of turbulence interacting with cloud particles and radiation fields will be reviewed: from inhomogeneous mixing, to inertial clustering, to stochastic coalescence. The fundamental role of the Lagrangian viewpoint in the cloud-particle coalescence problem will be discussed in the context of a toy model of stochastic rain formation. This provides a context for discussing the emerging recognition of the dominant role of fluctuations in cloud processes.

Support from the Alexander von Humboldt Foundation and the US National Science Foundation is gratefully acknowledged. The work described here has benefited greatly from my interaction with the International Collaboration for Turbulence Research (www.ictr.eu).

DY 26.2 Thu 14:30 MA 001

Wind velocity measurements under turbulent conditions using a sphere anemometer — •Hendrik Heisselmann, Michael Hölling, Bianca Schulte, and Joachim Peinke — Institute of Physics - University of Oldenburg

A well known problem of cup anemometry is the so-called overspeeding due to its momentum of inertia. As in nature turbulent flow conditions are predominant, cup anemometry leads to a wrong estimation of wind speeds. While cup anemometers do not provide the necessary time resolution to measure high frequency wind fluctuations, hot-wire anemometers are easily damaged under rough weather conditions. Therefore a robust, fast responding sphere anemometer was developed. The anemometer uses the thrust generated by the drag force on a sphere mounted on a flexible rod to detect wind velocities in two dimensions. The deflection of the rod is proportional to the drag force and can be measured either by means of a light pointer or by use of strain gauges. The two different measurement techniques were compared. The dynamic behaviour of the thrust anemometer was studied under laboratory conditions using a wind gust generator. The characteristics of different sphere-types and different rod materials were evaluated in order to optimize the setup. Results of open air measurements with hot-wire anemometer, sonic anemometer and sphere anemometer were compared by statistical methods.

DY 26.3 Thu 14:45 MA 001

Instationarity of the increment distribution of boundary layer wind speed — •Thomas Laubrich and Holger Kantz — Max-Planck-Institut fuer Physik Komplexer Systeme; Noethnitzer Str. 38, 01187 Dresden

The PDF of boundary layer wind speed increments can be understood as a superposition of Gaussian distributions whose variances are log-normally distributed (Castaing distribution). Motivated by instationarity of atmospheric winds we investigate the time dependence of the parameters of the Castaing distribution by analysing experimental data gathered in the boundary layer. We can recover the Castaing distribution on subsets smaller than a large time scale (hours) and show that the distribution parameters change with time. Studying this "dynamics" helps us to improve the prediction of wind speed increments, which plays an important role for wind gust prediction.

DY 26.4 Thu 15:00 MA 001

A new method for measuring lift forces acting on an airfoil under dynamic conditions — •Gerrit Wolken-Möhlmann and Joachim Peinke — Institute of Physics, University of Oldenburg, Germany

Wind turbines operate in a turbulent atmospheric boundary layer and are exposed to strong wind fluctuations in time and space. This can induce the dynamic stall, a phenomenon that causes extra loads.

Dynamic stall occurs under fast changes in the angle of attack (AoA) and was determined in detail in helicopter research. But in contrast to helicopter aerodynamics, the changes in the AoA of wind turbine airfoils are in general non-sinusoidal, and thus it seems to be difficult to use these measurements and models. Our goal is to acquire lift data under conditions more comparable to real wind turbines, including non-periodic changes in the AoA.

For this purpose a closed test section for our wind tunnel was built. An airfoil with a chord length of $0.2m$ will be rotated by a stepping motor with angular velocities of up to $300°/s$. With a maximum wind velocity of $50m/s$, Reynolds numbers of $Re = 700\,000$ can be realized. The lift force is determined by the counter forces acting on the wind tunnel walls. These are measured by two lines of 40 pressure sensors with sampling rates up to $2kHz$.

The results show distinct dynamic stall characteristics. Further experiments with different parameters and foils will give a better insight in dynamic stall and a verification and improvement of existing models.

DY 26.5 Thu 15:15 MA 001

Can aerosols be trapped in open flows? — •Rafael Vilela[1] and Adilson Motter[2] — [1]Max Planck Institute for the Physics of Complex Systems - Dresden — [2]Northwestern University, Evanston, IL 60208, USA

The fate of aerosols in open flows is relevant in a variety of physical contexts. Previous results are consistent with the assumption that such finite-size particles always escape in open chaotic advection. Here we show that a different behavior is possible. We analyze the dynamics of aerosols both in the absence and presence of gravitational effects, and both when the dynamics of the fluid particles is hyperbolic and nonhyperbolic. Permanent trapping of aerosols much heavier than the advecting fluid is shown to occur in all these cases. This phenomenon is determined by the occurrence of multiple vortices in the flow and is predicted to happen for realistic particle-fluid density ratios.

DY 26.6 Thu 15:30 MA 001

Numerical solutions of a recent theory for two-phase flow in porous media — •Florian Doster[1] and Rudolf Hilfer[1,2] — [1]Institute for Computational Physics, University of Stuttgart, 70569 Stuttgart, Germany — [2]Institute for Physics, University of Mainz, 55099 Mainz, Germany

The commonly used constitutive theory for multiphase flow in porous media on macroscopic scales – the extended Darcy theory – has several deficiencies regarding hysteresis and residual saturations. Experimental evidence shows that the fundamental parameter functions of the theory, i.e. capillary pressure and relative permeabilities are process dependent and hence are not parameter functions. A new constitutive theory addressed some of these challenges [1]. A subsequent work presented promising calculations in and near the hydrostatic equilibrium in [2]. We present a fully implicit finite volume algorithm to solve the set of coupled nonlinear PDE's in one dimension. Results of simulated reference problems, i.e. the Buckley-Leverett-Problem, the McWorther-Problem, etc. used for studying the parameter space of the theory and testing the algorithm are shown.
[1] R. Hilfer, Phys. Rev. E 58, 2090 (1998)
[2] R. Hilfer, Physica A 371, 209 (2006)

DY 26.7 Thu 15:45 MA 001

Prediction of transport parameters from resolution dependent analysis of porous media — •Thomas Zauner[1], Bibudhananda Biswal[1], Frank Raischel[1], Jens Harting[1], and Rudolf Hilfer[1,2] — [1]ICP, Universität Stuttgart, Pfaffenwaldring 27, 70569 Stuttgart, Germany — [2]Institut für Physik, Universität Mainz, 55099 Mainz, Germany

A recently proposed pore scale modeling technique [1] is used to obtain a laboratory scale (2.5 cm) continuum model of quartzitic sandstone. Synthetic μ-CT discretizations of the model are obtained at different resolutions and systematic resolution dependent microstructure analysis was carried out using Local Porosity Analysis [2]. Permeability measurements of digitized subsamples at different resolutions are obtained by large scale Lattice-Boltzmann simulations and extrapolated values for the macroscopic model are predicted.
[1] B. Biswal et al., Phys. Rev. E **75**, 61303 (2007)
[2] R. Hilfer, Adv. Chem. Phys. **XCII**, 299 (1996)

DY 26.8 Thu 16:00 MA 001

Boundary induced Spirals in counter-rotating Taylor-Couette flow — •Kerstin Hochstrate, Matti Heise, Jan Abshagen, and Gerd Pfister — Institute of Experimental and Applied Physics, Kiel, Germany

One of the classical hydrodynamic systems for the study of bifurcation events is the flow of a viscous fluid confined in the gap between two concentric rotating cylinders, i.e. Taylor-Couette flow. The focus of our study is the onset of spiral vortex flow as primary instability from basic laminar flow between counter-rotating cylinders with stationary and rotating end plates. Spirals are traveling waves in axial and rotating waves in azimuthal direction having an azimuthal wave number of $m = \pm 1$ in the parameter space studied here. In contrast to many theoretical investigations considering infinite axial length almost all experimental realization of Taylor-Couette flow use stationary rigid end plates confining the flow in axial direction. These end plates are relevant for the dynamical characteristics and the bifurcation behavior of 'global' spiral vortex flow and even may induce 'localized' spirals near these ends. We used independently rotating end plates in order to study the stability and the underlying physical mechanism for the onset of 'global' and 'localized' spirals.

DY 26.9 Thu 16:15 MA 001

Drying of substrates covered by thin liquid films — •Rodica Borcia and Michael Bestehorn — Lehrstuhl Statistische Physik/ Nichtlineare Dynamik, Brandenburgische Technische Universität Cottbus, Erich-Weinert-Strasse 1, 03046, Cottbus, Germany

Composite systems of two or more phases like two immiscible fluids or an open fluid with its own vapor can be described using an additional variable – named phase field. This field contains information about the local state of the composition and permits to distinguish between different phases. With the help of the phase field variable all system parameters can be expressed as functions varying continuously from one medium to another. Therefore, the problem is treated like an entire one phase problem and the interface conditions will be substituted by some extra-terms in the Navier-Stokes equation.

Simple, flexible and elegant, the phase field model becomes now an useful tool for describing wetting and drying phenomena, processes with large applications for treatments involving paints, insecticides, detergents, composite materials, and porous media. We investigate using a phase field model the stability of liquid films on a flat solid support with variable wettability, transition via nucleation from film to drop, drops motion on an inclined substrate under gravity effects and viscous flow over chemically patterned surfaces.

DY 26.10 Thu 16:30 MA 001

Temporal instability and breakup characteristics of liquid sheets — •Bernhard Heislbetz, Klaus Madlener, and Helmut Ciezki — DLR Lampoldshausen, Institut für Raumfahrtantriebe, D-74239 Hardthausen

We investigate the temporal instability and the breakup charakteristics of sheets formed by two impinging jets under atmospheric conditions. Thereby we extend the theory for inviscid and viscous liquid sheets to highly viscous Newtonian and Non-Newtonian fluids and show the influence of several hydrodynamic parameters on the breakup process of the fluid sheets.

The results of the theoretical considerations are compared to data obtained by experiments conducted on fluid sheets formed by an doubled like-on-like impinging jet injector.

DY 26.11 Thu 16:45 MA 001

Binary mixture thin film in vertical and horizontal temperature gradients — •Ion Dan Borcia and Michael Bestehorn — Lehrstuhl für Theoretische Physik II, Brandenburgische Technische Universität Cottbus, Germany

Models for thin film binary mixture were developed using lubrication approximation with the surface tension depending on both temperature and concentration. A 2D simplified equation for the concentration (mass conservation equation) was added. The big advantage of these models is that the dimension of the problem is reduced by 1 and therefore the computing time considerably decreases. But this kind of models can not take into account horizontal temperature gradients on the solid substrate. In this case a complete model which includes the 3D energy and concentration equations will be used.

In the first step we didn't include the evaporation in the model. In the case of the drying processes in polymers this corresponds to the situation when the film pattern formation is complete before the fast evaporation takes place.

DY 27: Quantum chaos II

Time: Thursday 14:30–17:00 Location: MA 004

DY 27.1 Thu 14:30 MA 004

Occupation probabilities of Floquet states in driven systems with a mixed phase space — Roland Ketzmerick and •Waltraut Wustmann — Institut für Theoretische Physik, Technische Universität Dresden, 01062 Dresden, Germany

We investigate time-periodic driven systems with regular and chaotic Floquet states weakly coupled to a heat bath. The stationary occupation probabilities of the two types of states turn out to follow fundamentally different distributions. Chaotic states have almost equal probabilities irrespective of their time-averaged energy. Regular states show Boltzmann-like probabilities proportional to $\exp(-E_n^*/kT^*)$ as in time-independent systems. In contrast, however, an effective temperature T^* appears that can be derived analytically and effective energies E_n^* that have to be determined from properties of the classical regular island they are localized on.

DY 27.2 Thu 14:45 MA 004

Modifications of the phase space structure of optical microcavities due to the Goos-Hänchen shift — •Julia Unterhinninghofen[1], Jan Wiersig[1], and Martina Hentschel[2] — [1]Institut für theoretische Physik, Universität Bremen, Postfach 330 440, 28334 Bremen — [2]Max-Planck-Institut für Physik komplexer Systeme, Nöthnitzer Str. 38, 01187 Dresden

Optical microcavities have important applications in various different fields of physics [1]. In the quantum chaos community microdisk cavities with deformed cross-sectional shape attracted considerable attention since they can be used to study the ray-wave correspondence in open systems in direct comparison to experiments [2,3]. As recent experimental progress allows for smaller and smaller cavities, wave corrections to the ray dynamics become highly relevant. We theoretically study the influence of the most important correction, the Goos-Hänchen shift [4], on the phase space structure of optical microcavities. We find an interesting relation to scarlike modes near avoided resonance crossings [5].

[1] K. J. Vahala, Nature **424**, 839 (2003). [2] J. U. Nöckel and A. D. Stone, Nature **385**, 45 (1997). [3] C. Gmachl *et al.*, Science **280**, 1556 (1998). [4] H. Schomerus and M. Hentschel, Phys. Rev. Lett. **96**, 243903 (2006). [5] J. Wiersig, Phys. Rev. Lett. **97**, 253901 (2006).

DY 27.3 Thu 15:00 MA 004

Dynamical tunneling rates in billiards — Arnd Bäcker, Roland Ketzmerick, and •Steffen Löck — Institut für Theoretische Physik, Technische Universität Dresden, 01062 Dresden, Germany

In systems with a mixed phase space regular islands are dynamically separated from the chaotic sea, while quantum mechanically these phase space regions are connected by dynamical tunneling. We present an approach using a fictitious integrable system which predicts dynamical tunneling rates from regular states to the chaotic sea in billiards. A comparison with numerical results, for e.g. the mushroom billiard and the annular billiard, shows excellent agreement.

DY 27.4 Thu 15:15 MA 004

Dynamical Husimi functions at dielectric interfaces of lasing cavities — •Tae Yoon Kwon and Martina Hentschel — MPIPKS, Dresden, Germany

We generalize the concept of Husimi functions to active optical microresonators by introducing dynamical Husimi functions at the interfaces of dielectric laser cavity systems. To this end we solve the spatio-temporal laser cavity equations, so-called Schrödinger-Bloch model, and deduce generalized, time-dependent Husimi functions. These functions give insight into the dynamics of the lasing modes in phase-space that conveniently complements the information derived from the time-dependence of the modes in configuration space. We apply these functions to characterize the near and far field optical properties of various two-dimensional microcavity systems.

DY 27.5 Thu 15:30 MA 004

Two-point correlations of spectral determinants — •Daniel Waltner[1], Stefan Heusler[2], Juan-Diego Urbina[1], and Klaus Richter[1] — [1]Institut für Theoretische Physik, Universität Regensburg, 93040 Regensburg — [2]Universität Münster

We consider the correlator of two spectral determinants using semiclassical methods. While in the unitary case the diagonal approximation reproduces the leading order contribution from Random Matrix Theory (RMT) [1], we show that semiclassical loop contributions are not consistent with RMT [2]. A complementary analysis based on a field theoretical approach shows that the additional terms occurring in semiclassics are cancelled in field theory by so-called curvature effects. We attempt to find a semiclassical interpretation of such effects.

[1] J. P. Keating, S. Müller, Proc. R. Soc. **463**, 3241
[2] D. Waltner et. al., *in preparation*

DY 27.6 Thu 15:45 MA 004

Doorway based model for superscars in the barrier billiard — Sven Åberg[1], Thomas Guhr[2], •Maksim Miski-Oglu[3], and Achim Richter[3] — [1]Matematisk Fysik, LTH, Lunds Universitet, Lund, Sweden — [2]Fachbereich Physik, Universität Duisburg–Essen, Duisburg, Germany — [3]Institut für Kernphysik, Technische Universität Darmstadt, Darmstadt, Germany

Superscars in a pseudointegrable barrier billiard serve as a paradigm for strength function phenomena in different quantum systems ranging from atoms to nuclei. Superscarring state are spatially localized in a channel of a family of classical periodic orbitis and have a simple structure. Their strength is spread over many other nonsuperscarring states in the billiard, i.e. it acts as a so called doorway state. We analyze the observed spreading for four different superscar families appplying random matrix theory. We design a doorway based model for superscarred wave functions. With this model we investigated the spatial correlations of the experimentally obtained billiard wave functions and their nodal domains statistics. The results for different bservables are consistent.

DY 27.7 Thu 16:00 MA 004

Level Density of a Fermi Gas: Average Growth and Fluctuations — •Roccia Jerome[1] and Leboeuf Patricio[2] — [1]Institut für Theoretische Physik, Universität Regensburg D-93040 Regensburg, Germany — [2]Laboratoire de Physique Théorique et Modèles Statistiques bâtiment 100 Université Paris-Sud centre scientifique d'Orsay 15 rue Georges Clémenceau 91405 Orsay cedex, France

We investigate the many-body level density ρ_{MB} for fermions. We establish its behavior as a function of the temperature and the number of particules. We propose a semiclassical expression of ρ_{MB} for two types of particules with an angular momentum. It is decomposed into a smooth part coming from the saddle point method plus corrective terms due to the expansion of the number of partitions for two types of particles and an oscillating part coming from the fluctuations of the single-particle level density. Our model is validated by a numerical study. For the case of the atomic nucleus, the oscillating part of ρ_{MB} is controled by a temperature factor which depends on the chaotic or integrable nature of the system and depends on the fluctuation of the ground state energy. This leads to consider in more detail this last quantity. For an isolated system, we give the general expression of the mean value for fixed potentials. We treat the self-bound system case through the example of the three dimensional harmonic oscillator (3DHO).

DY 27.8 Thu 16:15 MA 004

Friedel oscillations in microwave billiards — Arnd Bäcker[1], •Thomas Friedrich[2], Maksim Miski-Oglu[2], Achim Richter[2], and Steven L. Tomsovic[3] — [1]Institut für Theoretische Physik, Technische Universität Dresden, 01062 Dresden, Germany — [2]Institut für Kernphysik, Technische Universität Darmstadt, 64289 Darmstadt, Germany — [3]Dept. of Physics, Washington State University, Pullman, WA

Oscillations of the electronic wave function in the neighborhood of defect atoms or potential steps in metallic surfaces (so-called Friedel oscillations) are known for a long time. Scanning tunnelling microscopy brought up breathtaking pictures such as the well known quantum corrals where this phenomenon is visualized. We investigate the properties of Friedel oscillations in the experiment using two flat microwave billiards, the mushroom billiard with mixed dynamics and a pseudointegrable barrier billiard. The average of the field distributions of eigen-modes below the Fermi energy exhibits oscillations close to the boundary. We compare them with predictions of the random plane wave model. Taking into account the structure of the classical phase space, we find a good agreement.

DY 27.9 Thu 16:30 MA 004

Orthogonality catastrophe in mesoscopic systems: A quantum chaos perspective — •Georg Röder and Martina Hentschel — Max Planck Institute for the Physics of Complex Systems, Dresden, Germany

We study the response of integrable and chaotic mesoscopic systems to a sudden, localized perturbation caused, e.g., by an x-ray exciting a core electron into the conduction band. Anderson orthogonality catastrophe (AOC) refers to the disappearance of the overlap of the many-particle ground states before and after the perturbation is applied in the thermodynamic limit. In contrast, a finite number of particles causes AOC to be incomplete with a broad distribution of AOC overlaps originating from mesoscopic fluctuations, in particular those that occur close to the Fermi energy. We consider two integrable ballistic quantum dots (rectangle and disc with hard walls) subject to a rank-one perturbation and compare the results with those obtained for generic chaotic systems. We find that the distributions of AOC overlaps differ, especially in the presence of a magnetic field. Level degeneracies present in integrable systems lead to additional peaks in the AOC distribution that shift the average overlap to smaller values. Furthermore, we apply these results to study Fermi edge singularities in the photo-absorption spectra of mesoscopic systems and show that their signature can qualitatively deviate from metallic (bulk-like) systems.

DY 27.10 Thu 16:45 MA 004

Dephasing in quantum chaotic transport (semiclassical approach) — Robert S. Whitney[1], Philippe Jacquod[2], and •Cyril Petitjean[3,4] — [1]Institut Laue-Langevin, Grenoble, France — [2]Physics Department, University of Arizona, Tucson, USA — [3]Département de Physique Théorique, Genève, Switzerland — [4]Institut für Theoretische Physik, Universität Regensburg, Regensburg, Germany

Electronic systems in the mesoscopic regime are ideal testing-grounds for investigating the quantum-to-classical transition. Quantum coherence conservation in these systems is usually determined by the ratio of the dephasing time τ_ϕ to some relevant classical time scale.

We investigate the effect of dephasing on quantum transport through a two-terminal chaotic dot in the deep semiclassical limit. The decoherence originating from: an external quantum chaotic environment, a classical noise, a voltage probe. We find an exponential suppression of weak-localization $\propto \exp[-\tilde{\tau}/\tau_\phi]$ in addition to the universal algebraic suppression of weak localization. The parameter $\tilde{\tau}$ depends strongly on the source of dephasing. For a voltage probe, is of order the Ehrenfest time. In contrast, for a chaotic environment or a classical noise, where is related to the correlation length of the coupling/noise potential. We show also that the Fano factor is unaffected by decoherence. We connect these results to earlier works on dephasing due to electron-electron interactions, and numerically confirm our findings.

[1] Petitjean, Jacquod, Whitney, JETP Letters **86**, 736 (2007),
[2] Whitney, Jacquod ,Petitjean, arXiv:0710.5137v1

DY 28: Statistical physics far from thermal equilibrium

Time: Thursday 14:30–16:00 Location: A 060

DY 28.1 Thu 14:30 A 060

Model Studies on the Quantum Jarzynski Relation — •Jens Teifel and Günter Mahler — Universität Stuttgart, Institut für Theoretische Physik I, 70550 Stuttgart, Pfaffenwaldring 57/IV

We are particularly interested in the quantum Jarzynski relation, which has been shown to hold for closed quantum systems by S. Mukamel. We discuss different models of bipartite quantum systems, such as microcanonical coupling and canonical coupling. By generalizing the proof of Mukamel we show that the Jarzynski relation holds for microcanonical coupling as well as for open quantum systems at high initial temperatures. Furthermore we want to discuss a possible alteration of the Jarzynski relation in order to avoid the ambiguous definition of work in quantum systems.

DY 28.2 Thu 14:45 A 060

Nonequilibrium work distribution of a quantum harmonic oscillator — •Sebastian Deffner and Eric Lutz — Institute of Physics, University of Augsburg, D-86135 Augsburg, Germany

We analytically calculate the work distribution of a quantum harmonic oscillator with arbitrary time–dependent angular frequency. We provide detailed expressions for the work probability density for adiabatic and nonadiabatic processes, in the limit of low and high temperature. We further verify the validity of the quantum Jarzynski equality.

DY 28.3 Thu 15:00 A 060

Interaction effects and work theorems — •Mario Einax and Philipp Maass — Institut für Physik, Technische Universität Ilmenau, 98684 Ilmenau, Germany

We present an exact waiting time Monte-Carlo algorithm (WTMC) to simulate systems that follow a dynamics given by a master equation with time-dependent rates. The algorithm can be conveniently used to investigate many particle systems driven out of equilibrium by time-dependent external fields. We illustrate the method for a one-dimensional Ising-spin system with Glauber dynamics. In particular we compute the probability distributions of the fluctuating work and heat. Our results are compared to analytical findings and tested against various non-equilibrium fluctuation theorems.

DY 28.4 Thu 15:15 A 060

Non-equilibrium transport equations for randomly interacting quantum systems — •Pedro Vidal — 1 Institut für Theoretische Physik, Universität Stuttgart, Deutschland

We analyse the dynamics of some quantum models where the Hamiltonian possesses a random part. We show them to be solvable within certain size and time scaling limit. Particularly we consider the Van-Hove limit which is the long time-weak coupling regime. In these scaling regimes we find our systems to be described by diffusion equations or rate equations.

DY 28.5 Thu 15:30 A 060

Statistical properties of disordered driven lattice gases with open boundary conditions — •Philip Greulich — Institut für Theoretische Physik, Universität zu Köln, Köln, Germany

We investigate driven lattice gases with open boundary conditions in presence of randomly distributed defect sites with reduced hopping rate. These systems can be used as models for intracellular transport systems impurified by immobile blocking molecules. In contrast to equilibrium, even macroscopic quantities in disordered non-equilibrium systems depend sensitively on the defect sample. We show that the leading behaviour in the disordered system is determined by the longest stretch of consecutive defect sites. Using results from extreme value statistics, this single bottleneck approximation gives accurate results for probability distributions and the expectation value of the maximum current at small defect densities. Corrections from bottleneck interactions can be taken into account systematically by a perturbative expansion which also yields criteria for the validity of the single bottleneck approximation.

DY 28.6 Thu 15:45 A 060

Scaling Behaviour in a Cyclic Population Model on a Lattice — •Anton Winkler, Tobias Reichenbach, and Erwin Frey — Arnold Sommerfeld Center for Theoretical Physics and Center for NanoScience, Department of Physics, Ludwig-Maximilians-Universität München, Theresienstraße 37, D-80333 München, Germany

Cyclic (rock-paper-scissors-type) population models serve as simple models of more complex species interactions. Focusing on a paradigmatic three-species model with mutations in one dimension, we show how simple renormalization group arguments yield an excellent analytical understanding of the emerging reactive steady state. Care is taken in discriminating two types of mutations, giving rise to two different renormalization group eigenvalues. The results are compared to stochastic lattice simulations. Our methods and findings are potentially relevant for the spatio-temporal evolution of other non-equilibrium stochastic processes.

DY 29: Poster II

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

DY 29.1 Thu 16:00 Poster C

Constant Pressure Ensemble: Application to Small Systems and Relation to Einstein Fuctuation Theory. — •Bernhard Joachim Mokross — Instituto de Fisica de Sao Carlos, Universidade de Sao Paulo, Sao Carlos, SP, Brasil, CEP 13560-970

The constant pressure ensemble is the most appropriate to deal with small systems (as clusters and nuclei) since experiments are usually performed under constant pressure conditions. The conjugate variable of the pressure is the volume wherefrom this ensemble partition function requires the sum over discrete unspecified volumes which may lead to errors, presented by the necessity of a correct volume scale, which increase with decreasing size of the system. In order to represent the partition function as a dimensionless integral Koper and Reiss placed the ensemble on a firm fundamental foundation with the derivation of a proper length scale applicable to isothermal fluctuations of any size in ideal fluids. In this paper, by a careful derivation, it is I shown that their result is not limited to isothermal fluctuations in ideal fluids. It applies as well to non-ideal fluids and describes fluctuations which may evolve under conditions not necessarily isothermal. It applies to small systems as well as to systems in the thermodynamic limit where it has a connection with Einstein fluctuation theory. It is also shown how it may be applied to nucleation processes.

DY 29.2 Thu 16:00 Poster C

Efficiency at maximum work for quantum thermodynamic machines — •Thomas Jahnke and Günter Mahler — Universität Stuttgart, 1. Institut für Theoretische Physik, Pfaffenwaldring 57, 70550 Stuttgart

Quantum thermodynamic processes can be described by means of a control model [1]: Introducing a statistical and a mechanical control parameter allows to define these processes as curves on the 2-dimensional control plane. Any process type known from macroscopic thermodynamics can thus be reformulated. Here we investigate the efficiency at maximum work for the Otto- and the Escher-Wyss-cycle acting between two baths of given temperatures. These efficiencies are found to lie between the Curzon-Ahlborn- and the Carnot-efficiency for all investigated spectra. We also discuss the limit, where the Curzon-Ahlborn-efficiency is reached.

[1] J. Birjukov, T. Jahnke and G. Mahler: Eur. Phys. J. B (submitted 2007)

DY 29.3 Thu 16:00 Poster C

Chaotic and Stochastic 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, magnetic nanoparticles, or certain friction models are characterized by a non-trivial hysteretic behavior, implying e.g. a complex dependence on previous input events (hysteretic memory).

On that score, we study properties of hysteretic output time series for different well understood input scenarios with similar characteristics using a discrete Preisach-hysteresis transducer.

For some aspects the chaotic trajectory of the logistic map and the corresponding stochastic process are treated differently under hysteresis. On the other hand, since hysteresis creates long-term memory we observe e.g. a slow decay of the autocorrelation function for both types of signals. For trajectories of higher iterations of the logistic map some of the observed properties converge to the results for the stochastic trajectory. The hysteretic memory, however, still distinguish between deterministic chaos and noise.

DY 29.4 Thu 16:00 Poster C

Thermodynamic Casimir forces of n-component systems in slab geometries with free surfaces: Exact results for $n \to \infty$ — •Denis Comtesse, Alfred Hucht, Daniel Grüneberg, and Hans Werner Diehl — Fachbereich Physik, Universität Duisburg-Essen, D-47048 Duisburg

The $O(n)$ ϕ^4-model on a three-dimensional slab of thickness L and infinite lateral extension is investigated in the large-n limit. The resulting self-consistent Schrödinger-type equation is solved numerically to determine the resulting Casimir force at and near the bulk critical temperature exactly. This enables us to study the physically relevant case of free boundary conditions, corresponding to a spherical model with separate constraints for each layer parallel to the confining surfaces. The resulting large-n limit of the Casimir amplitude is obtained. To check the method, the Casimir amplitude for periodic boundary conditions is computed as well and found to be in excellent agreement with the analytically known exact result.

DY 29.5 Thu 16:00 Poster C

Crossover from attractive to repulsive thermodynamic Casimir forces — •Felix Schmidt and Hans Werner Diehl — Fachbereich Physik, Universität Duisburg-Essen, D-47048 Duisburg

Films whose long-length-scale behavior near the bulk critical point is described by n-vector ϕ^4-models in slab geometries with free surfaces are considered. The confining surfaces are presumed to preserve the $O(n)$ invariance of the Hamiltonian. Local enhancements or weakenings of the pair interactions at the two boundary planes $\mathcal{B}_1$ at $z = 0$ and $\mathcal{B}_2$ at $z = L$ are allowed and taken into account through quadratic surface contributions with different interaction constants $c_1 \geq 0$ and $c_2 \geq 0$ on $\mathcal{B}_1$ and $\mathcal{B}_2$, respectively. When $c_1 \neq c_2$, the thermodynamic Casimir force that occurs near the bulk critical temperature can be repulsive or attractive. Using the field-theoretical renormalization group in $d = 4 - \epsilon$ dimensions, the thermodynamic Casimir force is determined at and near the bulk critical temperature for general positive values of c_1 and c_2. For appropriate choices of $c_1 - c_2$, crossovers from attractive to repulsive Casimir interactions (or vice versa) occur as the bulk critical temperature is approached.

DY 29.6 Thu 16:00 Poster C

Techniques accelerating the dynamics of simulations of complex systems — •Frank Beyer, Elmar Bittner, and Wolfhard Janke — Institut für Theoretische Physik, Universität Leipzig, D-04009 Leipzig

Complex systems such as spin glasses simulated with local update schemes in the framework of Markov Chain Monte Carlo Simulations exhibit strong autocorrelations resulting in a slow dynamics especially pronounced in the temperature regime below the glass transition. Due to the rough energy landscape, trappings in local energy minima can be handled with (combinations of) different techniques such as parallel tempering and multicanonical simulations lowering relaxation times and autocorrelations. Our poster contains on the one hand a discussion of these methods with special attention to autocorrelation times giving a measure for assessing the goodness of a random walk. On the other hand it includes a survey on inherent structures and their highly degenerate configurations with minimal energy. Both issues concentrate on the 3d Edwards-Anderson spin glass model with bimodal interactions.

DY 29.7 Thu 16:00 Poster C

Monte Carlo study of the evaporation/condensation transition of Ising droplets — •Micha Wiedenmann, Andreas Nussbaumer, Elmar Bittner, and Wolfhard Janke — Institut für Theoretische Physik, Universität Leipzig, Postfach 100920, 04009 Leipzig

This work builds on recent work of A. Nußbaumer *et al.* [*Europhys. Lett.* **75** (2006) 716] and studies the evaporation/condensation transition of Ising droplets in three dimensions. We performed Monte Carlo simulations of the Ising model with nearest-neighbor couplings on a simple cubic lattice with periodic boundary conditions at a fixed magnetization, corresponding to a certain amount v_L of overturned spins. The volume v_d of the largest droplet was measured at constant magnetization employing a flood-fill algorithm. For values of the magnetization $m < m_c$ there exists no droplet in the system and the fraction of overturned spins above the equilibrium magnetization m_0 in the largest droplet $\lambda = v_d/v_L$ is zero. At $m = m_c$ one half of the overturned spins form a droplet which grows for larger values of the magnetization. This behavior can be compared to analytical results given by Biskup *et al.* [*Europhys. Lett.* **60** (2002) 21]. In order to do so we measured the spontaneous magnetization m_0, the magnetic susceptibility χ and the planar surface tension τ (which is a good approximation of a Wulff shaped droplet). Rescaling the magnetization to a dimensionless parameter $\Delta = \Delta(m, \chi, \tau, m_0)$, our measured results are in good agreement with the theoretical predictions.

DY 29.8 Thu 16:00 Poster C

Thermodynamic Casimir effects at *m*-axial Lifshitz points — •Matthias Burgsmüller, Daniel Grüneberg, and Hans Werner Diehl — Fachbereich Physik, Universität Duisburg-Essen, D-47048 Duisburg

Many-component spin systems with an $O(n)$-symmetrical Hamiltonian that have an m-axial bulk Lifshitz point in d dimensions are considered in a slab geometry under periodic and free boundary conditions. The thermodynamic Casimir forces generated by thermal fluctuations at the Lifshitz point are found to depend on the slab's thickness L in a distinct fashion, depending on whether the confining surfaces are perpendicular to one of the potential modulation axis or parallel to all of them. The small $\epsilon = d^*(m) - d$ expansion about the upper critical dimension $d^*(m) = 4 + m/2$ is utilized to study the Casimir effect via field-theoretic renormalization group methods and to determine the associated Casimir amplitudes for several boundary conditions.

DY 29.9 Thu 16:00 Poster C

Scaling limit of groundstate dislocation lines in the solid-on-solid model — •Karsten Schwarz and Heiko Rieger — Theoretische Physik, Universität des Saarlandes, PF 151150, D-66041 Saarbrücken

In some cases, it has already been proven that Schramm-Loewner Evolution (SLE_κ) is the scaling limit of a discrete model, e. g. SLE_2 is the scaling limit of the planar loop-erased random walk.
We study dislocation-lines of the groundstate of the disordered two dimensional solid-on-solid model $H = \sum_{\langle i;j \rangle}(h_i - h_j)^2$ with $h_i = d_i + n_i$ (d_i random offset $\in [0; 1)$, $n_i \in \mathbb{Z}$). The main aim of our investigation is to answer the question whether the scaling limit of this discrete model can also be described by SLE_κ. So we simulate such lines on several different simply connected domains and control whether properties of SLE_κ are satisfied. As our model is a frustrated system, it is hard to calculate the groundstate efficiently. So we also describe the used network algorithm.

DY 29.10 Thu 16:00 Poster C

Equilibrium properties of the Wang-Landau algorithm — •Mathias Aust, Elmar Bittner, and Wolfhard Janke — Institut für Theoretische Physik, Universität Leipzig, Postfach 100920, 04009 Leipzig, Germany

The Wang-Landau method is generally considered to be an efficient Monte Carlo algorithm. It certainly is an easily implemented method to determine the density of states which is required for simulations on generalized ensembles such as multicanonical simulations. But since the Wang-Landau method uses strongly fluctuating, time-dependent weights instead of a fixed ensemble, there is no mathematical proof that the method yields reliable results.

This work provides a scheme to evaluate statistical data from time series lacking a fixed ensemble. The scheme is applied to Wang-Landau simulations of the two-dimensional Ising model measuring the energy and magnetization. The results are compared with data from exact enumerations on small lattices as well as with the exact Beale solution and magnetization data from multicanonical simulations for lattice sizes up to 64×64 to check for systematic errors of the algorithm.

Additionally, the Wang-Landau method is combined with the Transition Matrix evaluation scheme by Wang and Swendsen to find a good working estimate of the density of states even faster.

DY 29.11 Thu 16:00 Poster C

Diffusion and dissipation in complex quantum systems — •Dominik Samson and Heiko Rieger — Theoretische Physik, Universität des Saarlandes, PF 151150, D-66041 Saarbrücken

The Hamiltonian of a quantum-mechanical system contains a time-dependent parameter X. The system is prepared in a highly excited eigenstate of the instantaneous Hamiltonian, and we compute the amplitudes $< n(t)|\phi(t) >$ to be in the eigenstates $|n >$ of the instantaeous Hamiltonian $H(X(t))$ at later times. It was already found for generic Systems that the occupation probability spreads diffusively away from the initial state [1]. The diffusion constant D is now investigated numerically in random matrix models (GOE and GUE) as a function of $\dot{X}$. We are able to prove numerically the theoretical predictions in two limiting regimes of both matrix models: in the GOE case, we have two $D(\dot{X})$ behaviours, in the GUE case D has an unitarity dependence, always corresponding to Ohmic dissipation predicted by the Kubo formula and Landau-Zener transitions. We also study the sample to sample fluctuation of energy, $\Delta E = \left\langle [E(t) - E(t=0)]^2 \right\rangle$ in both ensembles, which seems to have a sub-ohmic behaviour.

[1] Michael Wilkinson, Diffusion and dissipation in complex quantum systems, Phys. Rev. A **41**, 4645 (1990)

DY 29.12 Thu 16:00 Poster C

Coulomb Gap Revisited — •Arnulf Möbius[1], Peter Karmann[2], and Michael Schreiber[2] — [1]Leibniz-Institut für Festkörper- und Werkstoffforschung Dresden — [2]Institut für Physik, Technische Universität Chemnitz

One of the most prominent features of the Coulomb glass is the Coulomb gap, a soft gap in the single-particle density of states around the chemical potential [1,2]. Previous numerical studies of the gap yielded densities considerably deviating from the analytical results.

Because of the long-range interaction, the energy region which could be considered in previous simulations was limited by severe difficulties arising from finite-size effects. To overcome this problem, we use a renormalization like iteration procedure: A cutoff length of the interaction is introduced which increases step by step during relaxation. In this way, simulations of samples of up to $2 \cdot 10^9$ sites were performed.

For one- to three-dimensional samples, we studied the influence of the disorder strength. The consideration of extremely large samples opens new insight: There is a tendency to universal behaviour in all three cases as predicted analytically in [1]. Asymptotic power laws with the predicted exponents seem to hold in the two- and three-dimensional cases, but the prefactors are smaller than predicted in [2] by factors of 2 to 3. However, this behaviour is observed only for very low energies so that the experimental relevance of the asymptotics has to be judged with reservation.

[1] A.L. Efros and B.I. Shklovskii, J. Phys. C 8, L49 (1975).
[2] A.L. Efros, J. Phys. C 9, 2021 (1976).

DY 29.13 Thu 16:00 Poster C

Dynamic Analysis of Cup Anemometer Data — •Mathias Hölzer[1,2], Michael Hölling[1,2], and Joachim Peinke[1,2] — [1]Universität Oldenburg — [2]ForWind, Oldenburg

The cup anemometer is one of the most used wind measuring instruments in wind energy related context. The asymmetric form, on which its movement is based on, is the source of a systematic overestimation of the mean windspeed, the so called "Overspeeding".

The instrument inherent error is the biggest drawback of the instrument, since an error up to 10% in windspeed means an error up to 30% in wind energy output due to the cubic dependency between windspeed and energy content. Error correction methods have been devolped since the mid 1950's by a couple of authors. All these approaches yield a certain correction, but are complicated as they require additional information about the exact cup anemometer geometry.

With our new approach we treat the cup anemometer as a stochastic system with Markov properties. The dynamics of such a system can be described by the Fokker-Planck equation. By calculating the drift coefficient from the measured data it is possible to determine the correct mean wind speed. In comparison with other algorithms the presented approach leads to better results. Furthermore it is not nesesary to have additional information of the geometry of the anemometer.

The presented approach can be a considerable advance for the correct forecast of wind energy output in the future as well as for previously measured data as long as it is possible to apply the method to timeseries to correct the mean wind speed of a site.

DY 29.14 Thu 16:00 Poster C

Wetting on Geometrically Structured Surfaces — •Monica Marinescu[1,2], Mykola Tasinkevych[1,2], and Siegfried Dietrich[1,2] — [1]Max-Planck-Institut für Metallforschung, Heisenbergstr. 3, 70569 Stuttgart — [2]Universität Stuttgart, Institut für Theoretische und Angewandte Physik, Pfaffenwaldring 57, 70569 Stuttgart

Complete wetting on different geometrically structured substrates of a fluid close to its liquid-gas coexistence is studied. The system is described by an effective interface Hamiltonian which takes into account the long-range character of the substrate potential. Four structured geometries consisting of periodic arrays of rectangular and cylindrical pits and posts are considered. As a limiting case, wetting on a substrate with two rectangular, perpendicular "grooves" is also studied.

We describe wetting behaviour by the interfacial height function $l(\Delta\mu)$, where l is the height of the liquid/gas interface at the cavity midpoint and $\Delta\mu$ the distance from bulk coexistence. Based on this function, we find a filling regime for all aforementioned geometries provided the system is driven close enough to bulk coexistence. In the postfilling regime, universal scaling behaviour and covariance of the interfacial height function are analyzed.

DY 29.15 Thu 16:00 Poster C

Replica-exchange cluster algorithm — •Elmar Bittner and Wolfhard Janke — Institut für Theoretische Physik, Universität Leipzig, Postfach 100 920, 04009 Leipzig, Germany

In typical finite-size scaling analyses of Monte Carlo simulations of a model exhibiting a second-order phase transition, one often needs an extended temperature/energy range around the critical point. By combining the replica-exchange algorithm with cluster updates and an adaptive routine to find the range of interest, we introduce a new flexible and powerful method for systematic investigations of second-order phase transitions. As a result, we gain two further orders of magnitude for 2D and 3D Ising models in comparison with the recently proposed Wang-Landau recursion for cluster algorithms based on the multibondic algorithm, which is already a great improvement over the standard multicanonical variant.

DY 29.16 Thu 16:00 Poster C

Path Integrals Without Integrals — •Antun Balaž[1], Aleksandar Bogojević[1], Ivana Vidanović[1], and Axel Pelster[2] — [1]Scientific Computing Laboratory, Institute of Physics Belgrade, Pregrevica 118, 11080 Belgrade, Serbia — [2]Fachbereich Physik, Universität Duisburg-Essen, Lotharstraße 1, 47048 Duisburg, Germany

Studying the relationship between path integral discretizations of different coarseness, a hierarchy of discretized effective actions was recently derived, which yields an improved $(\beta/N)^p$ convergence of discretized transition amplitudes to the continuum limit up to $p = 12$ [1,2]. In this contribution we present a simpler procedure for obtaining these results through the derivation and solution of a set of recursive relations, and determine the effective actions even up to order $p = 25$. Higher values of p make it possible to have higher precision results even for small values of N. Ultimately, for short propagation times $\beta < 1$ it is possible to set $N = 1$ and obtain closed analytic expressions for path integrals of a generic quantum-mechanical theory. We verify the obtained formula by comparison with perturbative expansion, loop expansion, and exact Monte Carlo simulations for the case of an anharmonic oscillator with quartic coupling. Finally, we discuss the numerical and analytical use of the obtained effective actions for long propagation times $\beta > 1$.

[1] A. Bogojevic, A. Balaz, and A. Belic, Phys. Rev. Lett. **94**, 180403 (2005)

[2] A. Bogojevic, A. Balaz, and A. Belic, Phys. Lett. A **344**, 84 (2005)

DY 29.17 Thu 16:00 Poster C

Tackling Master Equations with a Loop Transform — •Stephan Herminghaus, Klaus Roeller, Axel Fingerle, and Jürgen Vollmer — MPI für Dynamik und Selbstorganisation, Göttingen

A procedure is introduced which allows to represent the dynamics of a non-equilibrium system violating detailed balance by its steady state loop fluxes. It is shown that detailed balance is restored in this representation, such that the non-equilibrium steady state follows a simple Boltzmann distribution. It is thereby shown that the loop transform maps the complex behaviour of a large class of systems far from thermal equilibrium onto standard statistics of multilevel systems with degeneracies. A novel algorithm for the construction of the steady state densities naturally emerges. Furthermore, we find an expression for a free energy functional governing both the steady state and some aspects of the dynamic behavior of the system.

DY 29.18 Thu 16:00 Poster C

Universal critical behaviour in wet granular matter — Axel Fingerle, Klaus Roeller, Kai Huang, and •Stephan Herminghaus — MPI für Dynamik und Selbstorganisation, Göttingen

Wet granular matter is meanwhile established as a versatile model system for a large class of phenomena far from thermal equilibrium. We have studied phase transitions in vertically agitated piles of wet glass beads by experiment, simulation, and analytical theory. The full phase diagram is obtained, in mutual agreement of all three approaches. Quite remarkably, we find that details of the capillary force characteristics are irrelevant for most of the observed features. The only relevant parameters are the capillary force at contact and the total energy which is necessary to rupture a capillary bridge.

DY 29.19 Thu 16:00 Poster C

Equation of state of wet granular matter — Axel Fingerle, Klaus Roeller, and •Stephan Herminghaus — MPI für Dynamik und Selbstorganisation, Göttingen

Wet granular matter is meanwhile established as a versatile model system for a large class of phenomena far from thermal equilibrium. We present the equation of state of wet granular matter, consisting of spherical grains wetted by a certain amount of liquid, and externally agitated to some finite granular temperature (mean kinetic energy per degree of freedom). Following earlier studies which demonstrated the enhancement of the Kolmogorov-Sinai entropy due to the capillary forces [1,2], we find expressions for the pressure of a wet granular gas as a function of granular temperature. Excellent agreement with dynamical simulations is obtained in the full relevant range of packing fractions and liquid content.

[1] A. Fingerle, S. Herminghaus, and V. Zaburdaev, *Phys. Rev. Lett.* **95** (2005) 198001.

[2] A. Fingerle, S. Herminghaus, and V. Zaburdaev, *Phys. Rev. E* **75** (2007) 061301.

DY 29.20 Thu 16:00 Poster C

The concept of correlated density and its application — •Klaus Morawetz[1,2], Pavel Lipavsky[3,4], Jan Kolacek[4], Ernst Helmut Brandt[5], 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, Noethnitzer Str. 38, 01187 Dresden, Germany — [3]Faculty of Mathematics and Physics, Charles University, Ke Karlovu 3, 12116 Prague 2, Czech Republic — [4]Institute of Physics, Academy of Sciences, Cukrovarnická 10, 16253 Prague 6, Czech Republic — [5]Max Planck Institute for Metals Research, 70506 Stuttgart, Germany

The correlated density appears in many physical systems ranging from dense interacting gases up to Fermi liquids which develop a coherent state at low temperatures, the superconductivity. The underlying quantum statistical theory in nonequilibrium is the nonlocal kinetic theory developed earlier. One consequence of the correlated density is the Bernoulli potential in superconductors which compensates forces from dielectric currents which allows to access material parameters.

P. Lipavský, J. Kolacek, K. Morawetz, E. H. Brandt, T. Yang; *Bernoulli potential in superconductors - how electric fields help to understand superconductivity*, Lecture Notes in Physics , Vol. 733, Springer, Berlin, 2007

P. Lipavský, V. Spicka, K. Morawetz; *Kinetic equation for strongly interacting dense Fermi systems*, Ann. Phys. Fr., Vol. 26, N^o 1, 2001, pp. 1-254, EDP Sciences

DY 29.21 Thu 16:00 Poster C

From hyperbolic regularization to exact hydrodynamics via simple kinetic models — •Matteo Colangeli[1], Martin Kröger[1], and Ilya Karlin[2] — [1]Polymer Physics, ETH Zürich, Switzerland — [2]Aerothermochemistry and Combustion Systems Lab, ETH Zürich, Switzerland

The derivation of hydrodynamics from a microscopic description is the classical problem of physical kinetics. The Chapman-Enskog method derives the solution from the Boltzmann Equation as a series in powers of Knudsen number. However, as demonstrated by Bobylev, even in the case of one-dimensional linear deviations from global equilibrium, the Burnett hydrodynamics violates the H-Theorem. We introduce a method to derive stable equations of linear hydrodynamics to any desired accuracy in Knudsen number. We first proceed with derivation from a thirteen Moments Grad System recovering and generalizing [1] the previous Bobylev result, including the proof of an H-theorem [2]. Further, we derive hydrodynamics from linearized Boltzmann Equation [3]. We demonstrate that stability of hydrodynamic equations arises as interplay between two basic features: dissipativity and hyperbolicity.

[1] M. Colangeli, I.V. Karlin, M. Kröger, From hyperbolic regular-

ization to exact hydrodynamics for linearized Grad's equations, Phys. Rev. E 75 (2007) 051204. [2] M. Colangeli, I.V. Karlin, M. Kröger, Hyperbolicity of exact hydrodynamics for three-dimensional linearized Grad's equations, Phys. Rev. E 76 (2007) 022201. [3] M. Colangeli, M. Kröger, I.V. Karlin, "Eigen"-closure of linear Boltzmann equation from Invariant Manifold Theory (to be submitted).

DY 29.22 Thu 16:00 Poster C

Features of Preferential Trapping on Energy Landscapes — •Andreas Fischer[1], Karl Heinz Hoffmann[1], and Christian Schön[2] — [1]TU Chemnitz, D-09107 Chemnitz, Germany — [2]Max-Planck-Institut für Festkörperforschung, D-70569 Stuttgart, Germany

Understanding complex systems is a very important task as they occur in various situations. The wealth of different temporal phenomena which have been observed in such systems needs to be understood in detailed analysis of the connectivity and the respective time scales of the transitions in the state space.

The hierarchical tree model has proven to be highly suitable for the description of a complex system's state space. as its capabilities were tested in various scenarios. The dynamics in such a hierarchical system is governed by the flow of probability and the points where the tree structure branches out. This flow of probability is determined by different factors which need to be discussed in detail.

The research presented here deals with a split of a probability flow when it runs towards the more branched out parts of a tree structure. It is this special probability splitting which determines in the sequence of successive branches what the overall time behavior of a system will be. While such an analysis has already been made for systems with very special exponential densities of state we here expand our analysis to the more general case of polynomial densities of states and investigate what the differences in the behavior of the branching probability flows are. We observe new and unexpected behavior towards different phenomena which have not yet been reported before.

DY 29.23 Thu 16:00 Poster C

Long-term correlations in human brain oscillations during sleep — •Fabian Gans[1], Aicko Schumann[1], Thomas Penzel[2], and Jan Kantelhardt[1] — [1]Institut für Physik, MLU Halle, Germany — [2]Charité Center for Cardiology, Berlin, Germany

The human brain spontaneously generates complex oscillations in different frequency bands, which can be recorded by electroencephalography (EEG). Studying time series of the spontaneous amplitude of the oscillations in several frequency bands, we observe long-term correlated fluctuations as well as nearly uncorrelated fluctuations. The correlation behaviour is compared with similar long-term correlations observed in autonomously regulated functions, i.e., heartbeat, blood pressure and respiration during different sleep stages representing different physiological modes.

DY 29.24 Thu 16:00 Poster C

Excitation of coherent oscillations in noisy medium — •Jan Köhler, Jörg Mayer Mayer, and Heinz Georg Schuster — Institut für Theoretische Physik und Astrophysik, Christian-Albrechts Universität, Olshausenstraße 40, 24098 Kiel, Germany

We study the influence of neuronal threshold modulation on the properties of cortical traveling waves. For that reason we simplify a Wilson-Cowan-type integro-differential equation model of propagating neocortical activity to a spatially discrete version. Further we introduce a noisy threshold. Depending on the noise level we find different states of the network activity, ranging from asynchronous oscillations, traveling waves, to synchronous oscillations. Finally we induce the transition between these different states by an external modulation.

DY 29.25 Thu 16:00 Poster C

The thalamocortical system: An example for control of synchrony in a biological system — Jörg Mayer[1], Heinz Georg Schuster[1], Jens Christian Claussen[1], •Hong-Viet Ngo[1], and Matthias Mölle[2] — [1]Institut für Theoretische Physik und Astrophysik, Christian-Albrecht-Universität Kiel — [2]Department of Neuroendocrinology, University of Lübeck

Thalamic circuits are able to induce state dependent oscillations with different frequencies and degrees of synchronization. Based on experimental results the simultaneous occurence of spindle oscillations over widespread territories of the thalamus are a consequence of corticothalamic projections, hence synchrony in a decorticated thalamus declines. Here we study the influence of corticothalamic projections on the degree of synchrony in a thalamic network. We uncover the underlying control mechanism, which yields a control method for a wide range of stochastically driven excitable units.

DY 29.26 Thu 16:00 Poster C

Conformational mechanics of polymer adsorption transitions at attractive substrates — •Monika Möddel, Michael Bachmann, and Wolfhard Janke — Institut für Theoretische Physik, Universität Leipzig

Conformational phases of a semiflexible off-lattice homopolymer model near an attractive substrate are investigated by means of multicanonical simulations. In our model, nonbonded pairs of monomers as well as monomers and the substrate interact via attractive van der Waals forces in addition to the chain's bending energy. We analyse thermal fluctuations of energetic and structural quantities and adequate docking parameters as a function of the temperature. Introducing a solvent parameter, that is related to the strength of the surface attraction, we discuss aspects of the solubility-temperature phase diagram. Apart from the main phases of adsorbed and desorbed conformations there is also a variety of other phase transitions such as the energetic transitions from filmlike surface-layer conformations to compact surface-attached globular structures.

DY 29.27 Thu 16:00 Poster C

Effects of quenched randomness on predator-prey interactions in a stochastic Lotka-Volterra lattice model — •Ulrich Dobramysl[1] and Uwe C. Täuber[2] — [1]Christian Doppler Labor für Oberflächenoptische Methoden, Johannes Kepler Universität Linz, Austria — [2]Virginia Polytechnic Institute and State University, Blacksburg, VA, USA

We study the influence of spatially varying reaction rates (i.e., quenched randomness) on a stochastic two-species Lotka-Volterra lattice model for predator-prey interactions using Monte Carlo simulations. The effects on the asymptotic population densities, transient oscillations, spatial distributions, and on traveling wave and invasion front speed velocities are investigated. We find that spatial variability in the predation rate yields an increase in the asymptotic population densities of *both* predators and prey.

DY 29.28 Thu 16:00 Poster C

Spectra of Husimi cacti: Exact Results and Applications — •mircea galiceanu and alexander blumen — Theoretische Polymerphysik, Universität Freiburg, Hermann-Herder-Stra*β*e 3, D-79104 Freiburg, Germany

We determine analytically the complete spectra of the Husimi cacti, which are dual structures to the dendrimers, but, distinct from these, contain loops. Our solution makes use of a judicious analysis of the normal modes [1]. Although close to those of dendrimers, the spectra of Husimi cacti differ. From the wealth of applications for measurable quantities which depend only on the spectra, we display for Husimi cacti the behavior of the fluorescence depolarisation under quasi-resonant Förster energy transfer and the loss and storage moduli.

[1] Galiceanu M. and Blumen A., *J. Chem. Phys.*, **127, 134904 (2007)**

DY 29.29 Thu 16:00 Poster C

Perturbation propagation in random and non-random Boolean Networks — •Christoph Fretter[1,2], Agnes Szejka[1], and Barbara Drossel[1] — [1]Institut für Festkörperphysik, Technische Universität Darmstadt, Deutschland — [2]Institut für Informatik, Martin-Luther-Universität Halle-Wittenberg, Deutschland

According to Derrida's definition of criticality, networks in which the perturbation of a single node propagates on an average to more (less) than one other node are chaotic (frozen). At the boundary between these two phases are critical networks. For Random Boolean Networks, the phase diagram can be derived analytically by considering the connectivity of the networks and the chosen update functions, and by using the annealed approximation. This consideration can be generalised to the Derrida plot, in which perturbations of all sizes are considered, and their value one time step later is evaluated.

By introducing a modification of this Derrida plot, we show that even Random Boolean Networks with a small size agree well with the results obtained by the annealed approximation, but non-random networks show a very different behaviour. We focus on networks that were evolved for high dynamical robustness. The most important conclusion is that the simple distinction between frozen, critical and chaotic networks is no longer useful, since such evolved networks can display properties of both frozen and chaotic networks.

DY 29.30 Thu 16:00 Poster C

Damage Spreading and Criticality in Finite Random Dynamical Networks — •Thimo Rohlf[1,2], Natali Gulbahce[3], and Christof Teuscher[4] — [1]Santa Fe Institute, 1399 Hyde Park Road, Santa Fe, NM 87501, USA — [2]Max-Planck Institute for Mathematics in the Sciences, Inselstrasse 22, D-04103 Leipzig — [3]Los Alamos National Laboratory, T-Division and CNLS, MS B284, Los Alamos, NM 87545, USA — [4]Los Alamos National Laboratory, CCS-3, MS B287, Los Alamos, NM 87545, USA

We systematically study and compare damage spreading at the sparse percolation (SP) limit for random boolean and threshold networks with perturbations that are independent of the network size N. This limit is relevant to information and damage propagation in many technological and natural networks. Using finite size scaling, we identify a new characteristic connectivity K_s, at which the average number of damaged nodes $\bar{d}$, after a large number of dynamical updates, is independent of N. Based on marginal damage spreading, we determine the critical connectivity $K_c^{sparse}(N)$ for finite N at the SP limit and show that it systematically deviates from K_c, established by the annealed approximation, even for large system sizes. Our findings can potentially explain the results recently obtained for gene regulatory networks and have important implications for the evolution of dynamical networks that solve specific computational or functional tasks.

DY 29.31 Thu 16:00 Poster C

Self-organization of heterogeneous topology and symmetry breaking in networks with adapative thresholds and rewiring — •Thimo Rohlf — Santa Fe Institute, 1399 Hyde Park Road, Santa Fe, NM 87501, USA

We study an evolutionary algorithm that locally adapts thresholds and wiring in Random Threshold Networks, based on measurements of a dynamical order parameter. A control parameter p determines the probability of threshold adaptations vs. link rewirings. For any $p < 1$, we find spontaneous symmetry breaking into a new class of self-organized networks, characterized by a much higher average connectivity $\bar{K}_{evo}$ than networks without threshold adaptation ($p = 1$). While $\bar{K}_{evo}$ and evolved out-degree distributions are independent from p for $p < 1$, in-degree distributions become broader when $p \to 1$, approaching a power-law. In this limit, time scale separation between threshold adaptions and rewiring also leads to strong correlations between thresholds and in-degree. Finally, evidence is presented that networks converge to self-organized criticality for large N.

DY 29.32 Thu 16:00 Poster C

Localization transitions in complex networks — •Lukas Jahnke[1], Jan Kantelhardt[1], Richard Berkovitz[2], and Shlomo Havlin[2] — [1]Theoretische Physik, Martin-Luther-Universität, Halle / Saale, Germany — [2]The Minerva Center, Department of Physics, Bar-Ilan University, Ramat Gan, Israel

Transitions between localized and extended states have been studied in various disordered systems. The most well-known case is Anderson localization, where a disordered potential landscape on a regular lattice drives a metal-insulator transition of electrons described by the tight-binding equation. Similar transitions occur for vibrational modes and on non-regular structures, e.g., on percolation clusters. Using numerical techniques based on random matrix theory, we study such localization phenomena also with magnetic field and on more complex networks, i.e., on random graphs and scale free networks. We find that a localization-delocalization transition can be driven by several other parameters than standard on-site disorder strength. The results are compared with quantum percolation on standard lattices.

DY 29.33 Thu 16:00 Poster C

Desiccation cracks on different substrates: simulation by a spring network model — Supti Sadhukhan[2], Dibyendu Mal[2], Sujata Tarafdar[2], Tapati Dutta[3], Karl Heinz Hoffmann[1], and •Janett Prehl[1] — [1]Institut für Physik, Technische Universität Chemnitz, D-09107 Chemnitz — [2]Condensed Matter Physics Research Center, Jadaypur University, Kolkata 700 032, India — [3]Physics Department, St Xavier's College, Kolkata 700016, India

Crack patterns formed due to desiccation of clay or similar materials show distinctive reprocucible patterns [1]. Plotting the cumulative area $A_{\rm cum}$ covered by the cracks versus their width $\geq W_{\rm min}$ a typical reproducible shape can be seen. In a log-log plot, this curve has two roughly linear regions with different slopes. For a ploypropylene substrate, there is a sharp change from a nearly horizontal line to a very steep line [2], whereas for a glass substrate, which is smoother, there is a gradual changeover between the two regions [3]. We propose a simple 1d and 2d spring chain model, in which reducing the natural length of the springs corresponds to the desiccation process. Springs may break, or slip over the substrate to accommodate strain beyond a specified threshold. The model successfully reproduces the successive stages of crack formation and behaviour of the cumulative area curve, as observed in experiments.

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[2] D. Mal, et al., *Fractals*, **14**, 283 (2006)

[3] D. Mal, et al., *J. Phys. Soc. Japan*, **76**, 014801 (2007)

DY 29.34 Thu 16:00 Poster C

Evolution of Boolean networks under selection for a certain attractor — •Christoph Jan Hamer and Barbara Drossel — Institut für Festkörperphysik, TU Darmstadt, Hochschulstraße 6, 64289 Darmstadt

Gene regulation networks are shaped by their evolutionary history. In several cases, it has been shown that a Boolean model captures correctly the essential dynamics of a gene regulation network. The best known and most investigated example is the network regulating the cell cycle of budding yeast, which has been successfully modeled as a Boolean threshold network. This model network has a fixed point that can be reached from most starting points in state space, and the approach to this fixed point during the cell cycle follows a trajectory that is stable against perturbations. We address in this poster the question whether this trajectory can be obtained in other networks with the same number of nodes. We search for such networks by an evolutionary process. We first create random networks and successively select for mutant networks the dynamics of which reproduces correctly more and more steps of the desired trajectory.

DY 29.35 Thu 16:00 Poster C

Detection of Modules in Boolean Networks — •Matthias Rybarsch und Stefan Bornholdt — Institut für Theoretische Physik

We investigate methods for detecting modules in Boolean networks. In particular, we study a damage spreading perspective on modular organization in Boolean networks and relate this to criticality in these systems. We find that the modular organization of a network is sensitively dependent on the dynamical regime of the network. We characterize quantities as the number of resulting modules, as well as the distribution of module sizes in the different regimes of the network. Finally we discuss possible implications for biological systems where these networks are used as models.

DY 29.36 Thu 16:00 Poster C

Gauge Dependence of the Critical Dynamics at the Superconducting Phase Transition — Maxim Dudka[1], •Reinhard Folk[2], and Günter Moser[3] — [1]Institute for Condensed Matter Physics, National Academy of Sciences of Ukraine, UA–79011 Lviv, Ukraine — [2]Institut für Theoretische Physik, Johannes Kepler Universität Linz, A–4040 Linz, Austria — [3]Fachbereich Materialforschung und Physik, Universität Salzburg, A–5020 Salzburg, Austria

The critical dynamics of superconductors in the charged regime is reconsidered within field-theory. For the dynamics the Ginzburg-Landau model with complex order parameter coupled to the gauge field suggested earlier [Lannert et al. Phys. Rev. Lett. **92**, 097004 (2004)] is used. Assuming relaxational dynamics for both quantities the RG functions within one loop approximation are recalculated for different choices of the gauge. A gauge independent result for the divergence of the measurable electric conductivity is obtained only at the weak scaling fixed point - unstable in one loop order - where the time scales of the order parameter and the gauge field are different.

Supported by the Austrian Fonds zur Förderung der wissenschaftlichen Forschung, project No P19583.

DY 29.37 Thu 16:00 Poster C

Liquid interfaces in Ising fluids — •Wolfgang Fenz[1], Igor Omelyan[1,2], Reinhard Folk[1], and Igor Mryglod[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 thermodynamic properties and microscopic structure of liquid-liquid and liquid-vapor interfaces in Ising spin fluids by an integral equation approach. The coupled set of the Lovett-Mou-Buff-Wertheim equations for the inhomogeneous one-particle distribution functions and the Ornstein-Zernike equations for the bulk two-particle correlation functions complimented by the closure relation are solved using a modified soft mean spherical approximation. The two-particle inhomogeneous direct correlation functions are consistently constructed by nonlinear interpolation of the bulk ones corresponding to the coexisting phases. The density and magnetization profiles at the liquid-liquid and liquid-vapor interfaces are calculated in a wide range of temperatures including subcritical regions. The liquid-liquid adsorption coefficient and the liquid-vapor surface tension are evaluated as well. The influence of the external magnetic field on the structure of the liquid-vapor interfaces is also analyzed.

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

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DY 29.38 Thu 16:00 Poster C

Melting transitions in 2D model colloids in presence of a 1D periodic potential — •Florian Bürzle and Peter Nielaba — Physics Department, University of Konstanz, 78464 Konstanz, Germany

In our work, we investigate phase transitions in 2D model colloids in presence of a 1D external periodic potential using Monte Carlo simulation techniques in the NVT ensemble. Thereby we extend former computational studies [1]. In particular, we explore a hard disk system with commensurability ratio $p = \sqrt{3}a/(2d) = 2$, where d is the period of the external potential and a is the mean distance between the disks. In this case, theoretical considerations [2] suggest a novel "locked smectic" phase between the well known locked floating solid and the modulated liquid. In our simulations this new phase, which has already been observed in an experimental study [3], was verified. Furthermore, by definition of appropriate order parameters, we were able to obtain a phase diagram [4] based on the cumulant intersection method.

[1] W. Strepp, S. Sengupta, P. Nielaba, Phys. Rev. E 63, 046106 (2001)
[2] L. Radzihovsky, et al., Phys. Rev. E 63, 031503 (2001)
[3] J. Baumgartl, et al., Phys. Rev. Lett. 93, 168301 (2004)
[4] F. Bürzle and P. Nielaba, Phys. Rev. E 76, 051112 (2007)

DY 29.39 Thu 16:00 Poster C

Scaling behavior of domain walls at the T=0 ferromagnet to spin-glass transition — •Oliver Melchert and Alexander K. Hartmann — Institut für Physik, Universität Oldenburg, 26111 Oldenburg

We study domain walls in two-dimensional Ising spin systems in terms of a minimum-weight path problem. The disorder has a fraction ρ of ferromagnetic bonds and $(1-\rho)$ of gaussian bonds with zero mean and unit width. We first study the magnetization to locate the critical point ρ_c, where the ferromagnet to spin-glass transition occurs. Further, for distinguished values of ρ close to the critical point, we investigate the stiffness exponent θ, which describes the scaling of the domain-wall energy with the system size $L\times L$ according to $\Delta E \sim L^\theta$ and we obtain the fractal dimension d_f, describing the scaling of the average domain-wall length, i.e. $\langle \ell \rangle \sim L^{d_f}$. We perform a finite-size scaling analysis for systems up to $L=512$. We find that both exponents remain constant in the spin-glass phase, i.e. $\theta = -0.28(1)$ and $d_f = 1.274(1)$. This is consistent with conformal field theory, where it seems possible to relate the expontents via $d_f - 1 = 3/[4(3+\theta)]$. Moreover we find that the scaling of the average domain-wall length near the critical point can be described by $\langle \ell \rangle \sim L^{d_f^c} f[(\rho-\rho_c)L^{1/\nu}]$, with the critical fractal dimension $d_f^c = 1.221(1)$, the critical exponent of the correlation length $\nu = 1.49(7)$ and a scaling function $f[\ldots]$.

DY 29.40 Thu 16:00 Poster C

Melting of trapped few particle systems — •Jens Böning[1], Alexei Filinov[1], Patrick Ludwig[1], Henning Baumgartner[1], Michael Bonitz[1], and Yurii Lozovik[2] — [1]Institut für Theoretische Physik und Astrophysik, Christian-Albrechts-Universität zu Kiel, D-24098 Kiel, Germany — [2]Institute for Optics and Spectroscopy of the RAS, Troitsk, Russia

Solid or liquid behavior are collective properties of macroscopic systems. Nevertheless, collective behavior emerges already in small systems. But, how many particles are required and how to reliably detect liquid or solid behavior and the melting point in a small system? While in large systems there exist many equivalent quantities, in small systems the predicted melting point strongly depends on the choice of quantity and on the way it is computed yielding ambiguous and even divergent results [1]. We present a very simple quantity which allows to overcome these problems – the variance of the block averaged interparticle distance fluctuations [2].

[1] D.D. Frantz, J. Chem. Phys. **115**, 6136 (2001)
[2] J. Böning, A. Filinov, P. Ludwig, H. Baumgartner, M. Bonitz, and Yu.E. Lozovik, arXiv:0711.1124.

DY 29.41 Thu 16:00 Poster C

Interfaces in Three-Dimensional Ising-like Systems — •Michael Köpf and Gernot Münster — Institut für Theoretische Physik, Universität Münster, Wilhelm-Klemm-Str. 9, 48149 Münster

We consider interfaces in systems belonging to the universality class of the three-dimensional Ising model. They can be described in the framework of the broken-symmetry phase of three-dimensional ϕ^4-theory. A proper choice of boundary conditions enforces the existence of an interface, which in mean-field theory resembles the well-known Cahn-Hilliard profile. To include thermal fluctuations to first order in the semiclassical approximation, an equation of motion for the interfacial profile is derived via the effective action formalism. The renormalized solution to this equation yields an interface which is shown to exhibit the behaviour predicted by capillary wave theory, i.e. the interfacial thickness diverges logarithmically with increasing system size. Ensuing a detailed investigation of interfacial features we estimate the region of validity of the approximation.

DY 29.42 Thu 16:00 Poster C

Colloids in External Fields and in Micro-Channels — Kerstin Franzrahe, Peter Henseler, and •Peter Nielaba — Physics Department, University of Konstanz, 78457 Konstanz

By Monte Carlo simulations we investigate the effect of an external periodic field on the structural properties and the phase diagram of a two-dimensional binary model colloid [1]. Interesting melting scenarios for the subsystems are analyzed. The layering formation in colloidal systems in micro-channels in external gravitational fields is explored by Brownian Dynamics simulations [2]. Interesting layer-reduction effects are found in the flow direction.

References:
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[2] M. Köppl, P. Henseler, A. Erbe, P. Nielaba, P. Leiderer, Phys. Rev. Lett. **97**, 208302 (2006).

DY 29.43 Thu 16:00 Poster C

Anisotropic three-dimensional Heisenberg antiferromagnets in a field — •Georg Bannasch and Walter Selke — Institut für Theoretische Physik, RWTH Aachen

Three-dimensional anisotropic Heisenberg antiferromagnets, the xxz-model as well as variants, in a field are investigated. Based on ground state considerations and Monte Carlo techniques, the role of biconical fluctuations and structures is studied. Results are compared to findings on two-dimensional anisotropic Heisenberg antiferromagnets [1,2,3,4].

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DY 29.44 Thu 16:00 Poster C

Quantum Monte Carlo study of the 2D quantum compass model — •Sandro Wenzel and Wolfhard Janke — Institut für Theoretische Physik, Universität Leipzig, Postfach 100 920, 04109 Leipzig

The so-called two-dimensional compass models have recently attracted interest in both the classical and quantum case due to its relevance for describing orbital interactions, arrays of superconducting Josephson junctions and as a model for protecting qubits in quantum computation [1]. Recently it was shown [2] that the classical version has a directional-ordering transition in the Ising universality class and it was proposed that this also holds for the quantum version [3–4]. Here we contribute to this question with a dedicated Quantum Monte Carlo study of the directional-ordering transition in the quantum compass model at finite temperatures. We obtain the critical temperature and the critical exponents and compare with reference [5].

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[5] T. Tanaka and S. Ishihara, Phys. Rev. Lett. **98**, 256402 (2007).

DY 29.45 Thu 16:00 Poster C

Segregation Dynamics and Local Order Parameters at Binary Alloy Surfaces — •Sebastian Kapfer[1], Harald Reichert[2], and Klaus Mecke[1] — [1]Institut für Theoretische Physik I, Erlangen, Germany — [2]Max-Planck-Institut für Metallforschung, Stuttgart, Germany

Ordering phenomena in alloys are known to be heavily modified by the presence of surfaces. Recent X-ray scattering experiments reveal surprising effects in the ordering dynamics of Cu_3Au [Europhys. Lett. **53**, 570 (2001)]. A T-CVM (tetrahedron cluster variation method) free energy expression is used which reproduces correctly the topology of the experimental phase diagram. The CVM is extended for systems with a surface to study in a kinetic model the effect of surface segregation on the dynamics of the ordering process following a rapid quench.

In a complementary effort, we study time-resolved transmission electron microscopy of Cu_3Au surfaces with atomic resolution. The monitored fluctuations of the local order parameter can be analyzed by morphological measures and compared with a Gaussian field theory in real space.

DY 29.46 Thu 16:00 Poster C

Comparison of phase-field models for surface diffusion — •Clemens Müller-Gugenberger[1], Robert Spatschek[1,2], and Klaus Kassner[3] — [1]Institut für Festkörperforschung, Forschungszentrum Jülich, 52425 Jülich — [2]Center for Interdisziplinary Research on Complex Systems, Northeastern University, Boston, MA 02115, USA — [3]Otto-von-Guericke-Universität Magdeburg, Postfach 4120, 39016 Magdeburg

Many pattern-forming systems require the understanding of the dynamics of the moving boundary between different phases. While phase-field approaches have proven to be versatile tools for tackling such problems, they mostly dealt with nonconservative interface dynamics. But in many cases, like for elastically induced morphological instabilities, the description of surface-diffusion controlled dynamics, which leads to conserved dynamics, is desirable.

We show that a seemingly straightforward approach from the literature to model surface diffusion via the phase-field method fails to produce the correct asymptotics. Two models that approximate known sharp interface equations without adding undesired constraints are constructed. The numerical implications that come with the use of a given model are compared.

DY 29.47 Thu 16:00 Poster C

Velocity Selection Problem in the Presence of the Triple Junction — efim brener, •claas hueter, denis pilipenko, and dmitri temkin — Institut für Festkörperforschung, Forschungszentrum Jülich, D-52425 Jülich

The melting processes along a grain boundary and the growth of an eutectoid dendrite are considered. In our previous work we have shown that under some assumptions it is possible to solve the corresponding integro-differential equation analytically. Here we consider also the growth of a eutectoid dendrite. In both cases the presence of a triple junction serves as selection mechanism. This theory is applicable to the practical important system: Dendritic growth of ferrite on an austenite grain boundary.

DY 29.48 Thu 16:00 Poster C

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

We investigate several growth stages of binary alloys, formed by co-deposition of A and B atoms on a flat substrate. We show that several so far unknown features emerge under co-deposition of two kinds of atoms: (i) Novel scaling relations for the density of stable islands in terms of the incoming fluxes, adatom diffusion coefficients and binding energies [1]. (ii) Perpendicular magnetic anisotropy (PMA) in a certain temperature window as a result of a competition of shape and segregation effects [2]. (iii) Increase of structural anisotropy and PMA upon application of a strong magnetic field during growth. This latter feature is suggested by calculations based on Landau theory and can be confirmed by kinetic Monte Carlo simulations [3].

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DY 29.49 Thu 16:00 Poster C

Controlling surface morphologies by time-delayed feedback — •Michael Block[1], Michael Wünscher[1,2], Eckehard Schöll[1], and Beate Schmittmann[3] — [1]Institut f. Theo. Physik, Sekr. EW 7-1, Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin, Germany — [2]Institut für Kristallzüchtung, Max-Born Str. 2, 12489 Berlin — [3]Department of Physics, Virginia Tech, Blacksburg, VA 24061, USA

We investigate methods to control the roughness of a growing surface, via a time-delayed feedback scheme. The method can be applied to a wide range of non-equilibrium growth phenomena, from solid-state epitaxy to tumor growth. As an illustration, we consider (i) stochastic growth equations and (ii) a Kinetic Monte Carlo (KMC) model, and show that the effective growth exponent of the surface width can be stabilized at different values. By comparison of the two models we establish a correspondence between parameters of the stochastic differential equations and the tuning of the temperature in the KMC simulation. Possible experimental realizations are suggested and the relation to experiments without feedback is shown in detail.

References:
[1] M. Block, B. Schmittmann, and E. Schöll, Phys. Rev. B 75, 233414 (2007).

DY 29.50 Thu 16:00 Poster C

Dynamic behaviour of granular matter in a circular vibrated conveyor — •Michael Heckel, Christof A. Kruelle, and Ingo Rehberg — Universität Bayreuth, 95447 Bayreuth, Germany

Understanding the behaviour of vibrated granular matter is important because many industrial processes rely on mixed multicomponent substances. The system has to be driven with energy to stay in motion due to dissipative particle interactions. In studies this is mostly achieved by horizontal or vertical stimulation.

A horizontal and vertical oscillation with the same amplitude was superposed at a phase shift of $\pi/2$. In this way a circular oscillation for each point of the annular container is achieved. As granulate a binary mixture of black glass beads with a diameter of 1 mm and white glass beads with a diameter of 4 mm are used.

Above a threshold frequency of the excitation the bigger particles move to the top of the granulate which is known as the Brazilnut 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. By increasing the shaker frequency even further, a final state can be achieved where both particle species are completely separated in two distinct domains.

DY 29.51 Thu 16:00 Poster C

Granular Dynamics Of Nonspherical Particles — •Wilhelm August, Ingo Rehberg, and Christof Krülle — Experimentalphysik V, Universität Bayreuth, 95440 Bayreuht

In our experiment we shake a monolayer of rice with an industrial conveyor which has been slightly altered. The vibration form possesses besides the vertical a horizontal azimuthal component which leads to a collective transport of the monolayer. We are able to focus on some tracers. Their velocity and orientation has been monitored for a long time interval. This method is an important tool for observing interesting dynamic phenomena [1]. We also measured the decay of the rotational diffusion constant over some decades [2]. Moreover, this setup allows to observe some other phenomena typical for granular matter, like e.g. segregation or heaping.

[1] Igor S. Aranson, Dmitri Volfson, and Lev Tsimring, Phys. Rev. E 75, 051301 (2007)

[2] P. Dhar, Th. M. Fischer, Y. Wang, T. E. Mallouk, W. F. Paxton, and A. Sen, Nano Letters 6, 66-72 (2006)

DY 29.52 Thu 16:00 Poster C

Mini-Ripples in fine granular matter — •Simon Fischer, Ingo Rehberg, and Christof Krülle — Experimentalphysik V, Universität Bayreuth, D-95440 Bayreuth

In 1940 R.A. Bagnold, one of the pioneers in the field of wind blown grains, discovered a small scale ripple structure in very fine sand in wind tunnel experiments. He described these ripples to have an - in comparison to known structures in coarse sand - extremely small wavelength, of about one centimetre near the threshold for grain motion. Moreover, he noticed an "interesting change in the ripple formation" towards "new ripples on a much larger scale" when the wind reached a certain critical strength [1]. Although many theories, simulations and experiments have been performed on wind driven ripple formation in coarse granular matter [2], science has not taken a closer look to structures in fine granular matter. In our setup we are able to investigate the formation, growth and long time behaviour of these mini-ripples to gain a better understanding of this phenomenon and its relation to other ripple structures observed in nature.

[1] R.A. Bagnold, The physics of blown sand and desert dunes (Chapman & Hall, London 1941)

[2] B. Andreotti, P. Claudin, O. Poliquen, Phys.Rev.Lett.. 96,028001 (2006)

DY 29.53 Thu 16:00 Poster C

Sequential random packings of spheres and ellipsoids — •Pedro Lind[1], Reza Baram[2], and Hans Herrmann[2] — [1]Institute for Computational Physics, Universität Stuttgart, Pfaffenwaldring 27, D-70569 Stuttgart, Germany — [2]Computational Physics, IfB, HIF E12, ETH Hönggerberg, CH-8093 Zürich, Switzerland

This study has two parts. First, we generalize the recent study of random space-filling bearings to a more realistic situation, where the spacing offset varies randomly during the space-filling procedure, and show that it reproduces well the size-distributions observed in recent studies of real fault gouges. In particular, we show that the fractal dimensions of random polydisperse bearings sweep predominantly the low range of values in the spectrum of fractal dimensions observed along real faults, which strengthen the evidence that polydisperse bearings may explain the occurrence of seismic gaps in nature. Second, we present some new remarks on sequential algorithms for packing ellipsoids.

DY 29.54 Thu 16:00 Poster C

Granular Robots — •Z. S. Khan[1], A. Steinberger[1], M. Scheel[1], R. Seemann[1,2], and S. Herminghaus[1] — [1]MPI for Dynamics and Self-Organization, Bunsenstr. 10, D-37073 Goettingen — [2]Experimental Physics, Saarland University, D-66041 Saarbruecken

We have recently observed that when a bidisperse mixture of glass beads is moistened by a fluid and shaken sinusoidally in a vertical container, small agglomerates of beads held together against the wall by liquid capillary bridges take off from the surface of the pile and rapidly climb up the container walls against gravity. These self-organized agglomerates have one large grain at the head of the structure with one or more small grains trailing behind. When similar agglomerates are placed on a horizontally vibrating substrate they travel horizontally along the axis of vibration. We report our investigations of this novel system, including the agglomerate speed as a function of the applied acceleration, viscosity of the wetting fluid and agglomerate structure.

DY 29.55 Thu 16:00 Poster C

Flight paths of vertically fluidized wet granulates — •Z. S. Khan[1], M. Scheel[1], M. Di Michiel[2], R. Seemann[1,3], and S. Herminghaus[1] — [1]MPI for Dynamics and Self-Organization, Bunsenstr. 10, D-37073 Goettingen — [2]European Synchrotron Radiation Facility, BP 220 F-38043 Grenoble Cedex — [3]Experimental Physics, Saarland University, D-66041 Saarbruecken

When dry granulates are shaken vertically and the peak acceleration exceeds the force of gravity, the grains move irregularly like the molecular motion of a fluid while they remain densely packed. It has been shown that when a fluid is added to the granulate, the critical acceleration at which fluidization occurs increased strongly when compared to the dry case [1], however it is not yet known which flow patterns evolve in this three dimensional system. Using fast synchrotron X-ray tomography techniques we track the motion of tracer particles embedded in the bulk of the granulate flow. We report on the effects of varying the frequency and amplitude of vibration as well as the liquid content on the granulate motion.

1. M. Scheel et al., J. Phys.: Cond Mat. 16, S4213 (2004).

DY 29.56 Thu 16:00 Poster C

Mimetic intruders in a two dimensional system of vertically excited granulate — •Jonathan Kollmer, Christof A. Kruelle, and Ingo Rehberg — Universität Bayreuth, 95440 Bayreuth, Germany

An initially close packed granular bed of hard spheres is confined by two glass plates with a separation only slightly larger than the particle diameter. In this experiment one or more intruders are inserted and the container is exposed to sinusoidal oscillations. When a critical value of the forcing strength is reached, the granular bed begins to fluidize[1] and segregation as well as intruder-intruder interaction can be observed. While common experiments[2] to study these effects use large disks as intruders this approach utilizes intruders composed of the same beads as the granulate.

[1] Andreas Götzendorfer, Chi-Hwang Tai, Christof A. Kruelle, Ingo Rehberg and Shu-San Hsiau, Phys. Rev. E **74**, 011304 (2006)

[2] D.A. Sanders, M.R. Swift, R.M. Bowley and P.J. King - Europhys. Lett., **73**(3), pp. 349-355 (2006)

DY 29.57 Thu 16:00 Poster C

Fluidization of granulates wetting by liquid Helium — •Kai Huang, Masoud Sohaili, and Stephan Herminghaus — Max Planck Institute for Dynamics and Self-Organization, Goettingen

To fluidize wet granulates by vertical vibration, extra force is necessary to overcome the capillary force. We explore experimentally the fluidization of a granulate wetted by liquid Helium, because of its special liquid properties. By varying temperature around the λ point, we study how liquid Helium changes the dynamic properties of granulates. For superfluid wetting, the critical acceleration for fluidization increases almost linearly with film thickness. This indicates that superfluid starts to flow and forms liquid bridges. For wetting by normal fluid Helium, the critical acceleration shows a relatively steep increase close to saturation. Above saturation, both superfluid and normal fluid give rise to a plateau of the critical acceleration, because the capillary force depends only weakly on the volume of the bridge. The plateau value is found to vary with temperature and shows a peak around the λ point, which indicates the influence of the specific heat of liquid Helium.

DY 29.58 Thu 16:00 Poster C

Dynamics of gas bubble in vibrofluidized wet granulates — •Kai Huang, Axel Hager-Fingerle, Klaus Roeller, and Stephan Herminghaus — Max Planck Institute for Dynamics and Self-Organization, D-37073, Goettingen

Recent studies on phase transitions of wet granulates show that the liquid-gas transition of wet granulates is dominated by the injected energy, because the hysteretic interaction of capillary bridges formed between particles introduces a characteristic energy scale. Between the liquid and the gas phase, there exists a co-existence regime where we always observe at least one stable gas bubble wandering around in the granular fluid. The gas bubble tends to reduce its surface and keep a circular shape, suggesting the existence of surface tension. Here we present an experimental study on the dynamic behavior of granular gas bubbles, including the nucleation, merging and vanishing processes. We use different methods to measure the velocity profile across the gas bubble. Inside the gas bubble, the velocity distribution is obtained by statistics on the track lengths of particles. In the fluid phase, the mean velocity is obtained by tracing Ruby particles illuminated with a green light source.

DY 29.59 Thu 16:00 Poster C

Synthetic microcomputertomography of a laboratory scale sandstone core with authigenic clay — •Bibudhananda Biswal[1] and Rudolf Hilfer[1,2] — [1]ICP, Universität Stuttgart, Pfaffenwaldring 27, 70569 Stuttgart, Germany — [2]Institut für Physik, Universität Mainz, 55099 Mainz, Germany

A continuum geometrical modeling technique for reconstructing three dimensional pore scale microstructure of multiscale porous media [1] is extended to generate the first laboratory scale computer model of a sandstone with chlorite cementation, quartz overgrowth and kaolinite pore fillings. The core plug, 2.5 cm in diameter and 2.5 cm long, contains roughly 10^{11} crystallites with sizes varying from roughly 1 mm down to 100 nm. The continuum representation of the pore scale geometry allows discretization at arbitrary resolutions and makes available, for the first time, truly multiscale synthetic μ-CT images for flow simulation. The method can be used to reconstruct pore scale microstructure of a large variety of clay textured sandstone morphologies.

[1] B. Biswal et al., Phys. Rev. E, **75**, 61303 (2007)

DY 29.60 Thu 16:00 Poster C

Transport of ferrofluid due to traveling-stripe forcing — •Thomas Friedrich, Christian Gollwitzer, Reinhard Richter, and Ingo Rehberg — Experimentalphysik V, Universität Bayreuth, D-95440 Bayreuth

Transport of ferrofluid can be achieved by rotating [1] or by traveling magnetic fields [2,3]. We apply a traveling-stripe forcing of the magnetic induction [4] to a shallow layer of magnetic liquid. The volume transport in the subcritical and overcritical regime of the Rosensweig instability [5,6] is studied by means of radioscopy.

- [1] R. Krauss, M. Liu, B. Reimann, R. Richter, I. Rehberg, Appl. Phys. Lett. **86** 024102-1 (2005)
- [2] H. Kikura, T. Sawada, T. Tanahashi, L.S. Seo, J. Magn. Magn. Mater. **85** 167 (1990)
- [3] K. Zimmermann, I. Zeidis, V.A. Naletova, V.A. Turkov, J. Magn. Magn. Mater. **268** 227 (2004)
- [4] A. Beetz, C. Gollwitzer, R. Richter, I. Rehberg, submitted (2007)
- [5] M. D. Cowley and R. E. Rosensweig, J. Fluid Mech. **30** 671 (1967)
- [6] C. Gollwitzer, G. Matthies, R. Richter, I. Rehberg, L. Tobiska, J. Fluid Mech. **571** 455 (2007)

DY 29.61 Thu 16:00 Poster C

Hexagon–Square Transition of the Rosensweig Instability in the presence of a magnetic ramp — •Leonhard Wiesen, Christian Gollwitzer, Reinhard Richter, and Ingo Rehberg — Experimentalphysik V, Universität Bayreuth, D-95440 Bayreuth

The Rosensweig instability has been predicted [1] and found experimentally [2] to show a hexagon-square transition. In a recent experiment we unveiled by means of radioscopy [3] that this transition does show an inverse hysteretic behaviour (proteresis) [4]. In our contribution we reinvestigate this transition in a container with larger aspect ratio and under the influence of a magnetic ramp.

[1] A. Gailitis, J. Fluid Mech. **82**, 401 (1977).
[2] B. Abou, J.-E. Wesfreid, S. Roux, J. Fluid Mech. **416**, 217 (2001).
[3] R. Richter and J. Bläsing, Rev. Sci. Instrum. **72**, 1729 (2001).
[4] C. Gollwitzer, I. Rehberg, and Richter, J. Phys. Condens. Matter **18**, 2643 (2006).

DY 29.62 Thu 16:00 Poster C

Interactions of colloidal particles with periodically deformed director fields in liquid crystalline free standing films — •Kirsten Harth, Christian Bohley, and Ralf Stannarius — Institut für Experimentelle Physik, Otto-von-Guericke-Universität Magdeburg, D-39106 Magdeburg, Universitätsplatz 2

We investigate textures of ferroelectric and paraelectric free standing liquid crystal films in the smectic C and C* phases by means of polarizing microscopy, with focus on colloidal liquid or solid inclusions. Periodic patterns have been observed around such inclusions and at film thickness steps. The inclusions interact with the director field, forming regular patterns, chains and lattices. An experimental investigation of the interactions between periodic patterns and inclusions is performed and the director field is analysed within an elastic continuum model.

DY 29.63 Thu 16:00 Poster C

Structure formation in bidisperse ferrofluid monolayers: Theory and Simulations. — •Sofia Kantorovich[1,2], Juan Cerda[3], and Christian Holm[1,3] — [1]MPI-P, Ackermannweg 10, D-55128, Mainz, Germany — [2]USU, Lenin av. 51, 620083, Ekaterinburg, Russia — [3]FIAS, Ruth-Moufang-Str. 1, D-60438, Frankfurt am Main, Germany

Molecular dynamics (MD) and Density functional theory are used to study thoroughly the mircrostructure formation in bidisperse ferrofluid monolayers. The simulation technique is close to the one used for monodisperse monolayers [Cerda et al., JP:CM, in print]. We show, that depending on the particle size ratio d_L/d_S (where $d_{L(S)}$ stands for the diameter of the <u>L</u>arge (<u>S</u>mall) particles), the presence of small particles can lead to the poisoning effect observed in 3D [Kantorovich, Ivanov, PRE, 70, 021401,(2004)] and 2D [Klokkenburg et al., private communication] ferrofluid samples with the size ratio $d_L/d_S \sim 1.5$, but also to the cluster growth, when $d_L/d_S > 2$ due to the depletion forces. An extensive comparison of theory to the simulation results is provided.

DY 29.64 Thu 16:00 Poster C

Non-periodic locked phase of a 2D colloidal system in a 1D quasicrystalline potential — •Michael Schmiedeberg and Holger Stark — Institut für Theoretische Physik, Technische Universität Berlin, D-10623 Berlin, Germany

We study a two-dimensional charge-stabilized colloidal system under the influence of a one-dimensional quasicrystalline optical lattice. The resulting quasicrystalline potential consists of two modulations with wave vectors whose magnitudes differ by a factor of τ^2, where τ is the number of the golden mean. For high values of the potential strength, periodically ordered structures do not exist [1].

By using Brownian dynamics symulations, we studied the dynamics of the non-periodic phases in the regime of high potential values and determined a phase transition between the well-known modulated liquid phase for small values of the Debye screening length and a non-periodic locked phase for large screening lengths. Details of our study will be presented.

[1] M. Schmiedeberg, J. Roth, and H. Stark, Phys. Rev. Lett. **97**, 158304 (2006)

DY 29.65 Thu 16:00 Poster C

A novel off-lattice cluster Monte Carlo algorithm for fluid simulation — •Markus Bellion[1], Ludger Santen[1], Heiko Rieger[1], and Werner Krauth[2] — [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 invention of Cluster Monte Carlo algorithms allowed for a much larger computational efficiency compared to local update schemes. By using cluster algorithms it was possible to reduce critical slowing down or even to avoid this problem. However, 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 are very few cluster algorithms that work for off-lattice models, because the identification of appropriate clusters while satisfying the detailed balance condition is even more challenging for continuous systems. Existing algorithms rely essentially on a geometric symmetry operation. Although these algorithms have been successfully applied to several model systems of complex fluids, their efficiency breaks down for higher densities. Here we report on an alternative algorithm: Particle clusters are identified by iterating a translational elementary move. The main advantage is the possibility to tune the size of generated clusters by varying the step size of the translation. As the trial step is not self-inverse, establishing detailed balance is a highly non-trivial task related to a well-known graph-theoretical problem. We show how this problem can be tackled or possibly circumvented for systems of hard particles.

DY 29.66 Thu 16:00 Poster C

Vibrational excitations in systems with correlated disorder — •Walter Schirmacher[1], Bernhard Schmid[2], Constantin Tomaras[1], Gabriele Viliani[3], Giacomo Baldi[4], Giancarlo Ruocco[5], and Tullio Scopigno[5] — [1]Phys.-Dept. E13, TU München — [2]FB Physik. Uni Mainz — [3]Dipt. di Fisica, Univ. di Trento, Italy — [4]INFM-CNR CRS-SOFT OGG c/o ESRF, Grenoble, France — [5]Dipt. di Fisica, Univ. di Roma; CRS SOFT-INFM-CNR c/o Univ. di Roma, Italy

We investigate a d-dimensional model (d = 2,3) for sound waves in a disordered environment, in which the local fluctuations of the elastic modulus are spatially correlated with a certain correlation length. The model is solved analytically by means of a field-theoretical effective-medium theory (self-consistent Born approximation[1]) and numerically on a square lattice. As in the uncorrelated case [1,2] the theory predicts an enhancement of the density of states over Debye's ω^{d-1} law ("boson peak") as a result of disorder. This anomaly becomes reinforced for increasing correlation length ξ. The theory predicts that ξ

times the width of the Brillouin line should be a universal function of ξ times the wavenumber. Such a scaling is found in the $2d$ simulation data, so that they can be represented in a universal plot. In the low-wavenumber regime, where the lattice structure is irrelevant, there is excellent agreement between theory and the simulation [3].

[1] W. Schirmacher, Europhys. Lett. **73**, 892 (2006)
[2] W. Schirmacher *et al.* Phys. Rev. Lett. **98**, 025501 (2007)
[3] W. Schirmacher *et al.* cond-mat 0711.1329

DY 29.67 Thu 16:00 Poster C

Brillouin spectroscopy of disordered systems — •Andreas Meier-Koll, Johannes Wiedersich, Peter Müller-Buschbaum, and Walter Schirmacher — Physik-Department E13, TU München

We have measured the longitudinal and transverse sound velocities in sodium silicate melts and polymeric materials by means of Brillouin spectroscopy using a tandem Fabry-Perot interferometer. In both material classes the relaxation processes can be observed from the smooth steps in the sound velocities and the maxima in the line widths. We interpret our data in terms of pertinent relaxation models.

DY 29.68 Thu 16:00 Poster C

Coupling effects to describe macroscopic glass-forming systems — •Christian Rehwald and Andreas Heuer — Institut für Physikalische Chemie, Westfälische Wilhelms-Universität, 48149 Münster

Studying the potential energy landscape of different small glass-forming systems with periodic boundary conditions common features can be identified, giving rise to the notion of ideal Gaussian glass formers [1]. In agreement with the experiment this model system displays deviations from the Stokes-Einstein relation which are, however, too large. We introduce a model of interacting elementary subsystems of ideal Gaussian glass formers to reproduce macroscopic glass-formers. The interaction reduce the long tails of the waiting time distribution and renders the relaxation function $S_0(t)$ less non-exponential. In particular, now the violation of the Stokes-Einstein relation is close to experimental observations. Furthermore we check the model with respect to finite size effects, extract some information about four point correlation functions and discuss the relation to facilitated spin models [2].

[1] A. Heuer, submitted to J. Phys.: Cond. Mat. (2007)
[2] Y. Jung, J. Garrahan, D. Chandler, Phys. Rev. E **69** (2004)

DY 29.69 Thu 16:00 Poster C

Modelling of susceptibility spectra of glass forming propylen carbonate with a schematic model of mode-coupling theory above and below T_c — •Markus Domschke[1], Thomas Blochowicz[1], Thomas Voigtmann[2], and Bernd Stühn[1] — [1]TU Darmstadt, Germany — [2]Deutsches Zentrum für Luft- und Raumfahrt, Germany

Recently the glass former propylen carbonate was investigated by a two-component schematic model of the extended mode-coupling theory (MCT). It was possible to describe the dynamic susceptibilities from microscopic frequencies down to the GHz range, but it was not successful to find a realistic model of the α peak and excess wing at the low-temperature regime [1,2]. Therefore we introduced a phenomenological frequency-dependent hopping parameter $\Delta(\omega)$ to model the α process even below T_c. This leads to a proper description of measured data by dielectric spectroscopy and depolarized-light scattering in the whole frequency and temperature range, derived from a common density correlator.

[1] H Z Cummins, J. Phys.: Condens. Matter **17**, 1457 (2005)
[2] W. Götze and Th. Voigtmann, Phys. Rev. E **61**, 4133 (2000)

DY 29.70 Thu 16:00 Poster C

Lattice Gas Simulation of Liesegang Pattern Formation — •Lukas Jahnke — Theoretische Physik, Martin-Luther-Universität, Halle / Saale, Germany

Liesegang patterns are a self-organized, quasi-periodic structuring that occur in diffusion-limited chemical reactions with two components. In recent experiments, where silver nano particles in glass are being generated behind a moving hydrogen front, Liesegang patterns emerge also. Due to the mesoscopic character of these experiments it is not clear whether the mean field approaches are adequate. Alternatively, the microscopic reaction-diffusion process can be modeled by Monte-Carlo simulations in a lattice gas approach. We present simulation results going beyond the mean field approach by studying the role of fluctuations. We show that the fluctuation have a major impact on the results for small concentrations of the reacting particles.

DY 29.71 Thu 16:00 Poster C

Nonlinear ion transport and resulting jump pathways in disordered systems — •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 single particle hopping model which contains a characteristic hopping distance between adjacent sites. The transition rates are deduced from different kinds of distributions of the trapping sites using periodic boundary conditions.

An analytical expression for the stationary current densities under a constant field in one dimension is presented and verified by numerical simulations. It turns out that the stationary current densities depend on the sample thickness and, interestingly, the first correction to the linear response display a non-analytical behaviour in the thermodynamic limit.

Numerical calculations of the current densities are expanded both to the ac regime and to two dimensional systems and compared with experimental results. In two dimensions possibly resulting jump pathways due to a percolation approach are also presented.

Furthermore, transition rates are extracted from three dimensional hopping dynamics analyzed by molecular dynamics simulations.

DY 29.72 Thu 16:00 Poster C

Role of ion-ion interaction for diffusion paths and residence sites in glassy electrolytes — •Egbert Zienicke, Christian Müller, and Philipp Maass — Institut für Physik, Technische Universität Ilmenau, 98684 Ilmenau, Germany

Properties of diffusion paths and residence sites for mobile ions in glassy elctrolytes are essential to understand ionic tranport in these complex materials. An important question is, whether the diffusion paths and residence sites can be determined from knowledge of the network structure, as e.g. provided by reverse Monte Carlo modelling of neutron or X-ray diffraction data. To study this question we analyze structures of a lithium silicate glasses obtained from molecular dynamics simulations [1]. We first check how far the mere network potential of the immobile ions determines the diffusion paths. Then we investigate the influence of the Coulomb interaction betweeen the mobile Li ions with the help of Monte Carlo simulations. Our results suggest that path properties are largely determined by the network, but that the location of residence sites is strongly influenced by Li-Li interactions.

In relation to this work it is necessary also to critically examine the reliability of the potential models for modified network glasses commonly used in molecular dynamics simulations. A new approach is presented to develop such models by means of electronic structure calculations based on disordered partial structures.

[1] C. Müller, E. Zienicke, S. Adams, J. Habasaki, and P. Maass, Phys. Rev. B **75**, 014203 (2007).

DY 30: Nonlinear stochastic systems

Time: Friday 10:15–13:00 Location: MA 001

DY 30.1 Fri 10:15 MA 001

Increase of Coherence in Excitable Systems by Delayed Feedback — Tobias Prager[1], Hans-P. Lerch[1], •Lutz Schimansky-Geier[1], and Eckehard Schöll[2] — [1]Institut für Physik, Humboldt-Universität zu Berlin, Newtonstr. 15, D-12489 Berlin — [2]Institut für Theoretische Physik, Technische Universität Berlin, Hardenbergstr. 36, D-10623 Berlin

The control of coherence and spectral properties of noise-induced oscillations by time-delayed feedback is studied in a FitzHugh-Nagumo system which serves as a paradigmatic model of excitable systems. A semianalytical approach based on a discrete model with waiting time densities is developed which allows one to predict quantitatively the increase of coherence measured by the correlation time, and the modulation of the main frequencies of the stochastic dynamics in dependence on the delay time. The analytical mean-field approximation is in good agreement with numerical results for the full nonlinear model.

Literature: Prager, T., Lerch, H. -P., Schimansky-Geier, L., and Schöll, E. "Increase of coherence in excitable systems by delayed feedback", J. Phys. A: Math. Theor. 40, 11045 (2007).

DY 30.2 Fri 10:30 MA 001

Controlling the coherence resonance in an excitable model exhibiting a global bifurcation — •Roland Aust, Johanne Hizanidis, and Eckehard Schöll — Institut f. Theor. Physik, Sekr. EW 7-1, Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin, Germany

We examine a generic model [1] exhibiting a global bifurcation, namely a saddle-node bifurcation on a limit cycle (SNIPER) under the influence of Gaussian white noise and time-delayed feedback control. It was shown earlier [2] that the delayed feedback itself is able to induce multistability in the system. Here we study the interaction between noise and time-delayed feedback. In the whole control-parameter plane the existence of coherence resonance can be confirmed. By varying the system's parameters we are able to choose the governing dynamics. In the regime where noise excites the system, the resulting oscillations can be controlled by the delayed feedback. We demonstrate the enhancement of coherence resonance by examining characteristic measures like the power spectral density and the correlation time. We also show how control enhances the regularity of the system's oscillations, and in which way noise affects the delay-induced oscillations in the multistability regime.

[1] G. Hu, T. Ditzinger, C. Z. Ning and H. Haken, *Stochastic resonance without external periodic force*, Phys. Rev. Lett. **71**, 807 (1993)
[2] J. Hizanidis, R. Aust and E. Schöll, *Delay-induced multistability near a global bifurcation*, Int. J. Bif. Chaos (2008), in print.

DY 30.3 Fri 10:45 MA 001

Stochastic modelling of experimental chaotic time series — Thomas Stemler[1,2], •Johannes P. Werner[1], Hartmut Benner[1], and Wolfram Just[3] — [1]Institut für Festkörperphysik, TU Darmstadt, 64289 Darmstadt — [2]School of Mathematics and Statistics, University of Western Australia, Crawley WA 6009, Australia — [3]Queen Mary / University of London, School of Mathematical Sciences, London E1 4NS, UK

Modelling dynamical degrees of freedom by suitable stochastic forces is a classical subject in theoretical physics and applied mathematics. While the replacement of many degrees of freedom in a thermodynamic system by Gaussian white noise is a textbook example and the foundation of e.g. irreversible thermodynamics, it is quite a recent finding that even few chaotic degrees of freedom can be modelled by stochastic differential equations.

Applying the Kramers–Moyal expansion to data from an electronic circuit experiment, we obtain a stochastic model of the low dimensional chaotic system [1]. We demonstrate that reliable drift and diffusion coefficients can be obtained even when there is no pronounced time scale separation. By comparing the *analytical* solution of the corresponding Fokker–Planck equation with *experimental* data we show that crisis induced intermittency can be described in terms of a stochastic model which is dominated by state space dependent diffusion.

[1] Phys.Rev.Lett. **98** No. 4, 044102 (2007)

DY 30.4 Fri 11:00 MA 001

Asymptotic continuous-time random walks models for deterministic diffusion — •Markus Niemann and Holger Kantz — Max-Planck-Institut fuer Physik komplexer Systeme, Dresden

Continuous-time random walks (CTRW) are often used to model anomalous diffusion. We set up a general description of a (possibly) space-time coupled version of a CTRW with continuous "virtual time". We identify the self-affine ones which emerge as long time limits. For a certain class of deterministic maps we identify the components of such CTRWs from the probabilistic behavior of these maps. In particular, we include classes with non-normalizable ergodic measure. Hence, we obtain a stochastic model for the long time behavior. This setup is exemplified analytically and numerically in a Manneville-Pomeau like setting. Depending on the ranges of the parameter we obtain sub- and superdiffusion.

DY 30.5 Fri 11:15 MA 001

Noisefree Stochastic Resonance at an Interior Crisis — •Thomas Jüngling[1], Thomas Stemler[1,2], Hartmut Benner[1], and Wolfram Just[3] — [1]Institut für Festkörperphysik, TU-Darmstadt, 64289 Darmstadt, Germany — [2]School of Mathematics and Statistics, University of Western Australia, Crawley, Australia — [3]Queen Mary/University of London, United Kingdom

We report on the observation of noisefree stochastic resonance in an externally driven diode resonator close to an interior crisis. At sufficiently strong excitation the diode resonator shows a strange attractor which, after the collision with a unstable period-3 orbit, exhibits crisis-induced intermittency. In the intermittency regime the system jumps between the previously stable chaotic attractor and the new phase space regions accessible due to the crisis. The random jumping between these two dynamic states can be used to amplify a weak periodic signal through the mechanism of stochastic resonance. In contrast to conventional stochastic resonance no external noise is needed, but its role is taken on by the fast intrinsic chaotic dynamics. Our data obtained at the diode resonator are compared with numerical results from the logistic map, where a similar crisis-induced intermittency is observed.

DY 30.6 Fri 11:30 MA 001

Noise-induced Nucleation in Spatially Extended Excitable Media — •Felix Müller — Institut für Physik, Humboldt-Universität zu Berlin, Newtonstr. 15, 12489 Berlin

We investigate the spontaneous noise-induced nucleation of dissipative structures. For this purpose we use the stochastic FitzHugh-Nagumo model in the excitable regime with diffusive coupling in one and two dimensions. The appearance of these structures like moving waves, stable wave segments or rotating spirals is well known from a wide range of complex systems. Famous examples are the Belousov-Zhabotinsky reaction or the intracellular calcium dynamics.

We explore the dependency of the mean nucleation time on the main features of the system as excitability, noise strength, and time scale separation and compare it with the scaling known from the analytical results in the limit of the local dynamics.

DY 30.7 Fri 11:45 MA 001

Noise-induced synchronisation in heterogeneous nets of neural elements — •Erik Glatt, Martin Gassel, and Friedemann Kaiser — Institute of Applied Physics, Darmstadt University of Technology, 64289 Darmstadt, Germany

Noise may have a strong influence on the dynamics of many spatially extended nonlinear systems. Variability (diversity, heterogeneity), where variability denotes static stochastic differences between otherwise equal elements of a system, may have similar effects. In this contribution the interplay of additive noise and additive variability in an oscillatory net of FitzHugh-Nagumo elements is studied. Both have a crucial influence on the phase synchronisation of the elements in the net. It is shown that additive variability induces pattern formation (phase waves) and hence even small values of the variability strength destroy the synchronised oscillation the net exhibits without variability. In such a heterogeneous net the synchronisation can be restored via additive noise. This noise-induced phase synchronisation exhibits a resonance-like dependency on the noise strength.

The variability-induced pattern formation is again a resonance-like effect provided additive noise is present in the net. In this case one finds maximally coherent patterns for intermediate values of the variability strength.

DY 30.8 Fri 12:00 MA 001

Noise-Dependent Stability of the Synchronized State in a Coupled System of Active Rotators — •Sebastian F. Brandt[1], Axel Pelster[2], and Ralf Wessel[1] — [1]Department of Physics, Washington University in St. Louis, MO 63130-4899, USA — [2]Fachbereich Physik, Universität Duisburg-Essen, Lotharstraße 1, 47048 Duisburg, Germany

We consider a Kuramoto model for the dynamics of an excitable system consisting of two coupled active rotators. Depending on both the coupling strength and the noise, the two rotators can be in a synchronized or a desynchronized state. The synchronized state of the system is most stable for intermediate noise intensity in the sense that the coupling strength required to desynchronize the system is maximal at this

noise level. We evaluate the phase boundary between synchronized and desynchronized states through numerical and analytical calculations.

DY 30.9 Fri 12:15 MA 001

Chaos induced oscillations by multiplicative noise in the Kapitza Pendulum — •Angelo Facchini[1,2], Chiara Mocenni[1,2], and Antonio Vicino[1,2] — [1]Center for the Study of Complex Systems, University of Siena, Italy — [2]Department of Information Engineering, University of Siena, Italy

Also known as the *Kapitza Pendulum*, the parametrically forced pendulum has been widely investigated by many scientists as the paradigmatic toy model of a wide range of phenomena. Physically it consists of a physical pendulum whose pivot oscillates sinusoidally with amplitude A and frequency ω. Despite the simplicity, the KP depends strongly on its parameters. In particular the variation of the amplitude of the sinusoidal forcing, produces complex behaviors such the stabilization of the inverted position, parametrically forced oscillations, bifurcations and chaotic oscillations (for more details see [*Am. J. of Physics*, **60**, 903-908, 1992;]). The influence of noise on the dynamical behavior of the KP has been also studied. In particular, the role of additive noise has been studied by Blackburn [*Proc. of the Royal Soc. A*, **462**, 1043-1052, 2006], while the case of the randomly oscillating pivot has been investigated by Landa [*Phys. Rev. E*, **54**, 3535, 1996]. Both found the arise of noise-mediated chaotic oscillations and noise-mediated transitions. We study the influence of the stochastic perturbation of the parameter A. This results in the study of the effect of multiplicative noise on the pendulum. We show that the adding of a very small amount of noise induces the anticipation of bifurcation points and sustains permanently chaotic oscillations, extending the results of Blackburn.

DY 30.10 Fri 12:30 MA 001

Reconstruction of nonlinear dynamics from discrete observations — •Andreas Ruttor and Manfred Opper — Institut für Softwaretechnik und Theoretische Informatik, Technische Universität Berlin, Franklinstr. 28/29, 10587 Berlin, Germany

Nonlinear dynamical systems are often described by diffusion models based on stochastic differential equations (SDEs). As long as the distance between observations is small, drift and diffusion can be calculated directly and used to determine unknown parameters. Otherwise, both the state of the system between observations and the parameters of the SDEs have to be estimated. However, Markov chain Monte Carlo based methods used for that purpose can be very time consuming. As an alternative a fast approximate approach is proposed. By solving the backward Fokker-Planck equation of the diffusion model in the weak noise limit, it is possible to obtain the drift of the posterior SDE directly. Afterwards the posterior statistics can be computed either by applying the weak noise limit again (leading to an approximate Gaussian posterior process), or more simply by simulating many samples of the posterior SDE. Parameter estimation is based on the negative log-likelihood of the data. Minimizing an upper bound of this quantity, which can also be calculated in the state inference algorithm, leads to type II maximum likelihood estimates of unknown system parameters. Results obtained in the case of reaction systems indicate that this approach works well.

DY 30.11 Fri 12:45 MA 001

Collective transport of an array of nonlinear coupled oscillators in a periodic potential — •Steffen Martens, Dirk Hennig, and Lutz Schimansky-Geier — Institut fuer Physik, Humboldt-Universitaet zu Berlin, Newtonstrasse 15 12489 Berlin, Germany

The transport of an array of nonlinear coupled particles subjected to a two-dimensional eaves gutter potential is investigated in the high-friction limit. Due to the application of an external point force the symmetry is broken and therefore a directed motion occurs. The mobility of the center of mass of the system of coupled particles possesses distinct properties depending on the system size. Thus, the behaviour is different compared to a monomer under the same transport conditions. In particular it is found that the mobility is a complicated non-monotonous function of the equilibrium distance. Depending on the coupling strength between the particles two different transport scenarious occur. For weak coupling, the transport is for a given set of parameters dominated by the temperature. In contrast, for strong coupling the mobility is determined by the applied point force only.

DY 31: Quantum dynamics, decoherence and quantum information

Time: Friday 10:15–13:00 Location: MA 004

DY 31.1 Fri 10:15 MA 004

Nonexponential decoherence in a quantum Lévy kicked rotator — Henning Schomerus[1] and •Eric Lutz[2] — [1]Physics Department, Lancaster University, Lancaster, LA1 4YB, UK — [2]Institute of Physics, University of Augsburg, D-86135 Augsburg

We investigate decoherence in the quantum kicked rotator (modeling cold atoms in a pulsed optical field) subjected to noise with power-law tail waiting-time distributions of variable exponent (Lévy noise). We demonstrate the existence of a regime of nonexponential decoherence where the notion of a decoherence rate is ill defined. In this regime, dynamical localization is never fully destroyed, indicating that the dynamics of the quantum system never reaches the classical limit. We show that this leads to quantum subdiffusion of the momentum, which should be observable in an experiment.

DY 31.2 Fri 10:30 MA 004

Survival Probabilities of Coherent Energy Transfer — •Oliver Mülken — Institute of Physics, University of Freiburg, Freiburg, Germany

We consider exciton trapping in the continuous-time quantum walk framework. The survival probability displays different decay domains, related to distinct regions of the spectrum of the Hamiltonian. For linear systems and at intermediate times the decay obeys a power-law, in contrast to the corresponding exponential decay found in incoherent continuous-time random walk situations.

Reference: [1] *Phys. Rev. Lett.* **99**, 090601 (2007).

DY 31.3 Fri 10:45 MA 004

Relaxation properties of Quantum Cellular Automata — •Alexander Kettler and Günter Mahler — Universität Stuttgart, 1. Institut für Theoretische Physik, Pfaffenwaldring 57, 70550 Stuttgart

In the recent years, much research has been done on the thermodynamical behaviour of small quantum systems [1]. Amongst others there have been investigations on the relaxation into (thermal) equilibrium states and on the effect of (classical) control on the thermodynamic properties of such small quantum systems. With this in mind, we have dealt with the question of using the formalism of Quantum Cellular Automata (QCA) to control the relaxational behaviour of closed quantum systems. Here we show the effect of several different rules for two different types of QCA, applied to a 1-dimensional spin-chain and how QCA-dynamics itself can produce relaxational behaviour.

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

DY 31.4 Fri 11:00 MA 004

Emergence of work and heat in the quantum limit — •Heiko Schröder and Günter Mahler — Universität Stuttgart, 1. Institut für Theoretische Physik, Pfaffenwaldring 57, 70550 Stuttgart

The emergence of thermodynamic properties from quantum mechanics like equilibrium, irreversibility and temperature have been under investigation for quite a while ([1] and others). Here we focus on how the concept of work (as opposed to heat) emerges from quantum mechanics even in finite quantum systems. We present a necessary and sufficient condition for pure work exchange between two (finite) quantum systems and elucidate its relation to classical control of a quantum system. Whether the concept of work is as generic in quantum sytems as it is in the classical context is discussed by means of a simple model system.

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

DY 31.5 Fri 11:15 MA 004

Entanglement evolution after connecting quantum chains —

•Viktor Eisler[1], Ingo Peschel[1], Dragi Karevski[2], and Thierry Platini[2] — [1]Freie Universität Berlin — [2]Universite Henri Poincare, Nancy

We consider quantum chains which are initially separated and in their ground states. After connecting them the quantum state evolves and the entanglement increases. It is found that the entanglement entropy displays a typical behaviour which is common for the different geometries considered. It is characterized by a rapid rise to values larger than in equilibrium followed by a slow relaxation. For critical systems the lattice results are in a very good agreement with predictions of conformal field theory.

DY 31.6 Fri 11:30 MA 004

Dephasing and the steady state in quantum many-particle systems — •Thomas Barthel and Ulrich Schollwöck — Institute for Theoretical Physics C, RWTH Aachen, D-52056 Aachen, Germany

We discuss relaxation in bosonic and fermionic many-particle systems. For integrable systems, the time-evolution from an arbitrary initial state can lead, for a given finite subsystem, to a definite steady state, determined by a certain maximum entropy density matrix. We give an explicit derivation of the steady state ensemble and devise sufficient prerequisites for the dephasing to take place. It is essential to restrict observations to a finite subsystem embedded into an (infinite) environment. We also find surprisingly simple scenarios, in which dephasing is ineffective and discuss the dependence on dimensionality and criticality. It also follows that, after a quench of system parameters, entanglement entropy will become extensive. It is thus simple to create strong entanglement for quantum computation applications, but in reduced Hilbert space simulations on classical computers, as MPS, PEPS or MERA algorithms, not possible to access arbitrarily long time scales.

DY 31.7 Fri 11:45 MA 004

Evolution of Correlation Functions in a System of Strongly Correlated Fermions after a Quantum Quench — •Salvatore R. Manmana[1], Stefan Wessel[2], Reinhard M. Noack[3], and Alejandro Muramatsu[2] — [1]Institute of Theoretical Physics (CTMC), EPF Lausanne, CH-1015 Lausanne, Switzerland — [2]Institut für Theoretische Physik III, Universität Stuttgart, Pfaffenwaldring 57/V, D-70550 Stuttgart, Germany — [3]AG Vielteilchennumerik, Fachbereich Physik, Philipps-Universität Marburg, D-35032 Marburg, Germany

We investigate the full time evolution of the density-density correlation function in a system of strongly correlated interacting spinless fermions on a one-dimensional lattice after a quantum quench, i.e., after suddenly changing the strength of the interaction between the particles [1]. Using the adaptive time-dependent density matrix renormalization group method (adaptive t-DMRG), we identify a horizon effect for specific parameters of the quench, confirming the expectation put forward by Calabrese and Cardy [2] based on conformal field theory (CFT) arguments. This effect is clearly visible when quenching into the critical regime, while it does not appear for a quench to the insulating regime.

[1] S.R. Manmana, S. Wessel, R.M. Noack, and A. Muramatsu, Phys. Rev. Lett. **98**, 210405 (2007).
[2] P. Calabrese and J. Cardy, Phys. Rev. Lett. **96**, 136801 (2006).

DY 31.8 Fri 12:00 MA 004

Decoherence properties of entangled single nuclear spins and one electron spin at room temperature in diamond — •Philipp Neumann, Torsten Gaebel, Florian Rempp, Christian Zierl, Fedor Jelezko, and Jörg Wrachtrup — 3. Physikalisches Institut, Universität Stuttgart, Germany

Generation of long-lived entanglement between single qubits is at the heart of quantum information processing. Since the coherence between single qubits in solid state systems is rather fragile one is looking for qubits with long coherence lifetimes. Those could be nuclear spins. In our case we use the electron spin of the NV-center in diamond to generate Bell States between two qubits associated with two proximal ^{13}C nuclear spins. Eventually the electron spin itself is used as a qubit and 3-particle entanglement is generated. The decoherence properties of these entangled states are investigated.

DY 31.9 Fri 12:15 MA 004

Exact dynamics in the central spin model — •Michael Bortz[1], Christian Schneider[2], Joachim Stolze[2], and Robert Stübner[2] — [1]Fachbereich Physik, TU Kaiserslautern, Germany — [2]Institut für Physik, TU Dortmund, Germany

We consider a single spin-1/2 which is coupled via inhomogeneous Heisenberg interactions to an arbitrary number of environment spins-1/2 (central spin model). The topic of this talk is the loss of polarization of the central spin due to its exchange with the bath spins. Since the central spin model is used widely to model the decoherence of an electron spin quantum bit interacting with nuclear spins in a quantum dot, this question also is of significant experimental interest.

Our focus here is on the investigation of exact solutions of the model, both for inhomogeneous couplings and in the homogeneous limit. Using these exact solutions, we discuss the effect of tuning free parameters of the model - i.e. the initial state, the inhomogeneity of the couplings, the number of bath spins and their magnetization - on the time evolution of the central spin.

DY 31.10 Fri 12:30 MA 004

Bypassing the quantum phase transition for the Ising model in a transverse field — •Gernot Schaller — Institut für Theoretische Physik, Technische Universität Berlin

The one-dimensional quantum Ising model describes a spin-1/2 chain coupled by ferromagnetic 1d next-neighbor interactions subject to a transverse magnetic field. It is a paradigmatic example for an analytically solvable model that exhibits a second order quantum phase transition in the continuum limit from a phase with a unique ground state to a two-fold degenerate ground state with a spontaneously broken symmetry.

For a system with n spins and a merely time-dependent external magnetic field, this is reflected in a $\mathcal{O}(1/n)$-scaling of the energy gap at the critical point between ground state and first excited state. However, the situation becomes different if one considers a spatially inhomogeneous magnetic field. For a special configuration one can demonstrate analytically that the energy gap in the relevant subspace is bounded from below by a constant independent of the system size. Likewise, the ground state does not change drastically at some critical point anymore. The dynamics through this transition will be compared with the original model in the adiabatic limit.

DY 31.11 Fri 12:45 MA 004

Entanglement entropy in disordered and non-equilibrium systems — •Zoltán Zimborás[1], Viktor Eisler[2], Róbert Juhász[3], and Ferenc Iglói[3] — [1]Theoretische Physik, Univerität des Saarlandes, Campus 1, D-66041 Saarbrücken, Germany — [2]Fachbereich Physik, Freie Universität Berlin, Arnimallee 14, D-14195 Berlin, Germany — [3]Research Institute for Solid State Physics and Optics, P.O. Box 49, H-1525 Budapest, Hungary

The effects of non-equilibrium currents and quenched disorder on the entanglement properties of quantum spin chains are studied. For the investigated models, we find that the entanglement entropy of a block of spins is smaller in the ground state, than in a minimally excited non-equilibrium current-carrying pure steady state. We relate this finding to recent studies on the dynamics of entanglement entropy after a quench. For disordered models, we falsify a recent conjecture stating that the ground state entanglement entropy decreases due to disorder. We show both for aperiodically disordered couplings and for randomly disordered couplings with spatially correlation, that the ground state entanglement can either decrease and increase depending on the type of interaction and on the type of disorder.
References:
1) F. Iglói, R. Juhász, and Z. Zimborás, Europhysics Letters 79, 37001 (2007).
2) V. Eisler and Z. Zimborás, Phys. Rev. A 71, 042318 (2005).