DYNAMIK UND STATISTISCHE PHYSIK (DY)

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ÜBERSICHT DER HAUPTVORTRÄGE UND FACHSITZUNGEN

(Hörsäle TU H3010 und TU H2032)

Hauptvorträge

DY 10.1	Fr	10:00	(TU H3010)	**On the connections between chaos theory and statistical mechanics**, Henk van Beijeren
DY 13.1	Fr	14:00	(TU H2032)	**Directed chaos in a mixed phase space**, Holger Schanz
DY 24.1	Sa	14:00	(TU H2032)	**Lambert diffusion in porous media in the Knudsen regime**, Stefanie Russ, Armin Bunde, Jörg Kärger
DY 30.1	Mo	10:00	(TU H3010)	**Evolution in complex systems: record dynamics in models of spin glasses, superconductors and evolutionary ecology.**, Henrik Jeldtoft Jensen
DY 32.1	Mo	14:00	(TU H3010)	**Disentangling trends and fluctuations in data sets of complex systems**, Rudolf Friedrich
DY 35.1	Mo	10:00	(TU A060)	**Domain walls in Ising spin glasses**, Timo Aspelmeier
DY 36.1	Mo	14:00	(TU A060)	**Neue Anwendungsmöglichkeiten nanopartikelhaltiger Gläser**, Klaus-Jürgen Berg
DY 40.1	Di	10:00	(TU H3010)	**Exploring Complex Dynamics with Transition Path Sampling**, Christoph Dellago
DY 42.1	Di	14:00	(TU H3010)	**Thermodynamics - Past, Present and Future**, Werner Ebeling
DY 50.1	Mi	09:45	(TU H3010)	**Integrable $sl(2/1)$ super spin chain and the spin quantum Hall effect**, Holger Frahm, Fabian H. L. Essler, Hubert Saleur

Hautvorträge im Symposium Renormalization and Scaling (SYRS)

gemeinsam veranstaltet von DY, DF, CPP und TT

SYRS 1.1	Sa	08:30	(TU H3010)	**Anisotropic Scale Invariance in Systems with Boundaries: Bulk and Surface Critical Behavior at Lifshitz Points**, Hans Werner Diehl
SYRS 1.2	Sa	09:00	(TU H3010)	**Stacked triangular antiferromagnets: critical and multicritical behavior**, Andrea Pelissetto, Ettore Vicari
SYRS 1.3	Sa	09:30	(TU H3010)	**Transport properties of percolation clusters**, Olaf Stenull
SYRS 2.1	Sa	10:30	(TU H3010)	**Reaction-diffusion processes: the non perturbative renormalization group approach**, Bertrand Delamotte, Leonie Canet
SYRS 2.2	Sa	11:00	(TU H3010)	**Functional renormalization group methods for interacting Fermi systems**, Walter Metzner
SYRS 2.3	Sa	11:30	(TU H3010)	**Functional Renormalization for Disordered Systems: The Way out of Dimensional Reduction**, Kay J. Wiese
SYRS 2.4	Sa	12:00	(TU H3010)	**Universality classes in coarsening**, Benjamin Vollmayr-Lee

Hautvorträge im Einstein Symposium Brownian Motion, Diffusion and Beyond (SYBM)

gemeinsam veranstaltet von DY und AKB

SYBM 1.1	Di	10:30	(TU HE101)	**Forms and scaling in diffusion-limited growth: lightning, crystals, rivers, and tumors**, Leonard M. Sander

SYBM 1.2	Di	11:00	(TU HE101)	**From Maxwell demon to Brownian motor**, Christian Van den Broeck
SYBM 1.3	Di	11:30	(TU HE101)	**How Biology breaks down Einstein's relation**, Jaques Prost
SYBM 1.4	Di	12:00	(TU HE101)	**Colloidal Suspensions as Brownian Computers**, Clemens Bechinger
SYBM 1.5	Di	12:30	(TU HE101)	**Photon random walks and beyond**, Georg Maret

Hautvorträge im Symposium Solitons and Nonlinear Waves in Periodic Complex Structures (SYSN)
gemeinsam veranstaltet von Q und DY

SYSN 1.1	Fr	14:00	(HU Audimax)	**Optical Fiber Solitons: Perturbations and Interactions**, Fedor Mitschke
SYSN 1.2	Fr	14:30	(HU Audimax)	**Solitons and nonlinear waves in photonic lattices**, Mordechai Segev
SYSN 1.3	Fr	15:00	(HU Audimax)	**Dissipative Optical Solitons**, Ulf Peschel
SYSN 1.4	Fr	15:30	(HU Audimax)	**Nonlinear lattice breathers and solitons: concepts and applications**, Sergej Flach
SYSN 2.1	Fr	16:30	(HU Audimax)	**Bose-Einstein Condensates in fast rotation**, Jean Dalibard
SYSN 2.2	Fr	17:00	(HU Audimax)	**Matter Wave Soliton Train from a Bose-Einstein Condensate**, Randall G. Hulet
SYSN 2.3	Fr	17:30	(HU Audimax)	**Towards controlling matter wave lattice solitons**, Anna Sanpera
SYSN 2.4	Fr	18:00	(HU Audimax)	**Non-spreading wave packets of interacting matter waves: Gap-Solitons and nonlinear self trapping** , Markus Oberthaler

Hautvorträge im Symposium Biological and Social Networks (SYBN)
gemeinsam veranstaltet von AKSOE, AKB, CPP und DY

SYBN 1.1	Mo	09:45	(TU HE101)	**Computation, evolution and tinkering in complex networks**, Ricard Sole
SYBN 1.2	Mo	10:15	(TU HE101)	**Properties of attractors and relevant nodes in random Boolean networks**, Barbara Drossel
SYBN 1.3	Mo	10:45	(TU HE101)	**Epidemic modeling: dealing with complex networks**, Alessandro Vespignani
SYBN 1.4	Mo	11:15	(TU HE101)	**Traffic and Computation in Genetic Regulation**, Kim Sneppen

Hautvorträge im Symposium Mesoscopic Physics of Ultracold Atoms (SYUA)
gemeinsam veranstaltet von A, Q, HL, TT und DY

SYUA 1.1	Mi	11:00	(HU Audimax)	**Atom Chips: Mesoscopic Physics with Cold Atoms**, Jörg Schmiedmayer
SYUA 1.2	Mi	11:30	(HU Audimax)	**Atomic Matter Waves in Magnetic Micro Potentials**, Claus Zimmermann
SYUA 1.3	Mi	12:00	(HU Audimax)	**Nonlinear resonant transport of Bose-Einstein condensates**, Peter Schlagheck
SYUA 1.4	Mi	12:30	(HU Audimax)	**Atomic Quantum Dots in a Bose-Einstein-Condensate**, Wilhelm Zwerger
SYUA 2.1	Mi	14:00	(HU Audimax)	**BEC of 6Li2 molecules: Exploring the BEC-BCS crossover**, Johannes Hecker-Denschlag
SYUA 2.2	Mi	14:30	(HU Audimax)	**Nonlinear matter waves in periodic potentials: From Adiabaticity to Zener**, Oliver Morsch
SYUA 2.3	Mi	15:00	(HU Audimax)	**Ultracold atomic gases in optical lattices: A bridge between Quantum Optics and Condensed Matter Physics**, Luis Santos
SYUA 2.4	Mi	15:30	(HU Audimax)	**Superfluid-insulator transition in a moving system of interacting bosons**, Eugene Demler

Fachsitzungen

DY 10	**Fluid Dynamics I**	Fr 10:00–13:00	TU H3010	DY 10.1–10.11
DY 11	**Nonlinear Dynamics**	Fr 10:30–12:30	TU H2032	DY 11.1–11.8
DY 12	**Fluid Dynamics II**	Fr 14:30–15:15	TU H3010	DY 12.1–12.3
DY 13	**Quantum Chaos**	Fr 14:00–18:30	TU H2032	DY 13.1–13.17
DY 14	**Complex Fluids**	Fr 15:30–18:30	TU H3010	DY 14.1–14.12
DY 20	**Symposium Renormalization and Scaling (SYRS)**	Sa 08:30–12:30	TU H3010	DY 20.1–20.1
DY 21	**Statistical Physics in Biological Systems**	Sa 08:30–11:15	TU H2032	DY 21.1–21.11
DY 22	**Networks**	Sa 11:30–13:00	TU H2032	DY 22.1–22.6
DY 23	**Symposium Renormalization and Scaling (SYRS) – Contributed Talks I**	Sa 14:00–15:30	TU H3010	DY 23.1–23.6

DY 24	**Granular Matter**	Sa	14:00–16:45	TU H2032	DY 24.1–24.10
DY 25	**Symposium Renormalization and Scaling (SYRS) – Contributed Talks II**	Sa	16:00–17:00	TU H3010	DY 25.1–25.4
DY 30	**Spiral Formation and Feedback**	Mo	10:00–12:45	TU H3010	DY 30.1–30.10
DY 31	**Nonlinear Stochastic Systems I**	Mo	10:30–12:45	TU H2032	DY 31.1–31.9
DY 32	**Nonlinear Stochastic Systems II**	Mo	14:00–15:00	TU H3010	DY 32.1–32.3
DY 33	**Ferrofluids and Liquid Crystals**	Mo	14:00–16:15	TU H2032	DY 33.1–33.9
DY 34	**Poster**	Mo	15:30–18:00	Poster TU D	DY 34.1–34.122
DY 35	**Glasses I (joint session DF/DY)**	Mo	10:00–13:00	TU A060	DY 35.1–35.11
DY 36	**Glasses II (joint session DF/DY)**	Mo	14:00–17:45	TU A060	DY 36.1–36.12
DY 40	**Statistical Physics (General) I**	Di	10:00–13:00	TU H3010	DY 40.1–40.11
DY 41	**Einstein Symposium Brownian Motion, Diffusion and Beyond (SYBM)**	Di	10:00–13:00	TU HE101	DY 41.1–41.1
DY 42	**Statistical Physics (General) II**	Di	14:00–15:45	TU H3010	DY 42.1–42.6
DY 43	**Einstein Symposium Brownian Motion, Diffusion and Beyond (SYBM) – Contributed Talks I**	Di	14:30–18:00	TU H2032	DY 43.1–43.14
DY 44	**Growth and Fracture**	Di	15:45–18:00	TU H3010	DY 44.1–44.9
DY 50	**Critical Phenomena and Phase Transitions**	Mi	09:45–12:30	TU H3010	DY 50.1–50.10
DY 51	**Einstein Symposium Brownian Motion, Diffusion and Beyond (SYBM) – Contributed Talks II**	Mi	10:15–13:15	TU H2032	DY 51.1–51.12
DY 52	**Statistical Physics far from Thermal Equilibrium**	Mi	12:30–14:00	TU H3010	DY 52.1–52.6

Poster

Die Posterfläche TU D steht am Montag ganztägig zur Verfügung.

Zordnung der Poster zu den Themenkreisen

DY 34.1-34.16 Statistische Physik (Allgemein)
DY 34.17-34.19 Gläser
DY 34.20-34.21 Neuronale Netze
DY 34.22-34.22 Brownsche Bewegung
DY 34.23-34.27 Nichtlineare Stochastische Systeme
DY 34.28-34.47 Nichtlineare Dynamik, Synchronisation und Chaos
DY 34.48-34.49 Quantenchaos
DY 34.50-34.51 Statistische Physik fernab vom thermischen Gleichgewicht
DY 34.52-34.62 weiche Materie
DY 34.63-34.64 Statistische Physik in biologischen Systemen
DY 34.65-34.78 Fluiddynamik
DY 34.79-34.88 Wachstumsprozesse und Grenzflächeneigenschaften
DY 34.89-34.99 Granulare Materie / Kontaktdynamik
DY 34.100-34.103 Ferrofluide / Flüssigkristalle
DY 34.104-34.112 Kritische Phänomene und Phasenumwandlungen
DY 34.113-34.113 Gitterdynamik und nichtlineare Anregungen
DY 34.114-34.118 Poster des Symposiums Renormalization and Scaling (SYRS)
DY 34.119-34.120 Poster des Einstein Symposiums Brownian Motion, Diffusion and Beyond (SYBM)

Mitgliederversammlung des Fachverbands Dynamik und Statistische Physik

Di 18:00–18:45 TU H3010

1. Bericht des Sprechers
2. Tagungen
3. Verschiedenes

gez. Franz Schwabl

Fachsitzungen

– Haupt-, Kurzvorträge und Posterbeiträge –

DY 10 Fluid Dynamics I

Zeit: Freitag 10:00–13:00 Raum: TU H3010

Hauptvortrag DY 10.1 Fr 10:00 TU H3010

On the connections between chaos theory and statistical mechanics — •Henk van Beijeren — Institute for Theoretical Physics, Utrecht University

The past years have seen a surge of activity on the connections between chaos theory and statistical mechanics. In the Gaussian thermostat formalism, developed by Hoover, Evans et al, the irreversible entropy production in a stationary non-equilibrium system is related to the sum of all of its Lyapunov exponents. In the escape-rate formalism of Gaspard and and Nicolis, transport coefficients determining the rate of escape of systems from phase space through an open boundary are related tot the Kolmogorov-Sinai entropy and the sum of all positive Lyapunov exponents on a small subset of phase space. In Ruelle's thermodynamic formalism chaotic as well as transport properties can be obtained from a single dynamical partition function. This is even more ambitious, but for the majority of many-particle systems calculation of the dynamical partition function is a very hard task.

Here I will briefly introduce dynamical systems and discuss their characteristic properties. I will show how quantities like Lyapunov exponents, Kolmogorov-Sinai entropies and topological pressures may be calculated for a dilute Lorentz gas (disordered billiard), which is a system with fixed scatterers on random positions, with which a point particle makes elastic collisions. Comparisons of the results with computer simulation results show a very good agreement.

For a dilute hard sphere gas in equilibrium both the KS entropy (equal to the sum of all positive Lyapunov exponents) and the largest Lyapunov exponent can be calculated analytically to leading orders in the density. Again, comparisons to computer simulations show good agreement. The smallest positive Lyapunov exponents for these systems show very interesting collective behavior, which can also be explained through kinetic theory calculations.

Finally I wil discuss some outstanding open problems.

DY 10.2 Fr 10:30 TU H3010

Patterns in Reaction-Advection-Diffusion systems — •Markus Abel — Universitaet Potsdam

We develop a theory describing the transition to a spatially homogeneous regime in a mixing flow with a chaotic in time reaction. The transverse Lyapunov exponent governing the stability of the homogeneous state can be represented as a combination of Lyapunov exponents for spatial mixing and temporal chaos. This representation, being exact for time-independent flows and equal Péclet numbers of different components, is demonstrated to work accurately for time-dependent flows and different Péclet numbers.

DY 10.3 Fr 10:45 TU H3010

Predictability and properties of turbulent wind gusts — •Detlef Holstein and Holger Kantz — MPIPKS, Noethnitzer Str. 38, 01187 Dresden

Dynamics in complex systems often contains long range memory. An information theoretical treatment aims for quantifying stochastic modelling of the dynamics behind time series data. As an application of our analysis an improvement of prediction of extreme events, especially of turbulent wind gusts in the atmospheric boundary layer is intended. Coherent structures in the turbulent boundary layer are analyzed for their impact on wind gusts.

DY 10.4 Fr 11:00 TU H3010

Linear stability of viscoelastic shear flows — •Juergen Buehrle — AG Komplexe Systeme, Philipps-Universität Marburg

The linear perturbation of a plane shear flow is decomposed into vortices and streaks. Their amplitudes decay exponentially at large times. At the same time, non-normal amplification of streaks leads to a transient growth, such that the maximum value of the kinetic energy associated with the perturbation exceeds its initial value by several orders of magnitude. For Newtonian fluids the maximum amplification occurs, when the width of the vortices is of the order of the channel height. We find, that for viscoelastic fluids the optimal vortex width is significantly larger. This motivates a different approach to the understanding of the transition to turbulence in viscoelastic flow.

DY 10.5 Fr 11:15 TU H3010

Change of the surface morphology in the evolution of liquid two-layer films — •Andrey Pototsky[1], Michael Bestehorn[1], Domnic Merkt[1], and Uwe Thiele[2] — [1]Lehrstuhl fuer Theoretische Physik II, BTU Cottbus, Erich-Weinert Str. 1, 03046 Cottbus, Germany — [2]MPI fuer Physik komplexer Systeme, Noethnitzer Str. 38, 01187 Dresden, Germany

We consider a two-layer liquid film placed on a solid support made of two different immiscible liquids, driven by long-range apolar and short-range polar interactions, with free liquid-liquid and liquid-gas interfaces. Using the long wave approximation we derive the evolution equations for the local film thicknesses. For the initially unstable flat films, the primary unstable mode can be of two different types: a varicose or a zigzag mode. We show that during the time evolution, the mode type can change via switching between two stable stationary solutions and due to coarsening.

DY 10.6 Fr 11:30 TU H3010

FEM simulations on the production of hyperpolarized xenon — •Alexander Fink and Eike Brunner — Institut für Biophysik und physikalische Biochemie, Universität Regensburg, 93040 Regensburg

Hyperpolarized xenon can be used to increase the sensitivity of NMR experiments by up to 6 orders of magnitude. Applications include medical imaging, low-field NMR, surface NMR spectroscopy, biological magnetic resonance, fundamental physics etc.

Hyperpolarized xenon is produced in pump cells within which Rb vapor is optically pumped by the irradiation of circularly polarized laser light. The Rb electron spin polarization is then transferred to the Xe-129 nuclei.

While the underlying quantum mechanical processes are understood quite well, little is known about the hydrodynamic and thermodynamic processes taking place inside the pump cell.

By use of the finite element method (FEMLAB 3.0a) we numerically solve 8 coupled macroscopic differential equations, coupling the velocity field, temperature, spin pump rate, and spin polarizations.

We discuss the optimisation of experimental parameters of the pump cell, e.g. flow rate, laser power etc., in order to receive a maximum Xe-129 spin polarization.

DY 10.7 Fr 11:45 TU H3010

Influence of noise on anomalous transport in steady viscous flows — •Michael Zaks — Institut für Physik, Humboldt-Universität Berlin

In time-independent plane flows of viscous fluids past arrays of vortices or solid obstacles there can be neither turbulence nor Lagrangian chaos. Nevertheless, such fluid motions may exhibit unusual transport properties which originate in the slowdown of tracers in vicinities of stagnation points or near the solid borders with no-slip conditions. We discuss modifications which appear if tracers are viewed as passive Brownian particles in noisy environments. In flows through periodic lattices of solid obstacles the anomalous transport yields to normal diffusion. For flows past arrays of vortices the outcome is different. Here introduction of noise allows the tracers to penetrate across the separatrices into the vortices which thus turn into a kind of traps; this enhances the spreading, ensuring long epochs of nearly ballistic transport.

DY 10.8 Fr 12:00 TU H3010

Long-wave evolution of thin liquid binary mixture films — •Ion Dan Borcia and Michael Bestehorn — Lehrstuhl für Theoretische Physik, Brandenburgische Technische Universität Cottbus, Erich-Weinert-Straße 1, 03046 Cottbus, Germany

The oscillatory regime for surface-driven convection was studied in [1] in the case of a binary mixture of two miscible liquids using a method based on the 3D hydrodynamic basis equations. In the present work the binary mixture is considered to form a thin film, case in which one can use the lubrication approximation [2]. That permits us to reduce the dimension of the equations to one (1D) for the two dimensional case and to two (2D) for the three dimensional case. Using 1D and 2D fully nonlinear codes, one investigates the long-wavelength instability and the Soret effect influence on the film dynamics.

[1] M. Bestehorn and Pierre Colinet, "Bénard-Marangoni convection of a binary mixture as an example of an oscilatorry bifurcation under strong symetry-breaking effects,"Physica D, **145**, 84-109 (2000).

[2] A. Oron, S. H. Davis and S. G. Bankoff, "Long-scale evolution of thin liquid films,"Rev. Modern Phys., **69**(3), 931-980 (1997).

DY 10.9 Fr 12:15 TU H3010

Luftströmung über Transversaldünen — •Volker Schatz und Hans J. Herrmann — Inistitut für Computerphysik der Universität Stuttgart, Pfaffenwaldring 57, 70569 Stuttgart

Sanddünen sind formschöne Ablagerungen granularer Materie, die auf allen Erdteilen zu finden sind. Sie sind besonders in Wüsten und in Küstengebieten verbreitet, und große Teile des Planeten Mars sind davon bedeckt. Dünen entstehen durch ein Wechselspiel zwischen dem Sandtransport durch Wind und die durch die Form der Düne beeinflusste Luftströmung. In Simulationen wurde festgestellt, dass die Form der sich bildenden Düne empfindlich davon abhängt, wie die Luftströmung über sie modelliert wird. In bisherigen Untersuchungen der Strömungsverhältnisse über Dünen wurde der Querschnitt der Düne in Windrichtung meist als ein Dreieck modelliert, was ein Untersuchen der Abhängigkeit von Länge und Höhe, aber nicht von der Form erlaubt. In der hier vorgetragenen Arbeit wurde die Fluiddynamik-Simulationssoftware FLUENT verwendet, um die Strömung üeber eine Düne in Abhängigkeit von der Dünenform zu untersuchen. Eine besondere Rolle spielt dabei die Position des "Slip Faces", an dem der an der windabgewandten Seite abgelagerte Sand herunterrutscht.

DY 10.10 Fr 12:30 TU H3010

Metastabilität geschichteter Fluide für großskalige Strukturen — •Domnic Merkt — Lehrstuhl für Theoretische Physik, BTU-Cottbus, Erich-Weinert-Str. 1, 03046 Cottbus

Ausgehend von der kürzlich abgeleiteten Evolutionsgleichung der Grenzfläche zweier geschichteter, nicht mischbarer Fluidschichten in Langwellennäherung wird unter der Einwirkung von Gravitation und Thermokapillarität (Marangoni-Effekt) die Möglichkeit einer Lyapunovformulierung vorgestellt. Diese ermöglicht 1.) eine Aussage über das Langzeitverhalten der Lösung für $t \to \infty$ und 2.) eine Untersuchung der Metastabilität. In diesem Vortrag wird die Metastabilität des Systems unter Verwendung des Energiefunktionals untersucht.

DY 10.11 Fr 12:45 TU H3010

Statistical properties of a particle model for twodimensional turbulence — •Oliver Kamps — Institut für Theoretische Physik WWU Münster, Wilhelm-Klemm-Str.9 48149 Münster

Starting from a point-vortex description of a forced twodimensional flow we investigate numericaly the statistical properties of the lagrangian and eulerian fluid dynamics. We focus on the probability distribution functions for the positions and the velocity increments of the vortex particles.

DY 11 Nonlinear Dynamics

Zeit: Freitag 10:30–12:30 Raum: TU H2032

DY 11.1 Fr 10:30 TU H2032

Dissipative optical solitons in the presence of a symmetry-breaking pitchfork bifurcation — •Matthias Pesch, Jens-Uwe Schurek, Thorsten Ackemann, and Wulfhard Lange — Institut für Angewandte Physik, Westfälische Wilhelms-Universität Münster, Corrensstr. 2/4, 48149 Münster

In this report, we consider the mechanisms leading to the stabilization of dissipative optical spatial solitons, which are observed in a specific realization of a single-mirror feedback experiment using sodium vapor as the nonlinear medium. This system exhibits a symmetry breaking pitchfork bifurcation leading to (nearly) equivalent homogeneous or patterned states with different polarization. By means of an addressing beam a circular domain of one polarization state existing on a background of the other can be ignited. We observe a curvature-driven shrinkage of the domain that can be counteracted by disturbing the pitchfork bifurcation. A family of spatial solitons can be stabilized if an operation point close to or above the threshold of a modulational instability is chosen. We observe clusters of different solitons, tightly bound compound states of solitons and solitons interacting with fronts.

DY 11.2 Fr 10:45 TU H2032

The influence of the breathing mode on the dynamic of dissipative solitons in a three-component reaction-diffusion system — •Svetlana Gurevich[1], Andreas Liehr[2], Shalva Amiranashvili[1] und Hans-Georg Purwins[1] — [1]Institut für Angewandte Physik, WWU Münster,Corrensstrasse 2-4, 48149 Münster — [2]Freiburger Materialforschungszentrum, Stefan-Meier-Str. 21, D-79104 Freiburg

We investigate the stability of the localized solutions in a three-component reaction-diffusion system with one activator and two inhibitors. Changing the time constants of inhibitors leads to the instability of a stationary solution. In many cases the breating mode comes first and the stationary dissipative soliton undergoes a bifurcation from a stationary to a "breathingßtate.This situation is analyzed performing a multiple scale perturbation expansion up to third order in the vicinity of the bifurcation point. To prove the correctness of the calculations,numerical simulations are carried out showing good agreement with the analytical predictions.

DY 11.3 Fr 11:00 TU H2032

Retinotopic Projections: Self-Organization of Neural Maps in the Visual System — •Martin Güssmann[1], Axel Pelster[2], and Günter Wunner[1] — [1]1. Institut für Theoretische Physik, Universität Stuttgart, Stuttgart, Germany — [2]Fachbereich Physik, Universität Duisburg-Essen, Essen, Germany

Neural connections in the visual system of vertebrates exhibit the essential feature that they conserve neighbourhood relations between different sheets of nerve cells. For instance, neighbouring cells of the retina project onto neighbouring cells of the tectum, a part of the brain which plays an important role in processing optical information. We use a general model for the development of such retinotopic projections between manifolds of different geometries to investigate the generation of ordered patterns between two strings and two planes, respectively. The generation of retinotopic projections between two strings turns out to be very similar to the case of discrete linear chains analyzed previously by Häussler and v.d. Malsburg [1]. It is shown that both for strings and for planes the emerging retinotopic states correspond to stationary solutions of the Häussler-equations. Finally, we present some numerical results of these self-organization processes and discuss, in particular, the influence of different cooperation functions within the retina and tectum.

[1] A.F. Häussler and C. von der Malsburg, J. Theoret. Neurobiol. **2**, 47 (1983)

DY 11.4 Fr 11:15 TU H2032

Nonlinear dynamics of micro-opto-mechanical cavities — •Florian Marquardt, S. M. Girvin, and Jack Harris — Department of Physics, Yale University, New Haven 06520, USA

We present a detailed theoretical analysis of the nonlinear dynamics of a Fabry-Perot cavity mirror moving under the influence of radiation pressure. We will discuss the existence of multiple stable dynamical attractors, the influence of noise, the possibility of tailoring the effective potential via multi-color laser input, and the effects of the dynamics on the output light.

DY 11.5 Fr 11:30 TU H2032

Stochastic Resonance in Colloidal Systems — •Carmen Schmitt[1], Dusan Babic[2], Igor Poberaj[2], and Clemens Bechinger[1] — [1]2. Physikalisches Institut, Universität Stuttgart, 70569 Stuttgart — [2]Faculty of Mathematics and Physics, University of Ljubljana, Jadranska 19, 1000 Ljubljana, Slovenia

The concept of Stochastic Resonance (SR) has been used to describe very different effects such as the periodic occurence of the ice ages, the feeding behaviour of paddlefish or human balance control and visual perception. The essential feature of SR is that in nonlinear systems noise can improve the detection of weak periodic signals.

Although characteristic features of SR have been observed in several experiments, there are only few examples where the effect is studied on a microscopic level. In our experiment we work with a model system where both the length scales and the time scales are conveniently accessible: we investigate the dynamics of colloidal particles fluctuating in double well potentials created by optical tweezers. In contrast to many other experiments, this configuration allows us to study systems of several coupled particles.

We present results on SR in an isolated system [1] and in systems with several coupled particles.

[1] D. Babič, C. Schmitt, I. Poberaj and C. Bechinger, Europhys. Lett. **67**, 158–164 (2004)

DY 11.6 Fr 11:45 TU H2032

Stimulation of subharmonic dynamics in electroconvection patterns — •Jana Heuer[1], Thomas John[2], and Ralf Stannarius[1] — [1]Otto-von-Guericke-Universität Magdeburg — [2]Carl-von-Ossietzky-Universität Oldenburg

Electroconvection (EHC) in nematic liquid crystals is classically driven by periodic sine or square wave voltages. The spontaneous formation of regular patterns is a critical phenomenon and characterized by threshold values for the excitation field.

An important aspect of our investigations is the fundamental influence of the excitation wave form on the dynamic response of the observed dissipative system. We study how the generation of the newly discovered subharmonic pattern regime (first described in [1]) depends on the symmetry of the excitation. Therefore we analyze the spatio-temporal dynamics of the system near the threshold voltage experimentally.

Since electroconvection in nematics can be described by a system of two coupled ordinary differential equations, we compare these experimental results with theoretical calculations. Many other dynamic systems can be characterized by these simple ODEs, thus we try to derive general conclusions about the relationship between the symmetry of the excitation and the dynamic response of the system.

Furthermore we characterize higher instabilities that occur far from threshold compared to the higher instabilies in the classical regimes.

A comprehensive representation of the subharmonic regime is the ambition of our investigations.

[1] T. John and R. Stannarius, Phys. Rev. E 70, 025202 (2004)

DY 11.7 Fr 12:00 TU H2032

Numerisch-analytische Untersuchungen zur verallgemeinerten Kuramoto-Sivashinsky-Gleichung — •Frank Löcse und Günter Radons — Institut für Physik, TU Chemnitz, D-09107 Chemnitz

Eine mikroskopische Beschreibung von Abtragsrate und Schnittfront beim Wasserabrasivstrahlschneiden und verwandten Schneidetechniken (Ionenstrahlschneiden, Laserstrahlschneiden) stößt aufgrund der Komplexität des Problems auf erhebliche Schwierigkeiten. Daher wurde im Sinne eines Landau-artigen Zugangs eine nichtlineare Evolutionsgleichung für die Schnittfront $S(\vec{r},t)$ aufgestellt, die wesentliche Aspekte der Schneidvorgänge qualitativ richtig wiedergibt.

Wir diskutieren das Lösungsverhalten der auf diesem Wege erhaltenen verallgemeinerten Kuramoto-Sivashinsky-Gleichung $\frac{\partial S(\vec{r},t)}{\partial t} + \vec{u}\nabla S(\vec{r},t) = v(\vec{r})\left\{\frac{1}{1+[\nabla S(\vec{r},t)]^2} + \alpha\Delta S(\vec{r},t) + \beta\Delta^2 S(\vec{r},t)\right\}$ für einen weiten Parameterbereich (α,β,u) und verschiedene Strahlfunktionen $v(\vec{r})$ numerisch und zeigen, daß wesentliche Lösungseigenschaften bereits aus einfachen analytischen Lösungsansätzen folgen.

DY 11.8 Fr 12:15 TU H2032

Crash Test for the Restricted Three-Body Problem — •Jan Nagler — Institut für Theoretische Physik, Universität Bremen, Otto-Hahn-Allee, 28334 Bremen, Germany

The restricted three-body problem serves to investigate the chaotic behavior of a small body under the gravitational influence of two heavy primary bodies. We analyze numerically the phase space mixing of bounded motion, escape and crash in this simple model of (chaotic) celestial mechanics. The presented extensive numerical analysis reveals a high degree of complexity. We extend the recently presented findings for the Copenhagen case of equal main masses to the general case of different primary body masses. Collisions of the small body onto the primaries are comparatively frequent, and their probability displays a scale-free dependence on the size of the primaries as shown for the Copenhagen case. Interpreting crash as leaking in phase space the results are related to both chaotic scattering and the theory of *leaking* Hamiltonian systems.

DY 12 Fluid Dynamics II

Zeit: Freitag 14:30–15:15 Raum: TU H3010

DY 12.1 Fr 14:30 TU H3010

Stretch-flow of thin layers of Newtonian liquids: Fingering patterns and lifting forces — •Anke Lindner[1], Didi Derks[2], and Michael Shelley[3] — [1]PMMH, Ecole Supérieure de Physique et de Chimie Industrielles, 10, rue Vauquelin, 75231 Paris Cedex 05, France — [2]Soft Condensed Matter, Debye Institute, Utrecht University, Princetonplein 5, 3584 CC Utrecht, The Netherlands — [3]Applied Math Lab, Courant Institute, New York University, New York City, NY 10012, USA

We study the stretch flow of a thin layer of Newtonian liquid constrained between two circular plates. The evolution of the interface of the originally circular bubble is studied when lifting one of the plates at a constant velocity and the observed pattern is related to the measured lifting force. By comparing experimental results to numerical simulations using a Darcy's law model we can account for the fully non-linear evolution of the observed fingering pattern. One observes an initial destabilization of the interface by growth of air fingers due to a Saffman Taylor like instability and then a coarsening of the pattern towards a circular interface until complete debonding of the two plates occurs. Numerical simulations reveal that when relating the observed patterns to the lifting force not only the number of fingers but also the amplitude of the fingering growth has to be taken into account. This is in agreement with the experimental observations.

DY 12.2 Fr 14:45 TU H3010

Thin liquid films on a slightly inclined heated plate: From Cahn-Hilliard to Kuramoto-Sivashinsky behaviour — •Uwe Thiele[1] and Edgar Knobloch[2] — [1]Max-Planck-Institut für Physik komplexer Systeme, Nöthnitzer Str. 38, D-01187 Dresden, Germany — [2]Department of Physics, University of California, Berkeley CA 94720, USA

After formulating the basic mathematical problem for a thin liquid film on a uniformly heated substrate we discuss the stationary solutions in the case of a horizontal substrate. These are time-independent and of two types: continuous solutions with thickness bounded away from zero, and discontinuous solutions consisting of drops separated by dry spots. We describe a construction that generates all such solutions and illustrate it with explicit examples. We then discuss how the solution landscape collapses once the substrate is inclined. The solutions are now devoid of dry spots and all slide down the substrate. These states are obtained by solving a nonlinear eigenvalue problem, and their stability properties can be mapped out by solving an additional linear eigenvalue problem. The results shed light on the multiplicity of states accessible to systems of this type and on the possible transitions among them.

[1] U. Thiele and E. Knobloch, *Physica D*, **190**, 213–248 (2004).

DY 12.3 Fr 15:00 TU H3010

Integral equations for simple fluids in a general reference functional approach — •Martin Oettel — Max–Planck–Institut für Metallforschung, Heisenbergstr. 3, D–70569 Stuttgart, Germany

The integral equations for the correlation functions of an inhomogeneous fluid mixture are derived using a functional Taylor expansion of the free energy around an inhomogeneous equilibrium distribution. The system of equations is closed by the introduction of a reference functional for the correlations beyond second order in the density difference from the equilibrium distribution. Explicit expressions are obtained for energies required to insert particles of the fluid mixture into the inhomogeneous system. The approach is illustrated by the determination of the equation of state of a simple, truncated Lennard–Jones fluid and the analysis of the behavior of this fluid near a hard wall. The wall–fluid integral equation exhibits complete drying and the corresponding coexisting densities are in good agreement with those obtained from the standard (Maxwell) construction applied to the bulk fluid. Self–consistency of the approach is examined by analyzing the virial/compressibility routes to the equation of state and the Gibbs–Duhem relation for the bulk fluid, and the contact density sum rule and the Gibbs adsorption equation for the hard wall problem.
[1] M. Oettel, cond-mat/0410185.

DY 13 Quantum Chaos

Zeit: Freitag 14:00–18:30 Raum: TU H2032

Hauptvortrag

DY 13.1 Fr 14:00 TU H2032

Directed chaos in a mixed phase space — •Holger Schanz — Max-Planck-Institut für Strömungsforschung und Institut für Nichtlineare Dynamik der Universität Göttingen, Bunsenstr. 10, 37073 Göttingen

In generic Hamiltonian systems regular and chaotic dynamics coexist in phase space. What happens when such systems are used to transport particles over a long distance? While global chaos leads to diffusion, chaotic transport may be directed and ballistic in a mixed phase space. This can be applied to rectify oscillating forces in a periodic potential without any dissipation, i.e., as a Hamiltonian ratchet. However, we address directed chaos also for undriven and for scattering systems.
Classical and quantum transport are in correspondence for a finite time only. After that tunneling and localization dominate. In the case of directed chaos localization can occur either in phase space or in configuration space, with different consequences for the long-time dynamics. We elucidate how in either case quantum transport is encoded in phase-space structures of the eigenstates.

DY 13.2 Fr 14:30 TU H2032

Flooding of regular islands by chaotic states — •Arnd Bäcker, Roland Ketzmerick, and Alejandro G. Monastra — Institut für Theoretische Physik, TU Dresden, 01062 Dresden

We introduce a criterion for the existence of regular states in systems with a mixed phase space. If this condition is not fulfilled chaotic eigenstates substantially extend into a regular island. Wave packets started in the chaotic sea progressively flood the island. The extent of flooding by eigenstates and wave packets increases logarithmically with the size of the chaotic sea and the time, respectively. This new effect can be observed for island chains with just 10 islands.

Reference: A. Bäcker, R. Ketzmerick, and A. G. Monastra, nlin.CD/0409029, http://arxiv.org/abs/nlin.CD/0409029

DY 13.3 Fr 14:45 TU H2032

Resonance-and chaos-assisted tunneling in mixed regular-chaotic systems — •Christopher Eltschka and Peter Schlagheck — Institut f. Theoretische Physik, Universität Regensburg

Despite its genuine quantal character, dynamical tunneling is strongly sensitive to details of the underlying classical phase space. A particularly prominent scenario in this context is "chaos-assisted" tunneling which takes place between quantum states that are localized on two symmetry-related islands in a mixed regular-chaotic phase space. We present evidence that nonlinear resonances govern this tunneling process. In a similar way as for near-integrable tunneling, such resonances induce couplings between regular states within the island and states that are supported by the chaotic sea. On the basis of this mechanism, we derive a semiclassical expression for the average tunneling rate, which yields good agreement in comparison with the exact quantum tunneling rates calculated for the kicked rotor and the kicked Harper.

DY 13.4 Fr 15:00 TU H2032

A super-Ohmic energy absorption in driven quantum chaotic systems — •Alexander Ossipov[1], Denis Basko[2], and Vladimir Kravtsov[1,3] — [1]The Abdus Salam International Centre for Theoretical Physics, Strada Costiera 11, 34014 Trieste, Italy — [2]Physics Department, Princeton University, NJ 08450, USA — [3]Landau Institute for Theoretical Physics, 2 Kosygina Street, 117940 Moscow, Russia

We consider energy absorption by driven chaotic systems of the symplectic symmetry class. According to our analytical perturbative calculation, at the initial stage of evolution the energy growth with time can be faster than linear. This appears to be an analog of weak anti-localization in disordered systems with spin-orbit interaction. Our analytical result is also confirmed by numerical calculations for the symplectic quantum kicked rotor.

DY 13.5 Fr 15:15 TU H2032

A universal ionization threshold for strongly driven Rydberg states — •Andreas Buchleitner and Andreas Krug — Max-Planck-Institut für Physik komplexer Systeme, D-01187 Dresden

We observe a universal ionization threshold for microwave driven one-electron Rydberg states of H, Li, Na, and Rb, in an *ab initio* numerical treatment without adjustable parameters. This sheds new light on old experimental data, and widens the scene for Anderson localization in light matter interaction. Recent experimental observations [1] confirm our predictions [2]. [1] H. Maeda and T.F. Gallagher, Phys. Rev. Lett. 93, 193002 (2004) [2] A. Krug and A. Buchleitner, quant-phys/0404117

DY 13.6 Fr 15:30 TU H2032

First experimental evidence for quantum echoes in scattering systems — •T. Friedrich[1], B. Dietz[1], H.-D. Gräf[1], A. Heine[1], C. Mejia-Monasterio[2], M. Miski-Oglu[1], A. Richter[1] und T. H. Seligman[3] — [1]TU-Darmstadt, Institut für Kernphysik, Schlossgartenstr. 9, 64289 Darmstadt — [2]Center for Nonlinear and Complex Systems, Como, Italy — [3]Centro Internacional de Ciencias, Cuernavaca, Mexico

We investigated a scattering system with mixed dynamics and a large stable island in phase space. In those systems the dynamics in the interface between the stable island and the surrounding chaotic sea is described by a Smale horseshoe and a periodic response to an incoming pulse has been predicted theoretically. We observed for the first time this self-pulsing effect, termed quantum echoes, experimentally in an open superconducting microwave billiard [Phys. Rev. Lett. 93, 134102 (2004)]. The periods of the echoes can be related to the development stage of the horseshoe and therefore the quantum measurement provides information about the classical scattering process. This work has been supported by DFG within SFB 634.

DY 13.7 Fr 15:45 TU H2032

Goos-Hänchen effect at curved interfaces — •Martina Hentschel[1] and Henning Schomerus[2,3] — [1]Universität Regensburg, 93040 Regensburg — [2]MPIPKS Dresden, Nöthnitzer Str. 38, 01187 Dresden — [3]University of Lancaster, Lancaster LA1 4YW

The Goos-Hänchen effect describes that under the conditions for total reflection the reflected beam is displaced along the dielectric interface from the point of incidence of the incoming beam. This effect leads to corrections to the ray picture, and at curved interfaces also implies corrections to Fresnel's laws, which become sizable when the wavelength becomes comparable to the system size. Here, we use Husimi functions generalized to dielectric interfaces in order to study the Goos-Hänchen effect at curved interfaces, for which we consider a focussed beam that hits a circular resonator. We show that the Husimi functions allow to read-off the Goos-Hänchen shift directly in phase space. We study the dependence on the angle of incidence, the index of refraction and the curvature of the resonator, as well as on the wavelength and the beam width. This allows us to distinguish between beam and curvature effects. We also determine the effective scattering radius of the cavity and discuss near and far field radiation characteristics.

DY 13.8 Fr 16:00 TU H2032

Langzeitasymptotik der Fidelity für kohärente Anfangszustände — •Jens Bolte und Tobias Schwaibold — Abteilung Theoretische Physik, Universität Ulm

Die *Fidelity* ist ein von A. Peres eingeführtes Maß für die Empfindlichkeit einer Quantendynamik auf Störungen des Hamiltonoperators. Für Systeme, die in Wechselwirkung mit ihrer Umgebung stehen, mißt sie auch die von der Ankopplung an die Umwelt induzierte Dekohärenz.

Wir untersuchen die Fidelity für kohärente Anfangszustände mit semiklassischen Methoden, insbesondere in Systemen mit chaotischer klassischer Dynamik. Dies geschieht ohne Verwendung von Störungstheorie. Hierbei nutzen wir aus, daß für Zeiten unterhalb der Ehrenfestzeit die Zeitentwicklung kohärenter Zustände rigoros bis auf $O(\sqrt{\hbar})$ kontrolliert werden kann. Für große Zeiten zerfällt die Fidelity in zwei Beiträge: Ein Faktor beschreibt das mit bzw. ohne Störung unterschiedliche Zerfließen des Wellenpakets, während der zweite Faktor vom Auseinanderlaufen klassischer Bahnen bestimmt wird. Bei einer instabilen klassischen Dynamik zerfällt die Fidelity daher typischerweise schneller als exponentiell.

DY 13.9 Fr 16:15 TU H2032

A new experimental setup for measuring wave functions in a microwave billiard — •M. Miski-Oglu, B. Dietz, T. Friedrich, H.-D. Gräf, A. Heine, A. Richter, and F. Schäfer — TU Darmstadt, Institut für Kernphysik, Schlossgartenstr. 9, 64289 Darmstadt

A new method for the measurement of field distributions in microwave billiards has been developed. It is based on a well-known perturbation body technique. From the experimentally determined electric field intensity distribution the wave function can be reconstructed. The reconstruction only uses the properties of the Fourier expansion of the wave function. The procedure is equally effective for low lying and highly excited wave functions. The whole set of wave functions up to the 1000th state can be obtained. This allows us to study properties of the nodal lines and nodal domains of a wave function in microwave billiards. This work has been supported by DFG within SFB 634.

DY 13.10 Fr 16:30 TU H2032

Signatures of Dynamical Tunneling in the Wave function of a Soft-Walled Open Microwave Billiard — •Ulrich Kuhl[1], Young-Hee Kim[1], Hans-Jürgen Stöckmann[1], and Jon Bird[2] — [1]Fachbereich Physik der Philipps-Universität Marburg, Renthof 5, D-35032 Marburg — [2]Department of Electrical Engineering, the University at Buffalo, Buffalo, NY 14260-1920, USA

Evidence for dynamical tunneling is observed in studies of the transmission, and wave functions, of a soft-walled microwave cavity resonator. In contrast to previous work, we identify the conditions for dynamical tunneling by monitoring the evolution of the wave function phase as a function of energy, which allows us to detect the tunneling process even under conditions where its expected level splitting remains irresolvable.

DY 13.11 Fr 16:45 TU H2032

Wavefunction analysis of coupled Bose-Einstein condensates: A non-perturbative approach — •Moritz Hiller, Tsampikos Kottos, and Theo Geisel — Max-Planck-Institut für Strömungsforschung und Fakultät Physik der Universität Göttingen, Bunsenstraße 10, 37073 Göttingen, Germany

We study a BEC in a double well trap. As we turn on the coupling between the two wells, the wavefunctions undergo a crossover from a perturbative to a non-perturbative structure. The latter is analyzed by employing semiclassical methods which allows us to identify traces of the underlying phase-space structure. The limitations of perturbation theory are exposed and analytical expressions for the wavefunction shape in all regimes are given.

DY 13.12 Fr 17:00 TU H2032

Bose-Einstein Condensation in Canonical Ensembles — •Konstantin Glaum[1] and Axel Pelster[2] — [1]Institut für Theoretische Physik, Freie Universität Berlin, Berlin, Germany — [2]Fachbereich Physik, Universität Duisburg-Essen, Essen, Germany

We set up a recursion relation for the partition function of a finite number of bosons in different trap configurations. This leads to explicit formulas for the specific heat and the number of particles in the ground state defining the condensate. All curves have the correct small T-behavior and approach their thermodynamic limits uniformly for all temperatures. This is in contrast to an earlier version of the theory in Feynman's textbook on Statistical Mechanics, which ignored the special role of the ground state.

DY 13.13 Fr 17:15 TU H2032

Quantendynamik von Wellenpaketen auf gekoppelten adiabatischen Potentialen — •Monika Hejjas und Bernd Esser — Institut fuer Physik, Humboldt-Universitaet, Berlin, Newtonstr. 15, 12489 Berlin, Germany

Die Dynamik von Wellenpaketen auf gekoppelten Potentialen wird mittels des Spin - Boson Modells untersucht. Die Spin Abhaengigkeit in den numerisch bestimmten Eigenzustaenden wird benutzt um die Wellenpakete bestimmten klassischen Phasenraumtrajektorien zuzuordnen. Anhand numerisch propagierter Zustandsvektoren des Spin - Boson Systems wird das Aufspaltungsverhalten der Wellenpakete in den Kreuzungspunkten der klassischen Trajektorien untersucht. Es wird die Ausbreitung verallgemeinerter kohaerenter Zustaende mittels numerischer und analytischer Methoden betrachtet. Die Ergebnisse werden durch Husimi Projektionen als zeitabhaengige Phasenraumdichten veranschaulicht.

DY 13.14 Fr 17:30 TU H2032

Local Equilibrium Aspects of Small Quantum Systems: Kubo Formula in Liouville Space — •Mathias Michel[1], Jochen Gemmer[2], and Günter Mahler[1] — [1]Institute of Theoretical Physics I, University of Stuttgart — [2]Department of Physics, University of Osnabrueck

We consider chains consisting of several identical subsystems weakly coupled by various types of next neighbor interactions. At both ends the chain is coupled to a respective heat bath with different temperature modeled by a Lindblad formalism [1]. The temperature gradient introduced by this environment is then treated as an external perturbation. We propose a method to evaluate the heat current and the local temperature profile of the resulting stationary state as well as the heat conductivity in such systems [2]. This method is similar to Kubo techniques used e.g. for electrical transport but extended here to the Liouville space.

[1] J. Gemmer, M. Michel and G. Mahler, Quantum Thermodynamics, Springer LNP657 (2005)

[2] M. Michel, J. Gemmer and G. Mahler, Eur. Phys. J. B, submitted (2004)

DY 13.15 Fr 17:45 TU H2032

Autonomous Quantum Thermodynamic Machines — •Friedemann Tonner and Günter Mahler — Institut für Theoretische Physik 1, Universität Stuttgart, Pfaffenwaldring 57, D-70550 Stuttgart, Universität Stuttgart

How far can a thermodynamic machine be down-scaled? We show, how each functional part of a thermodynamic machine (gas system, piston, control of bath coupling, work reservoir) can be modeled quantum mechanically. Our approach is unique in constructing an autonomous model consisting of a spin (acting as gas system) and a harmonic oscillator (acting as piston, bath-control and work variable) using autonomous Hamiltonians and incoherent Lindblad operators (bath coupling is Markovian). We present explicit results for Carnot-like cyclic processes (heat engine and heat pump). Thermodynamic machines prove to be ideal testbeds for exploring quantum control in open systems.

DY 13.16 Fr 18:00 TU H2032

Spacetime structures of continuous time quantum walks — •Oliver Mülken and Alexander Blumen — Institut für Physik, Universität Freiburg

The propagation by continous time quantum walks (CTQW) on one-dimensional (1d) lattices shows structures in the transition probabilities between different sites reminicient of quantum carpets. For a system with periodic and reflecting boundary conditions, we calculate the transition probabilities for a CTQW by diagonalizing the Hamiltonian and by Bloch function ansatz. Both results coincide.

DY 13.17 Fr 18:15 TU H2032

Dynamics of systems coupled to finite markovian environments: Deviations from standard quantum master equation results — •Jochen Gemmer[1] and Mathias Michel[2] — [1]Universität Osnabrück, Barbarastr. 7, 49069 Osnabrück — [2]Universität Stuttgart, Institut für Theoretische Physik I, Pfaffenwaldring 57, 70550 Stuttgart

We investigate few level quantum systems coupled to environments which are specified only by their energy spectra. For environments featur-

ing a finite but large enough number of eigenstates to represent markovian systems, we find local system dynamics that deviate from what Nakajima-Zwanzig type quantum master equations produce. We compare results from the Nakajima-Zwanzig method, the Hilbertspace average method and present exact numerical solutions for the corresponding Schrödinger equations.

DY 14 Complex Fluids

Zeit: Freitag 15:30–18:30 Raum: TU H3010

DY 14.1 Fr 15:30 TU H3010

Lattice-Boltzmann simulations of the self-organisation of amphiphilic mesophases and possible microfluidic applications — •Jens Harting — Instut für Computerphysik, Pfaffenwaldring 27, 79569 Stuttgart

The dynamical self-assembly of a particular amphiphilic mesophase, the gyroid, can be modelled using the lattice Boltzmann method. This mesophase forms from a homogeneous mixture, without any external constraints imposed to bring about the gyroid geometry, which is an emergent effect of the mesoscopic fluid parameters. We report on self-assembly and dynamics studies of gyroid mesophases, where our particular interest is on the formation and behaviour of defects in the system in order to understand their influence on the mesophases' properties. Defects can be grain-boundary defects between gyroid domains, dislocations, line defects, or localised non-gyroid regions. Gyroid mesophases can be very stable and might thus be applicable as microfilters in very confined geometries. We will present results from simulations of the gyroid in microchannels.

DY 14.2 Fr 15:45 TU H3010

A mesoscopic, particle-based model for fluid flow with a non-ideal equation of state — •Thomas Ihle[1], Erkan Tuzel[1,2], and Daniel Kroll[1] — [1]Department of Physics, North Dakota State University, Fargo, ND 58105, USA — [2]School of Physics and Astronomy, 116 Church Street SE, University of Minnesota, Minneapolis, MN 55414, USA

A recently introduced stochastic model for fluid flow, called Stochastic Rotation Dynamics (SRD), is a promising tool for the coarse-grained modeling of a fluctuating solvent, particularly for colloidal, vesicle and polymer suspensions. Instead of solving Navier-Stokes equations explicitly, the fluid is modelled by "fluid"-particles with continuous velocities and efficient multi-particle collisions. It is shown how the transport coefficients can be calculated exactly and that they are in very good agreement with numerical simulations. A new extension of the model is presented where the collision rules depend on particle velocities which leads to a nonideal equation of state. These rules obey detailed-balance and an H-theorem. Transport coefficients, equation of state and speed of sound are calculated and compared with numerics.

DY 14.3 Fr 16:00 TU H3010

Shear thickening, stick-slip like flow behavior and rheo-chaos in non-linear Maxwell model fluids — •Siegfried Hess[1] and Ortwin Hess[2] — [1]Inst.f.Theoret.Physik, TU Berlin — [2]Advanced Technology Institute, School of Electronics and Physical Sciences, University of Surrey, Guildford, GU2 7XH, UK

The nonlinear Maxwell model equation for the stress tensor as introduced previously in O. Hess and S. Hess, Physica A 207 (1994) 517 to treat the shear thickenening and shear thinning behavior of fluids can also be applied for temperatures and densities where a substance shows a yield stress. The basic equations are discussed. Analytic and mainly numerical results are presented for the plane Couette flow geometyry. Depending on the model parameters and on the imposed sheat rate, a stationary state can be reached or not. In the second case periodic solutions of stick-slip like motions or irregular chaotic behavior is found. For some typical cases the shear stress, the first and second normal stress differences as well as the stress components which break the Couette symmetry are displayed as functions of the time. Different types of time dependent solutions can be distinguished by the rheological phase portraits. Some remarks are made on the entropy production associated with the viscous flow and the stress relaxation.

DY 14.4 Fr 16:15 TU H3010

Einfluss der festen Grenzfläche auf Struktur und Dynamik in komplexen Flüssigkeiten unter Scherung — •Max Wolff[1,2], Andreas Magerl[3] und Hartmut Zabel[2] — [1]Institut Laue-Langevin, BP 156, 38042 Grenoble Cedex 9, Frankreich — [2]Lehrstuhl für Festkörperphysik, Ruhr-Universität Bochum — [3]Lehrstuhl für Kristallographie und Strukturphysik, Universität Erlangen-Nürnberg

Die Struktur von kondensierter Materie nahe einer Grenzfläche kann sich von der im Volumen, die mit Neutronenkleinwinkelstreuung (SANS) zugänglich ist, unterscheiden.

Kürzlich konnten wir zeigen, dass mittels einer Kombination von SANS und Neutronenreflektometrie die Struktur von Polymerlösungen nahe Grenzflächen mit unterschiedlicher chemischer Terminierung in 3 Dimensionen gelöst werden kann [1]. Wir fanden in Abhängigkeit von Parametern wie Temperatur, Scherrate oder Zusammensetzung des Polymers einen unterschiedlichen Einfluss von hydrophilen und hydrophoben Grenzflächen.

Neutronenspektroskopie gibt zusätzlich Aufschluss über die mikroskopische Dynamik der Polymerlösung. Unter Scherung wird die Translationsdiffusion in Richtung des Schergradienten verlangsamt wenn durch die Grenzfläche strukturelle Ordnung induziert wird. Fehlt die grenzflächeninduzierte Ordnung, dann wird kein Einfluss von Scherung auf die Diffusion beobachtet [2].

[1] M. Wolff et al.: Phys. Rev. Lett. 92, 255501 (2004).
[2] M. Wolff et al.: Phys. Rev. E (submitted).

DY 14.5 Fr 16:30 TU H3010

Point force manipulation and activated dynamics of polymers adsorbed on structured substrates — •P. Kraikivski, R. Lipowsky, and J. Kierfeld — MPI für Kolloid- und Grenzflächenforschung, 14424 Potsdam

We study the activated motion of adsorbed polymers which are driven over a structured substrate by applying a localized *point* force. Our theory applies to experiments on single adsorbed polymers using, for example, force microscopy tips to drive the polymer. We consider both flexible and semiflexible polymers, and the surface structure is represented by double-well or periodic potentials. The dynamics is governed by kink-like excitations for which we calculate shapes, energies, and critical point forces. Thermally activated motion proceeds by the nucleation of a kink-antikink pair at the point where the force is applied and subsequent diffusive separation of kink and antikink. In the stationary state of the driven polymer the collective kink dynamics can be described by an one-dimensional symmetric simple exclusion process.

DY 14.6 Fr 16:45 TU H3010

Stretching of polymers on sub-Kolmogorov scales in a turbulent flow — •Jörg Schumacher — Fachbereich Physik, Philipps-Universität Marburg, 35032 Marburg

We study the stretching behaviour of polymers on scales below the viscous Kolmogorov scale in a turbulent flow. Brownian dynamics simulations of an ensemble of dumbells are combined with direct numerical simulations of Navier-Stokes turbulence that resolve sub-Kolmogorov scales very well. The role of extreme stretching events on the overall statistics is discussed. Our results are compared with recent measurements in so-called von Karman swirling flows.

DY 14.7 Fr 17:00 TU H3010

Lattice and continuous models of random heteropolymer adsorption — •Alexey Polotsky[1,2], Andreas Degenhard[1], and Friederike Schmid[1] — [1]Condensed Matter Theory, Fakultät für Physik, Universität Bielefeld — [2]Institute of Macromolecular Compounds of the Russian Academy of Sciences, St.-Petersburg, Russia

Continuous and lattice models were used to study the adsorption of a random heteropolymer chain onto homo- and heterogeneous substrates. Different approaches were employed for the averaging over the

sequence/surface disorder and the computation of the conformational average. In the continuous case, these are the replica trick and the reference system approach, respectively, whereas in the case of a lattice model partial annealing (the so called "Morita approximation") in combination with the generating function approach were applied. For the continuous model simple equations for the desorption-adsorption transition line were obtained. In the lattice models, the temperature dependency with respect to different conformational characteristics of the chain above the adsorption threshold were calculated. Some of the results were tested by a comparison with numerical lattice calculations.

DY 14.8 Fr 17:15 TU H3010

Free Energy of a Charged Polymer in an Electrolyte — •Stephan Kramer[1], Reiner Kree[1], and Gert Lube[2] — [1]Institut f. Theoretische Physik, Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen — [2]Institut f. Numerische und Angewandte Mathematik, Universität Göttingen, Lotzestr. 16-18, 37083 Göttingen

Many physical issues fit into the context of parameter identification in optimal control problems with constraints given by partial differential equations (PDE). Solving these problems is usually extremely time-consuming. One important issue to make solving such problems feasible is optimizing the discretization of the PDE constraint especially for simulations in three dimensions. This is achieved by employing *goal-oriented* error estimation in the mesh adaption which minimizes the error of some target functional of the PDE solution rather than the error in the solution itself.

As a sample problem we use the interactions between the electrostatic field in an aqueous solution of a charged, semi-flexible polymer and its conformation. The target quantity is the combined free energy consisting of the free energy of the charge distribution and the elastic energy of the molecular conformation. Now, the optimization process consists of finding a conformation and thus a charge distribution such that the total free energy is minimal.

Besides the good convergence behavior and the need for adaptivity especially in three dimensions our numerical results demonstrate the influence of the electrostatic potential on the relationship between the conformation and the free energy.

DY 14.9 Fr 17:30 TU H3010

Colloidal transport in 2d restricted geometries — •Michael Koeppl, Artur Erbe und Paul Leiderer — Universität Konstanz

Transport of electrons in two dimensions has been studied in electronic systems for decades. Typical examples are the quantum point contact or the quantum Hall effect in a semiconductor 2-dimensional electron gas (2DEG). In the non quantum mechanical regime of low densities and large structures compared to the electron wave function, colloidal systems can serve surprisingly good as a model system for electronic transport on the nanoscale. Since the fundamental interactions are not dominated by quantum effects, even systems like pedestrians show comparable dynamical behavior.

We use a videomicroscopy setup to investigate the transport of driven particles through topological restrictions and bottlenecks with sizes comparable to the particle diameter. The use of superparamagnetic colloids allows us to tune the plasma parameter of the system simply by 'turning a knob' applying an external magnetic field. We report on lane formation of the particle trajectories due to interactions. Comparison of our colloidal transport measurements with simulations of electronic systems and traffic dynamics reveals good consistency.

DY 14.10 Fr 17:45 TU H3010

Preparation and Characterization of Capped Colloids.* — •Florian S. Merkt, Artur Erbe, and Paul Leiderer — Universität Konstanz

Colloids have been used to study interparticle and particle-wall interactions on the micron scale. Here we present a technique to fabricate colloids with a large variety of surface materials. This controlled design of surface properties enables us to investigate an even broader range of interactions than was covered by previous experiments.
In particular we prepare aqueous suspensions of capped colloids in which half of the surface is covered with a metal layer. Mono- and multilayers of magnetic and unmagnetic metals are evaporated onto micron-sized Silica spheres. By adjusting the layer structure the magnitude and direction of the magnetic moments can be tuned.
The particles' magnetic properties are characterized and their behavior in light and magnetic fields is observed. Further experiments to investigate adhesion forces and interactions in close contact between colloidal and plane surfaces are proposed. Especially the detachment dynamics of colloidal particles with various surface properties sticking to a surface will be investigated.

*Supported by the DFG through SFB 513

DY 14.11 Fr 18:00 TU H3010

The influence of particle size distribution on the solidification kinetics in colloidal hard sphere systems — •Hans Joachim Schöpe[1], Gary Bryant[2], and William van Megen[2] — [1]Johannes Gutenberg-Universität Mainz, Institut für Physik, KOMET 336, Staudinger Weg 7, D 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 (nucleation, crystal growth, ripening, vitrification) is one of the long-standing problems in solid-state physics. The use of colloidal model systems provides an ideal experimental system to reduce this lack of knowledge. A significant difference between the particles in a suspension and the atoms of a melt is that colloidal particles always have a particle size distribution (PSD). One of the least well characterized parameters in the solidification process in colloidal systems is the effect of the PSD. Here we present systematic measurements of the solidification kinetics and of the phase behaviour in dependence of the PSD of a one component system. This investigation shows that polydisperity has a significant influence to nucleation, growth velocity and the morphology and crystal structure of the resulting sample. These studies also indicate that in addition to the rate of crystallization, the crystal structure and the propensity to vitrify are also very sensitive to small variations in the particle size distribution. Surprisingly we observe a two step behaviour in the nucleation rate, which is independent of the PSD

DY 14.12 Fr 18:15 TU H3010

Why are effective potentials soft? — •Sabine H.L. Klapp — Stranski-Laboratorium für Physikalische und Theoretische Chemie, Sekr. TC7, Technische Universität Berlin, Strasse des 17. Juni 124, 10623 Berlin

In this contribution we focus on the question why effective potentials $\mathcal{W}(\mathcal{R})$ between interacting supramolecular are typically "soft", i.e., remain finite even for $R \to 0$ and vary much slower with R than the underlying interatomic interaction potentials. To this end we consider a number of special model systems, which can be treated semi–analytically, starting with an atom and a diatomic. However, the characteristic "softness" of *mesoscopic* effective potentials is recovered only for our most complex model, that is two "glassy disks" with liquid–like, yet frozen internal configurations of atoms. In this case $\mathcal{W}(\mathcal{R})$ varies so slowly that it can be parametrized by estimating the free energy change associated with the disk's overlap. The resulting overlap approximation behaves qualitatively like *ad hoc* effective potentials used in dissipative particle dynamics (DPD) simulations [1]. We also show that $\mathcal{W}(\mathcal{R})$ vanishes when the molecular units to be coarse–grained are *non–bonded* [2]. This sheds some doubts on the widely used procedure of coarse–graining water molecules in DPD simulations.

1) S. H. L. Klapp, D. J. Diestler, and M. Schoen, J. Phys.: Condens. Matter **16**, 7331 (2004). 2) H. Bock, K. E. Gubbins, and S. H. L. Klapp, in preparation.

DY 20 Symposium Renormalization and Scaling (SYRS)

Zeit: Samstag 08:30–12:30 Raum: TU H3010

DY 20.1 Sa 08:30 TU H3010

The program of the symposium is available under section SYRS.

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DY 21 Statistical Physics in Biological Systems

Zeit: Samstag 08:30–11:15 Raum: TU H2032

DY 21.1 Sa 08:30 TU H2032

Maximum Prinzip für Sequenzraummodelle der Populationsgenetik — •Uwe Grimm[1], Tini Garske[1], Ellen Baake[2] und Michael Baake[3] — [1]Applied Mathematics Dept., The Open University, Milton Keynes MK7 6AA, UK — [2]Technische Fakultät, Univ. Bielefeld, Postfach 100131, 33501 Bielefeld, Germany — [3]Fakultät für Mathematik, Univ. Bielefeld, Postfach 100131, 33501 Bielefeld, Germany

Wir untersuchen Mutations-Selektionsmodelle für die Evolution zwei- oder vierbuchstabiger Sequenzen. Mutation wird dabei als Markovprozess modelliert, Selektion durch eine Fitnessfunktion, die jeder Sequenz eine reproduktive Fitness zuordnet. Wir betrachten Fitnessfunktionen, die permutationsinvariant sind, oder allgemeiner durch ein Hopfield-artiges Überlappmaß mit einer Anzahl vorgegebener Referenzsequenzen bestimmt sind. Für unendliche Sequenzlänge lassen sich Gleichgewichtseigenschaften der Sequenzraummodelle durch ein einfaches Maximumsprinzip beschreiben [1,2,3], welches zudem eine gute Näherung für den Fall endlicher Sequenzlängen liefert.

[1] T. Garske und U. Grimm, A maximum principle for the mutation-selection equilibrium of nucleotide sequences, *Bull. Math. Bio.* **66** (2004) 397–421.
[2] T. Garske und U. Grimm, Maximum principle and mutation thresholds for four-letter sequence evolution, *J. Stat. Mech.: Theor. Exp.* (2004) P07007.
[3] E. Baake, M. Baake, A. Bovier und M. Klein, An asymptotic maximum principle for essentially linear evolution models, *J. Math. Bio.* (im Druck); Preprint q-bio/0311020.

DY 21.2 Sa 08:45 TU H2032

Breather induced anomalous charge diffusion in a DNA model — •George Kalosakas[1], Kia Ngai[2], and Sergej Flach[1] — [1]Max Planck Institute for the Physics of Complex Systems, Nothnitzer Str. 38, Dresden, 01187, Germany — [2]Naval Research Laboratory, Washington DC, 20375-5320, USA

We present results on the diffusive motion of a charge along a double stranded DNA, which interacts with the nonlinear opening dynamics of base pairs. Signatures of anomalous diffusive properties are found at relatively high temperatures. A sublinear diffusion and a plateau appears before the standard long-time diffusion during the evolution of the mean squared displacement and a significant degree of heterogeneity is exhibited among individual trajectories. Both properties are connected with the existence of vibrational hot-spots (breather or multibreather excitations). Transport parameters of the charge are strongly affected in this case, as can be exemplified by the significant suppression of the diffusion coefficient D. The variation of D with temperature follows a stretched exponential law. The results are contrasted with those of the linearized case, in the absence of breathers.

DY 21.3 Sa 09:00 TU H2032

Designability of RNA secondary structures — •Bernd Burghardt and Alexander K. Hartmann — Institut für Theoretische Physik, Universität Göttingen

Some RNA, e.g. ribozyme, provides by its secondary and tertiary structure enzymatic functionality. For a biologically relevant structure of an RNA sequence it is required that it is the most stable one, i.e. ground state, and that the ground state is unique, otherwise no definite functionality could be assigned to the sequence.

Given a RNA secondary structure the answer whether there is a RNA sequence which has this structure as its ground state structure or not, depends on the chosen energy model: for energy models with only pair contributions always such a sequence exits, while for energy models with stacking contributions there are structures that are not ground state of any RNA sequence. We numerically investigate whether this structures appear quite regularly in the space of all structures or are exceptional cases with an algorithm that exactly calculates the ground states in polynomial time. Because stacking contributions are always present in real RNA, this might have consequence for possible structures, and therefore functionality, of RNA structures.

DY 21.4 Sa 09:15 TU H2032

Comparison of RNA secondary structures with and without pseudoknots — •Alejandro Morales Gallardo, Bernd Burghardt, and Alexander K. Hartmann — Institut für Theoretische Physik, Universität Göttingen

RNA plays an important role in the biochemistry of all living systems. It does not only transmit pure genetic information, but, e.g. works as a catalyst. While for the former the primary structure, i.e. the sequence of the bases, is relevant, for the later the kind of higher order structures, i.e. secondary and tertiary structures, are relevant. While most studies concentrate on plain secondary structures without pseudo knots, we allow some special kinds of pseudo knots, which makes the computational problem more demanding, e.g. the effort for finding the ground state energy increases from $\mathcal{O}(L^3)$ without pseudo knots to $\mathcal{O}(L^6)$ the sequence length L. We have done numerical studies on statistical quantities, where we used algorithms that are able to calculate the ground-state energy exactly in polynomial time. We concentrate on the difference between models with and without pseudo knots.

DY 21.5 Sa 09:30 TU H2032

The dynamical lattice model of proteins — •Frank Dressel and Sigismund Kobe — Institut für Theoretische Physik, TU Dresden, D-01062 Dresden, Germany

Lattice models are used to investigate the energy landscape, folding properties and thermodynamics of proteins. The main disadvantage of such up to now considered rigid models is the disability to characterize the real structure. We propose a model, which is more appropriate to deal with biological conformations. The real positions of the amino acids are dynamically simulated using fixed bond lengths between the atoms and an angle distribution taken from Ramachandran plots. Data of the pairwise interactions between the amino acids are based on results of biological investigations [1]. The exact ground state (energy and conformation) is calculated using methods of optimization algorithms with respect to the global energy. Results for different proteins up to a chain length of 40 amino acids are obtained. The comparison with experimentally found biological structures [2] are in good accordance with respect to the secondary structure elements. As an example we discuss the Alzheimer's disease amyloid A4 peptide (residues 1-40).

[1] R. I. Dima, G. Settanni, C. Micheletti, J. R. Banavar, A. Maritan, J. Chem. Phys. 112 (2000) 9151.
[2] H.M. Berman, J. Westbrook, Z. Feng, G. Gilliland, T.N. Bhat, H. Weissig, I.N. Shindyalov, P.E. Bourne: The Protein Data Bank. Nucleic Acids Research 28 (2000) 235.

DY 21.6 Sa 09:45 TU H2032

Transition from local to global events in a stochastic medium — •Martin Falcke and Rüdiger Thul — Hahn Meitner Institut, Glienicker Str.100, 14109 Berlin

In the last 2-3 years, it could be shown by a sequence of simulations and analytic calculations that intracellular calcium dynamics is a stochastic nonlinear system. Spatial and temporal structures arise due to fluctuations only. The biological function of intracellular calcium dynamics is to generate transients of high calcium concentration or oscillations. Repetitive wave nucleation is one possibility to achieve this goal. A global event starts from a local fluctuation and travels through the whole system. We investigate the prerequisites for wave nucleation with master and Fokker Planck equations for calcium channel clusters and calculate average frequencies for the occurence of local events.

DY 21.7 Sa 10:00 TU H2032

Tumor induced angiogenesis: A theoretical model for neo-vascularization and tumor growth — •Heiko Rieger[1], Deok-Sun Lee[1], Raja Paul[1], and Katalin Bartha[2] — [1]Theoretische Physik, Universität des Saarlandes, 66041 Saarbrücken, Germany — [2]Department of Medical Biochemistry, Semmelweis University, Budapest, Hungary

Tumor-induced angiogenesis is the formation of new blood vessels from pre-existing capillaries around a growing tumor in a hypoxic (oxygen-depleted) microenvironment. Hypoxia induces growth factor (GF) synthesis and release from tumor cells (TC), that act on endothelial cells (EC) of nearby blood vessels. Angiogenic sprouting, new vessel formation and vessel dilatation is the result of this interaction leading to favorable tumor growth conditions. We introduce a stochastic hybrid cellular automaton model to describe quantitatively how vascularization develops in a melanoma type tumor. We present results for the spatio-dynamic evolution of the microvascular and tumor density, which reflect a compartmentalization of the tumor into rapidly vascularizing periphery and necrotic regions. Biological implications and possible physical universality classes are discussed.

DY 21.8 Sa 10:15 TU H2032

Positioning the division plane in *Escherichia coli* — •Giovanni Meacci[1], Markus Bär[1,2], and Karsten Kruse[1] — [1]Max-Planck-Institut für Physik komplexer Systeme, Nöthnitzer Straße 38, 01187 Dresden — [2]Physikalisch-Technische Bundesanstalt, Abbestraße 2-12, 10587 Berlin

During division of the bacterium *Escherichia coli*, the correct position of the division plane is determined in part by the Min proteins. For this purpose, pole-to-pole oscillations of these proteins are important. Here, a phenomenological description for these oscillations is presented, where lateral interactions between proteins on the cell membrane play a key role. The phenomenological parameters used can be linked to microscopic physical quantities and thus allow for a quantitative comparison with experimental results. To study the effects of fluctuations due to low protein numbers, we consider a Langevin equation for the fluctuating protein concentrations. It is derived through coarse graining of the microscopic master equation.

DY 21.9 Sa 10:30 TU H2032

Stable and unstable attractors in critical Boolean networks — •Konstantin Klemm[1] and Stefan Bornholdt[2] — [1]Bioinformatik, Universität Leipzig, Kreuzstr. 7b, 04103 Leipzig — [2]Theoretische Physik, Universität Bremen, Otto-Hahn-Allee, 28334 Bremen

Studying the dynamics of Boolean networks, we check the stability of the attractors against small perturbations. We perturb the synchrony in the model by slightly accelerating or decelerating the update of a subset of units. This set of perturbations is motivated by the noisy delay time with which a biological switch (neuron, expressed gene) responds to a changing input. An attractor is called stable if after any such perturbation synchrony is regained. In random Boolean networks at the critical point (connectivity K=2) the number of stable attractors grows sublinearly with increasing system size [1], while the growth of the total number of attractors is superpolynomial. Thus in large systems almost all attractors considered earlier are artefacts arising from the synchronous clocking mode.

[1] K. Klemm and S. Bornholdt, preprint cond-mat/0411102

DY 21.10 Sa 10:45 TU H2032

Theorie der AFM-Kraftspektroskopie an Rezeptor-Liganden-Systemen — •Martin Raible und Peter Reimann — Fakultät für Physik, Universität Bielefeld, PSF 100131, 33501 Bielefeld

Einzelmolekülprozesse in Rezeptor-Liganden-Systemen können mit dynamischer AFM-Kraftspektroskopie experimentell untersucht werden. In den meisten Fällen benutzt man dabei ein Rasterkraftmikroskop (AFM), wobei die einwirkende Kraft (approximativ) linear mit der Zeit zunimmt: $F(t) = \mu \cdot t$. Die allgemein akzeptierte Grundannahme [1] in allen diesbezüglichen Untersuchungen ist ein Ratengesetz mit einer nur von der momentan wirksamen Kraft $F(t)$ abhängigen Zerfallsrate $\nu(F(t))$. Bei der Anwendung einer neuen Methode [2] zur Auswertung der Kraftprokolle auf gemessene Daten [3] zeigte sich eine Inkompatibilität mit dieser Grundannahme [4]. Ein erfolgversprechender Ansatz zur Erklärung dieser Inkompatibilität wird diskutiert.

[1] E. Evans and K. Ritchie, Biophys. J. **72**, 1541 (1997).
[2] M. Evstigneev and P. Reimann, Phys. Rev. E **68**, 045103(R) (2003).
[3] F.W. Bartels, B. Baumgarth, D. Anselmetti, R. Ros, and A. Becker, J. Struct. Biol. **143**, 145 (2003).
[4] M. Raible et al., J. Biotechnology **112**, 13 (2004).

DY 21.11 Sa 11:00 TU H2032

Assessment of Parameters of Neural Ensembles for the Calibration of Modification Techniques — •Oliver Holzner[1], Alexander Kleinsorge[1], Eckehard Schöll[1], and Peter Tass[2] — [1]Institut für Theoretische Physik, Technische Universität Berlin, D-10623 Berlin, Germany — [2]Institut für Medizin, Forschungszentrum Jülich, D-52425 Jülich, Germany

Differential equations modeling neural ensemble behavior generally contain a multitude of parameters governing the ensemble's behavior. Their corresponding neurophysiological parameter values vary substantially between individuals, and even within one individual over time. The problem of calibrating these parameters without dissecting the system ("in-vivo") is solved by using nonlinear response theory in conjunction with calculating non-autonomous attractor landscapes for the dynamical system considered. Functioning of calibration by means of elementary versus feedback-looped input signals is demonstrated in the presence of various types of noise.

DY 22 Networks

Zeit: Samstag 11:30–13:00 Raum: TU H2032

DY 22.1 Sa 11:30 TU H2032

Active Control of Bipedal Locomotion — •Joachim Hass[1,2], J. Michael Herrmann[1], and Theo Geisel[1,2] — [1]Georg-August-Universität Göttingen — [2]MPI für Strömungsforschung

Passive walking machines can be realized by multiple inverted pendula with the pivot switching at each step. At small descending slopes walking cycles exist which are barely stable, but practically stability requires – in addition to fine-tuned parameters – an active suppression of perturbations. We show that control methods based on multi-step optimization of a discretized controller or on adaptive feedback are both effective in stabilizing the gait while relying only on adjusting damping constants. The energy consumption necessary e.g. at uphill motion can be controlled by the same methods. While the former method requires extensive training, the latter one adapts quickly and is realizable as a biologically plausible tuning scheme of a central pattern generator. After adaptation the CPG is sensitive to repeated features of the stride and may function as the target of high-level control. In addition we describe implications for the analysis of human gait and the control of leg prostheses.

DY 22.2 Sa 11:45 TU H2032

Neural Networks for Gamma-Hadron-Separation — •Christoph Kolodziejski and Georg Reents — Institiut für Theoretische Physik und Astrophysik, Universität Würzburg, Am Hubland, D-97074 Würzburg

The MAGIC-Telescope, an atmospheric imaging Cherenkov telescope in La Palma, gathers information in form of patterns of different types of particles. The interest is focused on the detection of gamma-rays. Compared to cosmic Cherenkov radiation signals they only constitute minor contributions, but look very alike. With the help of neural networks, a better separation than the currently used statistical algorithms is likely to be found. Different types of networks (e.g. Feed-Forward Multilayer Perceptrons, Pulsed Coupled Neural Nets) are analyzed to achieve this task.

DY 22.3 Sa 12:00 TU H2032

Synchronization in a net of FitzHugh-Nagumo neurons — •A. Skupin[1] and L. Schimansky-Geier[2] — [1]Hahn-Meitner-Institut Glienicker Str. 100 14109 Berlin — [2]Humboldt University Newtonstr. 15 12489 Berlin

While musing on Synchronization of clocks 100 years ago has led to

Einsteins theory of relativity nowadays Synchronization plays an important role in different fields of science, specially in Statisical Physics, the other theory Einstein has instituted in his mirical year. In the last three decades Synchronization was detected as an important feature in neurophysiology, where different diseases like Parkinson disease can be explained by Synchronization of neurons. Thus motivated we study a net of FitzHugh-Nagumo neurons and its behaviour to an external stimulation and delay coupling. This will be compared with the Kuramoto model and a gaussian approximation.

DY 22.4 Sa 12:15 TU H2032

Der wechselseitige Einfluss von Struktur und Dynamik in einem Polymeren Netzwerk — •Michael Lang, Marcus Wacha, Dietmar Göritz und Stefan Kreitmeier — Fakultät für Physik, AG Polymerphysik, Universität Regensburg, 93040 Regensburg

Dynamische Computer-Simulationen von polymeren Netzwerken und Einzelkettensystemen ermöglichen es, den wechselseitigen Einfluss von Netzwerkstruktur und Dynamik zu analysieren. Bei der Entstehung eines Netzwerkes ist es die Dynamik der einzelnen Moleküle, die einen wesentlichen Einfluss auf die Kinetik der Reaktion und damit auf die Entstehung der Netzwerkstruktur besitzt: Moleküle mit einer erhöhten Beweglichkeit besitzen eine größere Reaktionsgeschwindigkeit, da im gleichen Zeitintervall eine größere Anzahl von möglichen Reaktionspartnern erreicht werden kann. Aus der Statistik der Netzwerkbildung kann so eine Aussage über die Zusammensetzung der Netzwerkstruktur gewonnen werden. Diese Struktur ist es aber, die im Netzwerk wiederum die Dynamik der einzelnen Moleküle bestimmt. Dies wird exemplarisch anhand von Einzelkettensimulationen und Deformationen von Netzwerken gezeigt.

DY 22.5 Sa 12:30 TU H2032

Network properties of meteorological stations in the river Elbe basin quantified by phase synchronization — •Diego Rybski[1], Shlomo Havlin[2] und Armin Bunde[1] — [1]Institut für Theoretische Physik III, Universität Gießen, Germany — [2]Minerva Center and Department of Physics, Bar-Ilan University, Ramat-Gan, Israel

We study the phase synchronization of 317 daily precipitation records from meteorological stations located in the river Elbe basin by calculating for each pair (i, j) of records the synchronization index $\rho(i, j)$ based on the Shanon entropy, see, e.g., [1] and references therein. By shifting the time series relative to each other we determine the time delay that yields the maximum index $\rho_{max}(i, j)$. We find that $\rho_{max}(i, j)$ decays logarithmically with the distance d_{ij} between both sites. In order to study the network structure of phase synchronized sites, we determine the best fit $\overline{\rho_{max}}(d)$ of $\rho_{max}(d_{ij})$ and use the deviations $\Delta_{ij} = \rho_{max}(i, j) - \overline{\rho_{max}}(d)$ as nontrivial indicators of the bond strength between both sites. We consider those sites (i, j) as connected where the relative synchronization index Δ_{ij} exceeds a certain threshold value Δ_0, and discuss the network properties as a function of Δ_0. We show that they are distinctively different from the corresponding randomized system.

[1] D. Rybski, S. Havlin, A. Bunde, Physica A 320 (2003) 601.

DY 22.6 Sa 12:45 TU H2032

Arbitrarily Long Spike Patterns in Heterogenous Neural Networks — •Raoul-Martin Memmesheimer, Marc Timme, and Theo Geisel — Max-Planck-Institut für Strömungsforschung, D-37073 Göttingen

Patterns of precisely timed spikes are believed to be functional correlates of stimuli and as such considered key elements of brain computation [1]. A central question of theoretical neuroscience is thus how spike patterns can emerge in the dynamics of neural networks. Here we show that prescribed periodic spike patterns of arbitrary length can be stored as the attractors of heterogenous networks of neural oscillators with delayed inhibitory interactions [2, 3], generalizing [4]. We analyze the impact of specific coupling heterogeneity on the precise timings of individual spikes.

[1] M. Abeles, *Science* **304**:523 (2004).
[2] R.E. Mirollo, S.H. Strogatz, *SIAM J. Appl. Math.* **50**:1645 (1990).
[3] U. Ernst, K. Pawelzik, T. Geisel, *Phys. Rev. Lett.* **74**:1570 (1995).
[4] M. Denker, M. Timme, M. Diesmann, F. Wolf, T. Geisel, *Phys. Rev. Lett.* **92**:074103 (2004).

DY 23 Symposium Renormalization and Scaling (SYRS) – Contributed Talks I

Zeit: Samstag 14:00–15:30 Raum: TU H3010

DY 23.1 Sa 14:00 TU H3010

Large-n expansion for m-axial Lifshitz points — •Mykola Shpot[1], Yuri Pismak[2], and Hans Werner Diehl[3] — [1]Institute for Condensed Matter Physics, 79011 Lviv, Ukraine — [2]State University of Sankt-Petersburg, 198904 Sankt-Petersburg, Russia — [3]Fachbereich Physik, Universität Duisburg-Essen, Campus Essen, D-45117 Essen, FRG

A large-n expansion is presented for m-axial Lifshitz points with an arbitrary number of anisotropy directions m in d dimensional space. The first non-trivial terms of order $O(1/n)$ are derived for two independent correlation function critical exponents η_2 and η_4 and the related anisotropy index θ. Our results conform in appropriate limits with known large-n expansions for d-dimensional isotropic Lifshitz and critical points, as well as with available dimensionality expansions about the upper and lower critical dimensions. We give numerical values of the $1/n$ coefficients of η_2, η_4, and θ for physically most relevant case of uniaxial Lifshitz point in three dimensions, as well as for some other interesting choices of m and d. The $O(1/n)$ terms of these exponents are derived in a closed form in the special case $m = 1$, $d = 4$.

DY 23.2 Sa 14:15 TU H3010

Fractal structure and critical properties of planar loops — •Adriaan Schakel and Wolfhard Janke — Institut fuer Theoretische Physik, Universitaet Leipzig, Augustusplatz 10/11, 04109 Leipzig

The fractal structure of random loops formed by the high-temperature graphs of the two-dimensional O(N) model at the critical point are investigated by means of Monte Carlo simulations. At high temperatures, the loops have a finite line tension and are exponentially suppressed. Upon approaching the critical point, they gradually grow in size until reaching the critical point where the line tension vanishes and the loops proliferate–much like the sudden appearance of a spanning cluster at the percolation threshold in percolation phenomena. De Gennes' results for polymer chains, corresponding to the limit $N \to 0$, are generalized to arbitrary $-2 \leq N \leq 2$. The fractal structure of these loops is shown to encode the entire critical behavior of the O(N) models. The loops are also studied close to their tricritical point, corresponding to the Θ point in the context of polymers, where they collapse. A close connection between the fractal structures and thus the two critical behaviors is established.

DY 23.3 Sa 14:30 TU H3010

Phase structure of anomalous Coulomb gases — •Flavio Nogueira — Institut für Theoretische Physik, Freie Universität Berlin

An anomalous Coulomb gas differs from the usual one in the sense that anomalous scaling behavior makes it to deviate from the Coulomb potential form. This special type of Coulomb gas arises in the study of Mott insulators, superconductors, quantum Hall systems, and lattice gauge theories[see for example, H. Kleinert, F. S. Nogueira, and A. Sudbø, Phys. Rev. Lett. **88**, 232001 (2002); Nucl. Phys. B **666**, 361 (2003)]. One example is a logarithmic Coulomb gas in three dimensions, which undergoes a phase transition similar to the Kosterlitz-Thouless phase transition. Unlike the two-dimensional case, here the fugacity of the gas acquires an anomalous dimension. The general theoretical discussion will be illustrated by recent Monte Carlo simulations [S. Kragset, A. Sudbø, and F. S. Nogueira, Phys. Rev. Lett. **92**, 186403 (2004)].

DY 23.4 Sa 14:45 TU H3010

Infinite-dimensional symmetries in nonequilibrium systems and nonlinear differential equations — •Malte Henkel — LPM. Université Nancy I, B.P. 239, F - 54506 Vandœuvre lès Nancy, Frankreich

Spin systems quenched into their ordered phase undergo ageing and display dynamical scaling. A formal analogy with the well-known conformal invariance of equilibrium phase-transitions suggests the extension of dynamical scaling to a larger local scale-invariance. This leads to explicit predictions for the time-dependent reponse and correlation functions, in excellent agreement with recent results of numerical simulations [1]. We show that the group of local scale-transformations is infinite-dimensional

and is the dynamical symmetry group of certain nonlinear differential equations [2]. It also arises as dynamical symmetry in stochastic systems, including the simple random walk [3].

[1] M. Henkel, A. Picone and M. Pleimling, Europhys. Lett. **68**, 191 (2004). [2] R. Cherniha and M. Henkel, J. Math. Anal. Appl. **298**, 487 (2004). [3] M. Henkel and J. Unterberger, in preparation.

DY 23.5 Sa 15:00 TU H3010

Monte Carlo simulations of the 3D bond-diluted Potts model — Christophe Chatelain[1], Bertrand Berche[1], •Wolfhard Janke[2], and Pierre Emmanuel Berche[3] — [1]Laboratoire de Physique des Matériaux, Université Henri Poincaré, Nancy 1, France — [2]Institut für Theoretische Physik, Universität Leipzig, Germany — [3]Groupe de Physique des Matériaux, Université de Rouen, France

Large-scale Monte Carlo simulations of the three-dimensional bond-diluted Ising and 4-state Potts model are presented. The phase diagram and the physical properties at the phase transition are mainly studied using finite-size scaling techniques. In the Potts case, numerical evidences for the existence of a tricritical point dividing a regime where the transition remains of first order and a second regime where the transition is softened to a continuous one by the influence of disorder are briefly summarized. In the former regime, the nature of the transition is essentially clarified through an analysis of the energy probability distribution. In the latter regime critical exponents are estimated. In this talk, the main emphasis is placed on a careful analysis of rare and typical events. Their identification and role is qualitatively discussed in both regimes.

DY 23.6 Sa 15:15 TU H3010

RG flow of fermionic particle systems — •Holger Gies — Institut für theoretische Physik, Philosophenweg 16, 69120 Heidelberg

We study the renormalization flow of fermionic systems as part of (chiral) relativistic particle theories. At strong coupling, spontaneous breaking of chiral symmetry can occur, with composite bosonic fluctuations becoming important near the transition scale. We employ functional RG techniques together with a continuous transformation of fermion to bosons fields for a systematic study of symmetry breaking. In particular, we investigate how the interactions with a gauge field can induce chiral symmetry breaking in the fermionic sector.

DY 24 Granular Matter

Zeit: Samstag 14:00–16:45 Raum: TU H2032

Hauptvortrag DY 24.1 Sa 14:00 TU H2032

Lambert diffusion in porous media in the Knudsen regime — •Stefanie Russ[1], Armin Bunde[1], and Jörg Kärger[2] — [1]Institut fuer Theoretische Physik III, Justus-Liebig-Universitaet Giessen, D-35392 Giessen — [2]Fakultaet fuer Physik und Geowissenschaften, Universitaet Leipzig, D-04103 Leipzig

We study analytically and numerically molecular diffusion in nanopores with different types of roughness under the exclusion of mutual molecular collisions, i.e., in the so-called Knudsen regime. The diffusion problem can be mapped onto Levy walks, whose asymptotic behaviour decisively depends on the pore dimensionality and the angle distribution after molecular collisions with the pore walls. We calculate the roughness dependence of the diffusion coefficients D_s and D_t of self- and transport diffusion, respectively. In two-dimensional smooth pores, both types of diffusion are anomalous, i.e. D_s and D_t depend logarithmically on time t and system size L, respectively, $D_s \sim \ln t$ and $D_t \sim \ln L$. In rough pores and in $d = 3$, on the other hand, the logarithmic corrections are absent. We show, how this counterintuitive behavior can be understood from the Levy distribution of the jump lengths. Finally, we show that both diffusion coefficients decrease significantly when the roughness is enhanced, in remarkable disagreement with the previous literature.

DY 24.2 Sa 14:30 TU H2032

Solid - fluid transition of a monolayer of particles: Experiments — •Andreas Götzendorfer[1], Jennifer Kreft[1,2], Christof Krülle[1], and Ingo Rehberg[1] — [1]Experimantalphysik V, Universität Bayreuth — [2]Center for Nonlinear Dynamics, University of Texas at Austin

We study the fluidization of a monolayer of glass beads in a shaken annular container. In our experiment we superpose a vertical vibration with an angular oscillation around the axis of symmetry such that every point of the support follows a circular trajectory. As long as the maximum acceleration of the support is lower than the acceleration of gravity, the monolayer performs a sick-slip motion with respect to the support and moves as a solid block. Forcing with maximum accelerations above 1.5 times the acceleration of gravity fluidizes the monolayer completely. That means the individual particles jump high and the particle concentration is much lower than in the condensed phase. At intermediate forcing intensity we find that the two phases coexist. A block of condensed material travels around the ring at velocities of several cm/s, whereas in the rest of the ring the granular material is in a gas like state. The size of the condensed block and its speed vary with the forcing intensity.

DY 24.3 Sa 14:45 TU H2032

Can one hear the state of a granulate? — •C.A. Krülle and A. Garcia-Sanchez — Experimentalphysik V, Universität Bayreuth, D-95440 Bayreuth

If an ensemble of macroscopic particles is mechanically agitated, for example by vertical vibrations, the energy input is dissipated into the system by multiple inelastic collisions. As a result, the granular material can exhibit several physical states, like a gaseous phase for high energy input or a condensated state for low agitation. The transition between these two phases can be identified clearly by the different noise level and its dominant frequency range. We introduce a new method for quantifying this acoustical response of the granular system which allows us to identify critical parameters of the phase transition.

DY 24.4 Sa 15:00 TU H2032

Sound propagation in dense granular media — •Stefan Luding and Orion Mouraille — Particle Technology, DCT, TUDelft, Julianalaan 136, 2628 BL

The goal of the presented research is to understand information propagation in dense assemblies of spherical, polydisperse granular media. Using a discrete element method (DEM) simulation, the wave propagation is studied. After relaxation to an isotropic static equilibrium state, a wave is agitated by moving one side wall. First, the effect of the contact force-law is examined for a cubic sample; second, the effects of singular and periodic agitations are studied with Fourier analysis; third, pressure effects and an-isotropy are examined.

DY 24.5 Sa 15:15 TU H2032

Volume fluctuation measurements towards a granular statistical mechanics — •Matthias Schröter, Daniel Goldman, and Harry Swinney — Center for Nonlinear Dynamics, The University of Texas at Austin

Edwards and Oakeshott (Physica A 157, 1080 (1989)) proposed a statistical mechanics approach to static granular media based on the idea that each mechanically stable configuration of particles corresponds to a microstate of the system. We explore this granular phase space using flow pulses in a fluidized bed. This way of driving results in a steady state with a volume fraction ϕ which is controlled by the flow rate of the pulses. These steady states are shown to be history independent. ϕ exhibits Gaussian fluctuations with a standard deviation σ_ϕ which has has a parabolic minimum as a function of ϕ. Interpreting this result in terms of statistically independent regions leads to a better understanding of the geometrical properties of particle packings. The knowledge of σ_ϕ allows also to determine for the first time the compactivity X of a granular system. X is a temperature-like state variable introduced by Edwards and coworkers.

DY 24.6 Sa 15:30 TU H2032

Collective Behavior in Size Segregation of Granular Materials — •Stephan Ulrich, Matthias Schröter, and Harry L. Swinney — CNLD, University of Texas at Austin

Shaking a bidisperse mixture of particles can cause the large ones to rise (Brazil-nut effect) or to sink (reverse Brazil-nut effect). Studies of size segregation are often done in the limit of a single large intruder. However, theories based on granular temperatures (e.g. [1]) require collective interplay of many particles. Using image analysis, we experimentally investigate the importance of collective effects. Therefore the fraction of

large particles is changed from a single intruder to equal layer heights. Furthermore, the influence of the total layer height is examined. We find the reverse Brazil nut effect to be strongest in the single intruder limit, where segregation is not driven by collective effects like fluidization

[1] D. C. Hong, P. V. Quinn, and S. Luding, Phys. Rev. Lett. **86**, 3423 (2001)

DY 24.7 Sa 15:45 TU H2032

Temperature-dependent resistivity of and compacted and sintered metal powders — •Martin Gabl, Norbert Memmel, and Erminald Bertel — Institute of Physical Chemistry, University of Innsbruck, Innrain 52a, A-6020 Innsbruck, Austria

Compaction and sintering of powders are two essential steps in the powder- metallurgical production process. Various empirical approaches have been developed in order to control these processes and to characterize the properties (such as porosity or mechanical strength) of the sample by easy to apply methods, such as resistivity measurements. Since the sample resistivity depends not only on the porosity, but also on the sample purity and the nature of the contacts between individual grains a single measurement of resistivity cannot provide sufficient information to charcterize the compacted and sintered metal powder. In the present work we demonstrate that the measurement of resistivity Rho as a function of temperature T allows separating the influence of sample purity and grain-to-grain contacts on the one hand from porosity on the other hand. The latter is uniquely related to the temperature dependence dRho/dT. We further show that dRho/dT as a function of porosity is correctly described by percolation theory.

DY 24.8 Sa 16:00 TU H2032

Dynamic Scaling of Dune Evolution — •Sebastian Fischer and Klaus Kroy — Abteilung Theorie, Hahn-Meitner Institut, Glienicker Str. 100, 14109 Berlin, Germany

The beautiful shape of desert dunes is borne out by the complicated interaction between turbulent wind flow and sandy topography. In the case of unidirectional winds and limited sand supply highly mobile crescent–shaped dunes – so–called barchans – form.

In a recent approach, the key mechanisms governing barchan morphology and dynamics were identified and put into a 'minimal model for aeolian sand dunes'. The scale invariance of the turbulent flow is broken by the characteristic scale provided by the sand transport process. As an implication of broken scale invariance we distinguish two kinds of solutions, small sand heaps and larger dunes with a slip face.

We present solutions obtained for various wind and influx conditions. Fixed points of the system, corresponding to shape invariantly moving profiles, are found to be unstable. Dunes of a given volume that are oversupplied (undersupplied) with respect to this steady state grow (shrink). Interestingly, all trajectories obtained for a prescribed influx collapse (up to transients) on a single master curve. Thus the a priory very high–dimensional complexity of state space is significantly reduced. Universal scaling functions that neatly comprise growth kinetics are theoretically derived and numerically confirmed.

DY 24.9 Sa 16:15 TU H2032

Verdichtung kohäsiver Granularer Materie — •Lothar Brendel[1], Martin Morgeneyer[2], Dirk Kadau[1] und Lars-Oliver Heim[3] — [1]Universität Duisburg-Essen, Fachbereich Physik — [2]Technische Universität Braunschweig, IMVT — [3]Max-Planck-Institut für Polymerforschung, Mainz

Einer der elementarsten und am häufigsten vorkommenden Vorgänge im Kontext der Untersuchung der Spannungs/Dehnungs-Relation kohäsiver Schüttgüter ist die (einaxiale) Verdichtung. Dennoch ist in der Literatur keine Einhelligkeit hinsichtlich eines generischen funktionalen Zusammenhangs zwischen Verdichtungsspannung σ und Feststoffanteil ν bzw. Porosität $E = 1 - \nu$ zu finden [1,2]. Wir vergleichen Experimente an unterschiedlichen Modellsubstanzen (Carbonyleisenpulver, Kalkstein, Marmor) mit Computersimulationen und kommen zum Ergebnis, dass dabei dieser Zusammenhang als $E = (\sigma/\sigma^*)^\alpha + E_\infty$ über bis zu drei Dekaden zu beschreiben ist. Einflüsse auf den Exponenten α werden diskutiert.

[1] Denny, P.J.: "Compaction equations: a comparison of the Heckel and Kawakita equations", Powder Technology **127**, 162-172 (2002)

[2] Kawakita, K. and Lüdde, K.H.: SSome considerations on powder compression equations", Powder Technology **4**, 61-68 (1969)

DY 24.10 Sa 16:30 TU H2032

Influence of particle elasticity during steady state flow — •Dominik Schwesig[1], Dirk Kadau[1], Jörg Theuerkauf[2], and Dietrich E. Wolf[1] — [1]Department of Physics, Duisburg-Essen University, D-47048 Duisburg, Germany — [2]The Dow Chemical Company, Solids Processing, Freeport TX 77541, USA

Mechanical behavior of granular matter is often charachterized by using shear testers. Here, the steady state flow of non-cohesive powders plays an important role. It can be obtained in an experimental setup using a combination of strain and stress control. We present a simulation of such a biaxial shear tester. We use two complementary discrete element methods: the soft particle molecular dynamics models elastic particles whereas contact dynamics one can simulate perfectly rigid particles. Thus, one gets insight of the influence of particle elasticity on the steady state flow behavior of the powder.

DY 25 Symposium Renormalization and Scaling (SYRS) – Contributed Talks II

Zeit: Samstag 16:00–17:00 Raum: TU H3010

DY 25.1 Sa 16:00 TU H3010

The scaling of a self-avoiding walk on a percolation cluster — •Yurij Holovatch[1,2,3], Viktoria Blavats'ka[1], Christian von Ferber[4], and Reinhard Folk[2] — [1]Institute for Condensed Matter Physics, UA-79011 Lviv, Ukraine — [2]Institut für Theoretische Physik, Johannes Kepler Universität Linz, A-4040 Linz, Austria — [3]Ivan Franko National University of Lviv, UA-79005 Lviv, Ukraine — [4]Theoretische Polymerphysik, Universität Freiburg, D-79104 Freiburg, Germany

The scaling properties of a self-avoiding walk (SAW) on the d-dimensional diluted lattice at the percolation threshold are analyzed by a field-theoretical renormalization group approach. To this end we reconsider the model of Meir and Harris [1]. Although the former one-loop analysis points to a new universality class for a SAW on the percolation cluster, the numerical values found for the scaling exponents almost coincide with those for a SAW on an undiluted lattice. Our second order result for the mean square end-to-end distance exponent reads: $\nu_{\rm p} = 1/2 + \varepsilon/42 + 110\varepsilon^2/21^3$, $\varepsilon = 6 - d$ and leads to perfect agreement with known theoretical, MC and exact enumeration data [2,3]. Moreover, we argue that the observed scaling possesses multifractal properties and obtain a non-trivial spectrum of correlation exponents governing the multifractal scaling.

[1] Y. Meir and A.B. Harris, Phys. Rev. Lett. **63**, 2819 (1989).

[2] C. von Ferber, V. Blavats'ka, R. Folk, Yu. Holovatch, Phys. Rev. E **70** 035104(R) (2004).

[3] V. Blavats'ka, C. von Ferber, R. Folk, Yu. Holovatch, in: *Polymers in Random Media*, ed. by B. Chakrabarti, Elsevier, 2005 (to appear).

DY 25.2 Sa 16:15 TU H3010

Star polymer scaling - 4th order RG results and applications — •Christian von Ferber[1], Yurij Holovatch[2,3], Verena Schulte-Frohlinde[1] und Alexander Blumen[1] — [1]Theoretische Polymerphysik, Universität Freiburg — [2]Institute for Condensed Matter Physics and Ivan Franko National University of Lviv, Ukraine — [3]Johannes Kepler Universität Linz, Austria

The overall scaling properties of a branched polymeric structure in solution can be derived in terms of the scaling behavior of the star-like branching units that define its local topology. Various physical processes and situations are governed by these: the mean force between two star polymers, the correlations of the brancing units in a star burst dendrimer, the denaturation process of DNA double strands as well as trapping processes involving traps aligned on a polymer where the random walk of each trapped particle describes a branch with branching point at the trap. More complex multifractal behavior occurs in the latter example where the branches differ. In a field thoretic approach we map the problem of finding the scaling properties of the star-like branching unit to that of determinig the anomalous dimensions of an appropriate local field operator product. We present recent 4th order RG results obtained in the minimal subtraction scheme of the $\epsilon = 4 - d$ expansion. We compare our

results to previous 3rd order ϵ- and fixed dimension expansions as well as to exact results in 2D and MC simulations.
[1]V. Schulte-Frohlinde, Yu. Holovatch, C. von Ferber, A. Blumen. Phys. Lett. A 328:335-340 (2004).
[2]C. von Ferber, Yu. Holovatch, ed. Condens. Matt. Phys. 5(2002).

DY 25.3 Sa 16:30 TU H3010

Limits of real space renormalization group studies of network models for the quantum Hall effect — •Achim Manze and Bodo Huckestein — Theoretische Physik III, Ruhr-Universität Bochum, Bochum, Germany

We consider a models of Integer Quantum Hall systems with two Landau levels where each node represents a 4×4 scattering matrix and the bonds correspond to propagation along directed links subject to random Landau level mixing ($U(2)$-disorder). Restriction to a fractal structure allows for the implementation of a real-space renormalization (RSR). For the single channel model this model has been employed very successfully for the calculation of , e.g., critical conductance distributions, critical exponent of the localization length, and energy level statistics.

Applying the RSR procedure to the two-channel model, we find only two stable phases corresponding to Hall conductivities of $\nu = 0$ and $\nu = 2$ (in units of e^2/h), respectively, even in the limit of weak Landau level mixing. The absence of a stable localized phase with Hall conductivity $\nu = 1$ appears to be a feature of the RSR procedure. Comparison of the results of the RSR with exact calculations for small, square systems and weak mixing shows a tendency towards localization with increasing system size for the square systems while the RSR yields delocalization at $\nu = 1$.

As the RSR can also be interpreted as a numerically exact treatment of a hierarchical lattice, this study shows that the phase diagrams of a two-channel quantum Hall system on a hierarchical and a square lattice differ in topology, in contrast to the case of the one-channel model.

DY 25.4 Sa 16:45 TU H3010

Aging in the glass phase of a 2D random periodic elastic system — •Gregory Schehr[1] and Pierre Le Doussal[2] — [1]Theoretische Phisik Universitat des Saarlandes 66041 Saarbrucken Germany — [2]CNRS-Laboratoire de Physique Theorique de l'Ecole Normale Superieure, 24 Rue Lhomond 75231 Paris, France

Using RG we investigate the non-equilibrium relaxation of the (Cardy-Ostlund) 2D random Sine-Gordon model, which describes pinned arrays of lines. Its statics exhibits a marginal ($\theta = 0$) glass phase for $T < T_g$ described by a line of fixed points. We obtain the universal scaling functions for two-time dynamical response and correlations near T_g for various initial conditions, as well as the autocorrelation exponent. The fluctuation dissipation ratio is found to be non-trivial and continuously dependent on T.

DY 30 Spiral Formation and Feedback

Zeit: Montag 10:00–12:45 Raum: TU H3010

Hauptvortrag

DY 30.1 Mo 10:00 TU H3010

Evolution in complex systems: record dynamics in models of spin glasses, superconductors and evolutionary ecology. — •Henrik Jeldtoft Jensen — Department of Mathematics, Imperial College London, South Kensington campus, London SW7 2AZ, U.K.

What features characterise complex system dynamics? Drawing on analogies with equilibrium critical phenomena power laws and scale invariance of fluctuations are often taken as the hallmarks of complexity. Here we argue that slow, directed dynamics, during which the system's properties change significantly, is fundamental. The underlying dynamics is related to slow, decelerating but spasmodic release of a generalized intrinsic strain. Time series of a number of appropriate observables can be analysed to confirm this effect. The strain arises from local frustration. As the strain is released through 'quakes', some system variable undergoes record statistics with accompanying log-Poisson statistics for the quake event times. The talk will illustrate this scenario and its consequences through discussions of memory effects in spin glasses, the observed temperature independence of thermally activated magnetic creep in superconductors and a number of properties of biological macro evolution including the gradual decrease in the extinction rate during the last 470 million years

DY 30.2 Mo 10:30 TU H3010

Analytical tools for solving dynamics with time delay — •Andreas Amann[1], Wolfram Just[2] und Eckehard Schöll[1] — [1]Institut für Theoretische Physik, Technische Universität Berlin,Hardenbergstr. 36, D–10623 Berlin — [2]School of Mathematical Sciences, Queen Mary / University of London, Mile End Road, London E1 4NS, United Kingdom

Time-delay dynamics plays a prominent role in such diverse fields of science as e.g. biological systems, internet traffic, or the control of complex motion. Even for simple model systems analytical approaches face considerable challenges because of infinite dimensional phase spaces. We review in elementary terms how eigenmode expansions can be used to solve linear differential-difference equations and how the spectrum of the corresponding eigenvalue problem can be computed in terms of transcendental functions. We use such schemes for two particular applications: (i) the determination of power spectra of stochastic delay-dynamics, and (ii) the weakly nonlinear perturbation theory for time-delayed feedback control of chaos.

DY 30.3 Mo 10:45 TU H3010

Experimental relevance of global properties of time–delayed feedback control — •Clemens v. Loewenich[1], Hartmut Benner[1] und Wolfram Just[2] — [1]Institut für Festkörperphysik, Technische Universität Darmstadt, D-64289 Darmstadt — [2]School of Mathamatical Sciences, Queen Mary/ University of London, UK

We show by means of theoretical considerations and electronic circuit experiments that time–delayed feedback control suffers from severe global constraints if transitions at the control boundaries are discontinuous. Subcritical behaviour gives rise to small basins of attraction and thus limits the control performance. The reported properties [1] are on the one hand universal since the mechanism is based on general arguments borrowed from bifurcation theory, and on the other hand directly visible in experimental time series.
[1] C.v. Loewenich et al., Phys. Rev. Lett. 93, 174101 (2004).

DY 30.4 Mo 11:00 TU H3010

Delayed Feedback Control of Dynamical Systems at a Subcritical Hopf Bifurcation — •Klaus Höhne[1], C. von Loewenich[1], C.-U. Choe[1], H. Benner[1], W. Just[2], K. Pyragas[3], and V. Pyragas[3] — [1]Institut für Festkörperphysik TU-Darmstadt — [2]Queen Mary, University of London, UK — [3]Semiconductor Physics Institute, Vilnius, Lithuania

Delayed feedback control is a convenient tool to stabilize unstable periodic orbits embedded in strange attractors of chaotic systems. Here we consider the control of a torsion-free unstable periodic orbit originated in a subcritical Hopf bifurcation. Close to the bifurcation point the problem is treated analytically using a time averaging method. We discuss the necessity of employing an unstable degree of freedom in the feedback loop [1] as well as the effect of a nonlinear coupling between the controller and the controlled system. Our analytical approach is demonstrated for the specific example of a nonlinear electronic circuit [2]. Our analytical results are supported by both numerical simulations and real experiments.
[1]K. Pyragas, Phys. Rev. Lett. **86**, 2265 (2001). [2]K. Pyragas et al. Phys. Rev. E **70**,026412 (2004).

DY 30.5 Mo 11:15 TU H3010

Latency effects in the feedback-mediated control of spiral waves — •Jan Schlesner, Vladimir Zykov, Harald Engel, and Eckehard Schöll — Institut für Theoretische Physik, Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin, Germany

We propose several feedback schemes that allow to stabilize the regime of rigid rotation of spiral waves beyond the meander instability of the uncontrolled system. To study experimentally unavoidable latency effects in the control loop we determine the control domain in the parameter

plane spanned by the feedback strength and the latency time. As expected with increasing latency time the control domain shrinks. The account of latency effects reveals an explanation of our recent experimental results obtained for rotating concentration waves in light-sensitive Belousov-Zhabotinsky media.

DY 30.6 Mo 11:30 TU H3010

Feedback-mediated resonant drift of a spiral wave core near a one-dimensional detector — •Vladimir Zykov and Harald Engel — Institut für Theoretische Physik, Technische Universität Berlin, Hardenbergstr. 36, D-10623, Berlin, Germany

It is shown that a spiral wave core can be tracked along a prescribed trajectory through a two-dimensional excitable medium. Each time when the wave front is tangent to a virtual detector line or touches its open end, a short excitability perturbation is globally applied to the medium. Such a relatively simple, robust feedback loop has been successfully realized in a light-sensitive Belousov-Zhabotinsky medium. A theory of the feedback-mediated controlled motion of the spiral core is developed based on very general assumptions about the unforced spiral dynamics. This theory allows to reduce the partial differential equations describing the excitable medium in the presence of the feedback to ordinary differential equations for the coordinates of the spiral core. For the light-sebsitive BZ medium, the predictions of this theory are in perfect agreement both with the obtained experimental data as well as with the results of direct numerical integration of the underlying Oregonator model.

DY 30.7 Mo 11:45 TU H3010

Multi-armed spiral formation driven by defects in an excitable medium — •Maria Inmaculada Rodriguez Ponce and Franz Schwabl — Lehrstuhl 5 für theoretische Physik, Physik Department, Technische Universität München, James-Franck-Strasse, D-85747 Munich, Germany

We simulated a cellular automaton based on a model for Dictyostelium discoideum cells (Dd's) in order to study the appearance of multi-armed spirals and their stability in an excitable medium. In a certain parameter region, the model displays stable spiral structures, as well as concentric rings and other spatio-temporal structures. We focus on the appearance of multi-armed spirals when they are formed by the presence of defects inthe lattice. We describe the multi-armed spiral formation in terms of tip-tip interaction and defect size. We find that the number of arms in the spiral almost solely depends on the defect size.

DY 30.8 Mo 12:00 TU H3010

Selection of the number of spiral-arms in a single-mirror feedback scheme — •Florian Huneus, Thorsten Ackemann, and Wulfhard Lange — Institut für Angewandte Physik, Westfälische Wilhelms-Universität, Corrensstrasse 2/4, 48149 Münster

In the experiment we report on, sodium vapor in an oblique magnetic field is irradiated by a laser beam. A plane mirror feeds the transmitted light back into the vapor.

Beyond a certain input intensity, self-organized inwardly moving targets and spirals emerge in the transverse intensity profile. For the same set of parameters, targets and spirals with different numbers of arms are observed; the system is multistable. In experiments, in which the intensity is switched abruptly from zero to a value beyond threshold, histograms of the number of spiral-arms are obtained. The dependence of the most frequent number of arms on parameters is investigated experimentally and theoretically. A linear stability analysis that regards perturbations of different azimuthal order reproduces the experimental results qualitatively. A correlation is found between the most frequent number of arms and the focal-length of a self-induced lens.

DY 30.9 Mo 12:15 TU H3010

Verdrehte Spiralen und gefangene Phasenfronten in getriebenen ozillatorischen Systemen — •Oliver Rudzick und Alexander S. Mikhailov — Abt. Physikalische Chemie, Fritz-Haber-Institut der Max-Planck-Gesellschaft, Faradayweg 4-6, 14195 Berlin, http://www.rz-berlin.mpg.de/~complsys/

Die periodisch getriebene komplexe Ginzburg-Landau-Gleichung (CGLE) ist ein allgemeines Modell für räumlich ausgedehnte Systeme mit oszillatorischer Dynamik und periodischer äußerer Kraft. Sie beschreibt eine Vielzahl von Strukturbildungsphänomenen, wobei Phasenfronten eine Schlüsselrolle spielen. Wir haben die Dynamik periodischer Züge aus solchen Phasenfronten untersucht. Als wichtiges neues Ergebnis haben wir gefunden, daß sich die Ausbreitungsrichtung dieser Frontenzüge umkehren kann, wenn man die räumliche Periode verringert. Das bedeutet, daß die Phasenfronten „rückwärts“ laufen können, falls sie sich zu nahe kommen. Mit Hilfe der Phasenapproximation konnten wir zeigen, daß diese Umkehr der Wellenausbreitungsrichtung immer möglich ist, wenn man Benjamin-Feir-stabile Systeme periodisch treibt. Dies gilt für beliebige Resonanzen.

Als Konsequenz ist eine neue Form von Spiralwellendynamik möglich. Wir beobachten verdrehte Spiralen, in denen der innere und äußere Teil in entgegengesetzte Richtungen rotieren. In inhomogenen Systemen, wo die Rückwärtsbewegung von Phasenfronten nur in einem isolierten Teilbereich unterstützt wird, können Phasenfronten eingefangen werden. Diese Effekte lassen sich auch in einem realistischen Modell für die CO-Oxidation auf Pt(110)-Oberflächen beobachten.

DY 30.10 Mo 12:30 TU H3010

Stabilization of unstable steads states by time-delayed feedback methods — •Philipp Hövel and Eckehard Schöll — Technische Universität Berlin, 10623 Berlin, Germany

Time-delayed feedback methods have successfully been used to control unstable periodic ortbits. We show that the same technique provides a tool to stabilize unstable steady states. We present an analytical investigation of the feedback scheme using the Lambert function and discuss effects of both a low-pass filter included in the control loop and non-zero latency times, i.e., the time associated with the generation and injection of the feedack singal.

DY 31 Nonlinear Stochastic Systems I

Zeit: Montag 10:30–12:45 Raum: TU H2032

DY 31.1 Mo 10:30 TU H2032

Fluctuation-dissipation theorems and second order statistics of many-body systems described by means of nonlinear Fokker-Planck equations and Vlasov-Fokker-Planck equations — •Till Daniel Frank — Institute for Theoretical Physics, University of Münster, Wilhelm-Klemm-Str. 9, 48149 Münster, Germany

In line with mean field theory, we study stochastic properties of many-body systems in terms of nonlinear Fokker-Planck equations, in general, and Vlasov-Fokker-Planck equations, in particular. We show that the first order statistics of these models can be embedded into second and higher order statistics defined by self-consistent Langevin equations. We exploit this approach to derive exact analytical expressions for two-time point joint probability densities for some benchmark models and to address the fluctuation-dissipation theorem. In addition, we derive analytical expressions for short-time correlation functions and show how to determine time correlation functions in general in terms of hierarchies of coupled differential equations.

M. Shiino: Phys. Rev. A 36 (1987) 2393; M. Hütter and H. C. Öttinger: Phys. Rev. E 54 (1996) 2526

T.D. Frank: Phys. Lett. A, 319 (2003) 173; Physica A, 331 (2004) 391; Eur. Phys. Journal B 37 (2004) 139; Phys. Lett. A, 329 (2004) 475-485

DY 31.2 Mo 10:45 TU H2032

Estimation of Drift and Diffusion Functions of Stochastic Processes — •David Kleinhans and Rudolf Friedrich — Institut für Theoretische Physik, Universität Münster, Wilhelm-Klemm-Str. 9, 48149 Münster

We present a general method to extract drift and diffusion functions from experimental time series. This is based on a procedure recently published by Siegert et al[1]. However, our approach does not perform any limiting procedure regarding the sampling rate.

Drift and diffusion coefficients are embledded into families of functions depending on a set of parameters σ. A first estimate is given by the evaluation of drift and diffusion using the smallest availible time increment[1]. An optimal set of parameters is obtained by an iteration procedure minimizing the Kullback-Leibler distance between the measured and the calculated two point joined pdf. This pdf is obtained either by a simulation of the langevin equation of a numerical solution of the corresponding

Fokker-Planck equation for the parameter set σ.

For unidimensional data our method substantially can be simplified to analyse processes containing additive and multiplicative noise terms.

[1] S. Siegert et al., Physics Letters **A 234**, 275-280 (1998)

DY 31.3 Mo 11:00 TU H2032

Response of stochastic and chaotic systems to weak sinusodial and retangular modulation — •Thomas Stemler[1], Johannes Werner[1], Andrzej Krawiecki[2], and Hartmut Benner[1] — [1]Institut für Festkörperphysik, TU-Darmstadt — [2]Faculty of Physics, Warsaw University of Technology, Poland

We investigate stochastic resonance in a Schmitt trigger driven by white Gaussian noise and a circuit showing chaos-chaos intermittency. In the chaotic circuit at some critical control parameter R_c a merging crisis occurs. For higher control parameter values $R > R_c$ the system jumps intermittently between two dynamical states. The time series containing only state information filtered from the output signal of this circuit has a residence time distribution comparable to that of the stochastically driven Schmitt trigger. The mean value of this distribution can be changed by variation of the control parameter R like the Kramers time by variation of the noise intensity D. We focus on the question how the stochastic resonance behaviour of both systems is influenced by the kind of weak modulation applied. Therefore we test two different typs of modulation, a sinusodial and a retangular one and analyse the cross-correlation function between the response of the system and the drive. In addition the measured experimental data will be compared with approximated cross-correlations derived from linear response theory.

DY 31.4 Mo 11:15 TU H2032

Control of noise-induced oscillations in superlattices — •Johanne Hizanidis, Alexander Balanov, Andreas Amann, and Eckehard Schöll — Institut für Theoretische Physik, TU Berlin, Hardenbergstr. 36, 10623 Berlin

Superlattices are spatially extended systems with complex dynamics of interacting fronts [1]. We consider noise-induced dynamics of a superlattice below the Hopf bifurcation, where in the absence of noise the system exhibits a fixed point. We show that delayed feedback control that was previously used for manipulation of noise-induced oscillations in systems *without spatial degrees of freedom* [2], can not only enhance or deteriorate the regularity of stochastic *spatio-temporal* motion but also allows the manipulation of the system's timescales with varying time delay.

[1] A. Wacker, Phys. Rep. 357, 1-111 (2002)
[2] N. B. Janson, A. G. Balanov, and E. Schöll, Phys. Rev. Lett. 93, 010601 (2004)

DY 31.5 Mo 11:30 TU H2032

Kritisches Verhalten und Universalität bei rauschgetriebenen Nichtgleichgewichts-Phasenübergängen — •Ulrich Behn und Jens Przybilla — Institut für Theoretische Physik, Universität Leipzig, Augustusplatz 10, 04109 Leipzig

Für ein System global gekoppelter Stratonovich-Modelle wurde kürzlich ein kontinuierlicher Nichtgleichgewichts-Phasenübergang beschrieben [1], bei dem der kritische Exponent des Ordnungsparameters mit ansteigendem Verhältnis von Rauschstärke zu räumlicher Kopplungsstärke einen Übergang vom 'klassischen' Wert 1/2 zu einem kontinierlich von diesem Verhältnis abhängendem Verlauf zeigt.

Hier werden diese Untersuchungen auf Modelle mit nichtlinearen Termen höherer Ordnung ausgedehnt und daneben die kritischen Exponenten der Suszeptibilität und der Varianz des Ordnungsparameters analytisch und numerisch bestimmt sowie Universalitätsklassen diskutiert. Weiterhin beschreiben wir den Einfluss eines zusätzlichen additiven Rauschens.

[1] T. Birner, K. Lippert, R. Müller, A. Kühnel, U. Behn, Phys. Rev. E 65, 046110 (2002).

DY 31.6 Mo 11:45 TU H2032

Controlling Traffic Breakdowns — •Reinhard Mahnke[1], Reinhart Kühne[2], and Ihor Lubashevsky[3] — [1]Inst. of Physics, Univ. Rostock, D–18051 Rostock — [2]Inst. Transport. Res., DLR, D–12489 Berlin — [3]Physics Inst., Russian Acad. Sc., Moscow, Russia

A stochastic description of traffic flow, called probabilistic traffic flow theory, is developed.

Traffic breakdowns are described by a balance equation that models the dynamics of jam formation by two contributions: a discharge rate depending on the length of the congestion, and an adhesion rate mainly depending on the traffic volume of the considered road section. With this balance equation it is feasible to calculate the dynamics of traffic pattern formation especially the first passage time for a transition from free flow condition to congested traffic including the influence of the parameters affecting the discharge and adhesion rates.

Starting with the cumulative probability for breakdowns the change in the incident duration distribution is calculated and qualitatively given. The contribution concludes with recommendations for a comprehensive operation improvement and provides necessary steps for a long lasting stabilization of traffic for a given traffic flow time series pattern.

[1] R. Kühne, R. Mahnke, I. Lubashevsky, Phys. Rev. E **65**, 066125 (2002)

DY 31.7 Mo 12:00 TU H2032

Alterungsphänomene ohne detailliertes Gleichgewicht: der Kontaktprozeß — •Malte Henkel[1], Tilman Enss[2], Alan Picone[1], Maria Augusta Santos[3], Constantino da Silva Santos[3], Ulrich Schollwöck[4] und José Ramasco [3] — [1]LPM, Université Nancy I, B.P. 239, F - 54506 Vandœuvre lès Nancy, Frankreich — [2]MPI Festkörperforschung, 70569 Stuttgart — [3]Departamento de Física, Universidade do Porto, Portugal — [4]Institut Theoetische Physik C, RWTH Aachen

Das Langzeitverhalten des Kontaktprozesses in $(1 + 1)$ und $(2 + 1)$ Dimensionen wird numerisch mit Hilfe von Monte-Carlo Simulationen [1] und der Dichtematrixrenormierungsgruppe [2] untersucht. Wir finden in diesem System ohne detailliertes Gleichgewicht an seinem kritischen Punkt eine große Analogie zu alternden magnetischen Systemen, deren Dynamiken das detaillierte Gleichgewicht erfüllen. Unsere numerische Daten lassen sich durch einen dynamischen Skalenansatz beschreiben. Dagegen sind die Autokorrelations- und Selbstantwortexponenten b und a im Kontaktprozeß verschieden, so daß eine Definition eines nichttrivialen Fluktuations-Dissipationsverhältnisses nicht mehr möglich ist. Insbesondere können wir so zeigen, daß die von Sastre et *al.* [3] anhand des Wählermodells vorgeschlagenene Definition einer Nichtgleichgewichtstemperatur nicht auf den Kontaktprozeß übertragbar ist.

[1] JJ Ramasco, M Henkel, MA Santos und CA da Silva Santos, J. Phys. **A37**, 10497 (2004). [2] T Enss, M Henkel, A Picone und U Schollwöck, J. Phys. **A37**, 10479 (2004). [3] F Sastre, I Dornic und H Chaté, Phys. Rev. Lett. **91**, 267205 (2003).

DY 31.8 Mo 12:15 TU H2032

Non-monotonic Velocity Dependence of Atomic Friction — •Peter Reimann and Mykhaylo Evstigneev — Universität Bielefeld

We propose a theoretical model for friction force microscopy experiments with special emphasis on the realistic description of dissipation and inertia effects. Its main prediction is a non-monotonic dependence of the friction force upon the sliding velocity of the AFM-tip relative to an atomically flat surface.

DY 31.9 Mo 12:30 TU H2032

Analysis of the Dynamics of Dissipative Solitons using Stochastic Data Analysis — •Hans-Georg Purwins[1], Hendrik U. Bödeker[1], and Andreas W. Liehr[1,2] — [1]Institut für Angewandte Physik, WWU Münster, Corrensstr. 2/4, 48149 Münster — [2]Freiburger Materialforschungszentrum, Stefan-Meier-Str. 21, 79104 Freiburg

In this talk, we focus on the dynamics of solitary particle-like structures in nonlinear dissipative systems referred to as dissipative solitons (DSs). We consider theoretical prediction like intrinsic propagation, interaction and formation of molecules or clusters. The theoretical predictions are compared to experimental results obtained from planar gas-discharge systems. As strong fluctuations are present in the experimental system, the dynamics has to be modeled by stochastic differential equations in the form of a Langevin equation. On this background methods of stochastic data analysis are developed that allow for a quantitative separation of the deterministic and the stochastic part of the dynamics. Processing experimental data by this method, theoretical predictions with respect to the transition from a stationary to intrinsically propagating DSs and their interaction law can be verified. The latter is consistent with the locking distances of DSs in the observed molecules.

DY 32 Nonlinear Stochastic Systems II

Zeit: Montag 14:00–15:00 Raum: TU H3010

Hauptvortrag DY 32.1 Mo 14:00 TU H3010

Disentangling trends and fluctuations in data sets of complex systems — •Rudolf Friedrich — Institut für Theoretische Physik, WWU Münster, Wilhelm-Klemm-Str. 9, 48149 Münster

The behaviour of complex systems can often be described by order parameters whose dynamics involve both deterministic and noisy components. The origin of the noise is the fast and irregular dynamics of the microscopic degrees of freedom composing the complex systems. In the present talk we discuss how to perform an analysis of experimental data by disentangling the effects of dynamical noise and deterministic evolution. We discuss how drift and diffusion coefficients of Langevin equations can be estimated from data. We report on results obtained for various complex systems like chaotic electric circuits, the motion of dissipative solitons in gas-discharge systems, turbulent flows, and biological data.

DY 32.2 Mo 14:30 TU H3010

Delayed feedback control of noise-induced patterns in 1D excitable media — •Valentina Beato[1], Alexander Balanov[1], Natalia Janson[2], Harald Engel[1], and Eckehard Schöll[1] — [1]Institut für Theortische Physik, Technische Universtität Berlin, Hardenberstr. 36, Berlin 10623, Germany — [2]Department of Mathematical Sciences, Loughborough University, Loughborough, Leicestershire, LE11 3TU, UK

We show that characteristic features of noise-induced spatio-temporal patterns can be effectively controlled using time delayed feedback. Actually, by variation of the time delay and the strength of the feedback one can deliberately change either the spatial or temporal coherence of noise-induced dynamics as well adjust its timescales.

DY 32.3 Mo 14:45 TU H3010

Noise-induced pattern formation in a semiconductor nanostructure — •Grischa Stegemann, Alexander G. Balanov, and Eckehard Schöll — Institut für Theoretische Physik, Technische Universität Berlin, D-10623 Berlin, Germany

We study the influence of noise upon the dynamics of the current density distribution in a model of a semiconductor nanostructure, namely, a double barrier resonant tunnelling diode. We fix the parameters of the system at values below the Hopf bifurcation where the only stable state of the system is a spatially inhomogeneous "filamentary"steady state. We show that the addition of weak Gaussian white noise to the system gives rise to spatially inhomogeneous oscillations. As the noise intensity grows, the oscillations tend to become more and more spatially homogeneous, while simultaneously the temporal coherence of the oscillations decreases.

DY 33 Ferrofluids and Liquid Crystals

Zeit: Montag 14:00–16:15 Raum: TU H2032

DY 33.1 Mo 14:00 TU H2032

Band structure of surface waves on periodic fluid ridges resulting from the Rosensweig instability — •Rene Friedrichs — ABB AG, Corporate Research Center Germany, Wallstadter Str. 59, 68526 Ladenburg

Parallel fluid ridges can be generated on the free surface of a magnetic fluid by means of a tilted magnetic field [1]. Though the surface deformations resulting from this so called "Rosensweig instability" are static, surface waves can propagate on the periodic deformations since the developed structures remain liquid.

Based on a weakly nonlinear analysis of the static ridge pattern [2], we derive a closed equation for the dynamics of the free fluid surface. We calculate the dispersion relation of the surface waves in dependence on the amplitude of the periodic fluid ridges. The resulting band structure of the surface waves can be controlled easily by the external magnetic field. This is in contrast to other hydrodynamic systems such as waves on a fluid with periodic surface tension [3] or over a periodic bottom [4].

[1] Y. D. Barkov and V. G. Bashtovoi, Magnetohydrodynamics 13, 497 (1977)
[2] R. Friedrichs and A. Engel, Europhys. Lett. 63 (6), 826 (2003)
[3] T. Chou, J. Fluid Mech. 369, 333 (1998)
[4] M. Torres, et al., Phys. Rev. E 63, 011204 (2000)

DY 33.2 Mo 14:15 TU H2032

Comparing measurements of the growth rate of the Rosensweig instability with theoretical predictions — •Holger Knieling, Reinhard Richter, and Ingo Rehberg — Universität Bayreuth, Lehrstuhl Experimentalphysik V, 95440 Bayreuth

The surface of magnetic fluids subjected to a normal magnetic field is becoming unstable when a certain threshold of the magnetic induction is surpassed and the initially flat surface exhibits a stationary array of peaks (Rosensweig or normal field instability). Up to now there exists only a theoretical prediction of the behaviour of the growth rate of this surface instability [1]. Therefore we have performed time resolved measurements of the amplitude and their relaxation with the help of a linear array of 32 Hall sensors which are placed directly under the ferrofluid. Sensors situated under a ridge (trough) detect higher (lower) values of the local magnetic induction, respectively. By calibrating the magnetic signal with normed reliefs of the ferrofluid surface the height of the liquid surface can be measured as well. With a time resolution of the sensors of about a half millisecond the maximal growth rate of the modes of the Rosensweig instability can be measured and are compared with the theoretical predictions.

[1] A. Lange, Europhys. Lett., 55 (3), 327-333 (2001)

DY 33.3 Mo 14:30 TU H2032

Ferrofluid controlled by ac-fields — •Robert Krauss, Reinhard Richter, and Ingo Rehberg — Experimentalphysik V, Universität Bayreuth

Considering the effect of pumping ferrofluid by a rotating field [1] and its theoretical description, led us to the conclusion that the mechanism should work in the same manner with ferrofluid droplets. Thus we arranged an experimental setup where magnetic liquid droplets swimming on the surface of another non-permeable liquid move linearly in a rotating field. The velocity of the droplets is changed depending on the applied ac-field strength and frequency as well as the size of the droplets (making a size seperation possible). With some modifications to the field geometry the droplets can be forced to make any 2-dimensional movement on the surface plane.

[1] R. Krauss et al., *Fluid pumped by magnetic stress*, Appl. Phys. Lett. accepted

DY 33.4 Mo 14:45 TU H2032

Influence of a magnetic field on the Soret effect in ferrofluids — •Thomas Voelker and Stefan Odenbach — ZARM, University of Bremen

Investigations were made to determine the influence of a magnetic field on the Soret coefficient of magnetic particles in a ferrofluid. This so called magnetic Soret effect was theoretically predicted to be two to three orders of magnitude smaller than the conventional Soret effect. In contrast, former experiments have qualitatively shown that the magnetic Soret effect is much higher than the theoretical predictions. However in those experiments the influence of buoyancy and magnetically driven convection disturbed the measurement significantly. Thus it is still an open question how strong the magnetic Soret effect can be. Therefore an experimental setup was developed which minimizes parasitic effects, simplifying the analysis of the experimental results. These results provide quantitative measures of the magnetic field dependence of the Soret effect in suspensions of magnetic nanoparticles. It is shown, that the magnetic Soret effect can even be higher than the conventional one and that its strength as well as its direction depend on the magnetic field strength and its relative alignment to the temperature gradient in the fluid.

DY 33.5 Mo 15:00 TU H2032

Rosensweig instability and hysteretic behaviour of an inverse ferrofluid — •Christian Gollwitzer[1], Reinhard Richter[1], Ruben Saldivar-Guerrero[2], and Ingo Rehberg[1] — [1]Experimentalphysik V, Universität Bayreuth, D-95440 Bayreuth — [2]Centro de Investigación en Química aplicada, 25100 Saltillo, Coahuila México

An inverse ferrofluid is a suspension of non-magnetic particles in a conventional ferrofluid, and has been first investigated by Skjeltorp[1]. The particles can be treated as magnetic "holes", the magnetic moments of which point into the opposite direction of the external magnetic field. The Rosensweig instability of an inverse ferrofluid is investigated and compared to the pattern formation of the base fluid. Due to chain formation and magneto-visco-elastic effects[2] the qualitative behaviour changes drastically, in that hysteresis is introduced, which is not present in the base fluid. By the use of X-rays, complete surface profiles can be recorded[3] and phase separation of the inverse ferrofluid in gravitational and magnetic gradient fields are observed. In combination with the Rosensweig instability this gives rise to a memory effect.

References:

[1]A.T. Skjeltorp, *Phys. Rev. Lett.* **1983** *51,* 2306

[2] R. Saldivar: Magneto-rheological study of inverse ferrofluids with polystyrene particles of different size, *to be submitted*

[3]R. Richter, J. Bläsing: Measuring surface deformations in magnetic fluids by radioscopy. *Rev. Sci. Instrum.* **72**, 1729-1733

DY 33.6 Mo 15:15 TU H2032

Small angle neutron scattering study of the magnetoviscous effect in ferrofluids — •Loredana Mirela Pop[1], Stefan Odenbach[1], and Albrecht Wiedenmann[2] — [1]ZARM, University of Bremen — [2]HMI Berlin

The increase of the viscosity of ferrofluids, by means of moderate magnetic fields, the so called magnetoviscous effect, can be used for different technological applications like, for example, in active dampers. However, due to a strong shear thinning in commercially available ferrofluids, the viscosity changes diminish for technical useful shear rates to values that are not suitable for applications. Thus, an optimisation by development of new types of ferrofluids exhibiting stronger changes of the viscosity with the magnetic field and a higher shear stability of the effects is required. Therefore, a better understanding of the microscopic mechanisms of the magnetoviscous effect is essential. The results of the investigation of the microstructure of ferrofluids using small angle neutron scattering as well as of the corresponding rheological investigations will be presented. In addition, the comparison between experimental results and theoretical approaches will provide the information that is necessary for a detailed understanding of the magnetoviscous effects allowing the synthesis of suited ferrofluids for innovative applications in the future.

DY 33.7 Mo 15:30 TU H2032

Two-dimensional solitons on the surface of magnetic liquids — •Reinhard Richter[1] and Igor Barashenkov[2] — [1]Experimentalphysik V, Universität Bayreuth, D-95440 Bayreuth, Germany — [2]University of Cape Town, Rondebosch 7700, South Africa

We report the observation of a stable soliton-like structure on the surface of a ferrofluid in the hysteretic regime of the Rosensweig instability. Unlike other pattern-forming systems with localized 2D structures [1], magnetic fluids are characterized by energy conservation; hence their mechanism of soliton stabilization is different from the previously discussed gain/loss balance mechanism. The radioscopic measurements of the soliton's surface profile suggest that locking on the underlying *periodic* structure is instrumental in its stabilization [2].

[1] see e.g., P.B. Umbanhowar et al., Nature (London) **382** (1996) 793.

[2] R. Richter, I. Barashenkov, submitted to Phys. Rev. Lett. (2004)

DY 33.8 Mo 15:45 TU H2032

Ramanspektroskopie an ionisch-stabilisierten Ferrofluiden im äußeren Magnetfeld — •Dirk Heinrich[1], Alejandro Goñi[2] und Christian Thomsen[1] — [1]Institut für Festkörperphysik, Technische Universität Berlin, Hadenbergstrasse 36, 10623 Berlin,Deutschland — [2]Institut de Ciencia de Materials de Barcelona, Consejo Superior de Investigaciones Cientificas, Campus de la UAB, E-08193 Bellaterra, Spanien

Wir untersuchten die Cluster-Bildung magnetischer Nanoteilchen in Ionischen Ferrofluiden unter dem Einfluss von äußeren Magnetfeldern mit Hilfe von Ramanspektoskopie. Ein besonders Augenmerk lag dabei auf der Temperaturabhängigkeit der Bildungs- bzw. der Zerstörungsdynamik der sich unter den Einfluss des Feldes gebildeten Strukturen und deren Nachweis uns mittels Änderungen in der Ramanintensität der Streckschwingung der OH-Gruppen im Wasser (Trägermedium) gelungen ist. Dabei wird explizit den Effekt ausgenutzt, dass das Raman-Streuvolumen von der Stärke der Mie-Lichtstreuung im Kolloid und dies wiederum von Dichte und Größe der Magnetischen Partikeln bzw. Clustern abhängt. Bei den Experimenten zeigte sich, dass in ionischen Ferrofluiden die Änderungen in der Ramanintensitäten, die mit der Bildung bzw. Zerstörung der Cluster verknüpft sind, typische Zeitkonstanten in Bereich von Sekunden bis einige Minuten aufweisen. Die Dynamik wird mit zunehmender Temperatur schneller, wobei interessanterweise das Zeitverhalten sich bei ca. Zimmertemperatur abrupt ändert.

DY 33.9 Mo 16:00 TU H2032

Influence of Small Admixtures on Termal Director Fluctuations in Filled Flexoelectric Nematic Liquid Crystals — •Anna Berezovskaya — Univ. Kiev, UA–01033 Kiev, Ukraine

Thermal director fluctuation correlations were calculated in the case of flexoelectric liquid crystals (LC) without admixtures, when the effect of flexopolarisation appeared because of thermal director fluctuations [1].

In paper [2] it was shown that the interaction between the liquid crystal director and colloidal particle surface in filled liquid crystals leads to the screening of the thermally induced director fluctuation correlations.

Both these results will be linked together to consider the flexoelectric liquid crystal matrix filled with small spherical silica particles.These solid particles produce static LC director inhomogeneities around inclusions. Flexopolarisation appeared not only because of thermal director fluctuations but due to the static fluctuations too.

[1] P.G. de Gennes and J.Prost, The Physics of Liquid Crystals, Clarendon Press, Oxford, 1993

[2] O. Vasilyev, I. Pinkevich, T. Sluckin, Correlations of Thermal Director Fluctuations in Filled Liquid Crystals, Mol. Cryst. Liq. Cryst (preprint)

Török:

D. Willmann:

DY 34 Poster

Zeit: Montag 15:30–18:00 Raum: Poster TU D

DY 34.1 Mo 15:30 Poster TU D

Analytic properties of the Ruelle ζ–function for mean field models of phase transition — •Sarah Hallerberg[1], Wolfram Just[2], and Günter Radons[1] — [1]Institute of Physics, Chemnitz University of Technology, 09107 Chemnitz, Germany — [2]School of Mathematical Sciences, Queen Mary / University of London, Mile End Road, London E1 4NS, UK

ζ–functions are an important concept in different fields of theoretical physics, like equilibrium statistical mechanics, nonlinear dynamics, or semiclassical descriptions of chaotic quantum systems. Of particular interest are analytical properties of ζ–functions as they reflect nontrivial features like dynamical instabilities or phase transitions. For a simple globally coupled spin system we compute explicitly the Ruelle ζ–function. We study in detail how the ferromagnetic phase transition is reflected by changes in the analytical properties of the ζ–function.

DY 34.2 Mo 15:30 Poster TU D

Bonding of Hydrogen in Palladium Clusters: A molecular-dynamics study. — •Diana Marcano, H. Teichler, and A. Pundt — Institut fuer Materialphysik, Universitaet Goettingen

The binding energy of Hydrogen (H) in a fcc-Palladium (Pd) cluster (923 atoms) is studied with molecular-dynamics simulations. The Pd-H system was modelled using a "many body alloy potential"(MBAP) (Tomanek,1991) and a new pair potential with parameters chosen to reproduce the bulk modulus, dipole force tensor and local lattice expansion.

We were mainly concerned with the dependance of the H binding energy on the distance from a free surface, caused by the dynamics of the surface, the near surface and the atoms inside the cluster. Starting with 1 H-atom sitting at one site up to more H-atoms in different sites. Both potentials results will be compared and their advantages will be discused. This contribution is supported by the DFG via SFB602 and the DAAD.

DY 34.3 Mo 15:30 Poster TU D

Calculating the degrees of freedom governing dynamical systems — •Sebastian Getfert[1], Javier Rodriguez-Laguna[2], and Andreas Degenhard[1] — [1]Fakultät für Physik, Universität Bielefeld, Postfach 100131, 33501 Bielefeld — [2]Instituto de Fisica Teorica, UAM-CSIC, Madrid, Spain

The numerical analysis of dynamical systems that are described by evolutionary partial differential equations (PDEs) is inevitably connected with field discretization. Therefore, efficient computations are often difficult due to the high number of degrees of freedom involved.

For equilibrium phenomena Real Space Renormalization Group Methods were successfully developed to reduce the number of degrees of freedom. Here we investigate the use of such methods for dynamical systems [1]. Our approach is based on the construction of a reduction operator that projects the system to a subspace including only a restricted subset of all the degrees of freedom. The reduction operator concept explicitly allows for selecting the relevant degrees of freedom, i.e. those that dominate the time evolution of the system under consideration. As the final result we obtain a reduced description for the evolution of the PDE, thereby increasing the computational efficiency.

[1] Degenhard A., Rodriguez-Laguna J., J. Stat. Phys. 106, 1093 (2002)

DY 34.4 Mo 15:30 Poster TU D

Dynamics of liquid crystals with an improved Landau-de Gennes potential — •Sebastian Heidenreich, Patrick Ilg, and Siegfried Hess — Institut für Theoretische Physik, Technische Universität Berlin, D-10623, Germany

In liquid crystals, the dynamic of orientation can be described by a constituive equation of the alignment tensor **a** within the framework of irreversible thermodynamics [1] where the time evolution of **a** is determined by the velocity gradient and the derivative of the standard Landau-de Gennes potential.

Here, we propose an improved Landau-de Gennes potential based on Onsager's excluded volume potential of rigid rods and the generating momentum equation found by Öttinger et. al [2].

In contrast to the standard Landau-de Gennes potential our potential has the advantage to restrict the orientation to physically admissible values. The effect of the improved Landau-de Gennes potential on the dynamical behavior and viscous properties is investigated.

[1] S. Hess, Z. f. Naturforsch. **30a**, 728 (1975); S. Hess and I. Pardowitz, Z. f. Naturforsch. **36a**, 554 (1981); C. Pereira Borgmeyer and S. Hess, J. Non-Equilib. Thermodyn. **20**, 359 (1995)

[2] P. Ilg, V. Karlin and H. C. Öttinger, Phys. Rev. E **60**, 5783 (1999)

DY 34.5 Mo 15:30 Poster TU D

Lambert diffusion in three-dimensional porous media in the Knudsen regime — •Stephan Zschiegner[1,2], Stefanie Russ[1], Armin Bunde[1] und Jörg Kärger[2] — [1]Institut für Theoretische Physik III, Justus-Liebig-Universität, Giessen — [2]Institut für Experimentelle Physik I, Universität Leipzig, Leipzig

In general, diffusion of gas particles depends on the collisions between the gas molecules as well as on the collisions of the gas with the pore walls. Of particular interest for many real gases is the range of the so-called Knudsen regime, where the interaction of the molecules with the pore walls plays the crucial role and the intramolecular collisions can be neglected.

Here we present a new method to compute three-dimensional Knudsen diffusion in porous media. The trajectory of the diffusing particles is calculated using cube elements that assemble the porous system. The new algorithm is easy to implement in diffusion simulations and saves computation time due to its linear dependence on the system size.

For mimicking pores with different roughness, we consider the first four iterations of a generalized fractal Koch curve in three dimensions. For these model pores we have performed detailed investigations of self diffusion and transport diffusion. Our results show that both kinds of diffusion coefficients decrease with increasing surface roughness of the pores.

DY 34.6 Mo 15:30 Poster TU D

Large and small avalanches in the Olami-Feder-Christensen earthquake model — •Felix Wissel and Barbara Drossel — Institut f. Festkoerperphysik, TU Darmstadt, Hochschulstrasse 6, 64289 Darmstadt

We investigate the nature of the different types of avalanches occurring in the Olami-Feder-Christensen Earthquake model. Analytical considerations and computer simulations of the one-dimensional model show that for sufficiently large systems the distribution of small avalanches is independent of the system size, while that for large avalanches is proportional to the system size due to large synchronized blocks. We analyze how these results are changed when the symmetry of the system is broken or quenched randomness is introduced. We compare the one- and two-dimensional system and make a prediction for the behavior of the avalanche-size distribution in 2 dimensions in the limit of large system size. This leads to the question in what sense the OFC-model can be considered as self-organized critical.

DY 34.7 Mo 15:30 Poster TU D

Long-term persistence and clustering of extreme events in climate records — •Jan Kantelhardt[1,2], Jan Eichner[2], Armin Bunde[2], and Shlomo Havlin[3] — [1]FB Physik und Zentrum für Computational Nanoscience, Martin-Luther-Universität, 06099 Halle (Saale), Germany — [2]Institut für Theoretische Physik III, Justus-Liebig-Universität, 35392 Giessen, Germany — [3]Minerva Center and Department of Physics, Bar-Ilan University, Ramat-Gan 52900, Israel

We study the long-term persistence and the statistics of the return intervals between extreme events above a certain threshold in measured, reconstructed, and surrogate climate records. While long-term memory is rather universal in the measured temperature series, we find that some of the reconstructed local and global records show significant deviations. For the reconstructed records with long-term scaling and for surrogate data we find three consequences of long-term persistence: (i) a stretched exponential distribution of the return intervals, (ii) a pronounced clustering of extreme events and (iii) an anomalous behavior of the mean residual time to the next event that depends on the history and increases with the elapsed time in a counterintuitive way. The phenomena should also occur in heartbeat records, internet traffic and stock market volatility and have to be taken into account for an efficient risk evaluation.

DY 34.8 Mo 15:30 Poster TU D

Mosaikartige Strukturen in optischen Rückkopplungssystemen — •Guido Krüger und Rudolf Friedrich — Institut für Theoretische Physik, Wilhelm-Klemm-Str. 9, 48149 Münster

Musterbildung in optischen Einspiegel Rückkopplungssystemen mit einer Nichtlinearität ist seit langem bekannt. Zu den Mustern die in diesem System auftreten zählen Quadrate, Hexagone, Rollen, Spiralen, solitäre Strukturen und blumenartige Muster (Quasipatterns).

Das hier untersuchte System hat im Gegensatz zu den sonst untersuchten RKSystemen zwei Nichtlinearitäten und damit auch mehrere charakteristische Längenskalen. Ein nichtlinearer Effekt dieser Anordnung ist eine sogenannte Mosaik-Instabilität. Die erste Instabilität die in diesem System auftritt bringt typischerweise Quadrate hervor. Höhere Instabilitäten in diesem System bringen mosaikartige Strukturen hervor und der Übergang zu Quasiperiodischen Mustern wird diskutiert.

DY 34.9 Mo 15:30 Poster TU D

On the theory of the shear-induced isotropic-to-nematic phase transition of side chain liquid-crystalline polymers — •Patrick Ilg and Siegfried Hess — Institut für Theoretische Physik, Technische Universität Berlin

The shear-induced isotropic-to-nematic phase transition of side chain liquid-crystalline polymers is studied theoretically. A modification of previous models of main-chain liquid crystals [1] to the case of side chain liquid-crystalline polymers is proposed. Orientational and rheological properties of the model are studied in plane shear flow [2].

It is found that the coupling of the mesogenic side chains to the polymer back bone modifies the dynamical properties considerably. For example the shear-induced isotropic-to-nematic transition is shifted compared to ordinary nematics and liquid crystals. Due to the different relaxation times of the side chains and the polymer back bone, a stress plateau

is observed. Predictions of the present model agree qualitatively with experimental results [3].

[1] S. Hess, Z. Naturforsch. 31a, 1507 (1976). [2] S. Hess, P. Ilg, submitted to Rheol. Acta. [3] C. Pujolle-Robic, L. Noirez, Nature 409, 167 (2001).

DY 34.10 Mo 15:30 Poster TU D

Oscillating traveling pulses in a two-component reaction-diffusion model — •E. P. Zemskov[1], G. V. Bordiougov[1], H. Engel[1], J. Fort[2], and V. Méndez[3] — [1]Institut für Theoretische Physik, Technische Universität Berlin, Hardenbergstrasse 36, 10623 Berlin, Germany — [2]Departament de Física, Universitat de Girona, Campus de Montilivi, 17071 Girona, Catalonia, Spain — [3]Departament de Medicina, Universitat Internacional de Catalunya, c./Gomera s/n, 08190 Sant Cugat del Vallès, Barcelona, Spain

We consider traveling wave solutions with oscillatory tails in the one-dimensional, double diffusive Rinzel-Keller model which represents the piece-wise linear approximation of the cubic nonlinearity in the famous FitzHugh-Nagumo model for signal propagation in neural tissue. We prove the existence and the stability of those solutions in a certain range of the time scale ratio of the activator and the inhibitor as well as of the excitation threshold. Furthermore we discuss the dependence of the pulse velocity on these two parameters characterizing basic properties of the excitable medium.

DY 34.11 Mo 15:30 Poster TU D

Periodically controlled qubit system coupled to an environment — •Marcus Stollsteimer and Günter Mahler — Universität Stuttgart, Institut für Theoretische Physik 1, Pfaffenwaldring 57, D-70550 Stuttgart

We study the thermodynamic properties of a small quantum system which is subject to periodic external parameter control (Floquet-type system). This system proper is coupled to another quantum system that acts as environment or "bath". We consider the existence of "quasi-equilibrium" states, similar to the equilibrium states of the zero-control case, and the characteristics of these states.

DY 34.12 Mo 15:30 Poster TU D

Rauschfreier Grenzfall einer Ferroluid Ratsche und rotierende Ferrofluid Ratschen — •Volker Becker und Andreas Engel — Carl-von-Ossietzky-Universität, 26111 Oldenburg

Magnetische Nanopartikel in einem Ferrofluid können unter dem Einfluss eines oszillierenden magnetischen Feldes als thermische Ratsche arbeiten. Bei geeigneter Wahl der Zeitabhängigkeit des magnetischen Feldes wird durch Gleichrichtung thermischer Fluktuationen ein mittleres Drehmoment auf ein in Ruhe befindliches Ferrofluid ausgeübt, obwohl das Feld selbst keinen rotierenden Anteil enthält. Durch Untersuchung des deterministischen Grenzfalls der Dynamik wurde gezeigt, dass die thermischen Fluktuationen für den beschriebenen Effekt in der Tat unverzichtbar sind, was in der Literatur zuvor bezweifelt wurde. Weiterhin wurde der Fall untersucht, in dem das Ferrofluid nicht ruht, sondern mit konstanter Winkelgeschwindigkeit rotiert, sowie das Zusammmenspiel des Ratscheneffekts mit einer bei höheren Frequenzen auftretenden symmetriebrechenden Instabilität untersucht.

DY 34.13 Mo 15:30 Poster TU D

Scaling of energy barrier in two-dimensional spin glasses — •Carlo Amoruso[1,2], M.A. Moore[2], and Alexander K. Hartmann[1] — [1]Institut für Theoretische Physik, Friedrich-Hund-Platz 1, 37077 Göttingen — [2]Department of Physics and Astronomy, University of Manchester, Manchester, M13 9PL, United Kingdom

Energy barriers determine the dynamics of glassy systems that have a complex energy landscape with many metastable states, like spin glasses. In the droplet approach a central role is played by an exponent θ which characterizes the energetics of large scale excitation from the ground state. Such excitation scale like as L^θ. The system orders at low temperature if $\theta > 0$. The dynamics is controlled by the rate of creation of those excitations, and it is generally assumed that the barrier against this relaxation scales as L^ψ where $\theta \leq \psi \leq d-1$ for dimension d. We study the case of $d = 2$ spin glasses, where $\theta \approx -0.28$. We are using an optimization procedure [1], based on combinatorial matching algorithms, and suitable modifications of the disorder [2], which allows us to treat relative large samples. Using this approach, we are able to give the bounds $+0.28 < \psi < 0.58$.

[1] A.K. Hartmann and H. Rieger, *Optimization Algorithms in Physics, Wiley-VCH (2001)*

[2] A.K. Hartmann and M.A. Moore, Phys. Rev. Lett. **90**, 127201 (2003)

DY 34.14 Mo 15:30 Poster TU D

The effect of long-term correlations on the statistics of maxima — •Jan Eichner[1], Armin Bunde[1], Jan Kantelhardt[2], and Shlomo Havlin[3] — [1]Institut für Theoretische Physik III, Universität Giessen, Germany — [2]Fachbereich Physik und Zentrum für Computational Nanoscience, Martin-Luther-Universität Halle-Wittenberg, Germany — [3]Minerva Center and Department of Physics, Bar-Ilan University, Ramat-Gan, Israel

In common extreme value statistics one assumes that rare extreme events separated by a long time span are statistically independent (Extremal Types Theorem). Here we consider long-term correlated records, where the autocorrelation function $C(s)$ decays as $s^{-\gamma}$ with $0 < \gamma < 1$. Long-term correlations appear in many natural records, e.g. in temperatures, river flows, heartbeat intervals, and also in financial volatility records. Here we study artificial Gaussian distributed long-term correlated records. The records are segmented in windows of size R. The quantity we are interested in is the maximum-value m_i in each window i. We find that the sequence of these maxima is also long-term correlated, such that large maxima are more likely to be followed by large maxima, and small maxima by small maxima. This effect can be clearly seen in the (conditional) distribution of those m-values, that directly follow a fixed m_0-value. We show explicitly that the probability for the next event m to be larger than a certain threshold-value M depends significantly on the preceding event m_0, an effect that has to be taken into account in any risk estimation.

DY 34.15 Mo 15:30 Poster TU D

A new beam model for delamination of composite materials — •Frank Raischel[1], Ferenc Kun[2], and Hans J. Herrmann[1] — [1]Institut für Computerphysik, Universität Stuttgart, D-70569 Stuttgart — [2]Department of Theoretical Physics, University of Debrecen, H-4010 Debrecen

We present a novel model for shear failure of a glued interface between two solid blocks, which is a model system for the fiber-matrix interface in composite materials. The interface is treated as an array of elastic beams, which experience stretching and bending under shear load. Breaking is initiated if the two deformation modes exceed randomly distributed breaking thresholds, and global load sharing following the breaking of one beam can trigger avalanches in the system. We provide theoretical and simulation results for both the macroscopic behaviour and the microscopic dynamics, and compare our findings with experiments and the commmonly used dry fiber bundle models.

DY 34.16 Mo 15:30 Poster TU D

Electron-Polarization Coupling in Superconductor-Ferroelectric Superlattices — •Natalia Pavlenko[1,2] and Franz Schwabl[2] — [1]Institute of Physics, University of Augsburg, 86135 Augsburg, Germany — [2]Institute of Theoretical Physics, Department of Physics, Technical University og Munich, 85747 Garching, Germany

We present a phenomenological model of periodic ferroelectric-superconductor (FE-S) heterostructures containing two alternating ferroelectric and superconducting layers. The interaction at the FE-S contacts is described as a coupling of the local carrier density of the superconductor with the spontaneous ferroelectric polarization near the FE-S interface. We obtain a stable symmetric domain-type phase exhibiting a contact-induced polarization and the ferroelectric domain structure at temperatures above the bulk ferroelectric transition temperature. The system is analyzed for different thicknesses of the FE- and S-films demonstrating the dramatic change of the topology of the phase diagrams with a variation of the layers thickness. The results are expected to shed light on processes occurring in high-temperature superconducting films grown on perovskite alloy-substrates exhibiting ferroelectric properties at lower temperatures.

DY 34.17 Mo 15:30 Poster TU D

Identification of Ion Sites in Glasses — •Christian Müller[1], Hartmut Grille[1], Junko Habasaki[2], and Philipp Maass[1] — [1]Institut für Physik, Technische Universität Ilmenau, Germany — [2]Tokyo Institute of Technology, Japan

To understand the dynamics of ions in glasses from a microscopic viewpoint it is necessary to identify and to characterise the available sites for the mobile ions in the glassy network. Efforts in this direction have been

undertaken by means of molecular dynamic simulations. In these simulations it has been counted how many times a cell within the simulation box is visited by a mobile ion within a given (large) time period [1]. Using this procedure ion sites as well as their occupation probabilities are obtained. Here we focus on the question if it is possible to identify these sites on the basis of equilibrium configurations. Therefore we analyze the ionic potential energy surface with respect to the minima and their connectivity features.

[1] J. Habasaki and Y. Hiwatari, Phys. Rev. B **69**, 144207 (2004)

DY 34.18 Mo 15:30 Poster TU D

Mechanical analysis of polymer glasses — •Jörg Hachenberg, Peter Rösner, and Konrad Samwer — I. Physikalisches Institut, Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen

The mechanical behaviour of polymers close to the glass-transition-temperature is of great industrial interest but still not fully understood on molecular scale. In this work, mechanical spectroscopy and creep recovery measurements are performed highlighting the material properties at low frequencies / long times and the response to dynamic or static loads. PMMA has been chosen as a model system and shows interesting anelastic and Non-Newtonian viscoelastic features. This work is supported by the DFG, GRK 782

DY 34.19 Mo 15:30 Poster TU D

Vacancy model reproducing the most important features of the Mixed Alkali Effect — •Robby Peibst, Stephan Schott, and Philipp Maass — Institut für Physik, Technische Universität Ilmenau, Germany

The mixed alkali effect in glasses is a very impressing example of nonlinear behaviour in disordered systems. Some deviations from a simple additive behaviour upon mixing of two types of mobile ions are hardly understood so far, e.g. the limiting slope behaviour of the diffusion constant and the height of the mixed internal friction peak. By taking into account the results of recent molecular dynamik simulations as well as cognitions of preceding own investigations, we present a plausible vacancy model which is able to explain also these key problems. Furthermore, we discuss several possiblities for a general approach to transport processes in dense disorderd systems.

[1] H. Lammert, M. Kunow, and A. Heuer, Phys. Rev. Lett. **90**, 215901 (2003)
[2] J. Habasaki and Y. Hiwatari, Phys. Rev. B, in print
[3] Ph. Maass, J. Non-Cryst. Solids **255**, 35 (1999)

DY 34.20 Mo 15:30 Poster TU D

Neural Cryptography with Queries — •Andreas Ruttor and Wolfgang Kinzel — Institut für Theoretische Physik und Astrophysik, Universität Würzburg, Am Hubland, 97074 Würzburg

Neural cryptography is based on synchronization of tree parity machines by mutual learning. We extend previous key-exchange protocols by replacing random inputs with queries depending on the current state of the neural networks. The probability of a successful attack is calculated for different model parameters using numerical simulations. The results show that queries restore the security against cooperating attackers. The probability of success can be reduced without increasing the average synchronization time.

DY 34.21 Mo 15:30 Poster TU D

Supervised and unsupervised vector quantization: a solvable model — •Michael Biehl and Anarta Ghosh — Institute of Mathematics and Computing Science, University of Groningen, P.O. Box 800, 9700 AV Groningen, The Netherlands

Unsupervised Vector Quantization (VQ) and supervised (Learning) Vector Quantization (LVQ) are intuitively clear and widely used methods for the analysis of large amounts of structured data. In the former, the aim is the representation of data by a limited number of prototype vectors. In the latter, prototypes serve as reference vectors for a classification based on appropriate distance measures. We apply statistical physics methods in order to study analytically the dynamics and stability of various learning algorithms in a model situation. In particular, we compare unsupervised competitive learning with Kohonen's original formulation of LVQ and several modifications thereof. Recent attempts to identify appropriate cost functions for LVQ are also taken into account. We show that many appearently plausible approaches suffer from instability problem, in particular when the data belongs predominantly to one of the classes. The development of simple prescriptions which approximate (Bayes) optimal classification schemes under rather general circumstances is in the center of our interest.

DY 34.22 Mo 15:30 Poster TU D

Thermodynamics of quantum Brownian motion with internal degrees of freedom — •Christian Hörhammer and Helmut Büttner — Theoretische Physik I, Universität Bayreuth, 95440 Bayreuth

We examine the role of entanglement in the low temperature/ strong-coupling quantum regime and the applicability of thermodynamic relations such as the Clausius inequality. A model of two coupled Brownian oscillators based on the Caldeira-Leggett model is formulated and the influence of the additional internal coupling parameter on heat and entropy changes is described. The results are compared to the case of quantum motion of a single Brownian particle.

DY 34.23 Mo 15:30 Poster TU D

Control of noisy oscillations in the Van-der-Pol system — Jan Pomplun, Alexander Balanov, Andreas Amann, and Eckehard Schöll — Institut für Theoretische Physik, TU Berlin, Hardenbergstr. 36, 10623 Berlin

Effects of delayed feedback on noisy dynamics of the paradigmatic Van der Pol system are studied both analytically and numerically. It is shown that such a feedback in the form proposed earlier by Pyragas for the control of chaotic oscillations can be used for effective manipulation of the statistics of noisy oscillations either above or below the Hopf bifurcation; however, the action of the feedback in those two cases is different. We discuss this difference from the viewpoint of amplitude and phase dynamics and explain its origin.

DY 34.24 Mo 15:30 Poster TU D

Diffusion in time-dependent potentials — •E. Paule[1], Th. Pletl[1], P. Chvosta[2], and P. Reineker[1] — [1]Abt. Theoretische Physik, Universität Ulm, Albert-Einstein-Allee 11, 89069 Ulm — [2]Dep. of Macromolecular Physics, Faculty of Mathematics and Physics, Charles University, V Holešovičkách 2, CZ-180 00Praha, Czech Republic

We investigate numerically the one-dimensional diffusion of a particle in time-dependent potentials. For this purpose we solve the Fokker-Planck equation with the Finite-Element-Method (FEM). The time-dependence of the potential is given by a harmonically modulated force. The mean position of the particle as a function of time is of our interest. We focus on resonance-like behaviour of the response of the system in the stationary limit.

DY 34.25 Mo 15:30 Poster TU D

Impact of weak aperiodic signals on the response of a chaotic system: Noise-free Stochastic Resonance — •Johannes Werner[1], Thomas Stemler[1], Hartmut Benner[1], and Andrzej Krawiecki[2] — [1]Institut für Festkörperphysik, TU-Darmstadt — [2]Faculty of Physics, Warsaw University of Technology

In nonlinear autonomous circuits of the Chua family an attractor merging crisis occurs when two coexisting attractors of the precritical system collide as a control parameter (a resistor R) is increased. The system can then jump intermittently between those two subattractors. These jumps can be influenced by a weak signal that is fed into the system. Depending on the control parameter the correlation between input signal and system response varies, reaching several extrema on variation of the control parameter R. This is due to the effect of noise-free stochastic resonance, where the role of the noise is taken on by fast intrinsic dynamics of the system. We show that the dependency of the mean residence time on the control parameter has huge impact on the system's response behaviour and thus on the cross correlation between input and output. We compare the experimental results obtained with different aperiodic signals — bandwidth limited and dichotomic noise — to theoretical predictions derived from linear response theory.

DY 34.26 Mo 15:30 Poster TU D

Noise-induced order and ratchet effect in a thermal convection loop — •Chol-Ung Choe[1,2] and Hartmut Benner[1] — [1]Institut für Festkörperphysik, TU-Darmstadt — [2]Department of Physics, University of Science Pyongyang, DPR Korea

We show analytically and experimentally that noise-induced order as well as ratchet effects are efficiently achieved by applying vertical and horizontal noise fluctuations on a thermal convection loop. The idea of our investigation is based on the observation that a thermal convection

loop shows stability properties similar to those of the well-known Kapitza pendulum which can be stabilized or destabilized by rapid vibrations of its pivot. The mechanism of fast parametric modulation by regular oscillations could be extended to the case of irregular fluctuations.

DY 34.27 Mo 15:30 Poster TU D

The influence of measurement noise on esimating drift and diffusion coefficients — •Frank Böttcher and Joachim Peinke — Carl von Ossietzky University of Oldenburg

A new method of analysing measurement noise which is superimposed to a dynamical system is presented. It is shown that it is possible to distinguish between external measurement noise and dynamical noise which is an intrinsic part of the process. The distinction is based on the evaluation of the conditional moments that exhibit an increased offset with increasing measurement noise. It is found that the first moment shows an unexpected offset the second moment a modified one compared to the findings of earlier works.

For an Ornstein-Uhlenbeck process it is analytically possible to reconstruct the underlying process dynamics even for very large external noise amplitudes.

DY 34.28 Mo 15:30 Poster TU D

A tomographic study of a meandering scroll wave in a chemical excitable media — •Chaiya Luengviriya, Ulrich Storb, and Stefan C. Müller — Otto-von-Guericke-Universität, Institut für Experimentelle Physik, Universitätsplatz 2, D-39106 Magdeburg

The behavior of a meandering scroll wave in a ferroin-catalyzed MABZ reaction solution embedded in agarose gel is studied by optical tomographic observation with a parallel beam technique. The chemical recipe for the meandering case with extremely low wave velocity (less than 25 um/s) is firstly obtained from a 2D experiment with a special oxygen-free 2D reactor.In the 2D case the media supports a meandering spiral wave at the beginning of the experiment. Due to aging, the shape of the trajectory of the spiral tip changes from four-outer petals to three-outer petals and finally the spiral tip rotates rigidly. Using this recipie in the 3D case a scroll wave with a straight vertical filament is initiated. In the course of time the scroll wave exhibits a uniform twist rate all along its filament. This twist rate increases and eventually the filament changes to a helical form.

DY 34.29 Mo 15:30 Poster TU D

Breathing and traveling dissipative solitons in a three-component reaction-diffusion system — •Svetlana Gurevich[1], Andreas Liehr[2], Shalva Amiranashvili[1] und Hans-Georg Purwins[1] — [1]Institut für Angewandte Physik, WWU Münster, Corrensstr. 2-4, 48149 Münster — [2]Freiburger Materialforschungszentrum,Stefan-Meier-Str. 21, D-79104 Freiburg

We investigate the stability of the localized solutions in a three-component reaction-diffusion system with one activator and two inhibitors. Changing the time constants of inhibitors leads to the instability of a stationary solution. In many cases the breating mode comes first and the stationary dissipative soliton undergoes a bifurcation from a stationary to a "breathingßtate. On the other hand it is possible to observe a mode responsable for a movement first and a drift-bifurcation take a place. Moreover the interaction between this two modes can be observed. This situations are analyzed performing a multiple scale perturbation expansion up to third order in the vicinity of the bifurcation point. To prove the correctness of the theory, numerical simulations are carried out showing good agreement with the analytical predictions.

DY 34.30 Mo 15:30 Poster TU D

Dissipative solitons on a spiral background in a single-mirror feedback scheme — •Elmar Schöbel, Florian Huneus, Thorsten Ackemann, and Wulfhard Lange — Institut für Angewandte Physik, Westfälische Wilhelms-Universität, Corrensstr. 2/4, 48149 Münster

Most dissipative solitons exist on a stationary and constant background. Here we report on the observation of solitons on a modulated oscillatory state in an optical experiment. Sodium vapor in an oblique magnetic field is irradiated by a laser beam. The transmitted light is retro-reflected into the vapor by a plane feedback mirror.

Above a certain value of the laser intensity, this system generates different structures spontaneously. The regions of existence of dissipative solitons [1] and dynamical spirals [2] overlap under suitable conditions. Then, high-amplitude dissipative solitons on a low-amplitude spiral can be observed. The properties of these coexisting structures and the range of the region of coexistence are investigated experimentally.

[1] B. Schäpers, M. Feldmann, T. Ackemann, and W. Lange. Phys. Rev. Lett. **85**, 748–751 (2000).

[2] F. Huneus, B. Schäpers, T. Ackemann, and W. Lange. Appl. Phys. B **76**, 191–198 (2003).

DY 34.31 Mo 15:30 Poster TU D

Dynamics of hydrodynamic Lyapunov modes in coupled map lattices — •Hong-liu Yang and Günter Radons — Theoretische Physik I, Komplexe Systeme und Nichtlineare Dynamik, TU-Chemnitz

In our study of equal-time correlations of hydrodynamic Lyapunov modes in coupled map lattices, we found that there are two universality classes with different λ-k dispersion relations, $\lambda \sim k^2$ for coupled Hamiltonian maps and $\lambda \sim k$ for coupled dissipative maps. In this paper we perform numerical experiments to determine the form of the dynamic Lyapunov vector (LV) structure factors of coupled map lattices which provide detailed information on the LV dynamics. It is found that the dynamic LV structure factor for coupled circle maps has a single peak at $\omega = 0$ and can be well approximated by a single Lorentzian curve. This implies that the hydrodynamic Lyapunov modes of coupled circle maps are non-propagating and possess only diffusive thermo-motions. In contrast, in the dynamic LV structure factors of coupled standard maps, one observes two pronounced peaks located symmetrically at $\pm\omega_u$. The spectra can be well approximated by three Lorentzian curves centered at $\omega = 0$ and $\pm\omega_u$, respectively. The ω_u-k dispersion relation takes the form $\omega_u = c_u \cdot k$. This implies that the hydrodynamic Lyapunov modes of coupled standard maps are propagating. These findings demonstrate that the HLMs in the two classes of models have different dynamical behavior besides their difference in the spatial structure. The existence of propagating Lyapunov modes in a system without continuous time-translational invariance calls for a new theoretical interpretation different from the one for many-particle systems.

DY 34.32 Mo 15:30 Poster TU D

Echtzeit-Verkehrssimulation in komplexen Autobahnnetzwerken — •Florian Mazur, Roland Chrobok, Sigurdur F. Hafstein, Andreas Pottmeier und Michael Schreckenberg — Universität Duisburg-Essen, Physik von Transport und Verkehr, Lotharstr. 1, 47057 Duisburg

Mit Hilfe von aktuellen Zellularautomatenmodellen ist es mittlerweile möglich, den Verkehr auf komplexen Netzwerken, wie zum Beispiel dem Autobahnnetzwerk in Nordrhein-Westfalen, realitätsnah zu simulieren. Eine derartige Echtzeit-Verkehrssimulation kann man zum Beispiel nutzen, um Informationen über Verkehrszustände auf Autobahnen zu errechnen. In Nordrhein-Westfalen gibt es auf den Autobahnen über 4000 Induktionsschleifen, die online Informationen über das Verkehrsaufkommen an ihrem Standort geben können. Werden nun diese Informationen in einer Simulation berücksichtigt, so ist es möglich, Aussagen über den Verkehr in ganz Nordrhein-Westfalen zu treffen. Diese werden beispielsweise an der Universität Duisburg-Essen aufbereitet und im Internet grafisch abgebildet (http://www.autobahn.nrw.de) und dienen unter anderem zur Routenplanung. Das Konzept einer Echtzeit-Verkehrssimulation ist eine Abbildung des realen Verkehrs im Computer. Dabei wird jedes Fahrzeug mit Hilfe von gemessenen Verkehrsdaten virtuell im Computer nachgebildet. Sehr effektive Modelle mit verhältnismäßig wenig Rechenaufwand sind die so genannten Zellularautomatenmodelle. Mit diesen Modellen ist es möglich, den Verkehr realistisch zu beschreiben und zu analysieren.

DY 34.33 Mo 15:30 Poster TU D

Ein Zellularautomatenmodell für Fußgängerevakuationsdynamik — •Tobias Kretz und Michael Schreckenberg — Universität Duisburg-Essen, Physik von Transport und Verkehr, Lotharstr. 1, 47057 Duisburg

Im Hinblick auf Stauungen potentiell gefährliche Stellen in Gebäuden oder Veranstaltungsorten intuitiv zu erkennen, wird mit zunehmender Komplexität des Grundrisses und des zu bewältigenden Besucheraufkommens schwieriger oder sogar unmöglich. Übungen können - wenn überhaupt - nur in geringer Zahl durchgeführt werden und liefern daher nur Ergebnisse, deren statistische Aussagekraft weitgehend unbekannt bleibt. Einen Ausweg bieten Simulationen, die beliebig oft durchgeführt werden können, sofern das Simulationsmodell auf heute verfügbaren Rechnern auch für große Szenarien (z.B. Stadien) in akzeptabler Zeit durchgerechnet werden kann. Dabei muss bedacht werden, dass für eine breite Anwendbarkeit keine Supercomputer sondern nur handelsübliche Rechner

zur Ausführung der Simulation notwendig sein dürfen. Zellularautomatenmodelle erfüllen diese Bedingung in ausgezeichneter Weise, da sie in ihrer Struktur der grundlegenden Architektur aller Arten von Rechenmaschinen entgegen kommen.

DY 34.34 Mo 15:30 Poster TU D

High-Order Variational Calculation for Periodic Orbits — •Axel Pelster[1], Alexey Novikov[2], Ulrich Kleinkathöfer[2], and Michael Schreiber[2] — [1]Fachbereich Physik, Universität Duisburg-Essen, Essen, Germany — [2]Institut für Physik, Technische Universität Chemnitz, Chemnitz, Germany

Following Ref. [1], we develop a convergent variational perturbation theory for periodic orbits of nonlinear dynamical systems. An optimization with respect to artifically introduced variational parameters allows to convert divergent weak-coupling series for periodic orbits into convergent strong-coupling series. At first, the power of the theory is illustrated by applying it to the undamped Duffing oscillator where we obtain an exponentially fast convergence for the time-periodic solution. Then we investigate how our theory can be extended to the damped Duffing oscillator as this model system has many technical similarities with the quantum mechanical damped harmonic oscillator [2].

[1] A. Pelster, H. Kleinert, and M. Schanz: Phys. Rev. E **67**, 016604 (2003).
[2] A. Novikov, U. Kleinekathöfer, and M. Schreiber: J. Phys. A **37**, 3019 (2004).

DY 34.35 Mo 15:30 Poster TU D

Hydrodynamic Lyapunov modes in Lennard-Jones fluids: Dynamic Correlations — •Hong-liu Yang and Günter Radons — Theoretische Physik I, Komplexe Systeme und Nichtlineare Dynamik, TU-Chemnitz

Recently we succeeded in identifying hydrodynamic Lyapunov modes (HLMs) also in chaotic many-particle systems with soft core interactions [1,2]. In contrast to the previously studied hard-sphere systems, this became possible only by considering equal-time correlation functions of the coordinate fluctuation density $u^{(\alpha)}(x,t)$ of the Lyapunov vector (LV) associated with the α-th Lyapunov exponent $\lambda^{(\alpha)}$. This approach can be extended to the study of dynamic correlations of $u^{(\alpha)}(x,t)$ [2]. We present detailed results for the corresponding dynamic LV structure factors. They provide us, in addition to the Lyapunov exponent - wave vector dispersion, with the collective dynamic excitations of a given Lyapunov vector. The linear ω-k dispersion relation, which can be extracted from the "inelastic" peak of a numerical 3-pole approximation of the dynamic LV structure factor, implies that the hydrodynamic Lyapunov modes are propagating. We present results for the density dependence of the corresponding propagation velocities. Results for the k-dependence of the linewidth of the observed central peak are also elaborated.

[1] H.Yang and G. Radons, nlin.CD/0404027
[2] G. Radons and H. Yang, nlin.CD/0404028

DY 34.36 Mo 15:30 Poster TU D

Hydrodynamic Lyapunov modes in coupled map lattices: spatial correlations — •Hong-liu Yang and Günter Radons — Theoretische Physik I, Komplexe Systeme und Nichtlineare Dynamik, TU-Chemnitz

We present numerical and analytical results, which show that hydrodynamic Lyapunov modes (HLMs) also exist for coupled map lattices (CMLs). It is found that the dispersion relations, Lyapunov exponent vs. wave number, of these modes fall into two different universality classes. We obtain $\lambda \sim k$ e.g. for coupled standard maps and $\lambda \sim k^2$ for coupled circle maps. We discuss under which conditions HLMs can be observed. The role of the Hamiltonian structure, conservation laws, translational invariance, mass-disorder, and damping terms is elaborated. Furthermore, we present simulation results for two-dimensional lattices of coupled maps showing that the appearance of HLMs in CMLs is not restricted to the one-dimensional case.

DY 34.37 Mo 15:30 Poster TU D

Information processing in cellular automata with delay — •Thimo Rohlf and Jürgen Jost — Max-Planck-Institute for Mathematics in the Sciences, Inselstr. 22, D-04103 Leipzig, Germany

We investigate dynamics and information processing in cellular automata with delays in signal propagation. Dynamics is characterized using concepts from Statistical and Computational Mechanics, and compared to conventional cellular automata. The information processing properties of this new class of dynamical systems are demonstrated by application to non-trivial tasks in pattern recognition (e.g., density classification), or global synchronization; candidate solutions are identified by genetic algorithms. We find that the capacity to solve these computational tasks is preserved, and often improved, under dynamical delays, and the evolved strategies are compared to their "conventional" counterparts.

DY 34.38 Mo 15:30 Poster TU D

Length scales of vectorial solitons and hexagonal patterns in a single-mirror feedback arrangement — •Jens-Uwe Schurek, Matthias Pesch, Thorsten Ackemann, and Wulfhard Lange — Institut für Angewandte Physik, Westfälische Wilhelms-Universität Münster, 48149 Münster

In this report, we consider dissipative vectorial spatial solitons in a simple nonlinear optical system that uses sodium vapor as the nonlinear medium. For low input powers, we observe a symmetry-breaking pitchfork bifurcation between two homogeneous states of different polarization of the transmitted light field. At higher powers, each of these states becomes unstable against a modulational instability leading to a hexagonal pattern with small amplitude.

In this parameter region we observe four types of high-amplitude spatial solitons that differ from each other in size and in the number of radial oscillations. We show that the spatial frequency of these oscillations is connected to the underlying modulational instability though the solitons cannot be interpreted as a constituent of the pattern. The influence of the modulational instability on the distances between simultaneously existing solitons is discussed.

DY 34.39 Mo 15:30 Poster TU D

Localisation At Resonance — •Oliver Strebel — Handjerystr. 31, 12159 Berlin

In nonlinear Hamiltonian systems with two degrees of freedom resonances occur, when the frequencies of the constituting subsystems are integer multiples of each other. In perturbation theories this circumstance gives rise to the famous small denominators of Poincare [1]. At resonance however averaging methods yield reasonable results [2].

In this contribution numerical data are studied at resonance in position coordinates and are compared to analytical approximations. They show a clear localisation of the trajectory in the sense that the trajectory covers only a small fraction of the position coordinates, which are accessible under the restriction of energy conservation. Shifting away from resonance more and more position coordinates are reached by the trajectory. The results are discussed within the framework of the Poincare-Birkhoff theorem [1].

[1] A.J. Lichtenberg and M.A. Lieberman, Regular and chaotic dynamics, 2nd ed., Springer Berlin AMS 38 (1992).
[2] V.M. Volosov, Russ. Math. Surveys, 17, 1, (1963).

DY 34.40 Mo 15:30 Poster TU D

Modellierung von Anschlussstellen in Zellularautomaten-Modellen — •Florian Mazur und Michael Schreckenberg — Universität Duisburg-Essen, Physik von Transport und Verkehr, Lotharstr. 1, 47057 Duisburg

Mit den gängigen Verkehrssimulationsmodellen ist es nicht möglich, Auffahrten hinreichend realitätsnah zu modellieren. Dabei nimmt man zum Beispiel an, dass möglichst rasch und damit mit niedriger Geschwindigkeit auf die Hauptfahrbahn gewechselt wird. Eine andere Annahme ist, dass die Fahrzeuge möglichst lange auf der Beschleunigungsspur bleiben. Dadurch reduziert sich jedoch der Bereich, in dem der Spurwechsel vollzogen werden kann. Der entwickelte Ansatz teilt die Beschleunigungsspur in drei Abschnitte ein. Jeder Abschnitt hat eine besondere Funktion. Diese sind das Beschleunigen, das Orientieren und der Spurwechsel. Die neuen Regeln sind in der Lage, alle Phasen des Verkehrsflusses an Auffahrten realitätsnah nachzubilden, wie anhand entsprechender Daten mittels Videoaufnahmen verifiziert werden konnte. Daher eignet sich das neue Modell für die Dynamik an Auffahrten, der Drei-Abschnitts-Ansatz, gut für Simulationen wie die des Autobahn-Verkehrs in Nordrhein-Westfalen, welche auf einem weiteren Poster präsentiert wird.

DY 34.41 Mo 15:30 Poster TU D

Nonlinear Dynamics of a Hysteretic Transducer with Nonlocal Memory — •Sven Schubert and Günter Radons — Theoretische Physik I, Complex Systems and Nonlinear Dynamics, TU-Chemnitz

Many physical and technical systems such as shape memory alloys or certain friction models are characterized by a non-trivial hysteretic behavior with complicated subloop structure.

We study input-output-relationships and statistical properties of the system memory for a hysteretic transducer with non-local memory - represented by the Preisach operator. Our interests are input scenarios with chaotic or fractal behavior. Methods taken from time series analysis are used to compare structural properties of the input and output signal. We investigate the influence of different hysteretic nonlinearities generated by the same phenomenological model structure.

DY 34.42 Mo 15:30 Poster TU D

Self-organised pattern formation upon femtosecond laser ablation: circular polarisation — •Olga Varlamova[1,2], Florenta Costache[1,2], Michael Bestehorn[1], and Jürgen Reif[1,2] — [1]Brandenburgische Technische Universität Cottbus — [2]IHP/BTU JointLab

Upon multi-shot femtosecond laser ablation from different materials, self-organised regular patterns are observed at the crater bottom. For linearly polarised excitation, it has been shown that long periodic ripples develop, the orientation of which is determined by the polarisation direction, though the fundamental nature of this correlation is not yet known.

To investigate this phenomenon closer, we performed corresponding experiments using circularly polarised light. Scanning-Electron and Atomic-Force microscopy reveal that, again, a variety of self-organised patterns is obtained, from bead-string and skin-like structures to bifurcating longer lines. The orientation of these lines, however, is random and varies between different spots. First attempts are made to model this behaviour.

DY 34.43 Mo 15:30 Poster TU D

Synchronization of rotating helices by hydrodynamic interactions — •Michael Reichert and Holger Stark — Universität Konstanz, Fachbereich Physik, D-78457 Konstanz, Germany

Some types of bacteria use rotating helical flagella to swim. The motion of such organisms takes place in the regime of low Reynolds numbers where viscous effects dominate and where the dynamics is governed by hydrodynamic interactions. Typically, rotating flagella form bundles, which means that their rotations are synchronized. The aim of our study is to investigate whether hydrodynamic interactions can be at the origin of such a synchronization.

We consider two stiff helices that are modelled by rigidly connected beads, neglecting any elastic deformations. They are driven by constant and equal torques, and they are fixed in space by anchoring their terminal beads in harmonic traps. We observe that, for finite trap strength, hydrodynamic interactions do indeed synchronize the helix rotations. The speed of phase synchronization decreases with increasing trap stiffness. In the limit of infinite trap stiffness, the speed is zero and the helices do not synchronize. This limit is consistent with recent work by Kim and Powers based on slender-body theory [Phys. Rev. E **69**, 061910 (2004)].

DY 34.44 Mo 15:30 Poster TU D

Synchronization of spiral wave motion by spatio-temporal forcing — •Sergey Zykov[1], Harald Engel[2], Vladimir Zykov[2], and Vasilij Davydov[1] — [1]Moscow Institut of Radioengineering, Electronics and Automation, Russia — [2]Institut für Theoretische Physik, Technische Universität Berlin, Germany

A traditional way to control spiral wave motion is to apply an external forcing uniformly to an excitable medium. Here we consider spiral waves in a two-dimensional excitable medium under a spatio-temporal forcing $F(x, y, t) = a \sin(\omega_m t + k_m x)$, assuming that $k_m r_0 \ll 1$, where r_0 is the radius of the spiral core. We show, that within a certain synchronization band such forcing induces a spiral wave drift along a straight line, whose orientation depends on the modulation frequency ω_m, wavenumber k_m and the eigen frequency of the spiral wave. It turns out that during this drift the phase of the rotating spiral wave is synchronized with the external forcing. Kinematical description of spiral tip motion is in good agreement with the results of a direct integration of the underlying reaction-diffusion equations.

DY 34.45 Mo 15:30 Poster TU D

Time-evolution of the Rule 150 cellular automaton activity from a Fibonacci iteration — •Jens Christian Claussen — Theoretical Physics, University Kiel

The total activity of the single-seeded cellular rule 150 automaton does not follow a one-step iteration like other elementary cellular automata, but can be solved as a two-step vectorial, or string, iteration, which can be viewed as a generalization of Fibonacci iteration generating the time series from a sequence of vectors of increasing length [1]. This allows to compute the total activity time series more efficiently than by simulating the whole spatio-temporal process, or even by using the closed expression. [1] J. C. Claussen, arXiv.org math/0410429

DY 34.46 Mo 15:30 Poster TU D

Torusverdopplung in einem Serienschwingkreis mit nichtlinearer MOS-Struktur — •Martin Diestelhorst[1], Bogdan Mereu[2] und Marin Alexe[2] — [1]Martin-Luther-Universität Halle-Wittenberg, Fachbereich Physik, Friedemann-Bach-Platz 6, 06108 Halle — [2]Max-Planck-Institut für Mikrostrukturphysik, Weinberg 2, 06120 Halle

In einem Serienschwingkreis wurde neben einer linearen Luftspule als nichtlineare Kapazität eine Metall-Ferroelektrikum-p-Silizium-Schichtstruktur verwendet. Als Ferroelektrikum diente dabei eine $Bi_4Ti_3O_{12}$-Schicht von 300 nm Dicke. Das System zeigte eine Reihe von Periodenverdopplungskaskaden bei Variation von Amplitude und Frequenz der Anregungsspannung. Weiterhin wurden im System in einem Amplituden-Frequenz-Gebiet der Anregungsspannung Torusverdopplungen beobachtet. Die Ergebnisse werden auf der Grundlage eines modifizierten Modells einer MOS-Kapazität mit ferroelektrischem Dielektrikum interpretiert.

DY 34.47 Mo 15:30 Poster TU D

Dissipative Solitons in Planar Gas-Discharge Systems — •Hendrik U. Bödeker[1], Andreas W. Liehr[1,2], and Hans-Georg Purwins[1] — [1]Institut für Angewandte Physik, WWU Münster, Corrensstr. 2/4, 48149 Münster — [2]Freiburger Materialforschungszentrum, Stefan-Meier-Str. 21, 79104 Freiburg

Dissipative solitons (DSs) are self-organized structures in nonlinear dissipative systems with particle-like properties. They are known to exist in many different circumstances. DSs can be investigated in an exemplary manner in planar gas-discharge systems. On this poster, we give an overview of experimental observations. Among other things we observed propagation, scattering, formation of molecules, generation and annihilation. In case that the number of DSs is preserved, properties of DSs can be analyzed using stochastic data analysis. The basic mechanisms of the formation and the dynamics of DSs can be understood in terms of reaction-diffusion models that can be connected to microscopic models by adiabatically eliminating the fast time-scales in the system.

DY 34.48 Mo 15:30 Poster TU D

Playing with quantum walks — •Jochen Endrejat and Helmut Büttner — Theoretische Physik I, Universitaet Bayreuth, 95440 Bayreuth

We are simulating stroboscopic quantum walks with history dependence. This quantum system shows various phenomena from quantum game theory on the one hand and from quantum chaos on the other hand. We will report on results for different parameter values.

DY 34.49 Mo 15:30 Poster TU D

Quantum Chaos Experiments with Microwave Billiards — •F. Schäfer, B. Dietz, T. Friedrich, H.-D. Gräf, A. Heine, and A. Richter — TU Darmstadt, Institut für Kernphysik, Schlossgartenstr. 9, 64289 Darmstadt

We present experiments with normal conducting as well as with superconducting microwave resonators.

With the help of different experimental setups eigenfunctions and eigenvalues of arbitrarily shaped cavities can be measured. Due to an isomorphy between the Schroedinger equation and the Helmholtz equation describing two-dimensional electromagnetic resonantors, these investigations give insight to quantum chaotic phenomena. In experiments with normal conducting resonators at room temperature we address – among other aspects – effects connected with the breaking of time-reversal symmetry.

This work is supported by DFG within SFB 634.

DY 34.50 Mo 15:30 Poster TU D

Bifurcation in kinetic equation for interacting Fermi systems — K. Morawetz — Institute of Physics, Chemnitz University of Technology, 09107 Chemnitz, Germany — Max-Planck-Institute for the Physics of Complex Systems, Nöthnitzer Str. 38, 01187 Dresden, Germany

The nonlocal quantum kinetic equation for dense interacting Fermi systems [1,2] combines time derivatives with finite time stepping known from the logistic mapping [3]. This continuous delay differential equation equation is a consequence of the microscopic delay time representing the dynamics of the deterministic chaotic system. The responsible delay time is explicitly calculated and discussed for short range correlations. As a novel feature oscillations in the time evolution of the distribution function itself appear and bifurcations up to chaotic behavior occur [3]. The temperature and density conditions are presented where such oscillations and bifurcations arise indicating an onset of phase transition.

[1] P. Lipavský, K. Morawetz, and V. Špička; Annales de Physique, Paris, 2001, No. 26, 1, ISBN 2-86883-541-4
[2] K. Morawetz, P. Lipavsk'y, V. Spicka; Ann. Phys. 294 (2001) 135
[3] K. Morawetz; CHAOS 13 (2003) 572

DY 34.51 Mo 15:30 Poster TU D

Shear-driven flocculation of sticky spheres: crossover from kinetic aggregation to anisotropic percolation — •Kajetan Bentele[1], Klaus Kroy[1], and Hans Herrmann[2] — [1]Hahn-Meitner Institut Berlin — [2]Universität Stuttgart

Recent advances in mode-coupling theory have lead to substantial progress in our understanding of the complex non-equilibrium phase behavior of dense, weakly adhesive hard spheres and the shear-melting of their kinetically arrested states. The situation at low densities, high shear rates and stronger attractions is still very controversial and various universal jamming "phase diagrams"have been proposed. We report numerical studies of a simple, highly idealized, 2-dimensional adhesive-hard-sphere fluid under shear. Although temperature effects and hydrodynamic interactions are (so far) neglected, we expect the simulation to be indicative of the anisotropic large-scale properties of strongly sheared flocculating colloids. In particular, these approximations allow us to derive a simple but efficient analytical expression for the gel time that accounts for the structural crossover from kinetic aggregation to (anisotropic) percolation. A modified Flory argument further elucidates the crossover mechanism.

DY 34.52 Mo 15:30 Poster TU D

A parallel cluster algorithm applied to model DNA systems — •Jakob Schluttig[1] and Godehard Sutmann[2] — [1]Institut für Theoretische Physik, Universität Leipzig, Germany — [2]Zentralinstitut für Angewandte Mathematik, John von Neumann Institut für Computing, Forschungszentrum Jülich, Germany

The aim of this work was to build the basis for a parallel Monte Carlo cluster algorithm for continuous two-dimensional spin systems. A purely geometrical technique for searching clusters was developed. It is capable of being extended to an energetic cluster criterion, which is the basis in Monte Carlo cluster methods. The scaling of the implementation was measured and analyzed. Finally it was applied to model DNA systems [1] simulated with "*SpinCG*^{2d}" [2] using the Kornyshev-Leikin [3] potential. Geometric clusters were studied as a function of different DNA characteristics, e.g. the charge compensation parameter θ.

[1] H. M. Harreis, A. A. Kornyshev, C. N. Likos, H. Löwen, G. Sutmann, Phys. Rev. Lett. **89**, 018303-1 (2002)
[2] G. Sutmann, *SpinCG*^{2d} *- a parallel Monte Carlo program for spin systems*, in preparation
[3] A. A. Kornyshev, S. Leikin, J. Chem. Phys. **107**, 3656 (1997)

DY 34.53 Mo 15:30 Poster TU D

Computer simulation studies of model colloids in equilibrium and non-equilibrium — •Peter Henseler and Peter Nielaba — Lehrstuhl für Theoretische Physik, Fachbereich Physik, Universität Konstanz, D-78457 Konstanz

We perform classical Monte-Carlo simulations in the NVT ensemble to calculate isothermal elastic constants of crystal phases of hard-sphere systems [1]. The elastic constants are determined in a single simulation run from microscopic fluctuations of the instantaneous local Lagrangian strain tensor and the use of a finite-size scaling theory. This approach is a generalization of the method of Sengupta *et al.* [2] to three dimensions. We will discuss the importance of finite size effects. The outlined approach also allows us to study the effect of impurities on the elastic properties. On the other hand we study the non-equilibrium behavior of colloids flowing in a micro channel driven by the gravitational field. We perform Molecular Dynamics simulations with a Nosé-Hoover thermostat to study the occuring structures and flow rate behavior in dependence of the inclination angle of the micro channel and the mean particle density in the channel.

[1] P. Nielaba, K. Binder, D. Chaudhuri, K. Franzrahe, P. Henseler, A. Ricci, S. Sengupta, W. Strepp J. Phys: Cond. Matt. **16** No 38, S4115 (2004)
[2] S. Sengupta, P. Nielaba, M. Rao, K. Binder, Phys. Rev. **E 61**, 1072 (2000)

DY 34.54 Mo 15:30 Poster TU D

Depletion forces in colloidal systems — •Jules Mikhael, Laurent Helden, and Clemens Bechinger — 2. Physikalisches Institut, Universität Stuttgart, Pfaffenwaldring 57, 70550 Stuttgart, Germany.

The stability and phase behavior of colloidal suspensions containing particles of different size and shape is known to be strongly influenced by depletion forces. Various kinds of colloids as for example spheres, rod- and disc-like Particles or polymeres can serve as depletion agent. The depletion forces they induce can lead even in systems where all pair interactions are purely repulsive to attractive forces which may finally cause particle flocculation. Accordingly, the understanding of these forces is besides fundamental interest also essential for industrial processes. The technique of total internal reflection microscopy (TIRM) is capable to measure these weak depletion interactions with a force resolution in the order of 10 fN. Here we present direct measurements of depletion potentials between a sphere and a flat surface caused by various depletion agents.

DY 34.55 Mo 15:30 Poster TU D

Laser-Induced Freezing in 2D in Incommensurate Potentials — •Christine Kircher, Wolfram Strepp, and Peter Nielaba — Physics Department, University of Konstanz, Fach M692, 78457 Konstanz, Germany

Since the 1980s there is an ongoing experimental and theoretical research in the phenomena of laser-induced freezing and melting in 2D colloidal systems. The phase diagrams of such systems contain phase transitions from a modulated liquid to a triangular solid when a periodic external commensurate potential is applied.
We concentrated our work on the influence of external periodic incommensurate potentials on 2D systems. Incommensurate means that the potential wavelength is not any longer a multiple integer of the lattice constant of the triangular solid. Incommensurate potentials with smaller respectively larger wavelengths compared to the commensurate wavelength were applied to a hard disk system. A variety of different new phases was discovered. We concentrated our research on one new solid phase distinct from the typical triangular solid. Using finite size analysis of the order parameter and its cumulants for a constant wavelength $\lambda^* = 0.6558$ ($= \lambda/\sigma$; σ = particle diameter) the phase transition was determined.

[1] W. Strepp, S. Sengupta, and P. Nielaba, Phys. Rev. E **63**, 046106 (2001)
[2] W. Strepp, S. Sengupta, and P. Nielaba, Phys. Rev. E **66**, 056109 (2002)
[3] C. Kircher, diploma thesis, (2004)

DY 34.56 Mo 15:30 Poster TU D

Light Transport in Foams — •Michael Schmiedeberg and Holger Stark — Universitaet Konstanz, Fachbereich Physik, M621, 78457 Konstanz

Recent light-scattering experiments on foams suggest that the light transport is diffusive. This means that single photons can be considered as random walkers. In our studies, we construct two-dimensional Voronoi foams and replace the edges of the cells by channels of finite width to represent the liquid films. Based on geometrical ray optics, we then investigate how light propagates through a foam by using random walk theories and simulations.

Experiments by Durian *et al.* show that light possesses a higher probability to propagate in the liquid films. To model the extrem case of such a *photon channeling*, we first assume that all photons are completely reflected at each liquid-air interface so that they only move within the films. Then we relax this constraint and introduce reflection and transmission probabilities according to Fresnel's formulas. In both cases, simulations of the photons' random walk in a perfect honeycomb structure reveal

superdiffusive behavior which we also explain within the theory of Lévy walks. In disordered lattices, light transport is, however, diffusive and depends strongly on the amount of disorder.

DY 34.57 Mo 15:30 Poster TU D

Mode-coupling theory for a Lorentz gas with orientational degree of freedom — •Felix Höfling, Erwin Frey, and Thomas Franosch — Hahn-Meitner-Institut, Glienicker Str. 100, 14109 Berlin

In this poster, we address the question of how a semiflexible polymer moves in a network of semiflexible polymers. We concentrate on a simplified model that is based on the two-dimensional Lorentz gas: instead of a structureless particle a needle moves through a random but fixed array of spherical obstacles. This implies that the original Lorentz model is enriched not only by a orientational degree of freedom but also by an additional length scale. Therefore, the phase diagram of the system depends on two parameters, e.g. the obstacle density and the length of the needle. It shows a critical line which separates an ergodic regime from a non-ergodic one. Above this line, the needle is trapped in the medium. Using a mode-coupling approximation, we obtain closed equations for the relevant correlation functions of the system. The theory is solved numerically in order to yield the phase diagram, non-ergodicity parameters and diffusion coefficients.

DY 34.58 Mo 15:30 Poster TU D

Phase transitions of model colloids and quantum disks in external potentials — Wolfram Strepp[1], Surajit Sengupta[2], and •Peter Nielaba[1] — [1]Physics Department, University of Konstanz, Fach M691, 78457 Konstanz, Germany — [2]S.N. Bose National Centre for Basic Sciences, Block JD, Sector III, Salt Lake, Calcutta 700098, India

Systems of model colloids in a spatially periodic external potential show rich phase diagrams, including laser-induced freezing (LIF) and melting (LIM). We use finite size scaling analyses of the order parameter and its cumulants in order to map the phase diagrams, from which the width of the freezing- and reentrance region is calculated. The effect of the finite particle mass on the phase diagram is computed by path integral Monte Carlo (PIMC). Qualitatively new features like the direct "quantum melting" from an ordered solid structure to a modulated liquid by increasing external field amplitude are predicted, in contrast to the behaviour of purely classical systems.

DY 34.59 Mo 15:30 Poster TU D

Simulation of Peloids — •Martin Hecht[1], Jens Harting[1], Thomas Ihle[2] und Hans J. Herrmann[1] — [1]ICP, University of Stuttgart, Pfaffenwaldring 27, 70569 Stuttgart, Germany — [2]North Dakota State University, Department of Physics, Box 5566, Fargo, ND 58105-5566

We are investigating properties of dense suspensions and sediments of small spherical clay particles by means of a combined molecular dynamics (MD) and Stochastic Rotation Dynamics (SRD) simulation. We include electrostatic and van der Waals interaction between the colloid particles, as well as Brownian motion and hydrodynamic interactions which are calculated in the SRD-part.

We present the simulation technique and first results. We have measured velocity distributions, diffusion coefficients, sedimentation velocity, spacial correlation functions and we have explored the phase diagram depending on the parameters of the potentials and volume fraction.

DY 34.60 Mo 15:30 Poster TU D

Simulation of the localisation transition of the Lorentz gas — •Felix Höfling, Erwin Frey, and Thomas Franosch — Hahn-Meitner-Institut, Glienicker Str. 100, 14109 Berlin

The Lorentz model for transport in disordered media describes a structureless, classical particle moving through a random array of fixed spherical obstacles. It exhibits a localisation transition, i.e. above a certain density, the particle is trapped in the medium and the system becomes non-ergodic. Although this transition is related to the liquid-glass transition, a divergent length scale is present in the Lorentz model. This transition has been characterised theoretically by mode-coupling theory (MCT).

We have carried out computer simulations of the Lorentz gas at obstacle densities close to the critical point, such that the diffusion coefficient is suppressed by five orders of magnitude. Therefore, it becomes possible to determine the critical density and critical exponents. Our results indicate that the transition is compatible with the underlying problem of continuum percolation as conjectured in the literature. Furthermore, when approaching the critical point, we observe the opening of a time window where the particle shows subdiffusive behaviour—in agreement with the theoretical predictions of MCT.

DY 34.61 Mo 15:30 Poster TU D

Structural and elastic properties of two-dimensional model colloidal crystals: Monte-Carlo Simulations — •Kerstin Franzrahe and Peter Nielaba — Department of Physics, University of Konstanz, 78457 Konstanz, Germany

Structural and elastic properties of solids are of great interest for the design of soft materials. Monte-Carlo simulations are an effective means for a systematic analysis of these properties. Our main interest is in the behaviour of two-dimensional model colloidal crystals. As a model system we chose the hard disk system. Structural insight can be gained by finite-size-scaling analysis of suitable order parameters, while elastic properties can be studied using so called 'fluctuation' methods. We implemented a method by S. Sengupta et.al [1], which enables us to extract the elastic constants of the infinite system from microscopic fluctuations of the Lagrangian strain tensor ϵ_{ij} by making use of a block analysis procedure. The elastic constants of binary mixtures were thus determined via simulations in the NVT ensemble. Simulations in the NPT ensemble were done in order to analyse lattice formation in binary mixtures. In addition we analysed the influence of quenched impurities on the elastic properties of a mono-disperse hard disk system [2].

[1] S. Sengupta, P. Nielaba, M. Rao, K. Binder Phys. Rev. E 61,1072 (2000)

[2] P. Nielaba, K. Binder, D. Chaudhuri, K. Franzrahe, P. Henseler, A. Ricci, S. Sengupta, W. Strepp, J. Phys.: Condens. Matter 16 (2004) S4115-S4136

DY 34.62 Mo 15:30 Poster TU D

Universal properties of complexes formed by oppositely charged flexible polyelectrolytes — •Roland G. Winkler — IFF, Forschungszentrum Jülich, D-52425 Jülich

Results of molecular dynamics simulations for systems with two flexible, oppositely charged polymer chains are presented. It is shown that the chains aggregate into densely packed structures. The universal properties of the formed complexes are investigated as a function of chain length and interaction strength. For weakly interacting systems, a chain length depended effective interaction strength is obtained which governs the initiation of the aggregation process. At intermediate interaction strengths, the formed complexes exhibit a scaling behavior with respect to molecular weight typically for chain molecules in a bad solvent. An unusual weak dependence of the radius of gyration on the interaction strength is found in this regime. Finally, for strong interactions tightly packed globules are obtained. The radii of gyration and the densities of the complexes are discussed.

DY 34.63 Mo 15:30 Poster TU D

Coarse-Grained Polymer Models: On-Lattice vs. Off-Lattice — •Thomas Vogel, Michael Bachmann, and Wolfhard Janke — Institut für Theoretische Physik, Universität Leipzig, Augustusplatz 10/11, 04109 Leipzig, Germany

We investigated coarse-grained polymer models such as the HP on-lattice and the AB off-lattice formulations for heteropolymers ("proteins"). The poster will focus on the results of two problems.

Firstly, we will give results of investigations concerning *designing sequences* in the HP model on lattices. To this end we perform exact enumerations of the whole sequence-conformation space of HP proteins on the fcc lattice up to a certain chain length and compare with results from the simple cubic lattice.

Secondly we try to show how "far" lattice models are from "reality", or from similar off-lattice models, respectively. Therefore we simulate off-lattice AB model-like proteins with different potentials and compare putative ground states with those from on-lattice simulations.

DY 34.64 Mo 15:30 Poster TU D

Nonlinear dynamics of stiff polymers — •Benedikt Obermayer[1], Erwin Frey[1,2], Klaus Kroy[1], and Oskar Hallatschek[1] — [1]Abteilung Theorie, Hahn-Meitner Institut, Glienicker Str. 100, 14109 Berlin, Germany — [2]Fachbereich Physik, Freie Universität,14195 Berlin, Germany

We have theoretically analyzed the anisotropic (non)linear dynamic response of stiff polymers to external driving fields. A general (time–dependent) criterion is given for the crossover from a universal linear to a

nonlinear regime, the latter depending on the type of the driving. Asymptotic scaling laws are extracted from a set of coarse grained equations of motion obtained from a rigorous multiple scale analysis. To determine the precise behavior of a polymer in non–asymptotic and/or mixed scenarios occurring in vitro and in vivo, an efficient numerical algorithm has been developed which solves the corresponding partial integro differential equations.

DY 34.65 Mo 15:30 Poster TU D

3D-Simulationen im Phasenfeld-Modell — •Martin Ohlerich — BTU Cottbus, LS Theoretische Physik II, Erich-Weinert Str. 1, 03046, Cottbus

Betrachtet wird ein Zwei-Schicht-System aus Flüssigkeit und Gas über einem geheizten Substrat. Ein stetiges Feld, das Phasenfeld, indiziert in den Volumenelementen den Phasenzustand der Flüssigkeit. Da dieses Feld stetig ist, ist die freie Oberfläche zwischen Gas und Flüssigkeit nicht mehr scharf (Fläche), sondern das Phasenfeld fällt über eine gewisse Länge kontinuierlich ab (Oberfläche $\hat{=} Volumen$). Dadurch muß man die Randbedingungen an dieser Oberfläche nicht mehr explizit hinzufügen, da diese implizit in den stetigen Änderungen der Dichte enthalten sind. Betrachtet wird außerdem eine Temperatur-abhängige Oberflächenspannung, die zu Instabilität der glatten Oberfläche führen kann. Untersuch wird die Bildung von Strukturen durch diesen Mechanismus in diesem Phasenfeld-Modell.

DY 34.66 Mo 15:30 Poster TU D

Experimental investigation of Rayleigh-Bénard convection in cells of aspect ratio one — •Janet Neerken, Joachim Peinke, Achim Kittel, and Marco Munzel — Carl-von-Ossietzky Universität Oldenburg

We present experimental results of turbulent Rayleigh-Bénard convection in water in cells of aspect ratio one. The Rayleigh numbers in our experiments are up to $7 \cdot 10^9$. With different experimental methods we measure the flow structures close to the bottom or top plate. The aim of our work is to investigate the stability of the large-scale circulation and how this may be affected by the geometry of the Rayleigh-Bénard cell. Therefore we compare results from a cylindrical and a quadratic cell.

DY 34.67 Mo 15:30 Poster TU D

Lagrangian particle statistics in two dimensional turbulence — •Susanne Zeglin and Rudolf Friedrich — Institut für Theoretische Physik, Universität Münster, Wilhelm-Klemm-Str. 9, 48149 Münster

Based on a numerical solution of the forced Navier-Stokes equation we present results on the statistics of Lagrangian particles for two dimensional turbulence. Special emphasis is placed on the properties of particle acceleration. We show that the probabiliy distribution of the particle acceleration can be well approximated by streched exponentials. A comparison with the results on the basis of a point vortex model for twodimensional turbulence is made.

DY 34.68 Mo 15:30 Poster TU D

Lorenz-like Equations for the Taylor-Couette System — •Hans-Reinhard Berger — Technische Universität Chemnitz, Institut für Physik

The influence of elasticity on the flow between rotating cylinders is examined by a low-dimensional truncated expansion of trigonometric modes. The viscoelastic second-order model is used in order to describe the material properties of the fluid.

The resulting system of ordinary differential equations describes well the transitions from laminar Couette flow to Taylor-vortex flow, but no bifurcations towards more complex flow structures are observed. It is found that elasticity has a destabilizing influence on the laminar flow compared with the pure viscous flow.

The results of the stability analysis of the truncated system are compared with linear stability calculations of the original hydrodynamic and constitutive equations. The deviations are within a few percent.

DY 34.69 Mo 15:30 Poster TU D

Particle diffusion in fluid flow — •Michael Schindler, Peter Talkner, Marcin Kostur, and Peter Hänggi — Theoretische Physik I, Institut für Physik, Universität Augsburg

We present results showing the diffusive transport of advected particles in a fluid flow field. Such behaviour is important e.g. for large molecules in biological cells but also in more technical applications like "planar fluidics" [1] on partially wetting substrates. The drift term in the corresponding Fokker-Planck equation is taken to be a solenoidal velocity field given as the solution of the stationary Stokes equation. In order to find non-trivial distributions of the particle's position in the fluid we have to embed into the Fokker-Planck equation the fact that the particles are of finite size. The boundary conditions of the Stokes equation are determined by the considered systems. Especially in the limit of small fluid domains the strong surface tension at free surfaces dominates the functional form of the velocity field.

[1] Z. Guttenberg *et al.*, *Flow profiling of a surface acoustic wave nanopump*, Phys. Rev. E **70**, xxxxx (2004) in press; arxiv:cond-mat/0405199.

DY 34.70 Mo 15:30 Poster TU D

Pattern formation and regularized phase equation — •Nicole Rinke and Rudolf Friedrich — Institut für Theoretische Physik, Wesftälische Wilhelms-Universität, Wilhelm-Klemm-Str. 9, 48149 Münster, Germany

The phase equation of Cross and Newell [1] is used to study long wavelength instabilities in pattern forming systems like Rayleigh Bénard convection. Recently, a regularized version of this equation has been considered by Ercolani and Newell [2], which also allows the description of defects. We shall present results of a numerical investigation of these equations and discuss possible implications for a geometric description of patterns in nonequilibrium systems. [1] M.C. Cross and P.C. Hohenberg, Rev. Mod. Phys., Vol. 65, No.3 (1993) [2] N.M. Ercolani, R. Indik, A.C. Newell and T. Passot, J. Nonlinear Sci. Vol.10 (2000)

DY 34.71 Mo 15:30 Poster TU D

Roll drift within a localized electroconvection pattern — •Dan Spiegel — Trinity University (USA)

We have found that a locally supercritical electroconvection region can be generated in a nematic liquid crystal (MBBA) by an absorbed laser beam. If a cylindrical lens is used to extend the laser cross-section into a high-aspect-ratio rectangle with the long side parallel to the director, then the locally supercritical region is essentially one dimensional. In contrast to traditional MBBA electroconvection patterns with spatially extended rolls, the localized rolls drift with frequencies on the order of 0.1 Hz. The drift frequency displays a quadratic dependence on the voltage across the sample if both the amplitude and frequency of the applied voltage are increased in a manner that keeps the pattern amplitude constant. We will discuss a possible model for these dynamics based on a Ginzburg-Landau equation in which the parameters are functions of position.

DY 34.72 Mo 15:30 Poster TU D

Self-excited drop oscillations in electrowetting experiments — •Jean-Christophe Baret[1] und Frieder Mugele[2] — [1]Philips Research, Eindhoven (NL) — [2]University of Twente, Physics of Complex Fluids; 7500 AE Enschede (NL)

In electrowetting experiments the contact angle of a droplet on a substrate is modified by an external voltage applied between an electrode immersed in the drop and a substrate coated with an insulating layer. When the electrode is barely immersed into the droplet, a capillary neck develops between the droplet and the electrode upon applying a voltage. At a certain threshold voltage, the capillary neck breaks.
Working with AC voltage U at frequency f from 1 to 30 kHz, and electrical conductivity of the drop from 0.1 to 10 mS/cm, two regimes have been observed above the critical voltage: A regime of fast and regular oscillations of the drop (10-120 Hz) at high frequency f or low conductivity and a regime of eratic and slow oscillations at low frequency f or high conductivity.

The difference in the two regimes is explained by a simple electrical model based on the divergence of the resistance of capillary neck at the break-up $r(t) = r_0(t/t^*)^\gamma$, r_0 being representing the conductivity of the drop. From this analysis an dimensionless number $A = 2\pi r_0 C \nu^{\gamma+1} t^{*\gamma}$ is defined , C being the capacitance of the drop. For $A >> 1$, the charge kept in the drop after the break up is 0 which explains that the relaxation of the drop is purely hydrodynamical leading to regular oscillations, while for $A << 1$ the charge is randomly disctributed between 0 and CU explaining the eratic behavior.

DY 34.73 Mo 15:30 Poster TU D

Solitäre Wellen auf Ferrofluiden — •Dirk Rannacher — Fakultät V, Carl-von-Ossietzky Universität Oldenburg, 26111 Oldenburg

Wellenpakete, die sich ohne Verlust ihrer Form ausbreiten, heißen Solitonen. Diese entstehen durch das geschickte Zusammenspiel zwi-

schen Nichtlinearität und Dispersion. Für, im Vergleich zur Tiefe der Flüssigkeit, kleine Amplitude und großer Wellenlänge, werden Solitonen durch die Korteweg de Vries Gleichung beschrieben.
Ferrofluide sind spezielle Flüssigkeiten, die auf Magnetfelder reagieren. Aus den daraus resultierenden hydrodynamischen sowie elektrodynamischen Gleichungen leiten wir eine Korteweg de Vries Geleichung ab. Dabei gehen wir von einem magnetischen Gradientenfeld aus.

DY 34.74 Mo 15:30 Poster TU D

Statistik der Temperaturfluktuationen als passiver Skalar im Freistrahlexperiment — •Marco Munzel und Achim Kittel — Carl von Ossietzky Universität Oldenburg, Institut für Physik, 26111 Oldenburg

Es werden Messungen vorgestellt, die mit einem von uns neu entwickelten, schnellen Thermosensor durchgeführt wurden. Dieser Sensor hat eine aktive Fläche von ca. 0.05 μm^2, eine Ansprechzeit von ca. 10 μs in Wasser bei einer Temperaturauflösung von 50mK (gemessen mit einer Bandbreite von 100kHz). Mit diesem Sensor wurden Messungen in einem angewärmten Freistrahl (Wasser in Wasser) bei unterschiedlichen Sensorpositionen und Strömungsgeschwindigkeiten an der 2mm messenden Düse durchgeführt, die eine laminare Strömung mit rechteckigem Geschwindigkeitsprofil gewährleistet. Präsentiert werden Untersuchungen zur Ortsabhängigkeit der Leistungsspektren und der Inkrementverteilungen von Temperaturfluktuationen senkrecht und parallel zum Freistrahl.

DY 34.75 Mo 15:30 Poster TU D

Strömungsuntersuchung an schwingenden Wassertropfen — •Frank Rietz — Otto-von-Guericke Universität Magdeburg, Institut für Experimentelle Physik, Abteilung Biophysik

Wird etwas Wasser auf eine genügend heiße Kochplatte gegeben, bildet sich ein Tropfen, der auf seinem eigenen Dampffilm schwebt (Leidenfrost-Effekt). Der Tropfen schwingt dabei in verschiedenen sternförmigen Mustern. Dieses Phänomen wird seit den 1950er Jahren erforscht. Nicht experimentell untersucht wurden bisher die inneren Strömungsverhältnisse. Mit Particle Image Velocimetry (PIV) und einer neuartigen Hochgeschwindigkeitskamera wurde versucht das Strömungsfeld zu bestimmen. Es konnten Korrelationen zwischen der äußeren Verformung und dem Strömungsfeld festgestellt werden. Nähere Informationen gibt es unter: http://iep463.nat.uni-magdeburg.de/w3fr/welcome.html

DY 34.76 Mo 15:30 Poster TU D

Striations in Kundt's tube filled with water — •A. Langenbucher, C.A. Krülle, and I. Rehberg — Experimentalphysik V, Universität Bayreuth, D-95440 Bayreuth

Kundt's tube is a well-known device for demonstrating standing sound waves where dust particles assemble at the nodal lines. In between, the accumulation of dust is not homogeneously distributed but shows sharp parallel stripes, which are known as "striations"(E.N. da C. Andrade, Trans. Roy. Soc. A 230, 413 (1932)). Most works on this phenomenon were done with air as driving fluid. Here we report on first results on the hydrodynamic behavior in a water-filled tube, which is exposed to an oscillating flow generated by a vibrating piston. The observed pattern formation is due to the hydrodynamic interaction of a small amount of glass beads with the surrounding fluid.

DY 34.77 Mo 15:30 Poster TU D

Subdiffusion in Random Compressible Flows — •Vasily Zaburdaev[1,2] and Konstantin Chukbar[1] — [1]RRC "Kurchatov Institute", 123182 Moscow, Russia — [2]current affiliation: MPI for Dynamics and Self-Organisation, Bunsenstraße 10, 37073 Göttingen

In this work we study the diffusion of admixture particles in one-dimensional random velocity field given by a gradient of random potential. We start with the description of new approach developed and tested for the problem of anomalous diffusion on comb-like structures. We show that for the case of periodic potential wells with depth b macroscopic transport is diffusive but with exponentially small diffusion coefficient $D_{eff} \propto e^{-b/D}$. For the case of quenched disorder (fixed realization of the random potential relief) system exhibits complex subdiffusive behavior. We find the Green's function for macroscopic density of admixture particles and show that for some particular classes of distributions of potential wells it satisfies subdiffusive equation with fractional derivative with respect to time.

DY 34.78 Mo 15:30 Poster TU D

The break up of capillary bridges of complex liquids — •Rainer Sattler — Universität des Saarlandes, Geb. 38, 3.OG, Pf. 151150, 66041 Saarbrücken

The break up of capillary bridges of complex liquids is investigated first on a falling droplet and second in a capillary break up extensional rheometer (CABER). The latter describes a set up where a small amount of liquid is placed between two plates that are torn apart rapidly. In between a capillary bridge is formed that breaks up after the formation of an elastic filament. Both methods allow a determination of the elongational viscosity. We present conditions for experimental parameters under which both experiments are equivalent or not. The elongational viscosity η_e can be defined similar to the shear viscosity η_s and is given for Newtonian liquids by the so called Trouton ratio $\eta_e/\eta_s = 3$. For polymer solutions this factor can be higher by several orders of magnitude. But experimental data as well as theoretical understanding of the physical mechanisms of these phenomena are still very limited.

DY 34.79 Mo 15:30 Poster TU D

Control of Stochastic Differential Equations in growth phenomena — •Michael Block and Eckehard Schöll — Institut für Theoretische Physik, Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin

We solve the stochastic differential equations for crystal growth processes numerically utilizing a forward-backward Euler algorithm. The exponents describing the time-evolution of a surface are the growth exponent, the roughness exponent and the dynamic exponent, where only two are independent.

Concentrating on the evolution we involve simple control mechanisms in a classical way. The influence of different included control forces on the growth exponents and namely the surface roughness is analysed. The differences beetween uncontrolled and controlled growth processes are discussed by comparison in detail.

DY 34.80 Mo 15:30 Poster TU D

Controlling of fractal dimension and symmetry of growing Xenon dendrites — •Marco Fell, Herman M. Singer und Jörg H. Bilgram — Laboratorium für Festkörperphysik, ETH, CH-8093 Zürich, Switzerland

Xenon dendrites, grown in supercooled melt ($\Delta T \sim 100 - 200$ mK), show characteristic sidebranching frequencies depending on supercooling. They are statistically symmetric and the contours' outlines have a characteristic fractal dimension, depending on growth morphology (dendrite, dublon and seaweed) but not on supercooling.

In our experiments we disturb the free growth by heating of the melt. The crystal stops growing or begins to melt, depending on power and duration of heating. After stopping the heating, the liquid xenon cools down and growth restarts. Interestingly four absolutely symmetrical lobes start to grow at the main tip.

Repeating this process is found to lead to a new growth morphology, characterized by a lower fractal dimension, an average curvature of the contour lower than the ones found in other morphologies and a new hidden length scale.

DY 34.81 Mo 15:30 Poster TU D

Defect-Induced Coarsening in Step Flow Growth — •Gerrit Danker[1], Olivier Pierre-Louis[2], Chaouqi Misbah[2], and Klaus Kassner[1] — [1]Institut für Theoretische Physik, Otto-von-Guericke-Universität Magdeburg, PSF 4120, 39016 Magdeburg, Germany — [2]LSP, UJF-Grenoble 1, BP 87, 38402 Saint Martin d'Hères, France

Epitaxial growth on vicinal surfaces is known to lead to the so-called meandering instability: steps become wavy and the crystal surface acquires ripples perpendicular to the step direction. A simple theory which presumes that steps meander in phase predicts that the ripples have a constant lateral width and that their amplitude develops asymptotically like $t^{1/2}$ [1]. However, topological defects which arise early in the instability alter this scenario dramatically. We extend the theory to take phase perturbations into account and show by numerical simulations and simple arguments that the surface is subject to coarsening.

[1] F. Gillet, O. Pierre-Louis, and C. Misbah: Non-linear evolution of step meander during growth of a vicinal surface with no desorption. Eur. Phys. J. B. (2000).

DY 34.82 Mo 15:30 Poster TU D

Interaction Between Dendritic Doublon Tips — •Oliver Wittwer und Jörg Bilgram — Laboratorium für Festkörperphysik, ETH, CH 8093 Zürich, Switzerland

In our experiments we investigate in situ three dimensional pattern formation of xenon crystals during free growth. Well known morphologies are dendrites, dendritic doublons and seaweed. We also observe triplons and quadruplons. The transition from dendrite to dendritic doublon has gained interest since it has been discovered in metallic samples [1]. Transitions between these morphologies can be initiated in our experiments by changing the temperature distribution in the environment of a growing crystal [2].

During the growth of dendritic doublons the two tips are mutually interacting. Three different behaviors induced by this interaction can be observed: 1) Stabilization of the growth velocity of the two tips. 2) Multiple tip splitting. 3) Periodic oscillations in growth velocity where the amplitude is increasing with time. The amplitude is in the range of 20% of tip velocity. These oscillations have to be compared with the growth velocity of a freely growing isolated dendrite where fluctuations in growth rate (mainly due to pixel noise) are below ±1.5% of tip velocity at the same experimental conditions.

[1] K. Dragnevski, R. F. Cochrane, and A. M. Mullis, Phys. Rev. Lett. **89**, 215502 (2002)
[2] I. Stalder and J. H. Bilgram, Europhys. Lett. **56**, 829 (2001)

DY 34.83 Mo 15:30 Poster TU D

Numerical investigation of dendritic growth in external flows — •Dmitry Medvedev and Klaus Kassner — Institute of Theoretical Physics, Otto-von-Guericke University Magdeburg, Universitaetsplatz 2, 39106 Magdeburg

A combined phase-field/lattice-Boltzmann scheme is used to simulate dendritic growth from a supercooled melt in external flows with different geometries.

The phase change part of the problem is treated with the phase-field approach of Karma and Rappel, whereas the flow of the liquid is simulated by a standard lattice-Boltzmann-BGK (LBGK) method with interactions with solid and thermal convection incorporated. To simulate conductive and convective heat transfer we use the multicomponent LBE method.

Growth of patterns in a shear flow was simulated for different flow velocities. The results show much stronger influence of the flow on doublons than on dendrites.

The effect of parallel flow on dendritic growth was investigated for different undercooling, flow velocity and viscosity, and channel width. Decrease of the channel width leads to significant changes in the shape and operating parameters of the dendrite.

DY 34.84 Mo 15:30 Poster TU D

Phase-field simulation of pattern formation during GeSi crystal growth — •Wolfram Miller und Igor Rasin — Institut für Kristallzüchtung (IKZ), Max-Born-Str.2, 12489 Berlin

A modified version of the phase-field model of Kim et al. is used for calculating the solidification of binary system GeSi. The phase-field equation is solved by a finite-difference scheme. A recently developed kinetic scheme is used to compute the transport of silicon in the germanium melt. This allows the computation of pattern formation even in cases of low undercooling within reasonable times. We have studied the cellular growth in the regime of crystal growth experiments at the IKZ for different growth velocities and temperature gradients.

[1] Seong Gyoon Kim, Won Tae Kim, and Toshio Suzuki, Phys. Rev. E 60 (1999), 7186

DY 34.85 Mo 15:30 Poster TU D

Simulation of heteroepitaxial growth and misfit dislocations — •Markus Walther[1], Michael Biehl[1,2], Florian Much[1], and Christian Vey[1] — [1]Institut für Theoretische Physik und Astrophysik, Universität Würzburg, Am Hubland, D-97074 Würzburg — [2]Institute for Mathematics and Computing Science, University of Groningen, P.O. Box 800, NL-9700 AV Groningen

The atomistic simulation of strain effects in heteroepitaxial systems requires the development of off-lattice models which allow for continuous positions of the particles. We present the results of kinetic Monte Carlo simulations of heteroepitaxial growth where the particle interactions are described by simple pair-potentials, e.g. Lennard-Jones or Morse potentials in 1+1 dimensions. The lattice spacing of adsorbate materials differs from that of the substrate, resulting in the appearance of misfit dislocations at a characteristic film thickness. One important aspect is the relaxation of the vertical lattice spacing above the dislocations. Our findings are compared with experimental results on a qualitative level.

DY 34.86 Mo 15:30 Poster TU D

Simulation of heteroepitaxial growth and surface alloy formation — •Sebastian Weber[1], Thorsten Volkmann[1], Michael Biehl[1,2], and Miroslav Kotrla[3] — [1]Institut für Theoretische Physik und Astrophysik, Universität Würzburg, Am Hubland, D-97074 Würzburg — [2]Institute for Mathematics and Computing Science, University of Groningen, P.O. Box 800, NL-9700 AV Groningen — [3]Institute of Physics, Academy of Sciences of the Czech Republic, Prague

We study the hetero-epitaxial growth of an fcc(111) crystal surface, in which the lattice spacing of adsorbate materials differ from that of the substrate. We employ off-lattice equilibrium and kinetic Monte Carlo simulations based on simple model interactions between the particle species. Emphasis is on the formation of monolayers of binary adsorbates with a nontrivial composition profile. One important aspect is the formation of nano-structured surface alloys and the dependence on growth temperature and lattice mismatch.

DY 34.87 Mo 15:30 Poster TU D

What are the Mechanisms Governing Crystal Growth from Solution? A Computer Simulation Study. — •F. Kalischewski and A. Heuer — Institut für Physikalische Chemie, WWU, 48149 Münster

Oscillatory zoning is a frequently encountered phenomenon in solid solutions. It is characterized by periodic component-concentration fluctuations along the core-rim profile of a crystal. Putnis *et al.* showed the appearance of Oscillatory zoning in the absence of substrate fluctuations and convection. Thus this phenomenon can be ascribed to complex self-organizing interactions between thermodynamics and kinetics. A theoretical understanding of these interactions requires a detailed knowledge of the microscopic processes.

Our attempt is to gain deeper insight on the underlying mechanisms of this problem by molecular simulation. We apply the lattice free Monte-Carlo method to a system containing a crystal-seed surrounded by solvent. The crystallization behavior of solute particles is monitored by several "observables" such as their crystallization sites, number of (re)crystallizations, surface-diffusion as well as complete desorption. First results will be shown.

DY 34.88 Mo 15:30 Poster TU D

Kinetic Monte-Carlo simulations of sintering — •Frank Westerhoff, Ruslan Zinetullin, and Dietrich E. Wolf — Computational Physics, Universität Duisburg-Essen

We simulate the sintering of particle aggregates by means of surface diffusion. As a method we use Kinetic Monte-Carlo simulations in which elasticity can explicitly be taken into account. Therefore it is possible to investigate the shape relaxation of aggregates also under the influence of an outer pressure. Without elasticity we investigate the relaxation time and surface evolution of sintering aggregates and compare the simulations with the classical Koch-Friedlander theory. Differences to the theoretical predictions will be discussed.

DY 34.89 Mo 15:30 Poster TU D

Acoustic measurement of velocity-dependent coefficients of restitution — •A. Butsch, C.A. Krülle, and I. Rehberg — Experimentalphysik V, Universität Bayreuth, D-95440 Bayreuth

There are many ways to measure the restitution coefficient of an impact between a vertically falling sphere and a smooth horizontal surface. A very simple and practical method was suggested by Alan D. Bernstein (Am. Jour. Physics 45, 41 (1977)). It is based on the analysis of the sound signal produced by the collision between a falling sphere and a horizontal surface. The required instruments for this experiment are a microphone and a computer with a sound card for recording and evaluation of the stored data. The aim of this project is to determine the coefficient of restitution for beads of different material and size. We are especially interested in the dependency of the restitution coefficient on the impact velocity. The obtained data will serve for modelling of the transport behavior of granular matter under vibration.

DY 34.90 Mo 15:30 Poster TU D

Axial segregation in a long horizontal rotating drum — •Tilo Finger[1], Thomas John[2], Andreas Voigt[3] und Ralf Stannarius[1] — [1]Institut für Experimentelle Physik, Otto-von-Guericke Universität Magdeburg — [2]Institut für Physik, Carl-von-Ossietzky Universität Oldenburg — [3]Max Planck Institut für Dynamik komplexer technischer Systeme Magdeburg

The axial segregation of granular material in a long horizontal rotating drum is a well known phenomenon studied by several groups. We investigate experimentally the structures and the long time behaviour of this process. The drum is half filled with a mixture of glass beads of two different diameters and filled up with water. After starting a constant rotation the material shows a radial segregation in time scales of few seconds. In time scales of few minutes an additional axial segregation appears and a stripe pattern along the cylinder axis becomes visible. The initial width of stripes is more or less regular. When the rotation continues, the number of stripes decreases. The time scale of coarsening of the pattern is of the order of several hours up to days. We measure the coarsening at different rotation frequencies and determine the three dimensional distribution of the grains by magnetic resonance imaging.

DY 34.91 Mo 15:30 Poster TU D

Condensation of granular matter in a vertical shaker — •C.-H. Tai and C.A. Krülle — Experimentalphysik V, Universität Bayreuth, D-95440 Bayreuth

If an ensemble of macroscopic particles is mechanically excited by vertical vibrations, the energy input is dissipated into the system by multiple inelastic collisions. As a result, when a monodisperse set of glass beads exceeds a critical number of particles a phase transition can be observed from a fluidized gas-like state to a condensed crystalline state. Systematic studies of the dependence of this critical number on the internal parameters (size and material density of the spheres) as well as the external conditions (amplitude and frequency of the shaker) are presented.

DY 34.92 Mo 15:30 Poster TU D

Distribution of Liquid in Wet Granular Matter — •Mario Scheel[1], Klaus Mecke[2], Stephan Herminghaus[1], Marco DiMichiel[3], and Ralf Seemann[1] — [1]MPI for Dynamics and Self-Organization, D-37073 Göttingen — [2]University of Erlangen, D-91058 Erlangen — [3]ESRF, F-38043 Grenoble Cedex 9,

When wetted with moderate amounts of liquid, granular materials change their mechanical properties dramatically. This is most prominently observed comparing dry sand, as found in the desert, to the shapeable solid of which sand castles are made. The reason for this effect are the microscopic capillary bridges forming between adjacent grains, which by virtue of surface tension make a soft solid out of what was a heavy dissipative gas. The morphology of this complex network of liquid bridges is directly connected to the mechanical properties of the wet granulate. We have studied this network by using X-ray tomography, which we applied to random packings of small (few 100 microns diameter) glass spheres, wetted by a contrasting liquid. Upon increasing the liquid content, we find a crossover from individual bridges to random clusters of liquid. Geometrical quantities are compared to what has been obtained earlier with optical immersion techniques. A particular advantage of our setup is the possibility to study dynamical phenomena, which allowed us to investigate the imbibition of a front of liquid into the granular pile.

DY 34.93 Mo 15:30 Poster TU D

Investigations of horizontally shaken granular materials – the brazil-nut effect and nonspherical particles — •Olaf Brökmann und Achim Kittel — Carl-von-Ossietzky Universität Oldenburg, Institut für Physik, 26111 Oldenburg

We investigated horizontally shaken granular material. The studies include an analysis of the velocity fields of the granular material. Therefore particle image velocimetry (PIV) is used, a measuring method which is usually used for investigation of flow fields in fluids. One aspect of our research is the investigation of the so called brazil-nut effect, i.e. the rise of larger particles in a granular bed. We found results concerning its origin and features. Other results were obtained by investigating nonspherical granular materials. The investigation of shaken rice uncovers interesting features like the formation of layers with horizontal and vertical orientated rice grains.

DY 34.94 Mo 15:30 Poster TU D

Kolmogorov-Sinai Entropy of Wet Granular Gas — •Axel Fingerle, Vasily Zaburdaev, and Stephan Herminghaus — MPI for Dynamics and Self-Organisation, Bunsenstraße 10, 37073 Göttingen

Wet granular matter is a fast developing and modern branch of Soft Matter Physics. There is a growing number of experimental and numerical works, but the theoretical background is far behind that. We try to treat the wet granulate as a complex dynamical system and to use powerful tools available in this area. Such is for example the Lyapunov spectrum. A positive Lyapunov exponent indicates chaotic behavior. We aim to calculate the Kolmogorov-Sinai (KS) entropy [1], which in our case is the sum of positive Lyapunov exponents. We apply a technique similar to [2] developed for a gas of hard spheres. The main peculiarity of our system is the *hysteretic nature* of the interaction due to the liquid bridge formed upon each collision of two particles. By averaging binary collisions using the distributions of the N-particle system for velocities and free paths, we obtain an analytic expression for the KS entropy. The distribution functions of the velocities and impact parameter in real granular systems are also discussed.

[1] J.-P. Eckmann and D. Ruelle, Rev. Mod. Phys. **57**, 617 (1985).

[2] H. van Beijeren, J.R. Dorfman, H.A. Posch, and Ch. Dellago, Phys. Rev. E **56**, 5272 (1997).

DY 34.95 Mo 15:30 Poster TU D

Large Height fluctuations in a two-dimensional air fluidized bed — •Sabrina Nagel, Matthias Schröter, and Harry Swinney — Center for Nonlinear Dynamics, University of Texas at Austin

This work examines relaxation and compaction of a two dimensional granular system. It tests a proposed thermodynamic description of static granular media introduced by Edwards and co-workers. After being tapped with a pulse of air, the binary granular bed relaxes into a steady state volume about which the volume fluctuates as tapping goes on. The idea is to use the volume fluctuations to determine the compactivity X, which was introduced by Edwards and co-workers. For this purpose, a Gaussian is fitted to the histogram of deviations from the local average. The variance of the Gaussian is needed to calculate X. The steady state volume depends on the parameters of the tap, pulse duration and pulse strength. We found that the variance is a function of the steady state volume. This indicates that X is indeed a well-defined parameter.

DY 34.96 Mo 15:30 Poster TU D

Rotating granular flow: variing the Froude number by variing g — •A. Brucks[1], H. Oelze[1], S. Odenbach[1], and R. Lueptow[2] — [1]Zentrum f. angew. Raumfahrttechnologie u. Mikrogravitation, Universität Bremen, Am Fallturm, 28357 Bremen — [2]Dept. of Mechanical Engineering, Northwestern University, 2145 Sheridan Road, Rm. B223 Evanston, IL 60208-3111, USA

The effect of hyper gravity on granular flow in rotating tumblers is presented. For the flow in granular materials under motion in a rotating quasi 2D tumbler four characteristic flow types are known: avalanching, cascading, cataracting and centrifuging system. The Froude number, relating centrifugal forces and gravity in the system, is often used as a dimensionless parameter charaterizing the different flow regimes. Up to now experiments have been performed variing the Froude number by geometry and angular velocity.

In this study the focus lies on the variation of g and thus finding more hints whether the Froude number is the best dimensionless parameter to describe this problem.

DY 34.97 Mo 15:30 Poster TU D

Segregation effects in a swirled bowl — •T. Schnautz[1], C.A. Krülle[1], I. Rehberg[1], and R. Brito[2] — [1]Experimentalphysik V, Universität Bayreuth, D-95440 Bayreuth — [2]Fisica Aplicada I, Universidad Complutense, E-28040 Madrid

We present experimental results on the segregation of a binary mixture of spheres. These are compared with the results of a numerical simulation of sliding disks with additional sphere characteristics. Depending on the filling fraction in the system a monodisperse layer of spheres shows a "plastic"-liquid-like, and a liquid-solid-like phase transition. At slightly higher densities segregation effects, similar to the Brazil-nut effect and its reverse, occur for binary mixtures. So a phase transition seems to be a precondition for segregation. These critical particle densities are both found to be independent of the driving frequency, but decrease with in-

creasing vibration amplitude.

DY 34.98 Mo 15:30 Poster TU D

Solid - fluid transition of a monlayer of particles: MD simulations — •Jennifer Kreft[1,2], Andreas Götzendorfer[2], Christof Krülle[2], and Ingo Rehberg[2] — [1]Center for Nonlinear Dynamics, Universtiy of Texas at Austin — [2]Experimentalphysik V, Universität Bayreuth

Granular media can resemble different states of matter such as a solid, liquid and gas. Since grains are dissipative, maintaining a fluid like state requires constant input of energy. We study granular material that is shaken in both the horizontal (perpendicular to gravity) and vertical (parallel to gravity) directions with peak accelerations between 1 and 1.5 times gravity. When a single monolayer of particles is excited in this manner, a coexistence of the fluid like and solid like phases of the grains persists for many thousands of cycles. A molecular dynamics, event driven, three dimensional simulation of frictional hard spheres is used to study this phenomenon. The size of the fluidized region and the horizontal speed at which the boundary between states travels in simulation are compared to experimental results. Also, the granular temperature and trajectories of the grains are analyzed to investigate how the different regions can stably coexist.

DY 34.99 Mo 15:30 Poster TU D

Dynamics of granular avalanches caused by local perturbations — •Thorsten Emig[1], Philippe Claudin[2], and Jean-Philippe Bouchaud[3] — [1]Institut für Theoretische Physik, Universität zu Köln, Zülpicher Str. 77, 50937 Köln — [2]Laboratoire de Physique et Mécanique des Milieux Hétérogènes, ESPCI, 10 rue Vauquelin, 75231 Paris Cedex 05, France — [3]Service de Physique de l'État Condensé, Centre d'études de Saclay, Orme des Merisiers, 91191 Gif-sur-Yvette Cedex, France

Surface flow of granular material is investigated within a continuum approach in two dimensions. The dynamics is described by the non-linear coupling between a mobile layer and an erodible bed of static grains. Following previous studies, we use mass and momentum conservation to derive St-Venant like equations for the evolution of the thickness of the mobile layer and the profile of the bed. This approach allows the rheology in the flowing layer to be specified independently, and we consider in details the two following models: a constant plug flow and a linear velocity profile. We study and compare these models for non-stationary avalanches triggered by a localized amount of mobile grains on a bed of initially constant slope. We solve analytically the non-linear dynamical equations by the method of characteristics. This enables us to investigate the temporal evolution of the avalanche size, amplitude and shape as a function of model parameters and initial conditions. In particular, we can compute their large time behavior as well as the condition for the formation of shocks.

DY 34.100 Mo 15:30 Poster TU D

Dielectric properties of the polarizable Stockmayer fluid via molecular dynamics simulation using the Debye equation — •Jörg Bartke and Reinhard Hentschke — Fachbereich Mathematik und Naturwissenschaften, Bergische Universität, Wuppertal

The Stockmayer potential is employed in numerous model studies focusing on the properties of dipolar fluids. Of special interest is the static dielectric constant, i.e. its dependence on thermodynamic conditions. Determination of the dielectric constant usually is based on the Kirkwood-Froehlich-fluctuation equation. However, using this equation in computer simulations involves a number of subtle considerations depending on the boundary conditions and the symmetries of the system. Compared to the Kirkwood-Froehlich approach Debye's equation is easier to use, but, to our knowledge, has never been applied to the Stockmayer fluid, even though the local field can be obtained quite accurately with no great effort. Here we compare the static dielectric constant of the polarizeable Stockmayer fluid obtained via the equations of Debye and Kirkwood-Froehlich applied to molecular dynamics simulation trajectories for a wide range of thermodynamic conditions.

DY 34.101 Mo 15:30 Poster TU D

Experiments on Chain Formation Dynamics in Inverse Ferrofluids — •Tobias Sebald[1], Reinhard Richter[1], Christian Gollwitzer[1], Tobias Schnautz[1], Ruben Saldivar-Guerrero[1,2], and Ingo Rehberg[1] — [1]Experimentalphysik V, University of Bayreuth, D-95440 Bayreuth, Germany — [2]Centro de Investigacion en Quimica aplicada, 25100 Saltillo, Coahuila, Mexico

By disperging microsized polystyrene particles in ferrofluid an ideal magneto-rheological model fluid can be synthesized. The nonmagnetic polystyrene particles create holes in the ferrofluid, which appear to posses a magnetic moment corresponding to the amount and suszeptibility of the displaced fluid. Due to the dipolar interactions of the holes, chain formation sets in. We investigate this process in a quasi two dimensional layer inbetween two glass plates via a long distance video microscope. Here the magnetic field is oriented parallel to the plates, and applied in a pulse like manner. The number of particles in the chains and columns are extracted from the pictures. The average length shows to follow a logistic function in time. Moreover, structure formation of the agglomerates under shear flow is experimentally investigated.

DY 34.102 Mo 15:30 Poster TU D

Rotational Diffusion near Confining Walls — •Heidrun Gleisberg, Patrick Ilg, and Siegfried Hess — Institut für Theoretische Physik, Hardenbergstr. 36, Technische Universität Berlin

A simple model is proposed to study the influence of confining walls on the rotational dynamics of a molecule, with emphasis on the rotational diffusion coefficient.

In particular, a time reversible dynamics is considered which employs a recently introduced thermostat for rotational motion [1]. This model is compared to the corresponding approach via the irreversible Langevin equation.

Analytical and numerical results for a molecule in a channel are presented, exhibiting an interesting dependence of the rotational diffusion coefficient on the imposed spatial restrictions.

[1] S.Hess, Z. Naturforsch. **58a**, 377 (2003)

DY 34.103 Mo 15:30 Poster TU D

The planar-fingerprint transition in a thermo-reversible liquid crystalline gel — •Alberto de Lózar, Wolfgang Schöpf, Ingo Rehberg, Oscar Lafuente, and Günter Lattermann — Univerisität Bayreuth

A thermo-reversible (physical) gel consisting of a nematic liquid crystal mixed with a small quantity of a chiral organogelator is investigated in the planar configuration. The response of the system to an external electric field reveals multistability within a small hysteresis. The relaxation of the liquid crystal under this field is characterized by two different time scales: a fast one that is connected to the tilt of the director field, and a slow one that describes the reorientation of the chiral structure. In the first case, the relaxation is non-exponential and can be described by a Kohlrausch-Williams-Watts law with a stretching parameter of 0.5.

DY 34.104 Mo 15:30 Poster TU D

Das Phasendiagramm harter Sphärozylinder und Messung der Grenzflächenspannung — •Stefan Wolfsheimer, Richard Vink und Tanja Schilling — Institut für Physik, Staudinger Weg 7, 55099 Mainz

Zur Untersuchung von Flüssigkristallen verwendet man als theoretisches Arbeitsmodell häufig harte Sphärozylinder. Auf diesem Poster berichten wir über die Bestimmung des Phasendiagramms einer Suspension harter Sphärozylinder in der Nähe des isotropen - nematischen Übergangs mithilfe einer großkanonischen Monte-Carlo-Simulation. Dabei wurde die Dichte und der Orientierungsordungsparameter in Abhängigkeit des chemischen Potenzials aufgenommen. Desweiteren wurde unter Verwendung von Umbrella-Sampling und Histogram-Reweighting ein sehr genauer Wert des chemischen Potenzials bei Koexistenz und die Grenzflächenspannung zwischen isotroper- und nematischer Phase gemessen.

DY 34.105 Mo 15:30 Poster TU D

Kinetic Ising Model with Memory — •Thomas Michael and Steffen Trimper — Fachbereich Physik, Martin-Luther-Universität, Friedemann-Bach-Platz, 06108 Halle

The kinetic Ising model is studied alternatively by using a second quantized formalism for the underlying Master equation. Whereas in the original model due to Glauber the temperature is incorporated in the transition probability for the single spin-flip-process, in our approach the temperature is taken into account from the beginning by introducing a pseudo-Heisenberg picture of the operators. The method enables us to calculate the moments by applying the algebraic properties of the Pauli-operators. As a result we get an exact expression for the transition probability with a time scale, depending on the relevant spin variable. In the vicinity of the critical point the transition probability is similar to the

original expression where the differences will be discussed, especially for low temperatures. Near to the phase transition it is possible to derive a Ginzburg-Landau expansion. As an extension of our procedure we study the influence of short and long range memory effects within the kinetic Ising model. Near to Tc we observe an oscillatory behaviour.

DY 34.106 Mo 15:30 Poster TU D

Melting transitions of fluxline arrays — •Roland Schorr and Ludger Santen — Universität des Saarlandes, FR7.1 Theoretische Physik, Postfach 151150, 66041 Saarbrücken

We investigate the "melting transition" of fluxline arrays. The fluxlines are modeled as interacting elastic lines on two and three dimensional lattices. The model under consideration can be mapped on the six vertex model, which allows for very efficient simulations by using cluster MC algorithms, i.e. we obtain a vanishing dynamical exponent for the pure case. One observes two kinds of melting transitions either driven by the disorder or the temperature. In the pure case we observe a continuous melting of the fluxline lattice.

DY 34.107 Mo 15:30 Poster TU D

Monte-Carlo simulations of small metal clusters with DFT ab-initio energy surfaces — •Günter Schneider and Ralph Werner — Institut für Theorie der Kondensierten Materie, Universität Karlsruhe, D-76128 Karlsruhe

We investigate the melting and evaporation transition of small metal clusters by calculating the specific heat and bond length fluctuations with Monte-Carlo simulations in the canonical ensemble. Results for density functional theory (DFT) calculations for the potential energy are compared with those for effective many-body (Gupta) potentials for the case of Al clusters. While the details of the transitions depend on the potentials and the resulting structures, the qualitative behavior is found to be similar. The interplay between the melting and evaporation transition in Sn_{10} clusters is studied in detail in comparison with recently published results [2].

[1] R. Werner, submitted to Eur. Phys. J. B (2004).
[2] K. Joshi, D. G. Kanhere, and S. A. Blundell, Phys. Rev. B **66**, 155329 (2002)

DY 34.108 Mo 15:30 Poster TU D

Phase-Ordering and Aging Phenomena in Potts Models — •Eric Lorenz and Wolfhard Janke — Institut für Theoretische Physik, Universität Leipzig, Augustusplatz 10/11, 04109 Leipzig, Germany

Dynamical properties of Potts models with $q = 2$ and $q = 3$ are studied during phase-ordering through numerical simulations with a nonconserved order parameter. The systems are quenched from a highly disordered state into the ferromagnetic phase ($T < T_c$) whereafter the dynamical self-similarity of phase-ordering shows up. To reveal this aging phenomenon two-time quantities such as the autocorrelation $A(t, s)$, autoresponse $R(t, s)$ and spatiotemporal response $R(t, s, r)$ are measured and compared with scaling functions predicted from local scale invariance.

DY 34.109 Mo 15:30 Poster TU D

Quantum Phase Transitions in Inhomogeneous Spin Chains — •Rainer Bischof, Sandro Wenzel, Peter Crompton und Wolfhard Janke — Institute of Theoretical Physics, University of Leipzig, Augustusplatz 10/11, 04109 Leipzig, Germany

We identify the exponents associated with a second order quantum critical point in mixed-periodic spin chains of S = 1/2, 1, 3/2, via quantum Monte Carlo simulations. According to Haldane's conjecture gaps can occur above the ground state of metallic compounds at low-temperatures, but only for integer spin systems. Our investigation focuses on the experimentally relevant effect of doping quasi-1d metallic compounds with ions of higher spin. We show that, via doping, the original NLSM analysis can be extended to a broader range of systems and newly identify 'spin-glass' behaviour for half-integer inhomogeneous systems at low-temperatures.

DY 34.110 Mo 15:30 Poster TU D

Series expansions for disordered Potts models — •Meik Hellmund[1] and Wolfhard Janke[2] — [1]Mathematisches Institut, Universität Leipzig — [2]Institut für Theoretische Physik, Universität Leipzig

We derive high-temperature series expansions for the free energy and the susceptibility of random-bond q-state Potts models on hypercubic lattices using a star-graph expansion technique. This method enables the exact calculation of quenched disorder averages for arbitrary uncorrelated coupling distributions. Moreover, we can keep the disorder strength p as well as the dimension d as symbolic parameters. By applying several series analysis techniques to the new series expansions, one can scan large regions of the (p, d) parameter space for any value of q. We present results for the transition temperature and the effective critical exponent γ as a function of p for the diluted Ising model in three dimensions and discuss the observed crossover behaviour. As a by-product we get high-temperature series in the parameter q for pure q-state Potts models up to order 19 which allow us to analyze the different $q \to 0$ limits (percolation, tree percolation) in various dimensions.

DY 34.111 Mo 15:30 Poster TU D

Shape of critical fluctuations in LJ-fluids and wet granular media — •Christian Goll [1] and Klaus Mecke[1,2] — [1]MPI für Metallforschung, Stuttgart — [2]Institut für theoretische Physik, Universität Erlangen-Nürnberg, Staudtstrasse 7, D-91058 Erlangen

We present a molecular dynamics simulation of a Lennard-Jones fluid close to the liquid-vapor critical point to study the shape of the fluctuating configurations. Clusters of size R are defined by attaching spheres of radius R at each particle. The shape is measured by Minkowski functionals M_ν of the covered region in space. An effective local cluster shape m_ν is defined which takes all n-point correlations on scales smaller than $2R$ into account and describes the local structure in an illustrative way (depletion zone, clustering). A possible scaling behavior $m_\nu \sim R^{\alpha_\nu}$ is analysed at large lengths R where multi-point correlations become important which are not captured by the scaling of two-point structure function alone. We applied the same simulation and morphometric technique to a shear-induced solid-fluid transition in wet granular matter, where dissipation occurs in a hysteretic nature of a cohesive force induced by adsorbed liquid bridges between the spherical particles. Comparision of the critical morphology with LJ-fluid and with recent x-ray tomography data of wet bead packs are presented.

DY 34.112 Mo 15:30 Poster TU D

Spinodal decomposition in a three-dimensional Lennard-Jones fluid: A molecular dynamics study — •Hendrik Kabrede and Reinhard Hentschke — Fachbereich Mathematik und Naturwissenschaften, Bergische Universität, Wuppertal

Spinodal decomposition in a three-dimensional Lennard-Jones fluid with one million particles is studied via molecular dynamics. The large size allows the system to decompose into domains with different densities and clearly distinguishable domain boundaries. The atomistic description makes it possible to study relevant physical quantities like the Ginzburg-Landau free energy, the underlying density field, and velocity field on a coarse grained scale. We show that over a wide time range there is no directed velocity field. Thus, such a field is irrelevant for the phase separation description in the analyzed time range. The pair correlation function and the structure factor show scaling behavior over a wide time range. The asymptotic structure factor obeys the predicted power laws, and the domain growth follows $t^{1/2}$.

DY 34.113 Mo 15:30 Poster TU D

Lattice solitons under dissipative and stochastic forces — •Christian Brunhuber and Franz Georg Mertens — Universitaet Bayreuth, TP 1 , Universitaetsstr. , 95440 Bayreuth

Anharmonic atomic chains can posses soliton solutions which were used in the past to model different physical phenomena. The shape of the lattice solitons depends strongly on the interaction potential of the particles (e.g. non-local forces). We study the motion of such excitations in the presence of thermal fluctuations and/or dissipation. We apply both analytical calculations in the continuum limit and simulations of the discrete chain. We observe that the perturbed solitons show surprising phenomena concerning their stability and diffusive behaviour.

DY 34.114 Mo 15:30 Poster TU D

Violation of the scaling law and universality hypotheses in the statistical models — •Eugenia Soldatova and Alexandra Galdina — Dniepropetrovsk National University, Ukraine

Successes of the modern theory of critical phenomena have been connected with the fundamental conclusions about the critical state nature and existence of the class of systems, for which both the scaling law hypothesis and universality one are fulfilled. From this point of view real systems and consistent models contradicting to above-mentioned hypotheses are the problem of great importance. The 6-vertex Lieb model

and 8-vertex Baxter model are such models. We have analyzed the critical properties of the models on the basis of the thermodynamic method of investigation of one-component system critical state. The method is based on the critical state definition and its stability examination. It leads to existence of four types of critical behaviour [1]. The following conclusions have been made:

The violation of the scaling law hypothesis in the Lieb model is caused by the realization of different behaviour types in subcritical and supercritical regions;

The violation of universality hypothesis is concerned with two different behaviour types depending on an interaction parameter. Moreover, one of these types is represented by three cases (with different critical slope of phase equilibrium curve).

[1] E.D.Soldatova, Cond. Matt. Phys. **2**(4), 603 (1999)

DY 34.115 Mo 15:30 Poster TU D

Transport through double barriers in Luttinger liquids — •Tilman Enss[1], Sabine Andergassen[1], Volker Meden[2], Xavier Barnabé-Thériault[2], Walter Metzner[1], and Kurt Schönhammer[2] — [1]Max-Planck-Institut für Festkörperforschung, Stuttgart — [2]Institut für Theoretische Physik, Universität Göttingen

We study the conductance through an interacting nanowire containing impurities and coupled to non-interacting leads. Our functional RG method starts from the microscopical model and arrives at an effective low-energy model showing Luttinger-liquid behavior. For a double barrier enclosing a dot region, the conductance is determined over several decades of the temperature and for arbitrary impurity strength. Depending on the parameters of the dot we find temperature regimes in which the conductance follows power laws with universal exponents as well as non-universal behavior.

DY 34.116 Mo 15:30 Poster TU D

Functional RG for Luttinger liquids with impurities — •Sabine Andergassen[1], Tilman Enss[1], Volker Meden[2], Walter Metzner[1], Ulrich Schollwöck[3], and Kurt Schönhammer[2] — [1]Max-Planck-Institut für Festkörperforschung, Stuttgart — [2]Universität Göttingen — [3]Technische Hochschule Aachen

We improve the recently developed functional renormalization group (fRG) for impurities and boundaries in Luttinger liquids by including renormalization of the two-particle interaction, in addition to renormalization of the impurity potential. Explicit flow equations are derived for spinless lattice fermions with nearest neighbor interaction at zero temperature, and a fast algorithm for solving these equations for very large systems is presented. We compute spectral properties of single-particle excitations, and the oscillations in the density profile induced by impurities or boundaries for chains with up to 10^6 lattice sites. The expected asymptotic power-laws at low energy or long distance are fully captured by the fRG. Results on the relevant energy scales and crossover phenomena at intermediate scales are also obtained. A comparison with numerical density matrix renormalization results for systems with up to 1000 sites shows that the fRG with the inclusion of vertex renormalization is remarkably accurate even for intermediate interaction strengths.

DY 34.117 Mo 15:30 Poster TU D

Critical dynamics of disordered model C — •Reinhard Folk[1], Maxym Dudka[1,2], Yurij Holovatch[1,2,3], and Günter Moser[4] — [1]Institute für Theoretische Physik, Johannes Kepler Universität Linz, A-4040 Linz, Austria — [2]Institute for Condensed Matter Physics, National Academy of Sciences of Ukraine, UA-79011 Lviv, Ukraine — [3]Ivan Franko National University of Lviv, UA-79005 Lviv, Ukraine — [4]Abteilung für Physik und Biophysik, Univerität Salzburg, A-5020 Salzburg, Austria

We study the relaxational critical dynamics of the φ^4-model with an additional coupling between the order parameter φ and a conserved density - model C [1,2] - in presence of disorder. The asymptotic critical behavior of this model reduces to that of model A. However, the disorder affects considerably the non-asymptotic dynamical behavior. A field-theoretical renormalization group analysis of disordered model C is possible observing the same structure for dynamical vertex functions as for pure model. The investigations of asymptotic and effective critical behavior are performed mostly for region $n < n_c$, where disorder is relevant in statics. The non-monotonic character of the temperature dependence of the dynamical effective critical exponent z_{eff} at approach to the asymptotic regime is demonstrated.

[1] B. I. Halperin, P. C. Hohenberg, S.-k. Ma, Phys. Rev. B **10**, 139 (1974).

[2] R. Folk, G. Moser, Phys. Rev. Lett. **91**, 030601 (2003); R. Folk, G. Moser, Phys. Rev. E **69**, 036101 (2004).

DY 34.118 Mo 15:30 Poster TU D

Critical dynamics of a stochastic model with two conserved densities — •Reinhard Folk[1] and Günter Moser[2] — [1]Institute for Theoretical Physics, University of Linz, Austria — [2]Institute for Physics and Biophysics, University of Salzburg, Austria

We calculate the field theoretic functions of the generalized dynamical model C*', where two conserved secondary densities are coupled to a nonconserved complex order parameter (OP), in two-loop order. A transformation to 'orthogonalized' densities can be performed where only one secondary density with nontrivial static coupling to the OP exists while the second one remains Gaussian. The secondary densities remain dynamically coupled by the nondiagonal diffusion coefficent.

General relations for the field theoretic functions allow to relate the asymptotic critical properties of model C*' to the simpler model C* with only one conserved density coupled to the OP, the nonasymptotic properties however differ as can be seen from the flow of the dynamic parameters, which is presented for the case of a real OP with componets n=1,2,3.

DY 34.119 Mo 15:30 Poster TU D

Diffusion in a fluctuating membrane — •Ellen Reister and Udo Seifert — II. Institut für theoretische Physik, Universität Stuttgart, Pfaffenwaldring 57/III, 70550 Stuttgart

Experimental techniques, like fluorescence correlation spectroscopy, track the movement of fluorescent probes in membranes in order to determine diffusion constants. However, the deduction of diffusion constants from experimental data generally assumes that diffusion takes place in a plane, although real membranes are subject to thermal fluctuations. We are interested in the interplay of membrane fluctuations and diffusion within a membrane. To study the system we regard Brownian motion of particles on a curved surface. The particles are free to move within the membrane without influencing the membrane shape. The fluctuations of the membrane, that is described by a Helfrich Hamiltonian, lead to a time dependent metric of the curved surface. We calculate the rescaled projected diffusion constant for a fluctuating membrane and estimate the difference between the real and projected diffusion constant under typical experimental conditions.

DY 34.120 Mo 15:30 Poster TU D

Statistics of transition times, phase diffusion and synchronization in periodically driven bistable systems — •Michael Schindler[1], Peter Talkner[1], Lukasz Machura[1,2], Peter Hänggi[1] und Jerzy Łuczka[2] — [1]Theoretical Physics I, Institute of Physics, Augsburg University, Germany — [2]Department of Theoretical Physics, Institute of Physics, Silesian University, Poland

The statistics of transitions between the metastable states of a periodically driven bistable Brownian oscillator are investigated on the basis of a two-state description by means of a master equation with time-dependent rates. The results are compared with extensive numerical simulations of the Langevin equation for a sinusoidal driving force. Very good agreement is achieved both for the counting statistics of the number of transitions per period and the residence time distribution of the process in either state. The counting statistics corroborate in a consistent way the interpretation of stochastic resonance as a synchronization phenomenon for a properly defined generalized Rice phase [1].

[1] P. Talkner, L. Machura, M. Schindler, P. Hänggi and J. Łuczka, New Journal of Physics (January 2005); preprint physics/0409065

DY 34.121 Mo 15:30 Poster TU D

Feldtheorie hydrodynamischer Fluktuationen und der Glasübergang — •Mario Einax — Fachbereich Physik, Universität Konstanz, D-78457 Konstanz

Auf der effektiven Beschreibungsebene der hydrodynamischen Fluktuaktionen wird eine feldtheoretische Formulierung unterkühlter Flüssigkeiten untersucht. Von grundlegender Bedeutung ist die Klärung der Frage nach nach dem minimalen Satz relevanter Variablen (Felder) für die Ausbildung des unterkühlten Flüssigkeitsregimes. Hierbei werden zunächst die nichtlinearen hydrodydnamischen Bewegungsgleichungen der Fluktuationshydrodynamik im Rahmen eines erweiterten Martin-Siggia-Rose-Formalismus in eine feldtheoretische Form transformiert, welche eine systematische störungstheoretische Analyse (1-loop Approximation) der Langzeitdynamik in hochviskosen Flüssigkeiten erlaubt. Als

Resultat erhält man einen selbstkonsistenten Satz gekoppelter Differentialgleichungen für die Transportkoeffizienten, woran eine schrittweise Untersuchung der Ausbildung unterkühlter Flüssigkeitsregime möglich ist, d.h. in wie weit die Nichtlinearitäten das Transportverhalten in hochviskosen Flüssigkeiten verändern.

DY 34.122 Mo 15:30 Poster TU D

Self-adaptive Wang-Landau algorithm: densities of states, ϕ^4-model and Feynman integrals — •Andreas Tröster[1], Christoph Dellago[1], Wilfried Schranz[1], and Juan Manuel Perez-Mato[2] — [1]Faculty of Physics, University of Vienna, Boltzmanng. 5, A-1090 Vienna, Austria — [2]Dept. Fisica de la Materia Condensada, Universidad del Pais Basco, Bilbao, Spain

We report a new self-adapting version of the recently developed Landau-Wang algorithm which is also capable of determining densities of states for systems with complicated parameter dependence of possible energy ranges. Applications include high-precision numerical integration of sharply peaked functions on multidimensional integration domains, determination of 2-parameter densities of states and an analysis of the crossover behavior of the ϕ^4 model from the order-disorder to the displacive limit.

DY 35 Glasses I (joint session DF/DY)

Zeit: Montag 10:00–13:00 Raum: TU A060

Hauptvortrag DY 35.1 Mo 10:00 TU A060

Domain walls in Ising spin glasses — •Timo Aspelmeier — Institut für Theoretische Physik, Universität Göttingen

Domain walls, i.e. the boundaries of energetically low-lying droplets of overturned spins, are at the heart of the droplet theory of spin glasses. They are, however, not limited to droplet theory and their effects can also be found in the rivalling replica field theory (RFT). In particular it is possible to calculate the domain wall exponent θ within RFT exactly. The result of this calculation differs markedly from droplet picture expectations. Numerical measurement of θ can therefore provide a new test to distinguish between the two theories.

DY 35.2 Mo 10:30 TU A060

Atomic Dynamics in Molecular Dynamics Simulations of Glassy CuTi Thin Films — •Sebastian Vauth and S.G. Mayr — I. Physikalisches Institut, Georg-August-Universität Göttingen, Friedrich-Hund-Platz 1, 37077 Göttingen

We present results on atomic dynamics in metallic glass thin films below the glass transition temperature using molecular dynamics simulations. Thin CuTi films of different compositions are prepared by quenching the liquid to an amorphous state. The atomic dynamics on the amorphous surface and inside the bulk of the samples are quantitatively compared by calculating diffusion constants and jump length distributions. We focus on the collective or single particle character of the diffusion mechanism in dependence of the atom type. In addition, single atom exemplifications are analyzed for the different kinds of atomic dynamics. We find that Cu surface atoms diffuse with a single atom jump dynamics, whereas inside the bulk collective behavior dominates for both species. Our investigations are extended to ion irradiation of the surface with an energy of some keV or less. This work is financially supported by the DFG Sonderforschungsbereich 602, TP B3.

DY 35.3 Mo 10:45 TU A060

Atomic structure and dynamics of alumina melt: A computer simulation study — •Sandro Jahn[1] and Paul A. Madden[2] — [1]GeoForschungsZentrum Potsdam, Sektion 4.1, Telegrafenberg, 14473 Potsdam — [2]PTCL, University of Oxford, South Parks Road, Oxford OX1 3QZ, UK

The construction of accurate and transferable interatomic potentials for oxides and silicates is still a challenging task. The problem is related to the complex electronic structure that is profoundly affected by the interactions of neighboring ions. Effective interactions represented by pair potentials subsume many-body effects in some average sense and may work for a restricted set of coordination environments. However, they do not transfer well to other phases with different coordination environment or mixtures. Here we use an advanced ionic potential that allows for ion polarization, compression and aspherical deformation, and that was optimized by fitting to properties obtained from first principles calculations to study the atomic structure and dynamics of alumina melt. We show that the model is able to reproduce a number of experimental results, such as the static structure factor S(Q), the dynamic structure factor S(Q,ω) and the transport properties. Different cation coordination numbers lead to the splitting of the first peak of the Al-Al radial distribution function which might indicate the dynamic existence of high and low density regions in the melt. Extensions of the current model to multicomponent oxides and silicates will be discussed.

DY 35.4 Mo 11:00 TU A060

Beta-peak dynamics in the hard-sphere colloidal system — •Matthias Sperl — Duke University, Department of Physics, Box 90305, Durham, NC 27708, USA

The nearly-logarithmic decay of the correlation functions found recently in glass-forming *molecular* liquids is identified in the data for the mean-squared displacement of the *colloidal* hard-sphere system at the liquid-glass transition. The solutions of mode-coupling theory (MCT) fit the data well. An asymptotic expansion of the MCT equations of motion explains the nearly-logarithmic decay as a manifestation of the critical relaxation near a simple glass-transition singularity. The later phenomenon is therefore clearly different from the logarithmic decays at higher-order glass-transition singularities. A Cole-Cole formula can be derived rigorously for the nearly-logarithmic relaxation from the leading-order asymptotic expansion. The next-to-leading approximation describes the experimental data for three decades in time.

While previously only known for schematic models, the results identify a beta-peak phenomenon in a microscopic MCT calculation and clarify the origin of this feature of glassy dynamics.

DY 35.5 Mo 11:15 TU A060

Computer Simulations of liquid GeO_2 — •Michael Hawlitzky, Jürgen Horbach, and Kurt Binder — Institut für Physik, Universität Mainz, Staudingerweg 7, D-55128 Mainz

We present molecular dynamics computer simulation results for liquid GeO_2 (at temperatures 6100K $\geq$ T $\geq$ 2530K) and compare it with the appropriate results for the homologous substance SiO_2. This has been done by using classical MD (using a model pair potential developed by Oeffner and Elliott) as well as with the Car-Parrinello *ab initio* technique. We show that the structure and dynamics of GeO_2 exhibit similarities but also distinct differences compared to SiO_2.

In particular, we find that GeO_2 as well as SiO_2 displays a so-called fragile-to-strong transition, i.e. transport coefficients such as the diffusion constants show a change from a power-law behaviour as predicted by mode coupling theory (MCT) at high temperatures to an Arrhenius law at low temperatures. However, in GeO_2 the MCT regime is smaller and the activation energy within the the Arrhenius law regime is, in agreement with experiment, smaller than SiO_2.

DY 35.6 Mo 11:30 TU A060

Intermediate range order and transport processes in viscous aluminium silicates: A computer simulation study — •Patrick Pfleiderer, Jürgen Horbach, and Kurt Binder — Institut für Physik, Johannes Gutenberg-Universität Mainz, Staudinger Weg 7, D-55099 Mainz, Germany

Glassforming mixtures of SiO_2 with Al_2O_3 with different compositions are investigated by molecular dynamics (MD) computer simulations. These systems form tetrahedral network structures, i.e. both Al and Si are four-fold coordinated by oxygens. We show that these systems exhibit intermediate range order (IRO) that is reflected by prepeaks in partial static structure factors around 0.5 $Å^{-1}$. The underlying structure is a microphase-separated system where Al-O-rich regions form a percolating network through the Si-O structure. We study how the latter IRO is reflected in dynamical quantities such as the Debye-Waller factor and wave-vector dependent relaxation times.In the temperature range under investigation, i.e. for $T > 2000$ K, structural relaxation can be

well described by mode coupling theory.

DY 35.7 Mo 11:45 TU A060

Structure and transport in amorphous alkali silicates: Computer simulation studies — •Jürgen Horbach, Hans Knoth, and Kurt Binder — Institut für Physik, Johannes Gutenberg-Universität Mainz, Staudinger Weg 7, D-55099 Mainz, Germany

Mixtures of SiO_2 with an alkali oxide such as Na_2O, Li_2O or K_2O are ion-conducting materials for which the mobility of the alkali ions is much higher than that of silicon and oxygen atoms. We present molecular dynamics simulations for different alkali silicates with an alkali oxide content of about 33 mol%. In combination with inelastic neutron scattering [1] we show in the case of sodium disilicate the existence of a network of diffusion channels for the mobile sodium ions that are reflected by a prepeak in the static structure factor around 0.9 $Å^{-1}$. In systems with two alkali components (namely Li_2O and K_2O) the mixed alkali effect is seen which is most pronounced at low temperatures where the Si-O matrix is not in equilibrium anymore. We find the formation of two subnetworks of diffusion channels for each alkali component, and we discuss how aging effects in the Si-O matrix affect the diffusion of the alkali ions.

[1] A. Meyer, J. Horbach, W. Kob, F. Kargl, and H. Schober, Phys. Rev. Lett. **93**, 027801 (2004).

DY 35.8 Mo 12:00 TU A060

Is there a connection between microscopic particle arrangements and local heterogeneous dynamics in supercooled liquids? — •Hans König — Johannes Gutenberg-Universität Mainz, Institut für Physik, D-55099 Mainz

A binary 2D glass former of superparamagnetic colloids is experimentally investigated. The particles are confined to a plane water-air interface of hanging droplet geometry due to gravity. The particle positions are time-dependently distinguished by video-microscopy. An external magnetic field perpendicular to the monolayer allowed tuning the repulsive dipole-interaction between the induced magnetic moments from outside. The system is described by an interaction parameter Γ, given by the magnetic potential divided by k_BT. Because of this ratio, Γ corresponds to an inverse system temperature.

The amorphous particle configurations are microscopically characterized by triangles of nearest neighbouring particles (TNNP). These triangles form the cages around each particle. Their stability is responsible for locally resolved heterogeneous dynamics and α-relaxations. The local packing is compared to the idealized local density optimized so-called elementary triangles (ET). Large deviations between TNNP and ET detect less densely packed regions in the monolayer. There, fast moving particles are expected. However, does local structure rules dynamics like mode coupling theory predicts?

DY 35.9 Mo 12:15 TU A060

Konnektivität von α- und β-Relaxation in Glasbildnern — •Andre Nowaczyk[1,2], Manfred Winterlich[1,2], Gregor Diezemann[3], Gerald Hinze[3] und Roland Böhmer[1,2] — [1]Experimentelle Physik III, Universität Dortmund, 44221 Dortmund, Germany — [2]Interdisziplinäres Zentrum für magnetische Resonanz, Universität Dortmund, 44221 Dortmund, Germany — [3]Institut für Physikalische Chemie, Johannes Gutenberg-Universität, 55099 Mainz, Germany

Ungeordnete Materialien zeigen neben der strukturellen Relaxation meist auch einen sekundären Prozess vom Johari-Goldstein-Typ. In der Nähe des kalorimetrischen Glasüberganges sind die typischen Relaxationszeiten der beiden Prozesse um mehrere Größenordnungen getrennt. Deshalb liegt die Vermutung nahe, dass α- und langsame β-Relaxation unabhängige Prozesse darstellen. Um diese Vermutung zu testen, untersuchen wir unterkühlte Flüssigkeiten und ungeordnete Kristalle, die sich in der relativen Stärke ihrer β-Relaxation unterscheiden. Als Messmethode setzen wir die im ms...s-Bereich empfindliche stimulierte Echo-Spektroskopie in Kombination mit einem Spin-Gitter-Relaxationsfilter ein. Dies gestattet eine experimentell einstellbare Wichtung der langsamen Echozerfälle durch Relaxationsbeiträge im ms...ns-Bereich. Durch Vergleich der experimentellen Daten mit einem einfachen Modell diskutieren wir, inwieweit eine Selektion nach sekundären Eigenschaften das Erscheinungsbild der Primärrelaxation beeinflusst.

DY 35.10 Mo 12:30 TU A060

Low temperature dielectric properties of molecular glasses — •Catalin Gainaru[1], A. Rivera[1], E.A. Rössler[1], and G. Eska[2] — [1]Physikalisches Institut Experimentalphysik II, Universität Bayreuth, 95440 Bayreuth, Germany — [2]Physikalisches Institut Experimentalphysik V, Universität Bayreuth, 95440 Bayreuth, Germany

We present a systematic study of the dielectric response of simple molecular glass formers below the glass transition temperature T_g down to 4K. The investigations were carried out by applying the new Andeen Hagerling ultra-precision capacitance bridge (resolution $\tan\delta \sim 10^{-6}$, 50Hz - 20kHz). For systems showing no secondary relaxation peak ("type A") a nearly constant loss with an exponential temperature dependence prevails below T_g while for the other systems ("type B") the fluctuations are dominated by the β-process. Though the dynamics can be well distinguished between "type A"and "type B"systems down to 50 - 70 K, below the classification becomes meaningless: for all the investigated systems a crossover to another relaxation phenomena is found. For some systems the dynamics can be described by thermally activated transitions in asymmetric double well potentials. For others this model does not apply. Nevertheless, at temperatures below 10 K, an universal weak frequency dependence similar to the one for inorganic glasses is found for all the systems indicative of the tunneling regime.

DY 35.11 Mo 12:45 TU A060

Molecular reorientation dynamics of a supercooled molecular liquid, ionic liquid, and liquid crystal: a comparison — •Alexander Brodin, Alexei Pugachev, and Ernst Rössler — LS Experimentalphysik II, Universität Bayreuth

We report on a comparative depolarized light scattering study of three rather different supercooled systems: glycerol (molecular liquid), $LiCl{:}5H_2O$ (ionic liquid) and 5CB (nematic liquid crystal), at temperatures that cover the range from a deeply supercooled glassy state to a high temperature equilibrium liquid state, including the isotropic and supercooled nematic phases of 5CB. In molecular systems composed of anisotropic molecules, the main contribution to the depolarized light scattering comes from molecular reorientations - unrestricted and isotropic in the case of an isotropic liquid (glycerol, H_2O), and restricted about the director in the case of a liquid crystal (5CB). Despite the different nature of the studied systems, they all exhibit qualitatively similar spectra and temperature evolution thereof.

DY 36 Glasses II (joint session DF/DY)

Zeit: Montag 14:00–17:45 Raum: TU A060

Hauptvortrag DY 36.1 Mo 14:00 TU A060

Neue Anwendungsmöglichkeiten nanopartikelhaltiger Gläser — •Klaus-Jürgen Berg — Martin-Luther-Universität Halle-Wittenberg, FB Physik, Friedemann-Bach-Pl.6, D-06108 Halle

Der seit langem und allgemein bekannte Grund zum Einbau metallischer Nanopartikel in eine Glasmatrix ist die Erzeugung charakteristischer Farben. So führen z.B. sphärische Goldpartikel zu einem tiefroten Glas, dem im Kunsthandwerk häufig verwendeten Goldrubin. Technisch interessantere Anwendungen sind noch neu oder wurden erst in jüngster Zeit vorgeschlagen. Sie basieren auf nichtlinearen optischen Eigenschaften dieser Gläser, ihren anisotropen optischen Eigenschaften im Fall nichtsphärischer Metallpartikel und der Möglichkeit der Mikrostrukturierung von Eigenschaften unter Verwendung von Laserstrahlung oder Elektronenbestrahlung. Zur Mikrostrukturierung kann sowohl die Partikelbildung selbst als auch die gerichtete Deformation oder die Formrelaxation der Partikel ausgenutzt werden. Beispiele für den Einsatz der Effekte und Verfahren reichen von der lasergestützten Markierung, Beschriftung und Dekoration von Gläsern über die Herstellung farbiger Polarisatoren für den Einsatz in Flüssigkristall-Displays und Polarisatoren mit extrem hohem Kontrastverhältnis für den UV- und NIR-Spektralbereich bis zur Mikrooptik, Sensorik und optischen Datenspeicherung.

Alle erwähnten Beispiele lassen sich mit handelsüblichem Floatglas realisieren, in das nachträglich Nanopartikel aus Silber auf der Basis von Ionenaustauschprozessen eingebaut werden.

DY 36.2 Mo 14:30 TU A060

Berechnung der optischen Konstanten von Gläsern mit rotationsellipsoidförmigen metallischen Nanopartikeln — •F. Redmann, K.-J. Berg und G. Berg — Martin-Luther-Universität Halle-Wittenberg, FB Physik, Friedemann-Bach-Platz 6, 06108 Halle

Größe, Form und Konzentration von metallischen Nanopartikeln in Gläsern lassen sich durch Vergleich experimentell ermittelter und theoretisch berechneter Extinktionsspektren bestimmen. Basis für die Berechnungen ist im Fall sphärischer Partikel die auf der klassischen Elektrodynamik aufbauende Mie-Theorie. Sie gilt für geringe Konzentrationen, unterliegt aber hinsichtlich der Partikelgröße keinen Beschränkungen.

Für Partikel, die klein gegen die Wellenlänge sind, folgt aus der Mie-Theorie die sogenannte Dipolnäherung, in der die Extinktion nur aus der Absorption besteht und die Lichtstreuung an den Partikeln vernachlässigt wird.

Im selben Näherungsgrad liefern Effektiv-Medien-Theorien, mit denen eine effektive Dielektizitätsfunktion aus den Dielektizitätsfunktionen von Glasmatrix und Nanopartikel berechnet werden kann, neben dem Absorptionskoeffizienten auch noch den Brechungsindex des partikelhaltigen Glases. Hinsichtlich der Partikelkonzentration gibt es hier keine Beschränkungen.

Der Weg zu analogen Formeln für den Fall rotationsellipsoidförmiger Partikel ist in der Literatur skizziert. Allerdings existieren bisher keine expliziten Formeln dafür und auch keine numerischen Ergebnisse für konkrete Fälle. Im Vortrag werden entsprechende analytische Ausdrücke hergeleitet und erste numerische Ergebnisse für Silberpartikel diskutiert.

DY 36.3 Mo 14:45 TU A060

Mikro- und Nanostrukturierung der optischen Eigenschaften von metallpartikel-haltigen Gläsern — •Gerhard Seifert, Alexander Podlipensky, Amin Abdolvand und Heinrich Graener — Martin-Luther-Universität Halle-Wittenberg, Fachbereich Physik, 06099 Halle(Saale)

Metallische Nanopartikel in Gläsern dominieren deren optische Eigenschaften im sichtbaren und angrenzenden Spektralbereichen durch die Plasmonenresonanz der Partikel. Neben einem seit vielen Jahren etablierten thermo-mechanischen Deformationsprozess zur Herstellung ellipsoidaler Partikel, verbunden mit entsprechendem optischen Dichroismus dieser Materialien, wurde vor kurzem auch die gezielte Deformation zunächst sphärischer Metallpartikel durch intensive, ultrakurze Laserimpulse entdeckt. Dieses Verfahren erlaubt eine Strukturierung der optischen Eigenschaften solcher Verbundmaterialien bis herab zu Strukturgroessen der beugungsbedingt gegebenen Grenze (etwa der halben Wellenlänge des eingesetzten Lichtes). In diesem Jahr wurde eine weitere Möglichkeit der Strukturierung solcher Verbundmaterialien (z.B. mit eingelagerten Silberpartikeln) gefunden, die es erlaubt, durch starke elektrische Gleichfelder und erhöhte Temperaturen die Nanopartikel vollständig aufzulösen und damit die Mikro- und Submikrometerstrukturen geeigneter Elektroden in Form transparenter Bereiche auf Proben aus den erwähnten nanostrukturierten Verbundmaterialien zu übertragen. In dem Beitrag werden die Grundlagen und mögliche Anwendungen dieser neuartigen Technologie zur Herstellung optischer und optoelektronischer Funktionselemente diskutiert.

DY 36.4 Mo 15:00 TU A060

Reaction-Diffusion in Glasses — •Knud Zabrocki and Steffen Trimper — Fachbereich Physik, Martin-Luther-Universität, Friedemann-Bach-Platz, 06108 Halle

The formalism of reaction-diffusion rate equations is applied to an experimental measured phenomenon of particle creation in glasses. The description of the kinetic growth is major task of our investigation. There are three partial processes, which are proceeding in parallel: (i) Reduction of silver ions to silver atoms; (ii)Nucleation of the silver atoms; (iii) Creation of silver particles. Most of the known theoretical models are using homogeneous distribution of the silver ions in the first step. In our case we take a possible mobility of the silver ions into account resulting in a system of partial differential equation instead of ordinary ones. Whereas an effective linear theory is solved exactly in form of Fourier series, the complete non-linear system of equations is performed numerically. After the implementation of the other two steps of the kinetics, first in sequential manner and then in a parallel one we find the spatial distribution of the silver particles as well as the size distribution of them which influence the macroscopic properties of the glass like the colour and the rigidity.

DY 36.5 Mo 15:15 TU A060

Viaolation of the Frequency Temperature Superposition — •Oliver Baldus and Ernst Roessler — Universität Bayreuth, Lehstuhl für Experimentalphysik II, 95440 Bayreuth

Meth-Tricresylphosphate (m-TCP) was studied in mixtures with different polystyrenes. By carrying out 31P-NMR on m-TCP and 2D-NMR on polystyrene and using deuterated polystyrene we were able to investigate each component of the mixture independently. Two-phase spectra consisting out of a superposition of a solid state spectrum and a Lorentzian line were not only obtained for the small component (m-TCP) but also for deuterated polystyrenes of different chain length. That indicates that the dynamical distribution of reorientational jump times broadens in mixtures even for the large component in comparison to neat polystyrene. Therefore the frequency temperature superposition cannot be applied in those mixtures.

DY 36.6 Mo 15:30 TU A060

Röntgenbeugungsstudie zu Konzentrationsfluktuationen in ternären Metaphosphatgläsern — •Rainer Kranold, Günter Walter und Uwe Hoppe — Institut für Physik, Universität Rostock, D-18051 Rostock

Die strukturellen Effekte einer schrittweisen Substitution von K_2O für Na_2O, BaO für SrO und BaO für Na_2O in ternären Metaphosphatgläsern wurden mit Hilfe der Röntgenbeugung untersucht. Ein Maß für die in jedem Glas eingefrorenen Fluktuationen der Konzentration und/oder der topologischen Dichte ist durch den Grenzwert, $S(0)$, des totalen Strukturfaktors für den Streuwinkel Null gegeben. Die Abhängigkeit der experimentell bestimmten $S(0)$-Werte von der Glaszusammensetzung wird diskutiert, indem diese mit der zu erwartenden Konzentrationsabhängigkeit von $S(0)$ für den Fall einer idealen bzw. einer regulären Mischung verglichen wird. Die experimentellen $S(0)$-Werte der K-Na-Metaphosphatgläser lassen sich durch eine ideale Mischung von KPO_3- und $NaPO_3$-Einheiten erklären, während die $S(0)$-Werte der Ba-Sr-Gläser offenbaren, dass eine Nachbarschaft von ungleichen Metaphosphateinheiten deutlich bevorzugt wird. Im Gegensatz dazu wird für das Ba-Na-System eine starke Tendenz zur Segregation in Cluster von $NaPO_3$- und $Ba(PO_3)_2$-Einheiten festgestellt. Bei Zugrundelegung des Modells der regulären Mischung ergibt sich eine kritische Temperatur von T_c=340 K, die beträchtlich unterhalb der Temperatur des Glasübergangs liegt. Die beobachteten Unterschiede im Mischungsverhalten verschiedener Metaphosphateinheiten werden auf verschiedenartige Bauprinzipien der Ordnung mittlerer Reichweite zurückgeführt.

DY 36.7 Mo 15:45 TU A060

Cathodoluminescence of Hydrogen-related Defects in SiO_2 Layers — •Roushdey Salh, Andreas von Czarnowski, and Hans-Joachim Fitting — Institute of Physics, University of Rostock, Universitätsplatz 3, D-18051 Rostock

Hydrogen related defects in anhydrous "dry", hydrated "wet"and hydrogen implanted amorphous silicon dioxide (a-SiO_2) layers are investigated using scanning electron microscopy (SEM) and cathodoluminescence (CL) techniques in a wave length range λ=200-800 nm at specimen temperatures between room and liquid nitrogen temperature. Particular luminescent defect centers have been identified including the non-bridging oxygen hole center (NBOHC) associated with the red luminescence at 650 nm (1.9 eV), the oxygen deficient centers (ODC) with the blue (460 nm ; 2.7 eV) and the ultraviolet (295 nm ; 4.2 eV) bands and a yellow luminescence band at 580 nm (2.1 eV) associated with the self trapped exciton (STE) or a water state in the silicon dioxide network. The dose behavior of the red (R) luminescence in wet and dry oxide is quite different, decreasing in wet oxide from a high initial level and increasing in dry oxide from almost zero at room temperature. Additionally implanted hydrogen diminishes the red luminescence but increases the blue and the UV bands. Thus hydrogen passivates the NBOHC and keeps the ODC's in active emission state. A preliminary model of luminescence center transformation is based on radiolytic dissociation and re-association of mobile oxygen and hydrogen at the centers as well as formation of interstitial H_2, O_2, and H_2O molecules.

DY 36.8 Mo 16:30 TU A060

Mapping of Microwave-Induced Phonons by micro-Brillouin Spectroscopy: High Resolution Access To Acoustic Fields In Piezoelectric Materials — •J.K. Krüger, J. Mainka, L. Le Brizoual, B. Vincent, O. Elmazria, L. Bouvot, R. Sanctuary, D. Rouxel, and P. Alnot — Laboratoire Européen de Recherche Universitaire : Saarland-Lorraine, Universität des Saarlandes, Bau 38, D-66041 Saarbrücken

Brillouin spectroscopy (BS) is a versatile technique to measure acoustic properties at hypersonic frequencies and has been proven to be capable to detect thermally excited surface- and guided acoustic waves at microwave frequencies. BS on microwave induced phonons, generated at the surface of a piezoelectric crystal can be used to determine the hypersonic attenuation from the decay of the Stokes intensity of the BS. Only recently, BS was used for studying acoustic microscopy (BM). It turns out that this new technique is able to characterize the distribution of acoustic fields, generated by inter digital finger structures (IDT) at microwave frequencies in piezoelectric materials. The aim of this talk is to elucidate the efficiency of the electro-acoustic generation of hypersonic waves in thin piezoelectric films including their field properties and especially their spatial decay within the film plane.

DY 36.9 Mo 16:45 TU A060

Type A and type B glass formers: a ^{2}H NMR approach — •Sorin A. Lusceac, M. Vogel, C. Koplin, P. Medick, and E. A. Rössler — Lehrstuhl Experimentalphysik II, Uni. Bayreuth, Universitatsstrasse 30, 95440 Bayreuth

Concerning the manifestation of the secondary relaxation process in molecular glasses, the classification of glass formers in two groups was introduced based on dielectric spectroscopy investigations; type B glass formers present a secondary relaxation process (β-process) while type A do not. Since then ^{2}H NMR studies became a complementary approach. New NMR results, including mean spin-lattice relaxation time measurements ($< T_1 >$) and solid-echo line shape analysis will be presented for the type B glass former m-fluoroaniline, which has a β-process with a significantly smaller dielectric strength than the previous studied systems. The findings will be compared with those in glycerol, toluene, polybutadiene. We will estimate the relaxation strength of the β-process from NMR data and try to rationalize the different temperature dependence of $< T_1 >$ for the various systems.

DY 36.10 Mo 17:00 TU A060

Temperature-volume scaling of small molecule organic glass formers — •Andreas Reiser, Gernot Kasper, Christian Enss und Siegfried Hunklinger — Kirchhoff-Institut für Physik, Universität Heidelberg, Im Neuenheimer Feld 227, 69120 Heidelberg

The use of pressure besides temperature as a further external variable allows a variety of approaches to the glass-formation phenomenon. We have investigated the prototypical small molecule organic glass formers meta-fluoroaniline, propylene carbonate and glycerol using dielectric spectroscopy and dilatometry under hydrostatic pressure up to 700 MPa. We show that the volume and temperature dependence of the α-relaxation of these glass formers can be described by a single scaling variable $\Gamma := 1/(TV^w)$ with a material dependent parameter w and density independent fragilities.

DY 36.11 Mo 17:15 TU A060

Pressure dependent ionic conductivity of sodium-rubidium borate glasses — •Árpád W. Imre[1], Stephan Voss[1,2], Ioannis Konidakis[3], Frank Berkemeier[1], Malcolm Ingram[3], and Helmut Mehrer[1] — [1]Institut für Materialphysik, Universität Münster, Wilhelm-Klemm-Str.10, D-48149 Münster, Germany — [2]now at: Infineon Technologies, München, Germany — [3]Department of Chemistry, University of Aberdeen UK AB24 3UE

Measurements of the ionic conductivity as a function of pressure have been performed in a series of $0.3[X\mathrm{Na_2O}\cdot(1-X)\mathrm{Rb_2O}]\cdot 0.7\mathrm{B_2O_3}$ mixed- and single-alkali borate glasses. The activation volumes of the electrical conductivity are obtained at 453 K. The following fingerprints of the mixed-alkali effect were observed earlier in these glasses: i) the glass-transition temperature has a minimum near $X = 0.2$, ii) the diffusivities of ^{22}Na and ^{86}Rb crossover near $X = 0.2$, iii) the ionic conductivity σ_{dc} shows a minimum with composition near $X = 0.4$, iv) the activation enthalpy of σ_{dc} times temperature has a maximum near $X = 0.4$. As an additional feature of the mixed-alkali effect a maximum in the activation volume was found close to $X = 0.4$. The activation volumes obtained in the case of single-alkali borate glasses compare well with the corresponding ionic volumes for Na and Rb, respectively. In the single-alkali glasses the activation volume shows a constant behavior as a function of alkali content.

DY 36.12 Mo 17:30 TU A060

Translational and reorientational dynamics in room temperature ionic liquids — •Alberto Rivera, Alex Brodin, and Ernst A. Rössler — Experimentalphysik II, Universität Bayreuth, 95440 Bayreuth, Germany.

We present a study of the dynamics of molten salts, so called "room temperature ionic liquids", based on the 1-butyl-3-methylimidazolium cation with different anions, by means of dielectric spectroscopy and depolarized light scattering. Ionic liquids in general are easily supercooled, but the different anions determine the dynamics of the sample, changing the glass transition temperature (Tg) and eventually preventing supercooling. Two dynamic process can be accessed separately, the diffusion of ions and their reorientation. The electric spectra are dominated by the translational contribution, showing a typical ionic conductor behavior, a dc-plateau in the conductivity and, equivalently, a relaxation in the electric modulus representation. We find that both the conductivity characteristic times and the dc conductivity increase with the anion size. Below Tg diffusion of ions is still observed at sufficiently long times. To probe orientational dynamics, depolarized light scattering experiments were performed in a sample with a symmetric anion (PF6-). The time constants obtained correlate well with conductivity ones, indicating a strong rotational/translational coupling at high temperatures.

DY 40 Statistical Physics (General) I

Zeit: Dienstag 10:00–13:00 Raum: TU H3010

Hauptvortrag DY 40.1 Di 10:00 TU H3010

Exploring Complex Dynamics with Transition Path Sampling — •Christoph Dellago — University of Vienna, Institute for Experimental Physics, Boltzmanngasse 5, A-1090 Vienna, Austria

Numerous processes occurring in complex systems are governed by rare but important dynamical trajectories. Examples include the nucleation of first order phase transitions, chemical reactions and transport in and on solids. Such processes can be studied with transition path sampling, a computational methodology capable of bridging the time scale gap arising in these systems. Within this perspective, ensembles of trajectories can be sampled and manipulated in close analogy to standard techniques of statistical mechanics. I will discuss the statistical view of dynamics underlying the method and then report on the application of transition path sampling to the calculation of equilibrium free energies from non-equilibrium transformations on the basis of Jarzynski's theorem.

DY 40.2 Di 10:30 TU H3010

Non equilibrium dynamics below the super-roughening transition — •Gregory Schehr and Heiko Rieger — Theoretische Physik Universitat des Saarlandes 66041 Saarbrucken

The non equilibrium relaxational dynamics of the solid on solid model on a disordered substrate and the Sine Gordon model with random phase shifts is studied numerically. Close to the super-roughening temperature T_g our results for the autocorrelations, spatial correlations and response function as well as for the fluctuation dissipation ratio (FDR) agree well with the prediction of a recent one loop RG calculation, whereas deep in the glassy low temperature phase substantial deviations occur. The change in the low temperature behavior of these quantities compared with the RG predictions is shown to be contained in a change of the functional temperature dependence of the dynamical exponent $z(T)$, which relates the age t of the system with a length scale $\mathcal{L}(t)$: $z(T)$ changes from a linear T-dependence close to T_g to a $1/T$-behavior far away from T_g. By identifying spatial domains as connected patches of the exactly computable ground states of the system we demonstrate that the grow-

ing length scale $\mathcal{L}(t)$ is the characteristic size of thermally fluctuating clusters around "typical" long-lived configurations.

DY 40.3 Di 10:45 TU H3010

The driven mathematical pendulum revisited: precision analysis of the stability — •C. Jung, S. Hankemeier, H. Hübener, A. Struck und B. Kramer — 1. Institut für theoretische Physik, Universität Hamburg, Jungiusstraße 9, 20355 Hamburg, Germany

The dynamics of the damped mathematical pendulum with a periodic driving force renders the important features in many even non-classical systems suchs as Josephson junctions or Bose-Einstein condensates. The nonlinear equation of motion reveals periodic and chaotic motion for different choices of parameters and initial conditions.

We investigate the stability of trajectories by integrating the equation of motion using highly accurate numerical algorithms. The dependence of the Lyapunov exponents on the damping constant and amplitude A and frequency ω of the driving force is systematically analyzed.

Regions of regular and chaotic motion are identified. We discuss a possible self-similar structure in a systematic map of Lyapunov exponents in the A-ω-plane.

DY 40.4 Di 11:00 TU H3010

Mechanism of spontaneous symmetry breaking in a driven system with short range interaction — •Gunter M. Schütz[1], Richard Willmann[1], and Stefan Grosskinsky[2] — [1]Institut für Festkörperforschung, Forschungszentrum Jülich, 52425 Jülich — [2]Zentrum Mathematik, TU München, 85747 Garching

A one-dimensional two-species model with short-range interaction driven by an external field is considered. Although the dynamics is symmetric with respect to the two species, the steady state has a region in parameter space with broken symmetry which has no analogue in thermal equilibrium. We determine the exact phase diagram and describe quantitatively the dynamics of symmetry breaking by amplification of fluctuations. Our results are confirmed by Monte-Carlo simulations.

DY 40.5 Di 11:15 TU H3010

Nonlinear Tikhonov regularization for inverse problems with random noise — •Nicolai Bissantz[1], Thorsten Hohage[2], and Axel Munk[1] — [1]Institut für Mathematische Stochastik der Universität Göttingen — [2]Institut für Numerische und Angewandte Mathematik der Universität Göttingen

We consider nonlinear statistical inverse problems described by operator equations $F(a) = u$. Here a is an element of a Hilbert space which we want to estimate, and u is an L^2-function. The given data consist of measurements of u at n points, perturbed by random noise. We construct an estimator $\hat{a}_n$ for a by a combination of a local polynomial estimator and a nonlinear Tikhonov regularization and establish consistency in the sense that the mean integrated square error $E|\hat{a}_n - a|^2$ (MISE) tends to 0 as $n \to \infty$ under reasonable assumptions. Moreover, if a satisfies a source condition, we show for $\hat{a}_n$ a convergence rate result for the MISE, as well as almost surely. Further, it is shown that a cross validated parameter selection yields a fully data driven consistent method for the reconstruction of a. Finally, the feasibility of our algorithm is investigated in a numerical study for a groundwater filtration problem and an inverse obstacle scattering problem.

DY 40.6 Di 11:30 TU H3010

Universal energy distribution for interfaces in a random field environment — •Semjon Stepanow and Andrei Fedorenko — Martin-Luther-Universität Halle, Fachbereich Physik, D-06099

We study the energy distribution function $\rho(E)$ for interfaces in a random field environment at zero temperature by summing the leading terms in the perturbation expansion of $\rho(E)$ in powers of the disorder strength, and by taking into account the non perturbational effects of the disorder using the functional renormalization group. We have found that the average and the variance of the energy for one-dimensional interface of length L behave as, $< E > \sim L \ln L$, $\Delta E \sim L$, while the distribution function of the energy tends for large L to the Gumbel distribution of the extreme value statistics. We have also computed the energy distribution in the presence of a constant driving force.

DY 40.7 Di 11:45 TU H3010

Test of Replica Theory: Thermodynamics of 2D systems with quenched disorder — •Thorsten Emig — Institut für Theoretische Physik, Universität zu Köln, Zülpicher Str. 77, 50937 Köln

The so-called replica trick is a common tool to study disordered systems like spin glasses or elastic objects in a random potential. It relies on assumptions as, e.g., the analyticity in the replica number, which in general are uncontrolled. Therefore it is important to study sufficient simple but generic model glasses for which the general concepts can be tested.

Here we provide one of the first detailed tests of replica theory. We study a planar lattice of elastic strings pinned by disorder and the random bond dimer model on a square lattice are examined. Whereas the first system can be studied by Replica Bethe ansatz, the latter system is studied numerically by a polynomial algorithm which circumvents slow glassy dynamics. A mapping between the two systems is established which allows for the detailed quantitaive comparison of the replica theory predictions to simulation data. Over a wide range of disorder strength excellent agreement for various thermodynamic quantities is found. Realizations of the studied models include vortex lattices in superconductors, domain walls in incommensurate systems, rough crystal surfaces or frustrated Ising spin systems.

[1] T. Emig and S. Bogner, Phys. Rev. Lett. 90, 185701 (2003). [2] T. Emig and M. Kardar, Nucl. Phys. B 604, 479 (2001).

DY 40.8 Di 12:00 TU H3010

Crystallization and glass transition in a hard-core lattice gas model — •Martin Weigt[1], Hendrik Hansen-Goos[2], and Alexander K. Hartmann[2] — [1]Institute for Scientific Interchange, Viale S. Severo 65, I-10133 Torino - Italy — [2]ITP, Uni Göttingen, F.-Hund-Platz 1, 37077 Göttingen

We introduce a hard-core lattice-gas model on generalized Bethe lattices and investigate its compaction behavior analytically via the cavity method and numerically via Monte-Carlo simulations. If compactified slowly, the system undergoes a first-order crystallization transition. If compactified much faster, the system stays in a meta-stable liquid state and undergoes a discontinuous glass transition under further compaction. We also find two additional, more exotic metastable phases, a so-called inverse crystalline and a crystalline glass phase.

DY 40.9 Di 12:15 TU H3010

Approximations to phase transition dynamics of a diluted system — •Hendrik Hansen-Goos[1] and Martin Weigt[2] — [1]Institut für Theoretische Physik, Universität Göttingen — [2]Institute for Scientific Interchange, Torino

The dynamics of systems close to liquid-crystalline or liquid-amorphous phase tansition points is studied within a Bethe lattice gas model. We approach the flow of macroscopic observables by a projective approximation scheme (PAS) based on the use of generalized Gibbs ensembles for selected sets of observables which allows for a treatment of non-equilibrium configurations under the restricting assumption of microscopic equipartition.

PAS is applied to a system in the coexistence regime of liquid and crystalline phases for different sets of observables. Comparison with MC-simulated data shows that even a minimal description yields qualitatively good approximations.

Furthermore, PAS correctly predicts the divergence of stuctural relaxation time at the spin-glass instability for a system with a continuous glass-transition. When going to more detailed observables, PAS can be applied with an additional simplification causing a loss of the criticality.

We can conclude that PAS, which can be connected with ideas of dynamical replica theory [1], offers a normalisation for the general procedure "approximation via rate-equations" as recently introduced for diluted spin-systems [2].

[1] S.N. Laughton, A.C.C. Coolen and D. Sherrington, J. Phys. A **29**, 763 (1996); [2] G. Semerjian and M. Weigt, J. Phys. A **37**, 5525 (2004).

DY 40.10 Di 12:30 TU H3010

$1/f^\alpha$ spectra in elementary cellular automata and fractal signals — •Jan Nagler[1] and Jens Christian Claussen[2] — [1]Institut für Theoretische Physik, Universität Bremen, Otto-Hahn-Allee, 28334 Bremen, Germany — [2]Institut für Theoretische Physik und Astrophysik, Universität Kiel, Leibnizstraße 15, 24098 Kiel, Germany

We systematically compute the power spectra of the one-dimensional elementary cellular automata introduced by Wolfram. On the one hand our analysis reveals that one automaton displays $1/f$ spectra though considered as trivial, and on the other that various automata classified as chaotic/complex display no $1/f$ spectra. We model the results generalizing the recently investigated Sierpinski signal to a class of fractal signals that are tailored to produce $1/f^\alpha$ spectra. Because of the widespread ap-

plications of (elementary) cellular automata our findings may be relevant in chemistry, physics and computer sciences.

DY 40.11 Di 12:45 TU H3010

Generation of spatiotemporal correlated noise in 1+1 dimensions — •Arne Traulsen[1], Karen Lippert[2], and Ulrich Behn[2] — [1]Institut für Theoretische Physik und Astrophysik, Christian Albrechts Universität Kiel, Leibnizstrasse 15, D-24098 Kiel — [2]Institut für Theoretische Physik, Universität Leipzig, Augustusplatz 10-11, D-04109 Leipzig

We propose a generalization of the Ornstein-Uhlenbeck process in 1+1 dimensions which is the product of a temporal Ornstein-Uhlenbeck process with a spatial one and has exponentially decaying autocorrelation factorizing into a spatial and a temporal part [A. Traulsen, K. Lippert, and U. Behn, Phys. Rev. E 69, 026116 (2004)]. The process is an alternative to a spatiotemporal correlated model process proposed in [J. García-Ojalvo et al., Phys. Rev. A 46, 4670 (1992)] for which we calculate explicitely the hitherto not known autocorrelation function in real space.

DY 41 Einstein Symposium Brownian Motion, Diffusion and Beyond (SYBM)

Zeit: Dienstag 10:00–13:00 Raum: TU HE101

DY 41.1 Di 10:00 TU HE101

The program of the symposium is available under section SYBM.

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DY 42 Statistical Physics (General) II

Zeit: Dienstag 14:00–15:45 Raum: TU H3010

Hauptvortrag DY 42.1 Di 14:00 TU H3010

Thermodynamics - Past, Present and Future — •Werner Ebeling — Institute of Physics, Humboldt-University Berlin, 12489 Berlin

We begin with historical remarks on the basic contributions to thermodynamics and statistics with some bias to scientists working in Berlin as Helmholtz, Clausius, Nernst and Einstein [1]. We underline the key role of thermodynamic ideas in the scientific revolutions in the 20th century. Further we discuss several recent applications to natural, evolutionary and informational systems [3] as well as perspectives [3].

[1] W. Ebeling, D. Hoffmann: The Berlin School of Thermodynamics. Eur.J.Phys. **12**(1991)1-9.
[2] W. Ebeling, A. Engel, R. Feistel: Physik der Evolutionsprozesse. Akademie-Verlag Berlin (1990).
[3] W. Ebeling, I. Sokolov: Statistical Thermodynamics and Stochastic Theory of Nonequilibrium Systems, World Scientific (2005), to appear.

DY 42.2 Di 14:30 TU H3010

Coulomb Interactions via Local Dynamics: A Molecular Dynamics Algorithm Rejuvenating the Ether — •Burkhard Dünweg[1] and Igor Pasichnyk[2] — [1]Max-Planck-Institut für Polymerforschung, Mainz — [2]Max-Planck-Institut für Physik komplexer Systeme, Dresden

We derive and describe a recently proposed method for obtaining Coulomb interactions as the potential of mean force between charges which are dynamically coupled to a local electromagnetic field. We focus on the Molecular Dynamics version of the method and show that it is intimately related to the Car-Parrinello approach, while being equivalent to solving Maxwell's equations with freely adjustable speed of light. Unphysical self-energies arise as a result of the lattice interpolation of charges, and are corrected by a subtraction scheme based on the exact lattice Green's function. The method can be straightforwardly parallelized using standard domain decomposition. Some preliminary benchmark results are presented.

DY 42.3 Di 14:45 TU H3010

Casimir forces and Geometry — •Rauno Buescher and Thorsten Emig — Institut fuer Theoretische Physik, Universitaet zu Koeln, Zuelpicher Str. 77, 50937 Koeln, Germany

Casimir interactions between metallic surfaces can now be measured very precisely. However, on the theoretical side there is only little knowledge about Casimir forces in geometries going beyond the simplest cases as two parallel plates or a sphere and a plate. The only available approximations start from an expansion of the force at short distances, leading to the so-called proximity force approximation (PFA). Here we present a novel approach which is based on a numerical implementation of a path integral quantization of the electromagnetic field. It can be applied to surfaces with arbitrarily strong deformations at any distance. More specifically, we consider the normal and lateral force between periodically deformed surfaces. In contrast to the in general complicated behavior at short distances, as described by the PFA, we observe a universal behavior of the force at large distances is the sense that the interaction depends only on the mode with the largest wave length of the surface deformation spectrum and the modulations at smaller scales are irrelevant. Our findings thus complement the PFA approach, and yield even the crossover between the two regimes. We find that the in recent experiments detected lateral force changes with the lateral surface displacement in a way which can be distinct from the change of the surface profile itself. Our results can be extended to finite temperatures.

DY 42.4 Di 15:00 TU H3010

Morphological thermodynamics: shape dependence of free energies and density profiles — •Peter König[1], Roland Roth[1], and Klaus Mecke[1,2] — [1]MPI für Metallforschung, Stuttgart — [2]Institut für theoretische Physik, Universität Erlangen-Nürnberg

We show that a thermodynamic potential of a fluid bounded by an arbitrarily shaped convex container can be calculated fully from the knowledge of only four morphometric measures. This result is based on the assumption that a thermodynamic potential is an 'additive' functional which can be understood as a more precise definition for the conventional term 'extensive'. As a consequence, the surface tension and other thermodynamic quantities contain, beside a constant term, only contributions linear in the mean and Gaussian curvature of the container and not an infinite number of curvatures. Our findings are tested numerically in the entropic system of hard spheres bounded by a curved wall within the framework of density functional theory and by a systematic expansion of density profiles in powers of wall curvatures. The dependence of the fluid density on the wall shape for large distances from the wall can be derived analytically from Ornstein-Zernicke equation. The contact value of the fluid density and the asymptotic behaviour depend again only on the mean and Gaussian curvatures, i.e., on additive morphometric measures of the wall. Our approach can be generalised to systems with short-ranged fluid-fluid and wall-fluid interaction potentials, as long as intrinsic length scales remain small.

DY 42.5 Di 15:15 TU H3010

Finding hard problems — •Wolfgang Barthel and Alexander K. Hartmann — Institut für Theoretische Physik, Universität Göttingen, http://www.theorie.physik.uni-goettingen.de/~barthel

Why is it often so difficult to find the optimal solution? To answer this question computer scientists classify problems according to their complexity, i. e. how fast a worst-case realization of the problem can be solved depending on its size.
The specific problem we consider is the vertex-cover problem: Take a random graph consisting of undirected edges that meet at vertices. A vertex cover is a subset of the vertices that contains at least one of the two end vertices of every edge. Finding the vertex cover of minimal size is a NP-complete problem, i.e. the challenge of developing a fast algorithm or proving its non-existence is still open.
Typically the solution time heavily depends on the specific realization. To gain insight in the hardness of the problem one would like to compare typical realizations with the ones harder to solve. We present the results of a Monte Carlo simulation in the space of instances. Here the logarithm

of the solution time plays the role of the energy, so harder instances are more favorable at low "temperature" for the dynamics.

DY 42.6 Di 15:30 TU H3010

An EINSTEIN Memorial for Charge Transfer Reactions at the Phase Boundary of Molecular Crystals: Is it possible to Decide between FRENKEL and WANNIER Excitons by Applying his Mass-Energy Relation? — •Hermann M. M. Killesreiter — Privatgelehrter c/o TU Clausthal, priv. P. O. Box 1113, D-38669 Clausthal-Zellerfeld

One hundred years ago, EINSTEIN published amongst his current scientific considerations also his paper "Depends the Inertia of a Body from his Content on Energy?" [1905/2]. With reference to his paper on Relativity [1905/1], he assumed in a system a body which emitted two particles in opposite direction.

By comparision with earlier investigations by and with the author since his PhD Thesis [Munich 1970; 1972], dissociation of an exciton [1982] as well as sensitization from an adsorbed dye [1980] accross a phase boundary is quite similar to the situation described by EINSTEIN: it corresponds to the emission of two particles from a virtual entity, remaining one part at rest. The calculated mass values are far below the mass of atoms and exclude, therefore, the assumption of WANNIER Excitons.

[1905/1] Ann. Physik 17; [1905/2] Ann Physik 18; Surveys by [1972] H. Gerischer; [1980] P. S. Vincett and G. G. Roberts and [1982] in Electronic Processes in Organic Crystals by M. Pope and Ch. E. Swenberg.
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DY 43 Einstein Symposium Brownian Motion, Diffusion and Beyond (SYBM) – Contributed Talks I

Zeit: Dienstag 14:30–18:00 Raum: TU H2032

DY 43.1 Di 14:30 TU H2032

Ornstein-Uhlenbeck Process in Physics and Finance — •Ralf Remer and Reinhard Mahnke — Institute of Physics, Rostock University, D–18051 Rostock, Germany

We regard the Ornstein-Uhlenbeck process in Physics starting with the historic paper by Uhlenbeck and Ornstein [1] and its solution by Chandrasekhar [2]. We also demonstrate another way for solving the system of equations and visualize the solution.

Then we apply the Ornstein-Uhlenbeck process to the field of Finance by using appropriate transformations. We compare the received system of equations with empirical high frequency data of German stock market by calculating the probability density distributions of price changes for short time lags.

[1] G. E. Uhlenbeck and L. S. Ornstein 1930 On the theory of the Brownian motion *Physical Review* **36** 823–841
[2] S. Chandrasekhar 1943 Stochastic Problems in Physics and Astronomy *Reviews of Modern Physics* **15** 1–89

DY 43.2 Di 14:45 TU H2032

Brownian motion: Some puzzles 100 Years after Einstein and Smoluchowski — •Peter Hänggi — Institut für Physik, Universität Augsburg, Universitästrasse 1

The description of Brownian motion is well understood 100 years after Einstein and Smoluchowski. The stochastic process that describes Brownian motion in thermal equilibrium is a Gaussian. In classical statistical mechanics it is known as the Wiener process that can be derived from microscopic description in terms of a harmonic bath with a continuous spectrum for the bath-oscillator frequencies. The issue is more complex on a quantum level where the Brownian noise becomes operator-valued. Some open problems on the issue of Brownian motion remain nevertheless. These are: (1) the relaxation of an open quantum system in contact with a thermal heat bath that is prepared at initial time with some *arbitrary correlation* is still poorly understood (role of entanglement between bath and system under time evolution). Almost all literature treats the case of a Feynman-Vernon preparation where the system and the bath are not correlated at initial time. (2) The role of Brownian motion in systems exhibiting *aging* is not clear. (3) Another open problem is the problem of *relativistic Brownian motion*. For the latter area there exist practically no publications. In my talk I will review the state of the art and point out an Ansatz for solving the issues raised with points (1) and (2). For point (3), I will present a partial solution [1]. Moreover, I point out why the relativistic issue in its full generality will remain unsolved.

[1]J. Dunkel and P. Hänggi, *Theory of relativistic Brownian motion: The (1+1)-dimensional case*, Phys. Rev. E **70**, XXXXXX (2004), in press.

DY 43.3 Di 15:00 TU H2032

On the quantum description of Einstein's Brownian motion — •Bassano Vacchini[1] and Francesco Petruccione[2] — [1]Universita degli Studi di Milano, Italy — [2]University of KwaZulu-Natal, South Africa

A fully quantum treatment of Einstein's Brownian motion is given, showing the role played by the two original requirements of translational invariance and connection between dynamics of the Brownian particle and atomic nature of the medium. The former leads to a clearcut relationship with Holevo's result on translation-covariant quantum-dynamical semigroups, the latter to a formulation of the fluctuation-dissipation theorem in terms of the dynamic structure factor, a two-point correlation function introduced in seminal work by van Hove, directly related to density fluctuations in the medium and therefore to its atomistic, discrete nature. A microphysical expression for the generally temperature dependent friction coefficient is given. A comparison with the Caldeira Leggett model is drawn.

F. Petruccione and B. Vacchini, quant-ph/0411089; B. Vacchini, Phys. Rev. Lett. 84, p. 1374 (2000); J. Math. Phys. 42, p. 4291 (2001); Phys. Rev. E 66, 027107 (2002)

DY 43.4 Di 15:15 TU H2032

Intracellular Transport: A Levy Flight Process with a Log-Normal Velocity Distribution — •Erich Sackmann and Doris Heinrich — E22, Biophysik, Technische Universität München, Garching, Germany

The micro-viscoelastic behavior and intracellular transport in Dictyostelia cells has been evaluated by analysing the active and passive motion of magnetic and non-magnetic force probes, exploring a large region within the cell cytoplasm. A detailed analysis of the bead velocities showed that the motion can be described by Levy like quasi random walks, which can be represented by a log-normal distributions with velocities ranging from 0,25 -15 microns/s. The log-normal distribution is determined by the superposition of several distinct, statistically independent motions comprising the flagella like motion of the microtubules, the active motion of the bead along microtubules driven by kinesin and dynein motor molecules, the internal hydrodynamic flow, and the locomotion of the cell. The active forces measured in Dictyostelia cells (embedded in agarose) vary between 9 and 30 pN while larger forces (up to 100 pN) were found in free Dictyostelia. The large forces are attributed to actin-myosin mycromuscles. The cytoplasm behaves as a viscoplastic body. The force induced intracellular bead transport is described as a diffusive walk of a particle in a quasi-periodic potential and the mobility is determined by the fracture of intracellular networks. The direction is given by the constraints imposed by the microtubules and the intracellular compartment and the mobility has to be considered as a tensor.

DY 43.5 Di 15:30 TU H2032

Topological Superdiffusion — •Dirk Brockmann and Theo Geisel — MPI für Strömungsforschung, Göttingen

Superdiffusive phenomena abound in physical, biological, economical and ecological systems. Generally these processes, also known as Lévy flights, exhibit power laws in their spatial dispersal kernels. In a number of physical systems these scale free properties have been associated with anomalous thermal properties and corresponding fractional Fokker-Planck equations were established as the canonical way to describe these phenomena. In this talk I will reveal that the description of superdiffusive phenomena is a subtle issue. In particular I will show that paradigmatic systems exist which cannot be accounted for in the canonical way, which exhibit topological Lévy-type dispersal and which are thermally inconspicuous. The description of these processes requires a novel type of fractional Fokker-Planck equation with surprising and often counterintuitive properties. Systems exhibiting topological superdiffusion are numerous,

ranging from random walks on folded polymer chains, human dispersal in inhomogeneous environments, and the spread of epidemics in a globalized world.

DY 43.6 Di 15:45 TU H2032

On the proper boundary conditions for the anomalous subdiffusion–reaction processes — •Igor Goychuk and Peter Hänggi — Institut für Physik, Universität Augsburg, Germany

Diffusion can be of substantial importance for many processes in nature, e.g. for biochemical reactions occurring in the living cells. Due to the molecular crowding in the cytoplasm of the biological cells as well as in their membranes (which normally is the case) the molecular diffusion may become anomalously slow. The fractional diffusion equation presents a convenient mathematical tool to describe non-Markovian subdiffusion processes. Its application to the subdiffusion-reaction kinetics requires that the corresponding boundary conditions must be derived properly from the underlying physical consideration. There are two different kinds of the radiation boundary condition for the fractional diffusion equation at use. We justify the correctness and the physical relevance of one of them by invoking (i) the continuous time random walk picture of subdiffusional encounters, (ii) the probability conservation law and (iii) the standard assumption on the Markovian character of the chemical transformations at the encounter events. This justifies the correct use of the fractional Riemann-Liouville derivative for the diffusion part of the (sub)diffusion-reaction equations only. This implies also the failure of the known scaling recipe (in the Laplace-transformed time picture) to obtain the correct solution of a subdiffusion problem involving a pseudo-first order chemical reaction from its normal diffusion counterpart.

DY 43.7 Di 16:00 TU H2032

Anomalous Levy diffusion in an optical lattice and ergodicity breaking — •Eric Lutz — Abteilung Quantenphysik, Universitaet Ulm, D-89069 Ulm

We investigate anomalous transport in an optical lattice from the point of view of statistical mechanics and establish an explicit correspondence between ergodicity breaking and the divergence of the moments of the power-law tail distributions describing the behavior of the system, both in momentum space and in time.

DY 43.8 Di 16:15 TU H2032

Disordered iterated maps: Spectral properties, escape rates and anomalous transport — •Günter Radons and Andreas Fichtner — Institute of Physics, Chemnitz University of Technology, D-09107 Chemnitz, Germany

We investigate the transport properties of simple iterated maps with quenched disorder. The dynamics of these systems is mapped to random walks in random environments with next-nearest neighbour transitions, constituting generalisations of the well-known Sinai model. The non-equilibrium properties are studied numerically by a direct observation of the transport behaviour, by investigating the density of states of the propagator, and by considering the system-size dependence of the escape rate. Characteristic exponents associated with each of these quantities are determined and their dependence on the system parameters is evaluated. We find anomalously slow behaviour which in general deviates from the Sinai case and therefore generalises the latter.

DY 43.9 Di 16:30 TU H2032

Recurrence and Photon Statistics in Fluorescence Fluctuation Spectroscopy — •Christian Hübner[1], Johannes Hohlbein[1,2], and Gert Zumofen[3] — [1]Universität Halle, Fachbereich Physik, Hoher Weg 8, 06120 Halle — [2]Max-Planck-Institut für Mikrostrukturphysik, Weinberg2, 06120 Halle — [3]Eidgenössische Technische Hochschule Zürich, Physikalische Chemie, 8093 Zürich

We report on fluorescence fluctuations of nanoparticles diffusing through a laser focus. Subject to an intensity threshold the fluorescence signal is transformed into time traces of on- and off-periods. The distribution functions of the experimental on- and off-times follow power laws $t^{-\alpha}$ over several orders of magnitude with exponents $\alpha \simeq 1.5-2$. At long times the distribution functions cross over to exponential decays. For the interpretation of the experimental data a diffusion-reaction equation is proposed which covers both, the diffusion controlled recurrence and the photon statistics as the relevant processes.

DY 43.10 Di 16:45 TU H2032

Fluorescence correlation spectroscopy: Probing Brownian motion of molecules in solution — •Jörg Enderlein[1], Thomas Dertinger[1], and Ingo Gregor[2] — [1]IBI-1, Forschungszentrum Jülich, D-52425 Jülich — [2]IBI-2, Forschungszentrum Jülich, D-52425 Jülich

In the last three decades, advances in optical microscopy and photoelectric detectors had made it possible to routinely monitor the Brownian motion of molecules in and out of femtoliter detection volumes in solution. The resulting spectroscopic technqiue, fluorescence correlation spectroscopy (FCS), has found wide applications in biophysics, chemical analysis, and physical chemistry. The presentation focuses on recent advances of FCS concerning precise measurement of diffusion coefficient with multi-focal excitation and detection, as well as the combination of FCS with fluorescence lifetime spectroscopy for monitoring fast inter- and intramolecular processes such as conformational changes and molecular interactions.

DY 43.11 Di 17:00 TU H2032

Diffusion of single fluorescent dyes in nanometersized channels and cage structures — •Johanna Kirstein[1], Christian Hellriegel[1], Christophe Jung[1], Christoph Bräuchle[1], Nikolay Petkov[1], Barbara Fieres[1], Thomas Bein[1], and Ross Brown[2] — [1]LMU, Dept. Chemie und Biochemie, CeNS, Butenandtstr. 11, D-81377 München — [2]U.P.P.A., umr 5624 du CNRS, IFR, rue Jules Ferry, F-64075 Pau Cedex

We investigate the diffusion of individual molecules incorporated into mesoporous hosts. Using wide-field imaging and single particle tracking we collect trajectories of single fluorescent dye molecules (TDI) with high temporal (70 frames/s) and spatial (< 20 nm) resolution. In the present study thin films of spincoated mesoporous silica are used as hosts. Two different pore architectures were obtained by liquid crystal templating: a hexagonal (pore diameter 6 nm) and a cubic phase (9 nm). Our method provides a direct microscopic view of the diffusion process of single molecules, revealing not only differences in the mean diffusivity, but structural heterogeneities on a nanometer scale. Two populations of mobile molecules could be distinguished in the hexagonal samples. In the cubic phase a broad distribution of diffusion coefficients was observed. Strong deviations from Brownian motion occured: in some cases the shape of the trajectories reflects pore structure and topology of the host system. Simulations of the diffusional behavior based on the structural data of the host-guest systems are done for comparison.

DY 43.12 Di 17:15 TU H2032

Brownian motion of a single levitated mixed phase aerosol particle: Probing the dynamics of coupled Brownian motion employing dynamic light scattering — •Ulrich K. Krieger — Institute for Atmospheric and Climate Science (IACETH), ETH Zurich, 8093 Zurich, Switzerland

Within a liquid atmospheric aerosol particle a solid phase may coexist with the liquid over a wide range of ambient conditions. Aerosol particles often contain water insoluble components such as mineral dust or soot. Or, depending on composition, temperature, and relative humidity, a solid phase may form in an aqueous multicomponent salt particle, leaving a substantial fraction of the total particle mass in the liquid phase.

We apply dynamic light scattering spectroscopy (DLS) to probe the dynamics of single mixed phase particles levitated in a quasi-electrostatic trap under standard gas pressure. The Brownian motion of these particles is complicated because it is a coupled motion of the host droplet suspended in the gas phase and the movement of the inclusion via the viscous drag in the liquid phase. However, the analysis may allow obtaining information not only on the sizes of the host droplet and the inclusion but also on the viscosity of the liquid phase.

We will present experimental data and outline a route for interpreting the dynamic light scattering in the framework of coupled Brownian motion.

DY 43.13 Di 17:30 TU H2032

Studying Diffusion in Monolayers at the Air/Water Interface by Single-Particle-Tracking — •Carsten Selle[1], Florian Rückerl[1], Martin B. Forstner[2], Douglas S Martin[3], and Josef A. Käs[1] — [1]Universität Leipzig, Inst. Exp. Physik I, PWM, Linnestr. 5, 04103 Leipzig — [2]UC Berkeley — [3]Brandeis University

The diffusion properties of single biological membrane components were investigated by a Single-Particle-Tracking (SPT) technique employing monolayers at the air/water interface combined with Monte Carlo

simulations. Studies of lipid diffusion with long observation times revealed that (camera) noise can lead to the assumption of subdiffusion. Protein diffusion was mimicked by the motion of surface charged fluorescent polystyrene latexes in inhomogeneous monolayers. Associated with liquid-condensed (LC) lipid domains, dimensionally reduced diffusion was found. We assume that dipole-dipole interactions of beads with LC domains give rise to an underlying attractive potential. This view point is supported by Monte-Carlo simulations. Furthermore, the simulations demonstrated that model protein diffusion might be affected by the domain size and the potential depth. It is conceivable that living cells could make use of a similar mechanism to enhance kinetics of bimolecular enzyme reactions in the membrane.

DY 43.14 Di 17:45 TU H2032

multiple ion diffusion in disordered environments — •Joachim Sohns and Michael Schulz — Universität Ulm, Abteilung theoretische Physik, Albert-Einstein-Allee 11 89069 Ulm

The goal of this study is to give an analytical model to describe the mixed alkali effect. As a first step we discuss the behaviour of two different ions in a stochastic environment A random energy model is used which leads to a multi-particle fokker-planck equation with random potentials. As a model for the two different alkali ions we use two different potentials. We assume cross correlations between the potentials and interaction between the particles by coulomb forces. We use perturbation theory up to second order to find an approximation for the distribution of the particles. We discuss the influence of finite dimensions on our model.

DY 44 Growth and Fracture

Zeit: Dienstag 15:45–18:00 Raum: TU H3010

DY 44.1 Di 15:45 TU H3010

Hydrodynamic Interaction in Dendritic Solidification — •Thomas Fischaleck, Dmitry Medvedev, and Klaus Kassner — Otto-von-Guericke-Universität Magdeburg, FNW/ITP, PF 4120, D - 39016 Magdeburg

The effects of convective flow on dendritic crystal growth and pattern formation have been an active research topic for many years, but have not been fully understood on the theoretical side. This is mainly because the governing equations are considerably more complicated than without flow and microscopic solvability theory, successfully describing a single free crystal growing into its quiescent supercooled melt, is no longer applicable in its original formulation.

We present a new approach based on an asymptotic decomposition scheme and extend existing linear solvability ideas to include convective motion in the melt. In particular, we study the case of convection due to an external flow and compare theoretical results to numerical simulations.

DY 44.2 Di 16:00 TU H3010

Scaling properties of step bunches — •Joachim Krug — Institut für theoretische Physik, Universität zu Köln

Step bunching is a ubiquitous instability of vicinal crystal surfaces, which can be induced by a variety of mechanisms such as growth, sublimation or surface electromigration. Recently it has been found theoretically and experimentally that step bunches display characteristic scaling laws, which relate e.g. the height of a bunch to its width. A description of the surface shape evolution in terms of a continuum height equation suggests that step bunching instabilities fall into a few universality classes sharing the same scaling exponents. In this talk the basis of the universality scenario will be illustrated for a particular class of models, and the importance of understanding the properties of moving bunches will be emphasized. The talk is based on joint work with M. Kotrla, A. Pimpinelli, V. Popkov, F. Slanina, S. Stoyanov and V. Tonchev.

DY 44.3 Di 16:15 TU H3010

Komplexe Dynamik von elektromigrations-getriebenen zweidimensionalen Inseln — •Philipp Kuhn[1,2], Joachim Krug[2], Frank Hausser [3] und Axel Voigt [3] — [1]Fachbereich Physik, Universität Duisburg-Essen — [2]Institut für theoretische Physik, Universität zu Köln — [3]Forschungszentrum caesar, Bonn

Die Bewegung zweidimensionaler Inseln auf einer Kristalloberfläche unter dem Einfluss einer Elektromigrationskraft wird im Rahmen eines Kontinuumsmodells untersucht. Wir betrachten den Fall schneller Kantendiffusion, sodass die Fläche der Insel erhalten ist. Die Berücksichtigung der Kristallanisotropie in der Beweglichkeit der Kantenatome führt auf eine Vielfalt verschiedener Bewegungsmodi, die oszillatorisches wie irregulär-chaotisches Verhalten einschliessen. Ein Phasendiagramm der Bewegungsmodi wird als Funktion von Anisotropiestärke und Inselgrösse konstruiert. Für grosse Inseln lässt sich die oszillatorische Bewegung durch das Entstehen von stabilen, ortsfesten Facetten erklären, an denen die Insel vorbeiwandert. Die ausgewählten Facettenorientierungen können analytisch bestimmt werden.

DY 44.4 Di 16:30 TU H3010

Faceting and coarsening of a crystal surface — •Frank Hausser and Axel Voigt — Crystal Growth Group, Froschungszentrum caesar, Ludwig-Erhard-Allee 2, 53175 Bonn

The faceting and coarsening of a growing crystal surface caused by strongly anisotropic surface tension is studied. The dynamics is driven either by surface diffusion accompanied by a depositon flux normal to the interface or by attachment kinetics. In both cases the highly nonlinear evolution equations are derived from a curvature dependent surface energy.

We present detailed numerical studies for 1-dimensional surfaces. For both models, two stages in the formation of facets are found: at a first stage, a rather periodic hill-valley structure is formed. At the second stage three distinct morphologies emerge, depending on the growth rate of the surface: either faceting and subsequent coarsening occurs, or a periodic (faceted) pattern emerges, or the surface becomes rough. Moreover, in the first case, the only coarsening event is a kink ternary, i.e. a coalescence of two kinks and one antikink resulting in a kink. Also, the coarsening rate is shown to obey a power law. This results are in agreement with predictions based on a low dimensional dynamical system.

DY 44.5 Di 16:45 TU H3010

Ostwald Ripening of two-dimensional island — •Axel Voigt and Frank Hausser — Crystal Growth group, research center caesar, Ludwig-Erhard-Allee 2, 53175 Bonn

Ostwald ripening in homoepitaxy in the submonolayer regime is studied by means of classical LSW theory and large-scale numerical simulations. The simulations indicate, that the coarsening kinetics of the average island size is described by a $t^{1/a}$ power law, where $2 \leq a \leq 3$. For the two limiting cases of diffusion limited ripening and kinetics limited ripening the analytical results of the LSW theory are reproduced by the simulations. Besides the scaling law we also investigate island size distribution functions and the influence of anisotropic setp-edge energies and edge diffusion.

DY 44.6 Di 17:00 TU H3010

Slow crack propagation in heterogeneous materials — •Jan Kierfeld[1] and Valerii Vinokur[2] — [1]MPI für Kolloid- und Grenzflächenforschung, Potsdam — [2]Materials Science Division, Argonne National Laboratory

We consider crack nucleation and propagation in a heterogeneous two-dimensional material. Using the generalized Griffith criterion for crack propagation we derive an equation of motion for the crack tip position, which includes dissipation, thermal noise and quenched random forces due to heterogeneities. Depending on the exponent characterizing the power-law decay of the random forces we find qualitatively different behavior of propagating cracks. Sufficiently long-range random forces, as they are realized for frozen dislocations, lead to complete crack arrest thus preventing fracture. Random impurities lead to slowly propagating cracks with creep dynamics. Our results explain the enhanced fracture stability of certain heterogeneous materials, in particular, of work-hardened materials with frozen dislocations.

DY 44.7 Di 17:15 TU H3010

Fast Crack Propagation, Martensitic Transformations and the Grinfeld Instability — •R. Spatschek, M. Hartmann, E. Brener, and H. Müller-Krumbhaar — IFF, Forschungszentrum D-52425 Jülich

Fracture is an intriguing irreversible phenomenon that plays an important role in our day-to-day-life. It is commonly believed that crack propagation is dictated by microscopic details in the vicinity of the tip. However, we present a counterintuitive and surprisingly simple continuum theory which describes crack growth only by (macroscopic) surface diffusion or phase transformations in combination with the dynamical theory of elasticity. It predicts the complicated dynamics of a fast moving crack tip, the saturation of the steady state velocity appreciably below the sound speed, blunting of the crack and a tip splitting instability for high applied tensions. Phase field calculations confirm and illustrate these generic results. They also us allow to study elastically induced martensitic (solid-solid) transformations and melting and crystallization. Also, they demonstrate the development of stressed corrugated solid surfaces in contact with their melt phases (Grinfeld instability), leading to the formation of fast moving and interacting melt fingers. In contrast to earlier theories, it contains a self-consistent selection of the tip radius and the propagation velocity.

DY 44.8 Di 17:30 TU H3010

Explosive Metastable Pitting Corrosion on Stainless Steel (Experiment) — •Monika Bölscher[1], Christian Punckt[1], John L. Hudson[2], Alexander Mikhailov[1], and Harm H. Rotermund[1] — [1]Fritz-Haber Institut der Max-Plank-Gesellschaft, Abteilung für physikalische Chemie, Faradayweg 4-6, 14195 Berlin — [2]University of Virginia, Department of Chemical Engineering, 102 Engineers' Way, Charlottesville, VA, USA

Stainless steel is an alloy specially designed to be corrosion resistant. This resistance is due to a protective oxide layer, which forms naturally on the metal surface in the presence of oxygen. However, all stainless steels are susceptible to pitting corrosion, which can lead to severe damage of the material. It is observed, that pitting corrosion is preceded by the appearance of metastable pits. When metastable pits occur, the surface is eroded locally but the reaction stops after a few seconds and the oxide layer rebuilds. The onset of metastable pitting corrosion is investigated theoretically and experimentally.

Our experimental results show an exponential growth of surface activity and a rapid increase of the number of pits. These findings are consistent with a model, which explains the onset of corrosion as an explosive autocatalytic process.

DY 44.9 Di 17:45 TU H3010

Explosive Metastable Pitting Corrosion on Stainless Steel (Theory) — •Christian Punckt[1], Monika Bölscher[1], Alexander Mikhailov[1], John L. Hudson[2], and Harm H. Rotermund[1] — [1]Fritz-Haber-Institut der Max-Planck-Gesellschaft, Abteilung Physikalische Chemie, Faradayweg 4-6, 14195 Berlin — [2]University of Virginia, Dept. of Chemical Engineering, 102 Engineer's Way, Charlottesville, VA

Stainless steel is an alloy specially designed to be corrosion resistant. This resistance is due to a protective oxide layer, which forms naturally on the metal surface in the presence of oxygen. However, all stainless steels are susceptible to pitting corrosion, which can lead to severe damage of the material. It is observed, that pitting corrosion is preceded by the appearance of metastable pits. When metastable pits occur, the surface is eroded locally but the reaction stops after a few seconds and the oxide layer rebuilds. The onset of metastable pitting corrosion is investigated theoretically and experimentally.

Numerical simulations based on a new phenomenological model lead to a fresh understanding of the onset of corrosion. Metastable pits interact with each other and an explosive autocatalytic growth of the number of pits is found. This approach is supported by experimental results.

DY 50 Critical Phenomena and Phase Transitions

Zeit: Mittwoch 09:45–12:30 Raum: TU H3010

Hauptvortrag DY 50.1 Mi 09:45 TU H3010

Integrable $sl(2/1)$ super spin chain and the spin quantum Hall effect — •Holger Frahm[1], Fabian H. L. Essler[2], and Hubert Saleur[3,4] — [1]Institut für Theoretische Physik, Universität Hannover — [2]Theoretical Physics, Oxford University — [3]Service de Physique Théorique, CEA Saclay — [4]Dept. of Physics and Astronomy, University of Southern California

The analysis of network models – either directly or by numerical studies of related quantum spin chains with super group symmetry – allows to gain insights into the delocalisation transition of non-interacting two-dimensional electrons with disorder. Critical exponents determined this way are an important step towards the identification of the conformal field theory (CFT) describing the universal physics at the transition. To collect more information on the universal properties of the "spin quantum Hall" transition which may occur in disordered superconductors with certain restrictions on the symmetry an integrable version of the corresponding super spin chain has been proposed [1]. Analyzing the ground state and some low-lying excitations of this integrable chain we determine the central charge of the underlying CFT and obtain evidence for an infinite degeneracy of the finite size gaps (possibly related to a continuous sectrum of the CFT). Finally, we compare our findings for the integrable chain with known properties of the (non-integrable) network model for the spin QHE.

[1] R. M. Gade, *J. Phys. A* **32** (1999) 7071

DY 50.2 Mi 10:15 TU H3010

Phasendiagramm des zweidimensionalen, schwach anisotropen Heisenberg-Antiferromagneten — •M. Holtschneider, W. Selke und R. Leidl — Institut für Theoretische Physik, RWTH Aachen, 52056 Aachen, Germany

Das klassische Heisenberg-Modell auf einem Quadratgitter mit schwacher, Ising-artiger Anisotropie weist in einem äußeren Magnetfeld eine langreichweitig geordnete antiferromagnetische, eine algebraisch geordnete Spin-Flop- und eine paramagnetische Phase auf. Die Phasenlinien werden mithilfe einer Reihe von charakteristischen Größen, wie z.B. Untergittermagnetisierungen und Binder-Kumulante, in Monte-Carlo-Simulationen bestimmt. Gleichzeitig wird die Art der Phasenübergänge untersucht. Ergebnisse werden mit Resultaten zum entsprechenden $S = \frac{1}{2}$ Quanten-Heisenberg-Modell verglichen.

DY 50.3 Mi 10:30 TU H3010

Phasenraum-Topologie als Verbindung zwischen Dynamik und Thermodynamik von Phasenübergängen — •Michael Kastner — Physikalisches Institut, Theoretische Physik I, Universität Bayreuth, 95440 Bayreuth

Der Zusammenhang zwischen der mikroskopischen Dynamik eines Vielteilchensystems und dessen statistischer oder thermodynamischer Beschreibung ist eine Fragestellung, die schon seit Boltzmanns Zeiten diskutiert wird, die aber immer noch neue und interessante Aspekte bietet. Eine kürzlich aufgestellte Hypothese etabliert, mittels topologischer Konzepte, eine faszinierende derartige Verbindung zwischen mikroskopischer und makroskopischer Beschreibungsebene: ein Phasenübergang kann nur dann auftreten, wenn innerhalb einer Familie gewisser Unterräume des Phasenraums eine Topologieänderung stattfindet. Gleichzeitig kann die Topologie aber auch in Beziehung gesetzt werden zum Verhalten des maximalen Lyapunov-Exponenten, und damit zur mikroskopischen Dynamik, des Systems. Durch diese Nähe zur mikroskopischen Dynamik sowie durch die Tatsache, dass nicht auf die sonst in der statistischen Physik üblichen Gibbsschen Ensembles Bezug genommen wird, ist der „topologische Zugang zu Phasenübergängen" konzeptionell von großem Interesse. Weiterhin legt dieser Zugang, im Gegensatz zur Standarddefinition, eine (physikalisch wünschenswerte) „natürliche Verallgemeinerung" der Definition eines Phasenübergangs auch für endliche Systeme nahe. Die Grundideen des topologischen Zugangs sowie einige der zahlreichen noch offenen Fragen dieses neuen Forschungsgebiets sollen im Rahmen dieses Vortrags vorgestellt und erläutert werden.

DY 50.4 Mi 10:45 TU H3010

Evolution of equilibrium droplets — •Andreas Nussbaumer, Elmar Bittner, and Wolfhard Janke — Institut für Theoretische Physik, Universität Leipzig, Augustusplatz 10/11, 04109 Leipzig

At the critical temperature T_c the spin-1/2 Ising model exhibits a

phase transition and for temperatures below T_c there exists a spontaneous manetisation $\pm m_0(T)$. It is well known, that the distribution of the magnetisation $P(m,T)$ has a double peak-structure divided by a flat valley and that the peaks correspond to the so called "droplet"regime and the valley to the "strip"regime.

Following the analytic work of Leung and Zia [1] we used Monte Carlo (MC) simulations to identify the transition point between the droplet- and the strip regime in two and three dimensions. In both cases the Monte Carlo data was matched with data from the "Surface Evolver", a software to calculate minimal surfaces providing evidence for the exact transition mechanism.

Furthermore, using similar MC algorithms we observed the evaporation/condensation transition. When properly rescaled, our data confirm the analytical results found in [2], showing the absence of droplets of intermediate size.

[1] K. Leung and R. Zia, Geometrically induced transitions between equilibrium crystal shapes, J. Phys. A **23**, 54 4593 (1990).
[2] M. Biskup, L. Chayes and R. Kotecky, On the formation/dissolution of equilibrium droplets, Europhys. Lett. **60**, 21-27 (1990).

DY 50.5 Mi 11:00 TU H3010

Vortex Line Percolation in the Three-Dimensional Complex Ginzburg-Landau Model — •Elmar Bittner, Axel Krinner, and Wolfhard Janke — Institut für Theoretische Physik, Universität Leipzig, Augustusplatz 10/11, 04109 Leipzig, Germany

Percolation has been used to study phase transitions in various different theories, an example of this is the $O(2)$ field theory where the percolating objects are vortex lines forming closed networks. In discussing the phase transition of the three-dimensional complex Ginzburg-Landau model, we study a geometrically defined vortex loop network as well as the magnetic properties of the system in the vicinity of the critical point. Using high-precision Monte Carlo techniques we consider an alternative formulation of the geometrical excitations in relation to the global $O(2)$-symmetry breaking, and check if both of them exhibit the same critical behaviour leading to the same critical exponents and therefore to a consistent description of the phase transition. Different percolation observables are taken into account and compared with each other.

DY 50.6 Mi 11:15 TU H3010

Surface melting and partial surface melting in metal clusters — •Ralph Werner and Günter Schneider — Institut fuer Theorie der Kondensierten Materie, Universitaet Karlsruhe, 76128 Karlsruhe

We investigate the melting transition of small Al clusters by means of the specific heat and bond length fluctuations determined via canonical Monte-Carlo simulations using many-body Gupta potentials [1]. The determination of the fluctuations of individual bonds reveals that additional atoms in clusters with closed shell structures destabilize the surface, which in turn melts at least partially at very low temperatures. The size dependence of the different signatures of the melting is discussed in detail.
[1] R. Werner, submitted to Eur. Phys. J. B (2004).

DY 50.7 Mi 11:30 TU H3010

Profile and Width of Rough Interfaces — •Melanie Müller[1] and Gernot Münster[2] — [1]Max-Planck-Institut für Kolloide und Grenzflächen, 14421 Potsdam — [2]Institut für Theoretische Physik, Universität Münster, Wilhelm-Klemm-Str. 9, 48149 Münster

In the context of Landau theory and its field theoretical refinements, interfaces between coexisting phases are described by intrinsic profiles. These intrinsic interface profiles, however, are neither directly accessible by experiment nor by computer simulation as they are broadened by long-wavelength capillary waves. We apply a blocking procedure, using the block size as a variable cutoff, to separate the small scale intrinsic structure from the large scale capillary wave fluctuations in the Monte Carlo simulated 3D-Ising model. While the capillary wave picture is confirmed on large length scales and its limit of validity is estimated, an intrinsic regime is, contrary to expectations, not observed.

DY 50.8 Mi 11:45 TU H3010

Calculation of partition functions by measuring distributions of number of components — •Alexander K. Hartmann — Institut für Theoretische Physik, Friedrich-Hund-Platz 1, 37077 Göttingen

A new algorithm is presented, which allows to calculate numerically the partition function Z for systems, which can be described by arbitrary interaction graphs and lattices, e.g. Ising models or Potts models (for arbitrary values $q > 0$), including random or diluted models. The new approach is suitable for large systems. The basic idea is to measure the distribution of the number of connected components in the corresponding Fortuin-Kasteleyn representation and to compare with the case of zero degrees of freedom, where the exact result $Z = 1$ is known. As application, $d = 2$ and $d = 3$-dimensional ferromagnetic Potts models are studied, and the critical values q_c, where the transition changes from second to first order, are determined. Large systems of sizes $N = 1000^2$ respectively $N = 100^3$ are treated. The critical value $q_c(d = 2) = 4$ is confirmed and $q_c(d = 3) = 2.35(5)$ is found.

DY 50.9 Mi 12:00 TU H3010

Monte Carlo Simulationen mit optimalen statistischen Ensemblen — •Simon Trebst — ETH Zürich

Monte Carlo Methoden, welche es ermöglichen, die Zustandsdichte, Entropie und freie Energie eines klassischen oder quantenmechanichen Systems zu berechnen, simulieren ein statistisches Ensemble, das zu einem breiten Histogram etwa in der Energie führt. Kürzlich haben wir zeigen können, dass derartige Simulationen erheblich beschleunigt werden können, indem man das simulierte statistische Ensemble optimiert [1]. Im Vergleich zu multikanonischen, flachen Histogram-Methoden konnte ein Verbesserung um zwei Grössenordnungen gezeigt werden.

In diesem Vortrag berichten wir von neuen Anwendungen optimierter statistischer Ensemble. Wir zeigen, wie dichte Lennard-Jones Flüssigkeiten effizient simuliert werden können. Des weiteren lässt sich der Ansatz auf den viel benutzten "parallel tempering"-Algorithmus erweitern, indem man das simulierte Temperaturset optimiert. Wir zeigen Anwendungen für das 3D Edwards-Anderson Spinglass. Schliesslich berichten wir von Anwendungen auf stark korrelierte, quantenmechanische Systeme.

[1] S. Trebst, D. A. Huse, und M. Troyer, Phys. Rev. E 70, 046701 (2004).

DY 50.10 Mi 12:15 TU H3010

Critical Exponents of 3D Ising Model: Theory and Large–Scale Monte Carlo Simulations — •Jevgenijs Kaupužs — Univ. Latvia, LV–1459 Riga, Latvia

It is widely believed that the critical exponents of 3D lattice spin models are accurately predicted by the perturbative renormalization group (RG) theory [1]. An alternative analytical method has been developed in [2], where the perturbative RG theory has been critised and the set of possible exact values of the critical exponents for $O(n)$ models has been proposed.

Recently [3] some Monte Carlo simulations of 3D Ising model on unusually large lattices (with linear lattice size up to $L = 410$) very close to the critical point have been performed to verify the critical exponents.

We have improved the accuracy of our previous simulations and have extended them to $L = 512$. The magnetization at reduced temperatures $t \sim 0.00006$ have been considered. It shows that the critical exponent β deviates above the RG value 0.326 towards our [2] asymptotic value 3/8 when approaching the critical point. Generally, our results provide some arguments in favour of the theory developed in [2] and show that previous simulations by Hasenbusch and others relatively far away from criticality give effective rather than asymptotic values of the critical exponents.
[1] J. Zinn–Justin, Quantum Field Theory and Critical Phenomena, Clarendon Press, Oxford, 1996
[2] J. Kaupužs, Ann. Phys. (Leipzig) **10**, 299 (2001)
[3] J. Kaupužs, Proceedings of SPIE **5471**, 480 (2004)

DY 51 Einstein Symposium Brownian Motion, Diffusion and Beyond (SYBM) – Contributed Talks II

Zeit: Mittwoch 10:15–13:15 Raum: TU H2032

DY 51.1 Mi 10:15 TU H2032

Rate theory of the stick-slip motion of an AFM tip in friction force microscopy experiments — •Mykhaylo Evstigneev and Peter Reimann — Universität Bielefeld, Universitätsstraße 25, 33615 Bielefeld

During the stick-slip motion of an AFM tip contacting with a uniformly moving atomically clean surface, the force developed in the cantilever spring performs random sawtooth-like oscillations resulting from the thermally activated transitions of the tip from one surface site to the next. Using escape rate theory, the probability distribution of forces is calculated numerically to deduce the time-average lateral force as a function of pulling velocity. A much simpler analytic transcendental equation for the average force is proposed and its approximate solution is obtained. The high accuracy of this analytic approximation is demonstrated via comparison with the numerical results. The analogous force-velocity relations existing in the literature are shown to be the limiting cases of low and high cantilever spring constants of our formula.

DY 51.2 Mi 10:30 TU H2032

Jarzynski's relation: When is the work distribution a Gaussian? — •Thomas Speck and Udo Seifert — II. Institut für Theoretische Physik, Universität Stuttgart

Jarzynski's relation constrains the distribution of dissipated work spent in externally driven non-equilibrium processes like the mechanical stretching of biopolymers. Using this constraint, free energy differences can be extracted from non-equilibrium data. If the work distribution is a Gaussian, its mean and variance are related. We prove constructively that for slow driving this distribution is always Gaussian even for an underlying non-linear Langevin equation of motion [1]. For a linear Langevin equation, this distribution remains Gaussian even at fast driving. For this case, we determine its mean (and variance) as given by a non-local integral kernel [2]. This general result is illustrated for stretching Rouse polymers.

[1] T. Speck and U. Seifert, Phys. Rev. E, in press.
[2] T. Speck and U. Seifert, Eur. Phys. J. B, submitted.

DY 51.3 Mi 10:45 TU H2032

Experimental Verification of the Fluctuation Theorem for a Chemical Rate Equation — •Sebastian Schuler, Carsten Tietz, Thomas Speck, Udo Seifert, and Jörg Wrachtrup — Institute of Physics, University of Stuttgart, Pfaffenwaldring 57, 70550 Stuttgart

A non-linear fluctuation theorem for systems described by chemical master equations driven out of equilibrium is experimentally verified. In [1] starting out from Jarzynski's relation the fluctuation theorem is derived for transitions between n states. For experimental verification an optical 2-level system was used.

Defect centres in diamond can be switched from a fluorescent to a non-fluorescent state by illumination with red light (680 nm). By appliance of green light (514 nm) the system is switched back to its fluorescent state. Altering the intensity of the used wavelength changes the transition rates between bright and dark state.

While the system is driven out of equilibrium by introducing a time dependant transition rate the effect on the fluorescence is measured.

[1] U. Seifert J. Phys. A **37**, L517 (2004)

DY 51.4 Mi 11:00 TU H2032

The transition from Brownian to active Brownian motion — •Andreas W. Liehr[1,2], Hendrik U. Bödeker[2], Svetlana V. Gurevich[2], and Hans-Georg Purwins[2] — [1]Material Research Center Freiburg, Stefan-Meier-Str. 21, D-79104 Freiburg i. Br., Germany — [2]University of Münster, Institute of Applied Physics, Corrensstr. 2/4, 48149 Münster, Germany

In this talk we present recent results on Brownian and active Brownian motion in complex systems. On the example of self-organized current filaments in semiconductor-gas-discharge systems we discuss the detection of these different types of motion by means of stochastic time series analysis [1]. Furthermore, we report the transition from Brownian to active Brownian motion due to a change of system parameters. The theoretical discussion of this effect is carried out on basis of a qualitative reaction-diffusion model, which leads to the classification of the observed transition as supercritical drift-bifurcation [2,3].

[1] Liehr, A. W. ; Bödeker, H. U. ; Röttger, M. C. ; Frank, T. D. ; Friedrich, R. ; Purwins, H.-G.: Drift Bifurcation Detection for Dissipative Solitons. In: *New Journal of Physics* 5 (2003), Nr. 89, S. 1–9
[2] Bödeker, H. ; Röttger, M. C. ; Liehr, A. W. ; Frank, T. ; Friedrich, R. ; Purwins, H.-G.: Noise-covered drift bifurcation of dissipative solitons in a planar gas-discharge system. In: *Physical Review E* 67 (2003), Nr. 056220
[3] Gurevich, S. V. ; Bödeker, H. U. ; Moskalenko, A. S. ; Liehr, A. W. ; Purwins, H.-G.: Drift bifurcation of dissipative solitons due to a change of shape: experiment and theory. In: *Physica D* 199 (2004), Nr. 1–2, S. 115–128

DY 51.5 Mi 11:15 TU H2032

Why Hopping a Zig-zag Course — •Udo Erdmann[1], Niko Komin[1], Lutz Schimansky-Geier[1], Igor M. Sokolov[1] und Frank Moss[2] — [1]Humboldt-Universität zu Berlin, Instiut für Physik — [2]Center for Neurodynamics, University of Missouri at St. Louis

We investigate self-moving particles which prefer to hop with a certain turning angle equally distributed to the right or left. We assume this turning angle distribution to be given by a double Gaussian distributions. Based on the model of active Brownian particles and using the Green-Kubo formula we calculate the diffusion coefficient in dependence on the mean and the dispersion of the turning angles. It is shown that bounded distribution of food in patches will be optimally consumed by the objects if the hop preferable with a given angle and not straight forwardly

DY 51.6 Mi 11:30 TU H2032

Oscillating first passage time densities of strongly non-Markovian random processes. — •Tatiana Verechtchaguina, Igor M. Sokolov, and Lutz Schimansky-Geier — Institute for Physics, Humboldt University of Berlin, Newton Str. 15, 12489 Berlin

The first passage time (FPT) densities in many noise-driven dynamical systems do not resemble monomodal distribution with an exponential tail typical for Markovian systems. An example are interspike interval densities in resonant neurons driven by intrinsic noise and (or) external signal. The problem of finding ISI density can be reformulated as the first passage time problem for a non-Markovian random process with reset to a prescribed initial state after crossing a fixed barrier value.

As a mathematical example we consider a strongly underdamped harmonic oscillator driven with white Gaussian or colored harmonic noise. Using the general expression for the FPT density through multiple level-crossing densities of a stationary random process and truncating the corresponding integral series one obtains a good approximation for short and intermediate times which works especially well for processes with narrow spectral density, i.e. when the Markovian approaches fail, and reproduces very well quite a few first peaks of FPT densities.

DY 51.7 Mi 11:45 TU H2032

A paradox of non-Markovian dynamic disorder — •Igor Goychuk — Institut für Physik, Universität Augsburg, Germany

Rate processes with fluctuating rates are ubiquitous in nature. For example, a nonadiabatic donor-acceptor electron transfer (ET) in some proteins can be strongly influenced by the conformational jump dynamics between two macroconformations of the electron-transferring protein possessing two very different ET rates. The conformational dynamics will introduce a sort of stochastic time-dependence into the ET rates. This situation is known under the label of dynamic disorder. If the rate fluctuations are very fast on the time-scale of electron transfer, i.e. the mean residence times spent in the protein macroconformations are much less than the inverse of corresponding ET rates, a self-averaging occurs and the ET kinetics is described by the averaged ET rate. This is the fast fluctuation limit. In the opposite limit of quasi-static disorder, the averaged transfer kinetics is described by a weighted average of the two exponentials with the ET rates reflecting temporally "frozen"conformations. This picture is well established in the case of Markovian dynamic disorder which is characterized by the exponential distributions of the conformational residence times. I will show that the influence of non-Markovian dynamic disorder characterized by a broad distribution of the residence times can be highly nontrivial. A fast fluctuation limit, in accordance with the Markovian criteria, may surprisingly reveal a quasi-static rate distribution in the averaged dynamics. A clear-cut resolution of this ap-

parent paradox will be provided and its practical consequences will be discussed.

DY 51.8 Mi 12:00 TU H2032

AC-assisted DC-energy transport in spatially extended system: soliton ratchet — •Denysov Sergey — MPIPKS, Dresden

We study the directed energy diffusion in homogeneous spatially extended systems in the presence of an external AC-field. We showh that there are two channel for energy transport: heat current through the system and current due to nonhomogeneous energy exchange withe the AC-field.

DY 51.9 Mi 12:15 TU H2032

Brownian motors: current fluctuations and rectification efficiency — •Lukasz Machura[1,2], Marcin Kostur[1], Peter Hänggi[1], Peter Talkner[1], and Jerzy Łuczka[2] — [1]Theoretical Physics I, Institute of Physics, Augsburg University — [2]Department of Theoretical Physics, Institute of Physics, Silesian University, Poland

The quantity of foremost interest in the context of transport in Brownian motors is the mean velocity of the particle. Here, we address instead the fluctuations of the current, an often neglected aspect of the directed transport. These have a vital influence on the efficiency of rectifying noise [1]. Typically, we find that the asymptotic, time- and noise-averaged transport velocities are small, possessing rather broad velocity fluctuations. This implies a corresponding poor performance for the rectification power. For tailored profiles of the ratchet potential, however, and appropriate drive parameters, we can identify a drastic enhancement of the rectification efficiency [1].

[1] L. Machura, M. Kostur, P. Talklner, J. Łuczka and P. Hänggi, Phys. Rev. E **70** xxxxxx (2004); preprint cond-mat/0409314

DY 51.10 Mi 12:30 TU H2032

Phase diffusion in periodically driven systems — •Tobias Prager and Lutz Schimansky-Geier — Institut fuer Physik, HU Berlin, Newtonstr. 15, 12489 Berlin

We consider two differnt periodically driven two state models, a Markovian model for bistable dynamics and a non Markovian model for excitable dynamics. For these models we propose a theory to calculate the phase velocity and the effective phase diffusion coefficient. These quantities can be calculated analytically for the Markovian model with dichotomic driving. The non Markovian model can only be solved numerically, showing a complex behaviour with different frequency locking modes.

DY 51.11 Mi 12:45 TU H2032

Partially asymmetric exclusion models with quenched disorder — •Ludger Santen[1], Róbert Juhász[1], and Ferenc Iglói[2] — [1]Fachrichtung Theoretische Physik, Universität des Saarlandes, 66041 Saarbrücken — [2]Research Institute for Solid State Physics and Optics, H-1525 Budapest, P.O. Box 49, Hungary

We consider the one-dimensional partially asymmetric exclusion process with random hopping rates, in which a fraction of particles (or sites) have a preferential jumping direction against the global drift. In this case the accumulated distance traveled by the particles, x, scales with the time, t, as $x \sim t^{1/z}$, with a dynamical exponent $z > 0$. Using extreme value statistics and an asymptotically exact strong disorder renormalization group method we exactly calculate, z_{pr}, for particlewise (pt) disorder, which is argued to be related as, $z_{st} = z_{pr}/2$, for sitewise (st) disorder. In the symmetric with zero mean drift the particle diffusion is ultra-slow, logarithmic in time.

DY 51.12 Mi 13:00 TU H2032

From Sub- to Superthreshold Oscillations in Ensembles of Globally Coupled Excitable Systems — •Xaver Sailer[1], Michael Zaks[1], Alexander Neimann[2] und Lutz Schimansky-Geier[1] — [1]Institut fuer Physik, Newtonstrasse 15, 10119 Berlin — [2]Institute of Physics and Astronomy, Ohio University, Athens, Ohio

We investigate a globally coupled ensemble of excitable FitzHugh-Nagumo systems subject to Gaussian white noise. In a certain parameter regime we find for increasing noise intensity a transition from a stable fixed point to global oscillations. The transition is complex and we find different regimes exhibiting small amplitude oscillations, period doubling, chaos, and intermittent and non-intermittent spiking. We derive the dynamical system of the ensembles moment dynamics in the Gaussian approximation and calculate the Hopf bifurcation condition analytically.

DY 52 Statistical Physics far from Thermal Equilibrium

Zeit: Mittwoch 12:30–14:00 Raum: TU H3010

DY 52.1 Mi 12:30 TU H3010

Aging Properties of Critical Systems: the Renormalization-Group Approach — •Andrea Gambassi — Max-Planck Institut fuer Metallforschung, Heisenbergstr. 3, 70569 Stuttgart

In recent years much interest has been attracted by systems that cannot reach thermodynamic equilibrium because of their slow dynamics. During this everlasting nonequilibrium evolution aging phenomena are observed. A simple instance of such a behaviour is provided by the dynamics that takes place when a system is quenched from its high-temperature phase to the critical point. In the talk I focus on the renormalization-group approach to determine the relevant (universal) quantities, such as the fluctuation-dissipation ratio, associated with the nonequilibrium critical dynamics.

DY 52.2 Mi 12:45 TU H3010

Diffuse-interface model for rapid phase transformations in nonequilibrium systems — •Peter Galenko[1] and David Jou[2] — [1]Institute for Space Simulation, DLR, Cologne, D-51170, Germany — [2]Departament de Fisica, Universitat Autonoma de Barcelona, 08193 Bellaterra, Catalonia, Spain

A thermodynamic approach to rapid phase transformations within a diffuse interface in a binary system is developed. Assuming an extended set of independent thermodynamic variables formed by the union of the classic set of slow variables and the space of fast variables, we introduce finiteness of the heat and solute diffusive propagation at the finite speed of the interface advancing. To describe the transformation within the diffuse interface, we use the phase-field model which allows us to follow the steep but smooth change of phases within the width of diffuse interface. The governing equations of the phase-field model are derived for the hyperbolic model, model with memory, and for a model of nonlinear evolution of transformation within the diffuse-interface. The consistency of the model is proved by the condition of positive entropy production and by the outcomes of the fluctuation-dissipation theorem. A comparison with the existing sharp-interface and diffuse-interface versions of the model is given

DY 52.3 Mi 13:00 TU H3010

Hysteresis in One-Dimensional Reaction-Diffusion Systems — •Attila Rakos, Matthias Paessens, and Gunter M. Schuetz — Institut fuer Festkoerperforschung, Forschungszentrum Juelich, D-52425 Juelich

We introduce a simple nonequilibrium model for a driven diffusive system with nonconservative reaction kinetics in one dimension. The steady state exhibits a phase with broken ergodicity and hysteresis which has no analog in systems investigated previously. We identify the main dynamical mode, viz., the random motion of a shock in an effective potential, which provides a unified framework for understanding phase coexistence as well as ergodicity breaking. This picture also leads to the exact phase diagram of the system.

DY 52.4 Mi 13:15 TU H3010

Infinite reflections of shock fronts in driven diffusive systems with two species. — •Vladislav Popkov[1] and Gunter Schütz[2] — [1]Institut für Theoretische Physik, Universität zu Köln — [2]Institut für Festkörperforschung, Forschungszentrum Jülich

We study interaction of a domain wall with boundaries for several stochastic driven particle models, which have two species of particles. Reflection maps are introduced for the description of this process. We show that, generically, a domain wall reflects infinitely many times from the boundaries before a stationary state can be reached. This is in an evident contrast with one-species models where the stationary density is attained after just one reflection.

Adequate hydrodynamic description of driven systems with open boundaries is achieved when boundary conditions act like effective reservoirs of particles with fixed particle densities. We show how to define the respective stochastic dynamics introducing projection measures. From this point of view, we analyse reflections of domain walls in a hydrodynamic limit for a model exhibiting spontaneous symmetry breaking (SSB). We argue that SSB happens where hydrodynamic description breaks down.

DY 52.5 Mi 13:30 TU H3010

Paradoxical directed diffusion due to temperature anisotropies — •Ralf Eichhorn and Peter Reimann — Universität Bielefeld, Fakultät für Physik, D-33615 Bielefeld

An analytically tractable, but still experimentally realistic model dynamics is investigated, describing the Brownian motion of a particle in a "meandering" periodic potential landscape under the simultaneous influence of two different heat baths. The main characteristics of the resulting far from equilibrium environment is an anisotropy of the ambient temperature. When an external static force F is applied, the particle moves in the direction opposite to that force (absolute negative mobility), and this even for arbitrarily large forces $|F|$. Moreover, even when the "meandering" potential exhibits a broken spatial symmetry, no preferential direction of motion arises for $F = 0$.

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Phase separation in binary mixtures: Oscillatory instabilities under continuous cooling or heating — •Doris Vollmer[1], Jürgen Vollmer[2], and Günter Auernhammer[3] — [1]MPI for Polymer Research, Mainz — [2]Physics Department, Philipps University, Marburg — [3]Laboratoire de Dynamique des Fluides Complexes, Universite Louis Pasteur, Strasbourg, France

The kinetics of phase separation of binary mixtures under slowly ramping the temperature is discussed. For a broad range of compositions and heating rates the mixtures show pronounced oscillations in the turbidity. It hardly matters if phase separation is induced by cooling or heating, and whether the liquids are of low molecular weight or if a polymer solution is investigated. The oscillations in the coexisting liquid phases can be analysed separately. By choosing an appropriate temperature ramp the time averaged flux across the meniscus is kept constant in the experiments. For all investigated systems the oscillations can be observed over a wide temperature range, as far as 25 degrees away from the transition temperature. From simultaneous shadow graph imaging it can be shown that convection is always present, however amazingly, convection hardly influences the period of the oscillations. The oscillations are generic, of thermodynamic origin and caused by repeated cycles of nucleation, coarsening and sedimentation.