DY 30: Posters II

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

DY 30.1 Thu 16:00 Poster C

Asymptotics of work distributions in nonequilibrium systems — •Daniel Nickelsen and Andreas Engel — Universität Oldenburg, Germany

The asymptotic behaviour of work distributions in driven nonequilibrium systems, described by the Langevin equation with a potential $V(x,t)$, is determined using the method of optimal fluctuations. For that purpose, the corresponding Euler-Lagrange equation together with the appropriate boundary conditions and differential equations regarding the leading pre-exponential factor are derived for an arbitrary $V(x,t)$. The method is applied to an analytically solvable example, for more complicated examples the numeric implementation is demonstrated.

DY 30.2 Thu 16:00 Poster C

Shear simulations in the 2d-Ising model — •David Winter[1], Peter Virnau[1], Jürgen Horbach[2], and Kurt Binder[1] — [1]Institut für Physik, Johannes Gutenberg-Universität Mainz — [2]Deutsches Zentrum für Luft- und Raumfahrt (DLR), Köln

We study the critical behavior of the two dimensional Ising model under shear with Monte Carlo simulations. The system shows a strong anisotropy and one observes two different correlation lengths. By applying anisotropic finite-size scaling techniques we find that the critical point is shifted towards higher temperatures as a function of the shear rate.

DY 30.3 Thu 16:00 Poster C

Spread of information in complex networks — •Mirko Kämpf[1], Jan W. Kantelhardt[1], and Lev Muchnik[2] — [1]Institut fur Physik, Fachgruppe Theoretische Physik, Martin-Luther- Universitat Halle-Wittenberg, 06099 Halle (Saale), Germany — [2]Leonard N. Stern School of business, New York University, New York, USA

We study the process of collecting, processing, validating, and distributing information in self-organized complex social systems based on data from, e.g., the online encyclopedia Wikipedia. We correlate page access statistics, page edit statistics, and article network structure (defined by links) to characterize the lifecycle of relevant pieces of information. Results are also compared regarding regional contexts and different languages. Focusing on extreme events we analyze scaling behavior and investigate current limitations that could be eliminated by optimizing of the communication processes.

DY 30.4 Thu 16:00 Poster C

Using an evolutionary algorithm to obtain Boolean networks with reliable and robust trajectories — •Christoph Schmal[1,2], Tiago Peixoto[1], and Barbara Drossel[1] — [1]Institut für Festkörperphysik, TU-Darmstadt — [2]Fakultät für Physik, Universität Bielefeld

We investigate Boolean networks that follow a given reliable trajectory in state space, which is insensitive with respect to the updating schedules, as recently introduced in [1]. These trajectories have the property that two successive states differ only by the value of one node. We evaluate the robustness of these networks under small perturbations of the dynamics. Here, robustness is defined as the probability that the dynamics return to the reliable trajectory after a perturbation of the state of a single node. In order to achieve higher robustness, we explore the space of possible update functions by using an evolutionary algorithm. With this procedure, we obtain networks that are robust against noise in the update schedule as well as against perturbations of the Boolean values. We compare properties such as the probability distribution of the different types of update functions, the size of the basin of attraction of the reliable trajectory, the transient times and the attractor lengths, for networks before and after running the evolutionary optimization process.

References:

[1] Tiago P. Peixoto and Barbara Drossel, Phys. Rev. E 80, 056102 (2009)

DY 30.5 Thu 16:00 Poster C

Detecting transitions in paleoclimatological time-series using recurrence networks — •Jonathan Friedemann Donges[1,2], Norbert Marwan[1], Reik Donner[1,3,4], Yong Zou[1], and Jürgen Kurths[1,2] — [1]Potsdam Institute for Climate Impact Research, P.O. Box 601203, 14412 Potsdam, Germany — [2]Department of Physics, Humboldt University Berlin, Newtonstr. 15, 12489 Berlin, Germany — [3]Max Planck Institute for Physics of Complex Systems, Nöthnitzer Str. 38, 01187 Dresden, Germany — [4]Institute for Transport and Economics, Dresden University of Technology, Würzburger Str. 35, 01187 Dresden, Germany

We propose a novel, robust and effective approach for analysing time series using complex network theory. We identify the recurrence matrix calculated from time series with the adjacency matrix of a complex network, and apply measures for the characterisation of complex networks to the recurrence matrix. By using the logistic map, we illustrate the potentials of these complex network measures for detecting dynamical transitions. Finally we apply the proposed approach to speleothem palaeo-climate records and identify subtle changes of the past climate regime.

DY 30.6 Thu 16:00 Poster C

Singular spectrum analysis for a comparison of the climate data between the equatorial zone and the Arctic land — •Naoki Itoh[1] and Jürgen Kurths[2] — [1]Interdisciplinary Center for Dynamics of Complex Systems, Potsdam, Germany — [2]Potsdam-Institut für Klimafolgenforschung e.V., Potsdam, Germany

As one of the classical time series analysis, singular spectrum analysis (SSA) is applied to time series. This method gives us achievements in many fields. In our study monthly precipitation in climate data in the equatorial area (Kenya) and the Arctic land (71.25^oN and 179.75^oE) recently focused on, are analyzed in order to compare the properties of the information such as trends, periodic- and quasi periodic components extracted by the SSA. From the results climate interpretations are discussed.

DY 30.7 Thu 16:00 Poster C

Morphogenesis by coupled regulatory networks: Reliable control of positional information and proportion regulation — •Thimo Rohlf[1,2] and Stefan Bornholdt[3] — [1]Programme d'Epigenomique, Genopole Campus 1 - Genavenir 6, 5 rue Henri Desbruères, F-91030 Évry, France — [2]MPI -MIS, Inselstrasse 22, D-04013 Leipzig, Germany — [3]Institute for Theoretical Physics, University of Bremen, Otto-Hahn-Allee, D-28334 Bremen, Germany

Based on a non-equilibrium mechanism for spatial pattern formation we study how position information can be controlled by locally coupled discrete dynamical networks, similar to gene regulation networks of cells in a developing multicellular organism [1]. As an example we study the developmental problems of domain formation and proportion regulation in the presence of noise, as well as in the presence of cell flow. We find that networks that solve this task exhibit a hierarchical structure of information processing and are of similar complexity as developmental circuits of living cells. Proportion regulation is scalable with system size and leads to sharp, precisely localized boundaries of gene expression domains, even for large numbers of cells. A detailed analysis of noise-induced dynamics, using a mean-field approximation, shows that noise in gene expression states stabilizes (rather than disrupts) the spatial pattern in the presence of cell movements, both for stationary as well as growing systems. Finally, we discuss how this mechanism could be realized in the highly dynamic environment of growing tissues.

[1] T.R. and S.B., J. Theor. Biol., 2009, 261, 176-193

DY 30.8 Thu 16:00 Poster C

Accelerating glassy dynamics on graphics processing units — Peter H. Colberg[1,2] and •Felix Höfling[1,3] — [1]Arnold-Sommerfeld-Zentrum für Theoretische Physik und Center for NanoScience, LMU München, München — [2]Institut für Materialphysik im Weltraum, Deutsches Zentrum für Luft- und Raumfahrt (DLR), Köln — [3]Rudolf Peierls Centre for Theoretical Physics, University of Oxford, Oxford, United Kingdom

Modern graphics hardware offers peak performances close to 1 Tflop/s, and NVIDIA's CUDA provides a flexible and convenient programming interface to exploit these immense computing resources. Here, we demonstrate the ability of GPUs to perform high-precision MD sim-

ulations for up to 1 million particles running stable over weeks. The performance of our molecular dynamics simulation package on a single graphics processing unit compares with the LAMMPS package on 64 distributed processor cores.

As a demanding test case, we have reproduced the slow dynamics of a binary Lennard-Jones mixture close to the glass transition. We put particular emphasis on the numerical long-time stability in terms of energy and momentum conservation. Floating point precision is a crucial issue here, and sufficient precision can be maintained by single-double emulation of the floating point arithmetic. As a result of improved numerical accuracy, we were able to follow the slow relaxation dynamics over 4 non-trivial decades in time. Further, our data provide evidence for a negative power-law decay of the velocity autocorrelation function with exponent 5/2 in the close vicinity of the transition.

DY 30.9 Thu 16:00 Poster C

Harnessing the power of modern GPUs with LAMMPS — •Lars Winterfeld[1], Christian Robert Müller[1], and Philipp Maass[1,2] — [1]Institut für Physik, Technische Universität Ilmenau, Germany — [2]Fachbereich Physik, Universität Osnabrück, Germany

We present an extension to the widely used Molecular Dynamics Package LAMMPS, which allows the usage of graphic processing units (GPUs) to accelerate simulations. In contrast to other efforts of extending molecular dynamics codes, we not only rewrote the computational extensive parts of LAMMPS, such as the force calculations, but also most of the other functions invoked in the course of the simulation. This has the advantage that frequent data transfers between the GPU and the host processor are avoided. As a result a much higher performance is not only achieved for simulations of complex systems but also for simple systems such as Lennard Jones fluids. Features of our implementation include Coulomb forces using Ewald summation and the Particle-Particle Particle-Mesh (PPPM) method, temperature control through different thermostats, direct manipulation of atoms as well as mixed precision calculations. We report on benchmarks of typical usages, focusing on systems with Coulomb and Lennard Jones interactions. With a single NVIDIA GTX 280 speedups by a factor of 20 to 80 are obtained compared to a single processor calculation on an Intel Q6600 CPU. We furthermore investigate the accuracy with respect to different precision settings, and contrast it with other precision limiting factors such as cut-off radii of force fields and the grid size in the PPPM algorithm.

DY 30.10 Thu 16:00 Poster C

Varying Coulomb Trapping of Network Forming Units and the Mixed Glass Former Effect — •Michael Schuch[1,2], Christian Robert Müller[2], and Philipp Maass[1,2] — [1]Fachbereich Physik, Universität Onsabrück, 49069 Osnabrück, Germany — [2]Institut für Physik, Technische Universität Ilmenau, 98684 Ilmenau, Germany

Mixing of two types of glass formers in ion conducting glasses can lead to strong enhancements of ionic conductivities, a phenomenon commonly referred to as the Mixed Glass Former Effect (MGFE). A theory for the MGFE is presented which allows one to describe the change of concentrations of network forming units upon mixing and associated changes in Coulomb trapping energies. Using this structural information the change of the conductivity activation energies is calculated by means of percolation theory and Monte Carlo simulations. Fits of the theory to experiments on a borophosphate system yield good agreement with the measured data both for the concentration variation of the units and the variation of the activation energy.

DY 30.11 Thu 16:00 Poster C

Non-Contact Measurement of the Specific Heat of Insulating Glasses at Low Temperatures — •Angela Halfar, Masoomeh Bazrafshan, Andreas Fleischmann, and Christian Enss — Heidelberg University, Kirchoff Institute for Physics

Parasitic heat inputs through wires are a general problem in measurements at low and ultra low temperatures. To avoid such unwanted effects new contact-free techniques for investigating the thermal properties of glasses have been developed in recent years. Particularly challenging in this respect is the measurement of the specific heat of dielectric glasses at temperatures below about 25 mK. With a new technique based on the amplitude of coherent polarisation echoes as intrinsic temperature information and an optical heating method we hope to extend the temperature range, in which the specific heat of glasses can be measured reliably, to well below 10 mK. In this experiment the glass sample is located in a microwave cavity attached to the mixing chamber of a dilution refrigerator and is heated via an optical fibre by a pulsed LED mounted at the 1K pot. The properties of glasses at such temperatures are governed by atomic tunnelling systems. These degrees of freedom allow for the generation of polarisation echoes whose temperature dependent amplitude is used as a thermometer in the specific heat experiments. First heating sequences have been recorded using a BK7 glass as sample. We discuss this new technique and preliminary results obtained with it.

DY 30.12 Thu 16:00 Poster C

Thermodynamics of the Levy spin glass — •Katharina Janzen[1], Andreas Engel[1], and Marc Mezard[2] — [1]Uni Oldenburg — [2]Universite Paris Sud, France

We investigate the freezing transition in a mean-field spin glass with Levy-distributed couplings. A regularized model where the coupling constants smaller than some cutoff ϵ are subsumed into a Gaussian random variable can be studied by the replica symmetric (RS) cavity method for diluted spin glasses. Within the RS ansatz we determine the thermodynamic functions of the model and the deAlmeida-Thouless line signaling the breakdown of the RS assumption. Contrary to previous findings, in zero external field we do not find any stable replica-symmetric spin glass phase: the spin glass phase is always a replica-symmetry-broken phase.

DY 30.13 Thu 16:00 Poster C

Investigation of the low frequency dielectric constant of glasses at very low temperatures — •David Dähn, Michel Kinzer, Mihai Petrovici, Masoomeh Bazrafshan, Andreas Fleischmann, and Christian Enss — Kirchhoff-Institut für Physik, Heidelberg, Germany

At temperatures below 1 K the properties of glasses are governed by atomic tunneling systems. Recently Strehlow et al. reported an unexpected magnetic field dependence of the dielectric constant of the non-magnetic glass a-BaO-Al_2O_3-SiO_2 below 5 mK. Furthermore, they observed a discontinuity of the dielectric constant at a temperature of $T = 5.84$ mK. Later, dielectric two-pulse polarisation echo experiments revealed that nuclear quadrupole moments are responsible for the magnetic field dependence of the echo amplitude of non-magnetic glasses.

We investigated the influence of nuclear electric quadrupoles on the low frequency dielectric constant in the limit of very large quadrupole moments. A sample of the glass N-KZFS11, containing 25 mass percent of $^{181}Ta_2O_3$, which carries a very large quadrupole moment, was measured down to $T = 8$ mK using an interdigital capacitor microfabricated on one surface of the planar glass sample. This type of setup combines a large capacitance with a rather small thermal mass and good thermal coupling. In addition, echo experiments were carried out on this sample which surprisingly did not show any magnetic field dependence up to $B = 150$ mT. We discuss whether or not these observations are in conflict with present theories that include the nuclear moments in the standard tunneling model.

DY 30.14 Thu 16:00 Poster C

Measurements of the low-frequency elastic properties of a metallic glass with double paddle oscillators and SQUID based readout — •Marius Hempel, Andreas Reiser, Andreas Fleischmann, and Christian Enss — Kirchhoff-Institut für Physik, Im Neuenheimer Feld 227, 69120 Heidelberg

We investigated the elastic properties of the bulk metallic glass $Zr_{55}Cu_{30}Al_{10}Ni_5$ in the superconducting state.

A double paddle oscillator entirely made of one piece of this bulk metallic glass was fabricated. With this oscillator geometry background damping due to clamping is very small compared to the vibrating reed method. The sample is capacitively driven. A niobium pickup coil micro-fabricated on a silicon chip and connected to the input coil of a SQUID serves as a highly sensitive inductive displacement detector.

We measured the sound velocity and the internal friction at frequencies between 0.5 and 7.5 kHz down to a temperature of 5 mK. We present the experimental results and compare them to theoretical predictions. In particular, the observed temperature dependency of the internal friction is significantly weaker than suggested by the standard tunnelling model, but agrees reasonably well with the behaviour of thin ribbon samples of metallic glasses reported by other authors.

DY 30.15 Thu 16:00 Poster C

What can nuclear magnetic moments reveal about the microscopic nature of tunnelling systems in glasses? — •Masoomeh

Bazrafshan, Gudrun Fickenscher, Andreas Fleischmann, and Christian Enss — Kirchhoff-Institut Für Physik, Heidelberg

More than thirty years ago anomalies in glasses at low temperatures were successfully explained by introducing atomic tunnelling systems (TS), described by the phenomenological standard tunnelling model. However, the universal behaviour of glasses prevented the experimental investigation of the microscopic nature of these TSs. Recently, unexpected magnetic field effects of the dielectric constant and of the two pulse polarisation echo amplitude, observed in non-magnetic glasses, turned out to be a proper experimental tool to investigate the microscopics of TSs. The echo experiments, done on glycerol and deuterated glycerol, prove that the interaction of nuclear quadrupole moments with local electric field gradients as well as interacting nuclear magnetic dipoles cause the observed magnetic field effects. Interestingly, the magnitude of the echo amplitude variations in magnetic fields is governed by the motion of the TSs. We present the measured effects together with numerical calculations based on the mentioned interactions which enable us to derive details of the TS's microscopic motions in glycerol. These calculations were done without considering dissipative processes acting at finite temperatures and, therefore, are strictly valid only at T=0. An analysis of the measured echo decay at different temperatures suggests that this quantum behaviour is observed, on the time scale of our measurements, at temperatures below 5mK.

DY 30.16 Thu 16:00 Poster C

Thermal conductivity of superconducting bulk metallic glasses at very low temperatures — •Daniel Rotfhuss[1], Uta Kühn[2], Andreas Fleischmann[1], and Christian Enss[1] — [1]Kirchhoff-Institute for Physics, University of Heidelberg, Im Neuenheimer Feld 227, D-69120 Heidelberg, Germany — [2]IFW Dresden, Institute for Complex Materials, P.O. Box 270116, D-01171 Dresden, Germany

Based on new production processes in the technique of casting amorphous metallic alloys a wide range of bulk metallic glasses with various electric and magnetic properties can be produced. Hereby especially superconducting bulk metallic glasses offer several advantages. Particularly with this kind of vitreous material it is possible to probe not only the interaction between tunnelling systems and phonons, but also with electrons by switching between the normal and superconducting state with an external magnetic field. But until now only little is known about the physical properties of these amorphous systems down to millikelvin temperatures.

We present the thermal conductivity of bulk amorphous $Zr_{52.5}Ti_5Cu_{17.9}Ni_{14.6}Al_{10}$ in the superconducting state down to 6mK. Measurements were performed with a SQUID-based contact free technique. Our results show that the thermal conductivity of the sample scales nearly quadratically with temperature. This suggests that far below T_c, the thermal conductivity of this bulk metallic glass can be described well by the thermal diffusion of phonons and their resonant scattering at tunnelling systems.

DY 30.17 Thu 16:00 Poster C

Master Stability Function for time-delayed chaotic networks — •Anja Englert[1], Sven Heiligenthal[1], Wolfgang Kinzel[1], Maria Butkovski[2], Meital Zigzag[2], and Ido Kanter[2] — [1]Institut für Theoretische Physik, Universität Würzburg, 97074 Würzburg — [2]Departement of Physics, Bar-Ilan-University, Ramat-Gan, Israel

Chaos synchronization in a network with time delayed couplings and self-feedbacks plays an important role in secure communication, neural models or chaotic laser systems. The Master Stability Function (MSF) is a well known method to analyse the stability of the synchronization of such a network. We analyse the MSF for Bernoulli networks by using the Schur-Cohn theorem and derive symmetry arguments for the possible appearance of zero lag synchronization. We apply these results to chaotic semiconductor laser systems in simulations using the Lang-Kobayashi equations and present experimental results.

DY 30.18 Thu 16:00 Poster C

Hopf-pitchfork bifurcation as symmetry breaking transition in coupled nonlinear circuits — Martin Heinrich[1], •Thomas Dahms[1], Valentin Flunkert[1], Eckehard Schöll[1], and Stephen W. Teitsworth[2] — [1]Institut f. Theo. Physik, Sekr. EW 7-1, Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin, Germany — [2]Department of Physics, Duke University, Box 90305, Durham, North Carolina 27708-0305, USA

We investigate the dynamics of two coupled nonlinear circuit elements with a region of negative differential conductance (NDC), for example tunneling diodes. The NDC-elements are connected in series such that a mean-field coupling is observed. Varying the bifurcation parameter leads to a symmetry breaking transition, where a pitchfork bifurcation splits the symmetric branch of fixed points into a branch within the synchronization manifold and two branches outside of the synchronization manifold. Each branch of the pitchfork bifurcation is surrounded by limit cycles, which are generated by a Hopf bifurcation occurring simultaneously with the pitchfork bifurcation. This codimension-two bifurcation can be destroyed by introducing heterogeneity to the system.

DY 30.19 Thu 16:00 Poster C

Spreading of wave packets in nonlinear disordered chains — •Tetyana Laptyeva[1,2], Charalampos Skokos[1], Dmitry Krimer[1], Joshua Bodyfelt[1], and Sergej Flach[1] — [1]Max Planck Institute for the Physics of Complex Systems, Nöthnitzer Str. 38, D-01187 Dresden, Germany — [2]Donetsk Institute for Physics and Engineering NASU, R. Luxemburg Str. 72, 83114 Donetsk-114, Ukraine

We consider the spatiotemporal evolution of wave packets in anharmonic disordered chains, in particular, for a wide range of disorder strengths. Previous studies show that Anderson localization is destroyed, and for asymptotically large times the second moment m_2 grows as $m_2 \sim t^{1/3}$ [1, 2]. Extending our analytical approach, we expect that the second moment will spread on intermediate time scales even faster, namely as $m_2 \sim t^{1/2}$, with a crossover to the asymptotic $t^{1/3}$ law at larger times. In order to observe the intermediate fast subdiffusive process, we perform extensive numerical simulations with systematic variations of the disorder strengths, initial wave packet widths, and initial wave packet amplitudes.

[1] S Flach DO Krimer Ch Skokos, Phys. Rev. Lett. **102**, 024101 (2009)

[2] Ch Skokos DO Krimer S Komineas S Flach, Phys. Rev. E **79**, 056211 (2009)

DY 30.20 Thu 16:00 Poster C

Investigating Lyapunov spectra of spatially extended symplectic systems in the continuum limit by means of Langevin-type equations — •Ivan G. Szendro and Holger Kantz — Max-Planck-Institut für Physik Komplexer Systeme, Nöthnitzer Str. 38, 01187 Dresden, Germany

We study Lyapunov spectra of spatially extended systems with symplectic symmetry in the spatial continuum limit, $\Delta x \to 0$, by means of Langevin-type equations with colored noise. We find that, while the exponents corresponding to the most expanding and contracting directions converge to some finite values, the additional exponents are introduced into the spectrum around zero exponent. This leads to the appearance of an accumulation in the spectral density near zero that diverges in the continuum limit. The results are compared with data obtained for of the forced nonlinear Schrödinger equation.

DY 30.21 Thu 16:00 Poster C

Pattern Formation in Langmuir-Blodgett Transfer Systems — •Michael H. Köpf, Svetlana V. Gurevich, and Rudolf Friedrich — Institute for Theoretical Physics, University of Münster, Wilhelm-Klemm-Straße 9, D-48149 Münster

We present a theoretical investigation of self-organized pattern formation that has been observed during Langmuir-Blodgett transfer of phospholipids onto solid substrates. Two coupled differential equations describing the surfactant density and the height profile of the water subphase are derived within the long-wavelength approximation. If the transfer is carried out in the vicinity of the so-called main transition, the first-order phase transition between the liquid-expanded and the liquid-condensed phase, the interaction with the substrate plays a key role. We model this effect via a height dependent external field in the surfactant free-energy functional. Using transfer velocity and lateral pressure as control parameters a bifurcation from a homogeneous transfer to regular stripe patterns arranged parallel to the contact line is investigated in one and two dimensions. Moreover, in the two-dimensional case a secondary bifurcation to perpendicular stripes is observed in a certain control parameter range.

DY 30.22 Thu 16:00 Poster C

Dynamical multistability in a multimode optomechanical system — •Huaizhi Wu[1,2], Georg Heinrich[1], and Florian Marquardt[1] — [1]LMU, Department of Physics, ASC, CeNS, 80333 München, Germany — [2]Department of Physics, Fuzhou University,

350002 Fuzhou, Fujian, P. R. China

Optomechanical systems couple mechanical motion of macroscopic objects to electromagnetic fields. The standard setup comprises a laser-driven cavity with a movable end-mirror whose motion changes the optical resonance frequency and thus acts back on the light field. Studies of the complex nonlinear dynamics for this system revealed several dynamical attractors due to phase locking between the mechanical oscillations of the mirror and the ringing of the light intensity. Here we study such dynamical multistability for a novel setup where a moveable membrane is placed in the middle between two high-finesse mirrors. The membrane couples two optical modes residing in the left and right half of the cavity, respectively. Its motion is determined by the coupled light-field dynamics that was recently studied elsewhere and shows two-level dynamics such as Autler-Townes splittings and Landau-Zener-Stueckelberg oscillations. Here we discuss the result of these effects on the nonlinear dynamics in terms of the attractor diagram for different parameter regimes. This is the first study of dynamical multistability in one of the exciting new setups with multiple coupled optical (and vibrational) modes that have been developed recently.

DY 30.23 Thu 16:00 Poster C

Modelling brain activity during absence seizures in the framework of neural field equations — •Cornelia Petrovic and Rudolf Friedrich — Inst. für Theoret. Physik, WWU Münster

During different functional states of the brain, neurons in the thalamus fulfill two different important tasks. During periods of wakefulness, they generate tonic series of spiking, thereby enabling the transfer of incoming sensory signals from the periphery to the cerebral cortex. During periods of sleep, however, the same neurons generate rhythmic-oscillatory burst discharges which are synchronized in the thalamocortical network and lead to a dramatic reduction of responsiveness to sensory income. In the electroencephalogram these synchronous discharges are represented by typical sleep waves. Pathological alterations of these mechanisms can lead to epileptic seizures which are associated with reduced consciousness, so-called absence seizures. In the last years several major underlying mechanisms at the molecular level have been identified. In the presented theoretical model we try to bring together those recent molecular experimental (microscopic) results with aspects of well-established (mesoscopic/macroscopic) neural field theories in order to achieve a deeper understanding of the relevance of the different spatio-temporal scales of the brain during the processes of epileptogenesis and seizure generation.

DY 30.24 Thu 16:00 Poster C

Identifying shrimp structures in continuous dynamical systems using recurrence-based methods — Yong Zou[1], •Reik V. Donner[1,2,3], Jonathan F. Donges[1,4], Norbert Marwan[1], and Jürgen Kurths[1,4] — [1]Potsdam Institute for Climate Impact Research, Potsdam, Germany — [2]Max Planck Institute for Physics of Complex Systems, Dresden, Germany — [3]Institute for Transport and Economics, Dresden University of Technology, Germany — [4]Department of Physics, Humboldt University of Berlin, Germany

The identification of some specific periodic islands (so-called shrimps) in the two-dimensional parameter space of certain complex systems has recently attracted considerable interest. While for discrete systems, a discrimination between periodic and chaotic windows can be easily made based on the maximum Lyapunov exponent of the system, this is a challenging task for continuous systems, especially if only short time series are available (e.g., in case of experimental data). In this work, we demonstrate that nonlinear measures based on recurrence plots obtained from such trajectories provide a practicable alternative for numerically detecting shrimps. Traditional diagonal line-based measures of recurrence quantification analysis (RQA) as well as measures from complex network theory are shown to allow a reasonable classification of periodic and chaotic behavior in parameter space. Average path length and clustering coefficient of the resulting recurrence networks are found to be particularly powerful discriminatory statistics for the identification of shrimps in the Rössler system.

DY 30.25 Thu 16:00 Poster C

Using extreme value theory to determine transport statistics of a disordered Hamiltonian system — •Ines Hartwig and Günter Radons — TU Chemnitz, Germany

We combine the treatment of deterministic chaos in Hamiltonian systems with aspects of the theory of disordered systems for a simple two-dimensional twist map.

Motivated by applications from plasma turbulence, we replace the cosine potential of the well-known Chirikov-Taylor standard map by random one-dimensional analytic potentials with spatial disorder but periodic boundaries.

Structures in phase space include nested island hierarchies, chaotic seas and invariant tori. But while each disorder realization has its specific KAM behavior, the ensemble of systems has to be treated statistically. A fundamental domain of controllable size in phase space enables us to investigate the limit of a disordered system of infinite size using extreme value theory. We obtain distributions of critical perturbation amplitudes, which in turn allow us to conclude about transport exponents and fractions of particles actually contributing to unbounded motion.

DY 30.26 Thu 16:00 Poster C

Detecting synchronization in coupled stochastic ecosystem networks — •Nikolaos Kouvaris[1,2], Astero Provata[1], and Dimitris Kugiumtzis[2] — [1]National Center for Scientific Research "Demokritos", 15310 Athens, Greece — [2]Department of Mathematical, Physical and Computational Science, Faculty of Engineering, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece

The network under investigation is a spatial 2D lattice which serves as a substrate for Lotka - Volterra dynamics with 3rd order nonlinearities. At the mean field level this system exhibits conservative oscillations. Kinetic Monte Carlo simulations demonstrate that the system spontaneously organizes into a number of asynchronous local oscillators, when only nearest neighbor interactions are considered. In contrast, collective behavior such as global oscillations and synchronization can emerge when introducing different interactivity rules (diffusive or reactive) for nearby and distant species. Instantaneous phase difference, synchronization index and mutual information are considered in order to detect synchronization phenomena that emerge for different levels of diffusive and reactive activity in the stochastic network. The quantitative measures of synchronization show that long distance diffusion coupling induces complete synchronization after a well defined transition, while long distance reaction coupling induces smeared phase synchronization.

DY 30.27 Thu 16:00 Poster C

Stability of delay-coupled Stuart-Landau oscillators — Bernold Fiedler[1], Valentin Flunkert[2], •Philipp Hövel[2], and Eckehard Schöll[2] — [1]Institut für Mathematik I, Freie Universität Berlin, Arnimallee 2-6, D-14195 Berlin, Germany — [2]Institut f. Theo. Physik, Sekr. EW 7-1, Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin, Germany

We study diffusively coupled Stuart-Landau oscillators (Hopf normal forms). By introducing a noninvasive delay coupling we are able to stabilize the inherently unstable anti-phase orbits. For the super- and subcritical case we state a condition on the oscillator's nonlinearity which is necessary and sufficient to find coupling parameters for successful stabilization. We prove these conditions and review previous results on the stabilization of odd-number orbits by time-delayed feedback. Finally, we illustrate the results with numerical simulations.

DY 30.28 Thu 16:00 Poster C

Transient times for Pyragas control of steady states and periodic orbits — •Philipp Hövel, Robert Hinz, and Eckehard Schöll — Institut f. Theo. Physik, Sekr. EW 7-1, Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin, Germany

We investigate the transient behavior for the control of both steady states and periodic orbits by time-delayed feedback. By analytical arguments we relate the transient time to the real part of the leading eigenvalue and Floquet exponent in the case of a fixed point of focus type and supercritical Hopf bifurcation, respectively. We derive an algebraic scaling of the transient time and confirm our findings by numerical simulations in dependence on the control parameters feedback gain and time delay.

DY 30.29 Thu 16:00 Poster C

Optical Feedback Tolerance of Quantum-Dot Compared to Quantum-Well Lasers — •Christian Otto, Kathy Lüdge, and Eckehard Schöll — Institut f. Theo. Physik, Sekr. EW 7-1, Technische Universität Berlin, Hardenbergstr. 36, 10623 Berlin, Germany

In experiments quantum-dot (QD) lasers display lower feedback sensitivity than quantum-well (QW) lasers. This advantageous dynamical

behaviour is ascribed to their smaller phase-amplitude coupling that is expressed in small linewidth enhancement factors α. In this work we investigate the complex dynamics of both laser types subjected to external optical feedback from a distant mirror. To model the QW laser we use a conventional Lang-Kobayashi model with one equation for the complex field and one equation for the carrier inversion. The QD laser is modeled with a modified Lang-Kobayashi equation for the electric field combined with microscopically based rate equations for the carriers in the quantum dots and the surrounding wetting layer.

By varying the feedback strength we obtain complex bifurcation scenarios. For large $\alpha > 3$ we find bifurcation cascades leading to chaotic regions alternating with short regions of stable continuous wave (cw) operation. However, for low $\alpha < 1$ the model exhibits a reduced feedback sensitivity and performs stable cw operation over a wide range of increasing feedback strength.

By comparison of QW and QD diagrams we find that QD lasers are indeed more tolerant to optical feedback. Furthermore for the same value of α the routes to chaos are different for QD and QW lasers.

DY 30.30 Thu 16:00 Poster C

Floquet Stability Analysis of Memory Difference Control — •David Conal Higgins and Jens Christian Claussen — Institut für Neuro- und Bioinformatik, Universität zu Lübeck

A time discrete version of Pyragas control [1], difference control, was introduced by Bielawski, Derozier and Glorieux [2] and acts in the Poincaré section. It allows stabilization of orbits with Ljapunov number between -3 and -1. Outside of this range, the scheme can be extended by an additional term (MDC, memory difference control) as introduced in [3]. In general, Poincaré-based control schemes may show limitations in the length of the control impulse, which is relevant in the case of difference control [4]. The stability can be analyzed by Floquet theory, giving rise to a special class of delay differential equations. Here we analyze the stability properties of MDC by means of a Floquet stability analysis.

[1] K. Pyragas, Phys. Lett. A 170, 421 (1992)
[2] S. Bielawski, D. Derozier and P. Glorieux, Phys. Rev. A 42, 2492 (1993)
[3] J. C. Claussen, T. Mausbach, A. Piel, H. G. Schuster, Phys. Rev. E 58, 7256 (1998)
[4] J. C. Claussen, New J. Phys. 10, 063003 (2008)

DY 30.31 Thu 16:00 Poster C

Dimensional dependence of delay in simple system with varying delay — •Jian Wang, Hong-Liu Yang, and Günter Radons — Institute of Physics, Chemnitz University of Technology, 09107 Chemnitz, Germany

Delay systems used to model retarded actions are relevant in many fields such as optics, mechanical machining, biology or physiology. A frequently encountered situation is that the length of the delay time changes with time. Due to the fluctuation of the delay time the dimension of the system dynamics collapses. This implies infinite contraction rates thereby leading to diverging Lyapunov exponents. In this study we begin with simple iterated map systems to investigate the influence of fluctuating delay times on the system dimension. For simplicity, the delay time in our system switches between two values t_1 and t_2 periodically. The evolution of the capacity dimension and the relationship between dimension and Lyapunov spectrum are explored. Simple approximations of continuum limits are also investigated and the dimensional dependence is studied.

DY 30.32 Thu 16:00 Poster C

Hysteresis and visible unstable periodic solutions in coupled logistic maps with periodic fluctuating delay — •Jian Wang, Hong-Liu Yang, and Günter Radons — Institute of Physics, Chemnitz University of Technology, 09107 Chemnitz, Germany

Delay systems used to model retarded actions are relevant in many fields such as optics, mechanical machining, biology, ecology or physiology. A frequently encountered situation is that the length of the delay time changes with time. With the introduction of varying delay the system dynamic is more complex and new phenomena are obtained. To investigate the influence of varying delay on the dynamics of spatio-temporal system we compare in this study coupled logistic map with periodic fluctuating delay with coupled logistic maps and coupled logistic maps with constant delay. For simplicity, the delay time in our system takes only t_1 and t_2 discrete steps. Some interesting phenomena including hysteresis, defect and visible unstable stationary states are obtained.

DY 30.33 Thu 16:00 Poster C

Modeling the morphogenesis of brine channels in sea ice — Bernd Kutschan[1], •Klaus Morawetz[2,3], and Sibylle Gemming[4] — [1]Ident Technologies GmbH, Rudower Chaussee 29, 12489 Berlin, Germany — [2]University of Applied Science Münster, Stegerwaldstrasse 39, 48565 Steinfurt, Germany — [3]International Center for Condensed Matter Physics, Universidade de Brasília, 70904-910, Brasília-DF, Brazil — [4]Forschungszentrum Dresden-Rossendorf, PF 51 01 19, 01314 Dresden, Germany

Brine channels are formed in sea ice under certain constraints and represent a habitat of different microorganisms. The complex system depends on a number of various quantities as salinity, density, pH-value or temperature. Each quantity governs the process of brine channel formation. There exists a strong link between bulk salinity and the presence of brine drainage channels in growing ice with respect to both the horizontal and vertical planes. We develop a suitable phenomenological model for the formation of brine channels both referring to the Ginzburg-Landau-theory of phase transitions as well as to the chemical basis of morphogenesis according to Turing. It is possible to conclude from the critical wavenumber on the size of the structure and the critical parameters. The theoretically deduced transition rates have the same magnitude as the experimental values. The model creates channels of similar size as observed experimentally. An extension of the model towards channels with different sizes is possible. The microstructure of ice determines the albedo feedback and plays therefore an important role for large-scale global circulation models (GCMs).

DY 30.34 Thu 16:00 Poster C

Generating mechanism for fibrillatory states — •Claudia Lenk[1], Mario Einax[1], J. Michael Koehler[1], and Philipp Maass[1,2] — [1]Institut für Physik, Technische Universität Ilmenau, 98684 Ilmenau, Germany. — [2]Fachbereich Physik, Universität Osnabrück, 49069 Osnabrück, Germany.

Atrial fibrillation is the most common arrhythmia of the heart in the industrial countries. Although it is known since the early 1920s, its underlying mechanisms are still under discussion. We present a theoretical model for the generation of fibrillatory excitation patterns based on the mutual disturbance of two spatially separated pacemakers in the FitzHugh-Nagumo equations. The wavefronts emanating from these pacemakers propagate in regions connected by a small bridge. We find that the structure of the excitation patterns depends significantly on the pacemaker frequencies and the size and shape of the bridge. Irregular fibrillatory states can occur and the degree of irregularity is determined by two independent methods. We furthermore performed new experiments of the Belousov-Zhabotinsky reaction in a silica gel with spatially inhomogeneous catalyst distribution to compare parts of our numerical results with measurements on a real system.

DY 30.35 Thu 16:00 Poster C

A Statistical Model for Turing Patterns in Chemical Reaction Diffusion Systems — •Christian Scholz[1], Klaus Mecke[2], and Gerd E. Schröder-Turk[2] — [1]2. Physikalisches Institut, Universität Stuttgart, Germany — [2]Institut für Theoretische Physik, Universität Erlangen, Germany

The Lengyel-Epstein (LE) model is a system of reaction-diffusion equations, which is widely accepted to reproduce the stationary stripe and hexagonal Turing Patterns observed in the Chlorite-Iodide-Malonic Acid (CIMA) reaction with correct length scales. However the turbulent patterns identified in the CIMA reaction are not reproduced by the LE model. Additionally a morphological analysis via Minkowski functionals, as described in [1], reveals qualitative differences in the functional form of the concentration profiles observed in numerical solutions of the LE model and those observed in the CIMA reaction. Here we present an extended model based on the statistical superposition of basic LE patterns, which reproduces the morphology of stationary and for the first time also turbulent patterns. [1] K. Mecke, Morphological characterization of patterns in reaction-diffusion systems, Phys. Rev. E 53, 4794 (1996)

DY 30.36 Thu 16:00 Poster C

Synchronization of co-rotating scroll waves — •Dennis Kupitz and Marcus Hauser — Otto-von-Guericke-Universität Magdeburg, Abteilung Biophysik, Institut für Experimentelle Physik, Universitätsplatz 2, 39106 Magdeburg, Germany

Scroll waves are the three-dimensional counterparts of spiral waves occurring in excitable media. Single scroll waves may undergo a series of

instabilities that play an important role in the formation of cardiac arrhythmias, like ventricular tachycardia. While the dynamics of single scroll waves have attracted some experimental effort, the interaction of scroll waves has so far received much less attention.

We present an experimental study of the interaction of two corotating, meandering scroll waves. They were created in a Belousov-Zhabotinsky reaction medium and observed by optical tomography with a parallel beam technique. The organizing centres of the scrolls, the so-called filaments, were originally straight, and with time deformed to a zig-zag shape. The two filaments interact leading to a synchronization of the dynamics of the scroll waves, which is accompanied by the development of a pronounced twist along the scroll waves. The synchronization yields a stabilized collective motion of the two scroll waves.

DY 30.37 Thu 16:00 Poster C

Soret driven convection in a thermosensitive microgel suspension — •Jürgen Schmied[1], Stephan Messlinger[1], Wolfgang Schöpf[1], Ingo Rehberg[1], Miriam Siebenbürger[2], and Matthias Ballauf[2] — [1]Experimentalphysik V, Universität Bayreuth, 95440 Bayreuth — [2]Institut für Physik, Humboldt-Universität zu Berlin, Unter den Linden 6, 10099 Berlin

We investigate thermal convection in a microgel suspension that consists of core-shell colloids which change their size with temperature. The swelling and shrinking of the particles dramatically modifies the effective volume of the gel fraction and therefore the viscosity of the suspension. In our experiment, we expose a Hele-Shaw convection cell to a constant temperature difference. Due to the relatively large Soret effect of the suspension, a gradient of the colloid concentration is induced, which strongly influences both the onset and the nonlinear behaviour of the thermal convection. The convection patterns are monitored via a shadowgraph setup and also via tracking of single fluorescent tracer particles. We report on the formation and evolution of convection patterns in this thermosensitive suspension.

DY 30.38 Thu 16:00 Poster C

Convection in colloidal suspensions — •Martin Gläßl, Markus Hilt, and Walter Zimmermann — Theoretische Physik I, University of Bayreuth, 95440 Bayreuth, GERMANY

Thermal convection in colloidal suspensions is described by a generalized continuum model for binary fluid mixtures, considering additional terms unaccounted in Boussinesq approximation.

Via the Soret effect an external temperature gradient induces a gradient of the density of particles. Depending on the suspended particles this concentration gradient may lead to spatial variations of the shear viscosity as well as of the thermal conductivity of the mixture. Linear stability analysis shows that both dependencies change the onset of convection. A concentration dependent thermal conductivity may lead, for instance, in a certain range of material parameters to a restabilization of the nonlinear conductive state.

Thermosensitive colloidal particles change their size during the convective motion from warmer to colder volumes in the cell. We describe this behavior by introducing a temperature dependent Lewis number and discuss the resulting effects on convection.

DY 30.39 Thu 16:00 Poster C

Conditional velocity increment statistics in Lagrangian turbulence — •Daniel Schulz, Holger Homann, and Rainer Grauer — Institut für Theoretische Physik I, Ruhr-Universität Bochum, 44780 Bochum

The probability density functions(PDFs) and structure functions of velocity increments, conditioned to the local rate of energy dissipation, are analyzed via direct numerical simulations in the Eulerian frame of reference. As already observed in experiments, the conditioned PDFs are nearly Gaussian, thus intermittency is suppressed.

We transfer this ansatz to the Lagrangian framework and propose a new quantity for conditioning, since here the rate of energy dissipation seems not to be a suitable quantity.

DY 30.40 Thu 16:00 Poster C

A Lagrangian model for the evolution of turbulent magnetic and passive scalar fields — •Thorsten Hater, Holger Homann, and Rainer Grauer — Institut für Theor. Physik I, Ruhr-Universität Bochum

We present an extension of the *Recent Fluid Deformation (RFD)* closure introduced by Chevillard and Meneveau (2006) which was depeloped for modelling the time evolution of Lagrangian fluctuations in incompressible Navier-Stokes turbulence. We apply the RFD closure to study the evolution of magnetic and passive scalar field fluctuations. This comparison is especially interesting since the stretching term for the magnetic field and the passive scalar are similar but differ by a sign such that the effect of stretching and compression by the turbulent velocity field is reversed.

Probability density functions (PDFs) of magnetic and passive scalar field fluctuations using the RFD closure are compared against PDFs obtained from direct numerical simulations.

DY 30.41 Thu 16:00 Poster C

Spiral patterns in wet granular matter under vertical vibrations — Kai Huang, •Frank Gollwitzer, and Ingo Rehberg — Experimentalphysik V, Universitaet Bayreuth, 95440 Bayreuth, Germany

From the evolution of galaxy to hurricane, from the inner structure of sea shell to the cochlea of our inner ears, spirals are widely existing in nature. In the past decades, spiral patterns have been discovered and extensively studied in model systems such as Rayleigh-Bérnard convection, Belousov-Zhabotinksy reactions and various biological systems. Here we report spiral patterns observed in a thin layer of wet granular matter driven by vertical vibrations. In the phase diagram of driven wet granular matter, spirals appear close to a fluid-gas coexistence phase and show hysteresis. The trajectory and rotation velocity of the three-armed spirals are studied as a function of the driving parameters and compared with other model systems.

DY 30.42 Thu 16:00 Poster C

Sublimation of two dimensional wet granular matter under swirling motion — Kai Huang and •Ingo Rehberg — Experimentalphysik V, Universitaet Bayreuth, 95440 Bayreuth, Germany

The dynamical behaviors of two dimensional wet granular matter under swirling motion is studied by experiments. Different from dry granular matter, the cohesion induced by capillary bridges formed between particles tends to keep the wet granular clusters rigid against swirling motion. However, the rigid clusters are not stable: random sublimation and deposition transitions are observed. The transition dynamics and morphological changes of rigid clusters are studied by particle tracking techniques. The mechanism driving the transitions will also be discussed.

DY 30.43 Thu 16:00 Poster C

Mechanical Properties of Wet Granulates — •Somnath Karmakar[1], Martin Brinkmann[2], Stephan Herminghaus[2], Marco Di Michiel[3], Mario Scheel[3], Michael Sipahi[1], and Ralf Seemann[1,2] — [1]Universität des Saarlandes, Saarbrücken, Germany — [2]Max Planck Institute for Dynamics and Self-Organization, Göttingen, Germany — [3]ESRF, Grenoble, France

If a wetting liquid is added to dry granulates, the granulate turns into moldable material. This arises due to the formation of liquid capillary bridges and larger liquid clusters between adjacent grains, exerting an attractive force between granules. We study the mechanical properties (i.e. yield stress, critical fluidization and tensile strength) of wet granular materials with different size and for variable liquid contents and wettability. Our experimental results show that the mechanical properties of granulates wetted with a low contact angle liquid are largely independent on the liquid content over a wide range for all the applied mechanical tests. However, in case of a large contact angle liquid, the mechanical properties vary for the various mechanical tests and with the amount of liquid. To understand the mechanical behavior in more detail, we also image the sheared granulates by high speed X-ray micro-tomography.

DY 30.44 Thu 16:00 Poster C

Dynamics of vertically fluidized wet granulates — •Zeina Khan[1], Mario Scheel[2], Marco Di Michiel[2], Ralf Seemann[1,3], and Stephan Herminghaus[1] — [1]Max Planck Institute for Dynamics and Self-Organization, Göttingen, Germany — [2]European Synchrotron Radiation Facility, Grenoble Cedex, France — [3]Experimental Physics, Saarland University, Saarbrücken, Germany

When dry granulates are shaken vertically and the peak acceleration exceeds the force of gravity, the grains move irregularly like the molecular motion of a fluid while they remain densely packed. It has been shown that when a fluid is added to the granulate, the critical acceleration at which fluidization occurs increases acutely when compared

with the dry case; the material becomes stiffer [1]. Using fast synchrotron X-ray bulk imaging techniques we track the motion of tracer particles embedded in the granular flow and report on the effects of varying the vibration amplitude and wetting content on the resulting velocity statistics and caging dynamics. We also present results from a novel x-ray imaging technique used to determine the three-dimensional motion of tracer particles in a fluidized granulate.

[1]: M. Scheel et al., Nature Materials 7, 189 (2008) .

DY 30.45 Thu 16:00 Poster C

Turbulent fluctuations in the saltation process. Dust emission. — •Marc Lämmel and Klaus Kroy — Institut für Theoretische Physik, Universität Leipzig, PF 100920, 04009 Leipzig, Germany

Transport of granular material in turbulent flows is ubiquitous in nature, e.g. in aeolian sand transport, or dust emissions from arid regions. While the former is crucial for the development of ripples and dunes, the latter plays an important role for our global climate. Based on the efficient and successfull sand transport model by Sauermann et al. [1], we investigate the influence of turbulent fluctuations of the wind on the sand flux. By integrating out these fast turbulent wind velocity fluctuations, we obtain coarse-grained sand transport equations supposed to be more directly applicable to the average quantities typically determined in field and laboratory measurements. The model is further generalized to the sand-induced emission of dust.

[1] G. Sauermann, K. Kroy and H.J. Herrmann, Phys. Rev. E 64, 031305 (2001)

DY 30.46 Thu 16:00 Poster C

Compaction of tetrahedral particles — •Max Neudecker, Stephan Herminghaus, and Matthias Schröter — Max-Planck-Institute for Dynamics and Self-Organisation, Bunsenstr. 10, 37073 Göttingen

Research in granular matter has covered packing problems of spheres extensively, but interest in non-spherical particles (ellipsoids, polyhedra) has risen only recently [1].

In this presentation, we show results of experimentally generated packings of tetrahedral particles, which are prepared by shaking. The range of mechanically stable packings is explored, from the random loose to the random close packing. We use X-Ray-tomography to analyse samples with different packing fractions and present results on their structure.

[1] Torquato, S. , Jiao, Y. Dense packings of the Platonic and Archimedean solids, Nature 460 (2009)

DY 30.47 Thu 16:00 Poster C

Diffusive and subdiffusive axial transport of granular material in rotating mixers — •David Fischer[1], Tilo Finger[1], Frank Angenstein[2], and Ralf Stannarius[1] — [1]Otto-von-Guericke-University Magdeburg — [2]Leibniz Institute for Neurobiology Magdeburg

Binary granular mixtures tend to segregate by size when tumbled in a partially filled, horizontally rotating drum. After a few drum revolutions, the smaller component sinks below the flowing granular surface, forming a submersed radial core. After several dozen revolutions of the drum, the core can split into axial bands. Abnormal diffusion of the grains has been proposed to play an important role in that process [1]. On the other hand, DEM simulations indicate a normal Fickian diffusion in this system [2]. We measure axial diffusion of grains in binary mixtures, completely embedded in water, by means of Nuclear Magnetic Resonance Imaging (MRI). It is found that a narrow pulse of small size particles in a bed of large particles undergoes normal (Fickian) axial diffusion, whereas an initial narrow pulse of large particles in a bed of small particles shows subdiffusive behaviour [3].

[1] Z.S. Khan and S.W. Morris, PRL 94, 048002 (2005)
[2] N. Taberlet and P. Richard, PRE 73, 041301 (2006)
[3] in press PRE

DY 30.48 Thu 16:00 Poster C

Coarsening in granular segregation, an entropic approach — •Tilo Finger[1], Matthias Schröter[2], and Ralf Stannarius[1] — [1]Otto-von-Guericke-University-Magdeburg — [2]MPI for Dynamics and Self-organization Göttingen

Binary mixtures of different sizes or densities tend to segregate under several conditions of agitation. Segregation by size in a partially filled horizontal rotating drum has become a classical experiment in granular physics. Three types of segregation may occur in a rotating drum. An immediate radial segregation of the large and small particles (within few revolutions) is often followed by an axial segregation into a stripe pattern, on a slower time scale (several hundred revolutions). Subsequently, a coarsening process leads to the dissolution and merging of individual stripes, towards a complete axial demixing of the two particle species [1]. Here we present an X-ray tomography study which indicates that the driving mechanism of this coarsening process might be the increase of configurational entropy [2].

[1] T. Finger et al., PRE 74, 031312 (2006)
[2] S.F. Edwards & R.B.S. Oakeshott, Physica A 157, 1080 (1989)

DY 30.49 Thu 16:00 Poster C

Tailoring the frictional properties of granular media — •Philipp Aurin[1], Sonia Utermann[1,2], and Matthias Schröter[2] — [1]Georg August Universität Göttingen — [2]Max-Planck-Institut für Dynamik und Selbstorganisation

Where the theorist often neglects friction, this most intriguing of granular interactions, the experimentalist cannot, and instead must embrace it. Here, we go a step further and develop a protocol which allows us to use friction between grains as an experimental control parameter. We present two simple chemical etching procedures which alter the rugosity of soda-lime glass spheres: a procedure to smoothen the surface and one to roughen it. The rugosity has an influence on the frictional properties of the grains because it alters the topology and size of the microscopic contacts between grains. We characterise the spheres using atomic force microscopy. Additional underwater angle-of-repose measurements on our etched samples give us a measure of frictional properties in the bulk.

DY 30.50 Thu 16:00 Poster C

The mean free path of photons in granular media — •Sonia Utermann[1,2], Jonathan Kohler[2,3], and Matthias Schröter[2] — [1]Georg August Universität Göttingen — [2]Max-Planck-Institut für Dynamik und Selbstorganisation — [3]Vanderbilt University

Light transport is a powerful tool for probing the dynamics of dense, multiply scattering media. We use it to measure the kinetic granular temperature of a water-fluidised bed of glass spheres. This contribution shows our quest for the necessary light transport length scale: the photon mean free path, l^*. We measure l^* using both transmission and incoherent backscattering and present our results as a function of (a) the packing density of the grains; (b) the size of the grains; (c) their refractive index; and (d) their surface roughness.

DY 30.51 Thu 16:00 Poster C

Granular dam-break inside an inclined rectangular channel — •Christian Kröner, Birte Domnik, and Shiva P. Pudasaini — Steinmann Institut, Universität Bonn

We aim to understand the granular incidents during a dam-break. Therefore the collapse of a granular column inside an inclined rectangular channel was recorded by a high speed camera to calculate the velocity field inside the granular medium. For this purpose, two different methods were utilized: a granular PIV for fine grains and a particle tracking method for coarse grains. We are currently analysing the recorded velocity field to determine the boundary between the resting and the flowing fraction. The temporal evolution of this boundary, together with the velocity profile of the flowing material, will be used to gain a deeper understanding of the rheological behaviour of granular media. In addition to that, the experimental observations will serve as a test case to determine visco-elastic-plastic parameters for numerical simulations.

DY 30.52 Thu 16:00 Poster C

Volume correlations in disk packings — •SongChuan Zhao, Stephan Herminghaus, and Matthias Schröter — Max-Planck-Institut für Dynamik und Selbstorganisation, Göttingen,Germany

Particles in packings influence their nearest neighbors e.g by force chains.[1] An open question is how far reaching these interactions are. Here we present an experiment of bi-disperse disks driven by periodical air pulse. Images of packings are taken by a CCD camera. Then we compute the distribution of Voronoi volume and probe for a length scale using the Central Limit Theorem.[2]

[1] T.S. Majmudar, and R.P. Behringer, Nature (2005) **435** 1079
[2] F. Lechenault, F. da Cruz, O. Dauchot, and E. Bertin, J. Stat. Mech. (2006) P07009

DY 30.53 Thu 16:00 Poster C

Nonextensive statistics with application to financial processes from nonlinear stochastic differential equations — Vygintas Gontis, Julius Ruseckas, Aleksejus Kononovicius, Miglius Alaburda, and •Bronislovas Kaulakys — Institute of Theoretical Physics and Astronomy, Vilnius University, A. Gostauto 12, LT-01108 Vilnius, Lithuania

Starting from the multiplicative point process and nonlinear stochastic models of $1/f$ noise and power-law distributions [1] we present nonlinear stochastic differential equations generating processes with the q-exponential and q-Gaussian distributions of the observables with the long-range power-law autocorrelations and $1/f^{\beta}$ noise [2]. Further we analyze properties of solutions of these equations in relation with the superstatistical approach [3] and relevance of the generalized and adapted equations for modeling of the financial processes [4].

[1] B. Kaulakys and M. Alaburda, J. Stat. Mech. P02051 (2009).

[2] V. Gontis, B. Kaulakys, and J. Ruseckas, AIP Conf. Proc. **1129**, 563 (2009).

[3] B. Kaulakys, M. Alaburda, V. Gontis, and J. Ruseckas, Brazilian J. Phys. **39**, 456 (2009).

[4] V. Gontis, J. Ruseckas, and A. Kononovicius, Physica A **389**, 100 (2010).