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Participant	Title	Abstract
Adrian Baule	A path integral approach to random motion with nonlinear friction	Using a path integral approach, we derive an analytical solution of a nonlinear and singular Langevin equation, which has been introduced previously by P.-G. de Gennes as a simple phenomenological model for the stick-slip motion of a solid object on a vibrating horizontal surface. We show that the optimal (or most probable) paths of this model can be divided into two classes of paths, which correspond physically to a sliding or slip motion, where the object moves with a non-zero velocity over the underlying surface, and a stick-slip motion, where the object is stuck to the surface for a finite time. These two kinds of basic motions underlie the behavior of many more complicated systems with solid/solid friction and appear naturally in de Gennes' model in the path-integral framework.
Giuliano Benenti	Increasing thermoelectric efficiency: Dynamical models unveil microscopic mechanisms	Dynamical nonlinear systems provide a new approach to the old problem of increasing the efficiency of thermoelectric machines. In this talk I will discuss stylized classical and quantum models, including the disordered hard-point gas and one-dimensional (interacting) quantum electron systems. The main focus will be on the physical mechanisms, unveiled by these dynamical models, which lead to high thermoelectric efficiency approaching the Carnot limit and to high efficiency at maximum power.
Sergey Bezrukov	Entropic potentials in one-dimensional transport description	In many problems of practical and theoretical interest, motion of Brownian particles is spatially constrained. When diffusion occurs in quasi one-dimensional structures, it is intuitively appealing to introduce an effective one-dimensional description, where the spatial constraints are partially accounted for by entropy potentials. The entropic contribution arises naturally if one considers one-dimensional distribution of non-interacting point particles. In equilibrium, the effect of entropic contribution is not different from that of the other components of the potential of mean force. However, under non-equilibrium conditions corresponding to transport of particles that interact with each other or with an applied external force, the situation can be different. In this talk we analyze, both analytically and by Brownian dynamics simulations, several examples of the effective one-dimensional description. In case of a right truncated cone expanding in the left-to-right direction, we show how the fluxes depend on the geometric parameters of the channel and on the particle concentrations. For non-interacting particles the flux is direction-independent in the sense that inversion of the concentration difference leads to the inversion of the direction of the flux without changing its magnitude. This symmetry is broken for repelling particles: the flux in the left-to-right direction exceeds its right-to-left counterpart.
Poornachandra Sekhar Burada	Diffusion in confined geometries: transport and stochastic resonance	We study the diffusion of Brownian particles through irregularly shaped, narrow confining quasi-one-dimensional channels. Applying the so-called Fick-Jacobs approximation, i.e. assuming fast equilibration in the direction orthogonal to the channel axis, the higher dimensional problem can be described in terms of a 1D effective dynamics with an entropic contribution to the potential function. We found that the constrained dynamics yields a scaling regime for the particle current and the diffusion coefficient in terms of the ratio between the work done on the particles and available thermal energy. In addition, in these confined geometries, the interplay between a periodic input signal and intrinsic thermal noise leads to a resonant phenomenon in which feeble signals become amplified.
Michele Campisi	Quantum Measurements and the Fluctuation Theorem	We explore the impact that quantum measurements have on the fluctuation theorem. It will be first shown with a specific example (the Landau-Zener-Stueckelber-Majorana model) that quantum measurements do affect the statistics of work performed on driven quantum systems. Then it will be shown that those modifications are such that they do not affect quantum fluctuation theorems. Finally, we will discuss the impact of this result for the experimental verifications of exchange fluctuation theorems in quantum transport setups. [1] M. Campisi, P. Talkner, and P. Hänggi "Fluctuation Theorems for continuously monitored quantum fluxes", Phys. Rev. Lett. 105, 104601 (2010) [2] M. Campisi, P. Hänggi, and P. Talkner "Colloquium. Quantum Fluctuation Relations: Foundations and Applications" arXiv:1012.2268 [3] M. Campisi, P. Talkner, and P. Hänggi "Influence of measurements on the statistics of work performed on a quantum system" arXiv:1101.2404
Jesús Casado-Pascual	Effect of a high-frequency magnetic field on the resonant behavior displayed by a spin-$1/2$ particle under the influence of a rotating magnetic field.	In this paper, we investigate the role of a high-frequency magnetic field in the resonant behavior displayed by a spin-$1/2$ particle under the influence of a rotating magnetic field. We propose two alternative methods for analyzing the system dynamics, namely, the averaging method and the multiple scale method. The analytical results achieved by applying these two methods are compared with those obtained from the numerical solution of the Schr\"odinger equation. This comparison leads to the conclusion that the multiple scale method provides a better understanding of the system dynamics than the averaging method. In particular, the averaging method predicts the complete destruction of the resonant behavior by an appropriate choice of the parameter values of the high-frequency magnetic field. This conclusion is disproved both by the numerical results, and also by the results obtained from the multiple scale method.
Cristiane de Morais Smith	Artificial staggered magnetic field for ultracold atoms in optical lattices	Uniform magnetic fields are ubiquitous in nature, but this is not the case for staggered magnetic fields. In this talk, I will discuss an experimental set-up recently proposed by us [1], which allows for the realization of a "staggered gauge field" in a 2D optical lattice loaded with cold atoms. If the lattice is loaded with bosons, the effective Hamiltonian of the system is a Bose-Hubbard one, with complex and anisotropic hopping coefficients. A very rich phase diagram emerges from the model: besides the usual Mott-insulator and zero-momentum condensate, a new phase with a finite momentum condensate becomes the ground-state at high-rotation [2]. By using the technique of Feshbach resonance, it is possible to realize bosonic molecules and observe a coherent superposition of a vortex-carrying atomic condensate and a conventional zero-momentum molecular condensate [3]. On the other hand, if the lattice is loaded with fermions, the system allows us to emulate graphene under uniaxial pressure [4]. When the system is loaded with a mixture of bosons and two-species fermions, several features of the high-Tc phase diagram can be reproduced. Starting from a DDW phase, with a staggered pi-flux traversing each plaquette, unconventional superconductivity with features of the RVB state is obtained for a certain range of parameters. Even more interestingly, the complexity of the normal phase surrounding the superconducting dome emerges naturally in this system, and the evolution from a non-Fermi liquid to a Fermi-liquid behavior with increasing doping can be naturally understood. The evolution of the Fermi-surface upon doping also shows that CDW and SDW instabilities could easily occur, due to nesting [5]. Finally, I will discuss a completely different set-up, which allows for the realization of an ffective staggered Zeeman fieldfor fermions in a 2D optical lattice [6]. The resulting band structure is quite exotic; fermions in the third band have an unusual rounded picture-frame Fermi surface (essentially two concentric squircles), leading to imperfect nesting. We develop a generalized SO(3,1) SO(3,1) theory describing the spin and charge degrees of freedom simultaneously, and show that the system can develop a coupled spin-charge-density wave order. [1] A. Hemmerich and C. Morais Smith, Phys. Rev. Lett. 99, 113002 (2007). [2] Lih-King Lim, A. Hemmerich, and C. Morais Smith, Phys. Rev. Lett. 100, 130402 (2008). [3] Lih-King Lim, T. Troppenz, and C. Morais Smith, arXiv:1009.1471. [4] Lih-King Lim, A. Hemmerich, and C. Morais Smith, Phys. Rev. A 81, 023404 (2010). [5] Lih-King Lim, A. Lazarides, A. Hemmerich, and C. Morais Smith, EPL 88, 36001 (2009) and Phys. Rev. A 82, 013616 (2010). [6] D. Makogon, I. B. Spielman, and C. Morais Smith, arXiv: 1007.0782.
Sebastian Deffner	Quantum fluctuation theorems in the strong damping limit	We consider a driven quantum particle in the strong friction regime described by the quantum Smoluchowski equation. We derive Crooks and Jarzynski type relations for the reduced quantum system by properly generalizing the entropy production to take into account the non-Gibbsian character of the equilibrium distribution. In the case of a nonequilibrium steady state, we obtain a quantum version of the Hatano-Sasa relation. We further propose an experiment with driven Josephson junctions that would allow to investigate nonequilibrium entropy fluctuations in overdamped quantum systems.
Jonathan Demaeyer	Caustics in the stochastic Perron-Frobenius equation	We consider one-dimensional maps with fixed points and perturbed by an additive Gaussian white noise. In such systems, the stochastic Perron-Frobenius equation governs the time evolution of the probability. In the weak-noise limit, the propagator of this equation can be approximated by an expression similar to a WKB semiclassical propagator. The contributions to this latter expression are given by the paths of a symplectic map. We show that these contributions exhibit a set of singularities, i.e. a ``caustic''. Using an initial value

		representation in the phase space of the symplectic map, we obtain a uniform approximation for the semiclassical propagator valid in a region containing the caustic. We check the accuracy of this approximation numerically for two maps : the logistic map and a quadratic map, both perturbed by noise.
Sergey Denisov	Quantum gear	I consider two nonlinear quantum nanoelectromechanical(NEMS) oscillators in contact. One of them is driven by an external ac-force, while the second one is decoupled from the driving field. By using the Floquet-Markov approach and the exact diagonalization, I address three issues: the role of decoherence in quantum synchronization, entanglement between oscillators at the high-temperature limit, and (anti)correlations between synchronization and bound entanglement.
Stanislav Denisov	Superslow diffusion: The continuous-time random walk approach	We present the continuous-time random walk (CTRW) theory of superslow diffusion [1]. Superslow diffusion, i.e., diffusion that evolves slower than any power of time, is studied in the framework of the decoupled CTRW model characterized by a waiting time distribution which is assumed to be a slowly varying function of time, and by a jump distribution whose first two moments are assumed to be finite. Within this approach, we derived laws of superslow diffusion for both biased and unbiased versions of the CTRW. In the former case the mean-square displacement is inversely proportional to the second power of the survival (exceedance) probability, while in the latter case to the first power. Illustrative examples of the reference waiting time distributions and the corresponding laws of superslow diffusion are also considered. [1] S.I. Denisov and H. Kantz, EPL, 92, 30001 (2010).
Thomas Dittrich	Directed transport in a ratchet with internal and chemical freedoms	We consider mechanisms of directed transport in a ratchet model intended to account for the physical essentials of motor molecules but remaining on a level of abstraction that allows for analysis beyond biophysical detail. It comprises, besides the external freedom where transport occurs, a chemical freedom replacing the familiar external driving and an internal freedom representing a functional mode of a motor molecule. The dependence of the current on various parameters is is studied in numerical simulations. As a main conclusion, we point out and provide evidence that the internal freedom could play the role of a buffer between energy input and output of mechanical work, allowing a temporary accumulation and storage of injected energy. In this way, it can contribute to the efficiency of current generation.
Alexander Dubkov	Verhulst model with fluctuating rate of population reproduction in the form of white non-Gaussian noise	The Verhulst model with arbitrary white non-Gaussian rate fluctuations and fixed saturation factor is considered. To calculate the mean population density it is better to use not the Kolmogorov equation for probability distribution but rather the exact solution of corresponding Langevin equation. Based on previously obtained results (Dubkov A.A. and Spagnolo B. Fluct. Noise Lett. 2005. V.5, L267) we find the nonlinear relaxation time and stationary value of mean population density for different non-Gaussian noise sources. The possibilities to calculate the stationary probability distribution are also discussed.
Jörn Dunkel	Fluid dynamics and noise in bacterial cell-cell and cell-surface scattering	Bacterial processes ranging from gene expression to motility and biofilm formation are constantly challenged by internal and external noise. While the importance of stochastic fluctuations has been appreciated for chemotaxis, it is currently believed that deterministic long-range fluid dynamical effects govern cell-cell and cell-surface scattering -- the elementary events that lead to swarming and collective swimming in active suspensions and to the formation of biofilms. Here, we report the first direct measurements of the bacterial flow field generated by individual swimming Escherichia coli both far from and near to a solid surface. These experiments allowed us to examine the relative importance of fluid dynamics and rotational diffusion for bacteria. For cell-cell interactions it is shown that thermal and intrinsic stochasticity drown the effects of long-range fluid dynamics, implying that physical interactions between bacteria are determined by steric collisions and near-field lubrication forces. This dominance of short-range forces closely links collective motion in bacterial suspensions to self-organization in driven granular systems, assemblages of biofilaments, and animal flocks. For the scattering of bacteria with surfaces, long-range fluid dynamical interactions are also shown to be negligible; however, once a bacterium has aligned with a surface by an inelastic collision and swims within a few microns of the surface, the self-generated flow traps the bacterium and large fluctuations in orientation are needed to escape. Since these results are based on purely mechanical properties, they will apply to a wide range of bacteria and other microorganisms.
Werner Ebeling	Shotnoise models and efficiency of ATP-driven nano-scale machines operating under far-from-equilibrium conditions	We consider ATP-driven nano-scale machines operating under far-from-equilibrium conditions which are able to do machanical work against an external force or momentum on the cost of ATP-energy inflow into a depot. Efficienecy is defined as the relation of the the mechanical work to the input of chemical energy. The input of ATP-energy is at first modelled as a continuous flow and then - more realistic - as as shot noise considering the supply as energy quanta arriving at Poisson distributed times. We consider simple models of linear climbing motors, rotating motors and stepper motors. We calculate the efficiency - analytically and numerically - in dependence on the external load and the parameters of the noise. The effienecy shows typically - as demonstrated also in several experiments and other theoretical studies - a maximum for intermediate strength of the external load force or momentum. The dependence on noise parameters, which is more complex is studied for several examples. Coauthors: A. Fisasconaro, E. Gudowska-Nowak, Yu.M. Romanovsky, M. Zabicki. References: Fiasconaro et al. Eur.Phys.J.B 65, 403 (2008) Fiasconaro et al. JSTAT/2009/P01029 Bödeker,H.U. at al.,Eur.Phys.Lett.90, 28005 (2010) Zabicki, M. et al., J. Chem. Phys 7975 (2010)
Stephan Eule	A stochastic model describing transport of PSD-95 molecules in spiny dendrites leading to self-organization	Molecules in neurons are in a state far from equilibrium. Therefore their transport properties are strongly affected by fluctuations. We present a model of stochastic molecular transport in neurons which have their synapses located in the spines of a dendrite. In this model we assume that the molecules perform a random walk between the spines that trap the walkers. If the molecules are assumed to interact with each other inside the spines, the trapping time in each spine depends on the number of molecules in the respective trap. The corresponding mathematical problem has non-trivial solutions even in the absence of external disorder due to self-organization phenomena. We obtain the stationary distributions of the number of walkers in the traps for different kinds of on-site interactions between the walkers and furthermore analyze how birth and death processes of the random walkers affect these distributions. We apply this model to describe the dynamics of the PSD-95 proteins in spiny dendrites. PSD-95 is the most abundant molecule in the post-synaptic density (PSD) located in the spines. It is observed that these molecules have high turnover rates and that neighboring spines are constantly exchanging individual molecules. Thus we predict the distribution of PSD-95 cluster sizes that determine the size of the synapse and thus the synaptic strength.
Sergej Flach	The weak password problem: Chaos, criticality and encrypted p-CAPTCHAs	
Thomas Franosch	Persistent memory for a Brownian walker in a random array of obstacles	
Hans Frauenfelder	Noise is essential for proteins.	Biomolecules must move in order to work. Fluctuations in the hydration shell and the environment are essential for the function. Input from the physics of glasses, supercooled liquids, and polymers is helpful. At the same time, proteins may feed back with new knowledge.
Fakhteh Ghanbarnejad	Noise and stability in Boolean dynamics	Regulatory dynamics has mathematical descriptions in terms of rate equations for continuous variables and, after discretization of the state space, as Boolean maps. One can ask how the respective approaches cope with noise inevitably present in biochemical systems. Here we define the stability of a Boolean state sequence in consistency with the stability of the original continuous trajectory that has been discretized. In essence, the stability criterion translates infinitesimal perturbations in the state space of the continuous system into infinitesimal time lags in the Boolean counterpart. For a class of randomly connected systems with randomly drawn Boolean functions, so-called Kauffman networks, we find that the dynamics is stable for almost all choices of parameter values. The so-called "chaotic" regime in Kauffman networks appears only as a damage spreading effect after flip perturbations. We conclude that regulatory systems amenable to state discretization do not exhibit chaotic behaviour.

Igor Goychuk

Viscoelasticity, dispersive kinetics and anomalous diffusion

I will discuss anomalous kinetic and diffusion processes within the Generalized Langevin Equation (GLE) description typified by a viscoelastic power-law memory kernel and a fractional Gaussian noise source related by the fluctuation-dissipation relation and featured by an ultraslow power-law relaxation in harmonic potentials. Approximating the power-law memory kernel by a sum of exponentials obeying a fractal scaling it will be shown that such a profoundly
non-Markovian GLE dynamics can be nicely approximated by a multi-dimensional Markovian dynamics of a finite embedding dimension sufficient to describe anomalously slow diffusion in nonlinear force fields on practically any experimentally observed time scale [1]. The proposed Markovian embedding scheme allows also for a simple and insightful physical interpretation. In the case of bistable transitions it leads to the physical picture of fluctuating non-Markovian rates, combining static and dynamical rate disorder and yielding dispersive non-exponential kinetics even if the activation energy barrier can many times exceed the thermal energy. Strikingly enough, in spite of ultraslow intra-well relaxation there are many
fast escape events. The corresponding dispersive kinetics has a stretched-exponential tail and the non-Markovian rate theory [2] is shown to describe the most probable logarithm of the residence times [1]. Moreover, it is confirmed to work excellently in the limit of very high barriers, when the rate disorder gradually diminishes and the normal rate description is restored. Furthermore, viscoelastic subdiffusion is shown to be asymptotically not sensitive to the presence of a periodic potential and asymptotically ergodic [1]. However, the transient to this asymptotical regime can be extremally slow which leads to a possibility of non-adiabatically driven subdiffusive ratchets with unusual properties [3].

[1] I. Goychuk, Phys. Rev. E 80, 046125 (2009).
[2] P. Hanggi, P. Talkner, and M. Borkovec, Rev. Mod. Phys. 62, 251 (1990).
[3] I. Goychuk, Chem. Phys. 375, 450 (2010).

Milena Grifoni

Quantum spin-orbit ratchets

We discuss mechanisms to obtain a pure spin-current, i.e., a directed spin current withouth charge current, in dissipative periodic structures with spin-orbit interaction subject to an unbiased time-dependent field.
We also demonstrate that in the presence of
electric and magnetic driving the coexistence of
quantum dissipation with the spin flip processes induced by spin-orbit interactions can yield a charge current even for inversion symmetric periodic potentials.

Frank Großmann

Semiclassics plus noise: A trajectory approach to dissipation in quantum mechanics

Using the stochastic, wavefunction-based approach to the Feynman-Vernon influence functional developed by Stockburger and Grabert, we investigate two different scenarios:

1) The thermalization of an anharmonic oscillator in a bath with Ohmic spectral density [1]
2) Tunneling of a particle through an Eckart barrier in the presence of a heat bath [2]

In the first case we will use the Herman-Kluk propagator for the propagation of the wavefunction and in the second case the BOMCA approach developed by the Tannor group.

[1] W. Koch, F. Grossmann, J. T. Stockburger and
J. Ankerhold, Phys. Rev. Lett. 100, 230402 (2008)

[2] W. Koch, F. Grossmann, and D. J. Tannor,
Phys. Rev. Lett. 105 (2010)

Frank Großmann

1D Schrödinger equation with open boundaries for pumping potentials

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Abstract: In order to generate a non-vanishing average current within the time-periodic Schrödinger equation the potential has to break parity and generalized parity. We therefore firstly consider the following potentials with position-dependence only in a central region and a non-static bias: a harmonically driven sawtooth potential (a) and a step-like potential (b). Secondly, we study a dipole field in the central region (c). The cases (b) and (c) contain driving by the fundamental and the second harmonic, so-called harmonic mixing [1]. To calculate the current, we use Floquet scattering theory as well as an open boundary wavefunction method [2] and show that the time-dependent approach leads to the Floquet result in the long-time limit. In case (c) we optimize the relative amplitude ratio between the fundamental and the second harmonic leading to a maximum in the pumping current [3].

[1] S. Kohler, J. Lehmann, and P. Hänggi, Phys. Rep. 406 379-443
(2005)
[2] S. Kurth, G. Stefanucci, C.-O. Almbladh, A. Rubio, and E. K.
U. Gross, Phys. Rev. B 72, 035308 (2005)
[3] N. Rohling and F. Grossmann, arXiv:1012.4663v1

Rouhollah Haji Abdolvahab

Sequence Dependence of Passage Times for Chaperone-Assisted Polymer Translocation

Polymer translocation is one of the ubiquitous processes in biology. There are many theoretical
and experimental works on this field. In vitro, experimentalists usually use the electric field as a driving force for translocation. But in vivo there are other kinds of chemical potentials. One of the famous sources of the chemical potential differences in vivo is the binding of some proteins called chaperones to the polymer and ratcheting the translocation through the Trans side. Without the chaperones because of the entropic barrier the translocation is definitely improbable, but because of the small size of channel that is smaller than the size of chaperones, polymer translocation will be biased with binding of these proteins to the polymer in the Trans side.

Using a master equation approach and a one dimensional Monte Carlo simulation and also with a quantitative mean field view through the sequence we show some of the important and interesting effects of changing the sequence on translocation time and its distribution. We also show that how with changing the chaperone binding energies with polymer, the translocation changes from a purely diffusing to a completely ratcheting one or in other words how its scaling exponent with length will be changed from 2 to 1. Moreover we discuss about our expecting of the dependence of this exponent with length and the binding probability and speculate that the important parameter here isn't the length or biding probability separately, but their product and show that this product is a measure of the Péclet number in our problem.

Mikhail Ivanchenko

Disorder-induced mobility edges and heat flow control in anharmonic acoustic chains

M.V. Ivanchenko and S. Flach

One-dimensional momentum-conserving arrays serve as simple qualitative models to study
anomalous heat conduction. Despite intense research and some qualitative understanding, we still lack quantitative agreement on the main characteristics of anomalous conductivity.

Moreover, mostly harmonic chains with disorder, or anharmonic ordered chains were studied.
Harmonic systems do not equilibrate and the conductivity depends on the boundary conditions and the spectrum of thermal noise. For anharmonic ordered systems one lacks control over the number of relevant long wavelength modes which contribute to anomalous conductivity.

We uncover and study the intricate impact of the disorder-induced mobility edge on the thermal conductivity of the Fermi-Pasta-Ulam (FPU) chain with fixed boundaries. Upon variation of the temperature and the chain size we observe transitions between the following regimes of insulating behavior, normal-like conductivity, disorder-dominated anomalous conductivity, nonlinearity-dominated anomalous conductivity.

The underlying mechanisms are: (i) ballistic transfer by metallic delocalized modes coupled directly to the heat baths, (ii) diffusive transfer by the insulating localized modes, (iii)
ballistic transfer by metallic delocalized modes, the heat flux coming indirectly from the heat baths mediated via the insulating localized modes,
(iv) turbulent transfer by metallic delocalized modes above the stochasticity threshold.

The studied system size is comparable to the number of atoms along nanotubes; therefore, the predicted crossovers may prove to be observable even in the current experimental systems, if the temperature is varied.

Frank Jülicher

The stochastic dance of helical swimmers

Many eucaryotic cells possess motile cilia to propel their swimming motion.
We discuss the role of chirality of the ciliar structure for helical swimming

motion. Microswimmers driven by chiral beating patterns can be steered reliably in a chemical concentration field using a simple and general mechanism. We discuss the principles underlying reliable steering of helical micro-swimmers towards a target. This mechanism of chemotaxis permits sperm to find the egg by following a chemoattractant gradient secreted by the egg. Signaling noise due to stochastic arrival of chemoattractant molecules leads at low concentrations to fluctuations in the swimming path that can be described by stochastic differential geometry.

Peter Jung	How Nerves get into Shape	Nature has endowed dendritic and axonal trees with a huge variety of shapes and morphologies, reflecting the diversity of their function. Morphology is important as, for example, the speed of an action potential depends on the caliber of the axon. Yet, we are only beginning to understand the mechanisms by which an axon acquires its shape during development. In this presentation I will give a review on the axonal cytoskeleton and slow axonal transport, i.e. the mechanism by which neurofilaments, the main structural elements of the axon, are transported along the axon. I will give a brief account of the main experimental techniques, their strengths and weaknesses, and how mathematical modeling has become a useful tool to complement experimentation. Our central hypothesis is that neurofilament kinetics and modulation thereof regulates axonal morphology. Mathematical modeling starts at the level of single neurofilaments and their measured kinetics and can predict local neurofilament content and axonal caliber which in turn can be measured. Specifically, I will address the relation between neurofilament kinetics and content in the mouse optic nerve and the effects of myelination on axon caliber.
Sigmund Kohler	Graphene ratchets	The ratchet effect, i.e., the induction of a dc current by an ac force in the absence of any net bias, represents one of the most intriguing phenomena in non-equilibrium transport. In graphene, one expects that the gapless and chiral nature of this material negatively affects ratchet effects, because it hinders the confinement of electrons. Despite this expectation, a ratchet mechanism that is particularly efficient in graphene exists: It is based on the promotion of electrons in evanescent modes to propagating modes, provided that they enter the barrier from one particular side. Electrons entering from the other side, by contrast, fade away before they reach the driving region. The efficiency stems from the fact that within a certain energy range, all evanescent modes contribute. The corresponding mechanism in a two-dimensional electron gas works only with modes that fulfill certain resonance conditions, which leads to a much smaller current.
Jörg Kotthaus	Self-oscillation in nanoelectro- and nanooptomechanical systems	The sensitive interaction of nanomechanical resonators with electrical and optical fields can be utilized to induce nanomechanical self-oscillations without a periodic external driving field. Different routes will be discussed how such self-oscillations can be triggered and sustained out of thermal or mechanical fluctuations.
David Lacoste	Non-equilibrium Fluctuation-Response relations and applications to molecular motors	We present a theoretical framework to understand a modified fluctuation-dissipation theorem valid for systems close to non-equilibrium steady-states and obeying markovian dynamics. We discuss the interpretation of this result in terms of trajectory entropy excess. The framework is illustrated on a simple pedagogical example of a molecular motor. We also derive in this context generalized Green-Kubo relations similar to the ones obtained recently in U. Seifert, Phys. Rev. Lett., \textbf, 138101 (2010) for more general networks of biomolecular states.
Jörg Lehmann	Stochastic load-redistribution model for cascading failure propagation	We consider a class of probabilistic fiber-bundle-type models for cascading failure propagation in interconnected systems. These models assume that after the failure of a fiber, each intact fiber obtains a random fraction of the failing load. Within a Markov approximation, the breakdown properties of this model can be reduced to the solution of an integral equation. As one type of examples we consider two different versions of these models that both can interpolate between global and local load redistribution in fiber bundles. For the strength thresholds of the individual fibers, we consider a Weibull distribution and a uniform distribution, both truncated below a given initial stress. We furthermore discuss the application of stochastic load-redistribution models to the description of blackouts in power transmission grids.
Baowen Li	Creating heat current from zero thermal bias	
Nianbei Li	Understanding heat conduction of 1D coupled rotors in therms of single kicked rotor	
Heiner Linke	An approach to an artificial protein motor	I will describe an ongoing, experimental effort to design and construct a synthetic molecular protein motor designed to move along a synthetic DNA track, the Tumbleweed [1]. This motor will move unidirectionally by rectified thermal fluctuations, and it will be powered by temporal changes in chemical potential. The experimental approach will be described, and the focus will be on modeling efforts to identify the optimal motor design. We use a combination of Langevin Dynamics, Molecular Dynamics and Master Equations [2], to estimate the flexibility of motor parts based on molecular structure, and to identify optimal design details including the role of stiffness and non-specific binding to the motor's DNA track. Finally, we study the interplay of relevant time scales for optimal motor performance (speed, processivity, load force tolerance). 1) B. Bromley, N. Kuwada, M. Zuckermann, R. Donadini, L. Samii, G. Blab, G. Gemmen, B. Lopez, P. Curmi, N. R. Forde, D. N. Woolfson, and H. Linke, The Tumbleweed: Towards a synthetic protein motor. HFSP J. 3, 204 (2009). 2) N. Kuwada, G. Blab, and H. Linke, A Master equation approach to modeling an articial protein motor arxiv.org/abs/1004.1114. accepted by J. Chem. Phys. (2010).
Stefan Linz	Modeling global and local avalanching of granular matter	In spite of two decades of intensive research, the theoretical description and understanding of avalanching processes of granular matter and, more specifically, of granular surface flow along heaps and inclines still constitute a major challenge. In this contribution, we generalize a previous approach based on a minimal model for global avalanches [1] in two directions: First, using an appropriate stochastic extension [2] of the model for global avalanches [1] that incorporates static and dynamic fluctuations, we present a unifying description for the global surface flow along heap and in rotated drums that reproduces recent thorough experimental findings in surprising detail. Second, we present and analyze a cellular automaton model for granular surface flow including local avalanches and its corresponding continuum approximation [3]. The modeling approach takes advantage of the global model [1] for granular avalanching and is based on the intuitive idea that such flows arise from successive excitations of small-scale avalanches. Also here, we show that many essential experimental results for global and local avalanching can be recovered. [1] S.J. Linz, P. Hänggi, Phys. Rev. E 51, 2538-2542 (1995) [2] D. Sandbrink, S.J. Linz, in preparation [3] A. Hoffmann, S.J. Linz, Physica D 239, 2025–2038 (2010)
Jerzy Luczka	Interaction-induced negative mobility in a systems of two overdamped Brownian particles	
Steffen Martens	Entropic particle transport: higher order corrections to the Fick-Jacobs diffusion equation	Transport of point-size Brownian particles under the influence of a constant and uniform force field through a three-dimensional channel with smoothly varying periodic cross-section is investigated. Here, we employ an asymptotic analysis in the ratio between the difference of the widest and the most narrow constriction divided through the period length of the channel geometry. We demonstrate that the leading order term is equivalent to the Fick-Jacobs approximation. By use of the higher order corrections to the probability density we derive an expression for the spatially dependent diffusion coefficient D(x) which substitutes the constant diffusion coefficient present in the common Fick-Jacobs equation. In addition, we show that in the diffusion

		dominated regime the average transport velocity is obtained as the product of the zeroth-order Fick-Jacobs result and the expectation value of the spatially dependent diffusion coefficient <D(x)>. The analytic findings are corroborated with the precise numerical results of a finite element calculation of the Smoluchowski diffusive particle dynamics occurring in a reflection symmetric sinusoidal-shaped channel.
Jose L. Mateos	Experimental Control of Transport in a Deterministic Optical Ratchet	I will present results of an experiment with a deterministic optical rocking ratchet. A periodic and asymmetric light pattern is created to manipulate a suspension of dielectric microparticles in water. The sample is moved with respect to the pattern with an unbiased time-periodic function that tilts the optical potential in alternating opposite directions. We obtain a current of particles whose direction depends on the particle size and that can be controlled at will in real time.
Volkhard May	Quantum transport in nanohybrid systems	
Debasish Mondal	Intermediates can accelerate entropic diffusion	When Brownian particles are confined in an effective entropic potential subjected a two-dimensional bilobal enclosure connected by an intermediate narrow rod or lobe, the mean first passage time (MFPT) from one lobe to another through the intermediate shows a fascinating turn-over behavior with the variation of the stability of the entropic intermediate state. The MFPT shows a minimum for an optimal value of the barrier height parameter of the intermediate lobe. We propose a novel three-state model to explain the non-monotonic behavior of the entropic diffusion.
Manuel Morillo-Buzon	Noise effects on collective variables of finite arrays driven by time-periodic forces	The equilibrium properties of finite chains of coupled noisy bistable units and their response to time periodic forces will be discussed. Different types of couplings will be considered. I will focus on the study of a collective variable and its emerging properties. The possibility of a reduced description of the collective dynamics by a one-dimensional Langevin equation will be explored. For the types of chains considered, both the power spectral amplification and the signal-to-noise ratio of the collective variable are analyzed as the noise strength, the coupling parameter and the number of bistable units in the system are varied. Compared with the effects observed in single unit systems, the collective variable shows a strong enhancement of the stochastic resonance effects.
Bernard Mulligan	Spin Dynamics in Phase Space	The dynamics of a quantum spin is presented in the representation (phase) space of polar and azimuthal angles via a master equation for the quasiprobability distribution of spin orientations, allowing the averages of quantum mechanical spin operators to be calculated just as the classical case from the Weyl Symbol of the operator. The phase space master equation has essentially the same form as the classical Fokker-Planck equation, allowing existing solution methods (matrix continued fractions, integral relaxation times, etc.) to be used. For illustration, the time behavior of the longitudinal component of the magnetization and its characteristic relaxation times are evaluated for a uniaxial paramagnet of arbitrary spin S in an external constant magnetic field applied along the axis of symmetry. In the large spin limit, the quantum solutions reduce to those of the Fokker-Planck equation for a classical uniaxial superparamagnet. For linear response, the results entirely agree with existing solutions.
Roland Netz	DNA dynamics and the measurement problem in protein force spectroscopy	- The local dynamics of DNA is scale dependent and exhibits elastic effects, hydrodynamic interactions and center-of-mass dynamics as one goes from smaller to larger scales. A dynamic mean-field approach is validated by hydrodynamic simulations and quantitatively compare with recent fluorescence-correlation spectroscopy data. Problems in experimental data are discerned. - In modern single-molecule force-spectroscopic studies of RNA or protein unfolding, DNA functions as a stochastic force-transducer. Extracting folding landscapes and transition rates requires a novel dynamic deconvolution approach. The dynamic response functions of DNA needed for this are supplied by theory.
Abraham Nitzan	Unidirectional hopping transport of interacting particles on a finite chain	Coauthors: Mario Einax, Gemma Salomon and Wolfgang Dieterich Particle transport through an open, discrete 1-D channel against a mechanical or chemical bias is analyzed within a master equation approach. The channel, externally driven by time dependent site energies, allows multiple occupation due to the coupling to reservoirs. Performance criteria and optimization of active transport in a two-site channel are discussed as a function of reservoir chemical potentials, the load potential, interparticle interaction strength, driving mode and driving period. Our results, derived from exact rate equations, are used in addition to test a previously developed time-dependent density functional theory, suggesting a wider applicability of that method in investigations of many particle systems far from equilibrium.
Riza Ogul	Transport properties of nonequilibrium states	Using the quantum mechanical kinetic equations to describe nonequilibrium states, we discuss the transport properties. We show the calculations of transport coefficients like viscosity, heat conductivity and diffusion.
Maria Laura Olivera	Size-induced synchronization in a coupled noisy system	In this poster we investigate the role played by the system size in the phenomenon of stochastic synchronization between switching events and an external driving. In order to do that, we consider an ensemble of coupled nonlinear noisy oscillators driven by a periodic force, and introduce an output frequency associated to a collective variable of the system. By studying the dependence of this output frequency on the system size, we find that there exists a size-induced frequency locking.
Gloria Platero	Topology and phase: Two ways to control the coherent dynamics of electrons	
Eli Pollak	Stochastic theory of atom surface scattering	
Alexey Ponomarev	Thermal equilibration between two quantum systems	Two identical finite quantum systems prepared initially at different temperatures, isolated from the environment, and subsequently brought into contact are demonstrated to relax towards Gibbs-like quasiequilibrium states with a common temperature and small fluctuations around the time-averaged expectation values of generic observables. The temporal thermalization process proceeds via a chain of intermediate Gibbs-like states. We specify the conditions under which this scenario occurs and corroborate the quantum equilibration with two different quantum models. A. V. Ponomarev, S. Denisov, and P. Hanggi, Phys. Rev. Lett. 106, 010405 (2011)
Georg Michael Reuther	Monitoring Coherent Quantum Dynamics	We propose a scheme for monitoring coherent quantum dynamics with good time-resolution and low measurement back-action. The underlying idea is to measure the response of the quantum system to a high-frequency ac field. It turns out that the phase of an outgoing signal, which can directly be detected in an experiment with lock-in technique, is proportional to the expectation value of a particular system observable. We corroborate this result by numerically solving the quantum master equation for a charge qubit realized in a Cooper-pair box. As a fundamental example, we first focus on monitoring coherent qubit oscillations. Beyond that, we demonstrate that our scheme also enables observing quantum dynamics with many frequency scales, such as that of a qubit undergoing Landau-Zener transitions. Moreover, we propose how to measure the entanglement between two qubits. References: [1] Time-resolved measurement of a charge qubit, G. M. Reuther, D. Zueco, P. Hänggi, S. Kohler, PRL 102, 033602 (2009) [2] Monitoring entanglement and collective quantum dynamics, G. M. Reuther, D. Zueco, P. Hänggi, S. Kohler, PRB 83, 014303 (2011)
Klaus Richter	Quantum universality and its breakdown in ergodic mesoscopic systems	Electric transport properties of complex mesoscopic systems are determined by the presence of few symmetries only, most notably time-reversal symmetry. This character of universality is believed to be independent of the source of scattering in the system, and to exist in both ballistic chaotic quantum dots or diffusive disordered conductors under the sole assumption that scattering generates complete ergodicity. Several recent works have further suggested that spin transport in mesoscopic systems with spin-orbit interaction also displays universal behavior similar to electric transport. The above universality conjecture for charge and spin transport is based on predictions and assumptions from random matrix theory (RMT). In this talk I will consider different cases where RMT universality breaks down even if the underlying dynamics is ergodic. In particular I will show that subtle geometric correlations render the average spin conductance finite, in contrast to its vanishing RMT value. We will see that the direction of the spin porization is governed by the direction of average charge

		flow. Moreover the size of the spin conductance crucially depends on the number of terminals of the mesoscopic conductor. I will first show how RMT univerality of obervables at mesoscopic scales can be deduced within a semiclassical path integral approach, invoking classical trajectory correlations as a key element. I will then demonstrate how these semiclassical tools are used to go beyond random matrix theory and to explain the above mentioned features in spin transport.
Miguel Rubi	Thermodynamics and stochastic dynamics of transport in confined media	We show how a probabilistic interpretation of non-equilibrium thermodynamics can be used to analyze the stochastic dynamics of entropy driven diffusion processes characterized by the presence of entropic barriers. This approach sets up a systematic method to study the effect of confinement on the transport properties, providing a derivation of a generalized Fick–Jacobs equation for the constrained dynamics of the mesoscopic degrees of freedom. It is shown that confinement originates an entropic bias which gives rise to a geometric rectification of non-equilibrium fluctuations and that entropic effects in transport can be controlled by means of the application of an external force.
Keiji Saito	Additivity principle in high-dimensional harmonic lattices	We consider heat transfer across disordered harmonic lattice, which is connected to two heat baths at different temperatures. Harmonic crystals in three dimensions are known to exhibit different regimes of transport such as ballistic, anomalous and diffusive. We investigate universal current fluctuation in these three regimes. We first derive a formula of cumulant generating function (CGF) of heat transfer, which satisfies Gallavotti-Cohen fluctuation symmetry. Using recursive Green function method, we numerically consider properties of CGF, and discuss so-called additivity principle.
Lutz Schimansky-Geier	Fluctuations in Models of Self-Propelled Particles	The dynamics of particles with fluctuating velocity and orientation in two spatial dimensions is analyzed. The difference between passive (e.g. thermal fluctuations) and active fluctuations which emerge in active systems far from equilibrium as for example living organisms or chemically driven colloids is outlined. Analytical expressions for the speed and velocity distributions for generic models of (active) Brownian particles are derived. The presence of active fluctuations already for simple Stokes friction results in speed and velocity distributions which differ from the classical Maxwell distribution. Active Gaussian fluctuations lead to speed distributions with a many probability concentrated at small or vanishing speeds . Finally it is shown that such a behavior may also occur in non-Gaussian active fluctuations.
Michael Schindler	Anomalous elasticity from confocal microscopy	We present a theory of projected elasticity which describes the elastic properties which one expects if only the displacements in a two-dimensional slice is regarded instead of the whole crystal. We find that the apparent dispersion curve has a different behaviour than expected from Debye theory. (Work together with Anthony C. Maggs and Claire Lemarchand)
Wolfgang Schleich	Focusing without a lens	
Gerhard Schmid	Entropic transport in energetic potentials	We study the transport of point size particles in micro-sized two-dimensional periodic channels, exhibiting periodically varying cross-sections. The particles are subjected to a constant external force acting alongside the direction of the longitudinal channel axis and a varying force stemming from a periodic substrate potential profile. While particle transport in tilted periodic potentials is facilitated by noise, the transport through pores with periodically varying cross-sections worsens with increasing noise level, i.e. increasing temperature. The competition between the noise-assisted propagation for energetic potentials and the hampered transport in confined structures leads to a striking, non-monotonic behavior which sensitively depends on the phase lag of the periodic channel structure and the periodic potential. By controlling this phase lag the symmetry could be broken and rectification observed.
Udo Seifert	Stochastic thermodynamics	
Igor Sokolov	Particles in confining potentials under Levy noise: Old and new results	
Uwe Thiele	Transport of free surface liquid films and drops by external ratchets and self-ratcheting mechanisms	We discuss the usage of ratchet mechanisms to transport a continuous phase in several micro-fluidic settings. In particular, we study the transport of a dielectric liquid in a heterogeneous ratchet capacitor that is periodically switched on and off. The second system consists of drops on a solid substrate that are transported by different types of harmonic substrate vibrations. We argue that the latter can be seen as a self-ratcheting process and discuss analogies between the employed class of thin film equations and Fokker-Planck equations for transport of discrete objects in a 'particle ratchet'.
Michael Thorwart	Competition between relaxation and external driving in the dissipative Landau-Zener problem	Landau Zener transitions in a dissipative environment reveal an interesting nontrivial dynamical competition between relaxation processes and the external sweep. Numerically exact results are presented which can be explained in terms of a simple physical picture. In the limits of large and small sweep velocities and low temperatures, our results coincide with existing analytical predictions for the Landau-Zener transition probability. For small sweep velocities and medium to high temperatures, however, we find nonmonotonic dependencies on the sweep velocity, temperature, coupling strength, and cutoff frequency, which are not captured by perturbative approaches. In addition to the Landau-Zener transition probability, we also address the excitation survival probability and provide as well a qualitative understanding of the involved competition of time scales. [1] P. Nalbach and M. Thorwart, Phys. Rev. Lett. 103, 220401 (2009). [2] P. Nalbach and M. Thorwart, Chem. Phys. 375, 234 (2010).
Christian Van den Broeck	The efficiency of small machines	
Thomas Wellens	Efficient and coherent excitation transfer across disordered molecular networks	We show that finite-size, disordered molecular networks can mediate highly efficient, coherent excitation transfer which is robust against ambient dephasing and associated with strong multi-site entanglement. Such optimal, random molecular conformations may explain efficient energy transfer in the photosynthetic FMO complex. We investigate the properties of optimal configurations with respect to different measures of the transport efficiency, and examine under what conditions transport is increased or decreased by adding noise.
Robert Whitney	Temperature enhancing coherent oscillations at a Landau-Zener transition	The coupling of a quantum system to its environment causes dissipation in the system; this is expected to suppress the coherent oscillations of superpositions of system states (as the superpositions decohere into mixed states). Here we consider coherent quantum oscillations generated by sweeping the system through a Landau-Zener avoided-crossing. Remarkably, we find that weak-coupling to a high-frequency (e.g.~super-Ohmic) environment can strongly {\it enhance} such quantum oscillations. Under certain conditions, the coherent oscillations also grow as temperature is increases. This effect should be observable in many quantum systems; such as solid-state qubits, molecular magnets, polarized He3 or polarized neutrons.
Martijn Wubs	Coherent destruction of tunneling in diamond	Nitrogen vacancy (NV) centers in diamond are promising candidate qubits for quantum information processing. Recently it has been shown experimentally that their quantum states can be manipulated fast by short and strong light pulses [1]. I proposed that also in the strong-coupling regime and for a smaller interaction between the qubit states, coherent destruction of tunneling (CDT) [2] could be observed, both in pulsed and in continuously driven NV centers [3]. Indeed, for continuous driving, CDT in diamond has recently been observed [4]. NV centers are becoming the work horse for quantum state manipulation in the strong-coupling regime. Besides their efficient interaction with light, NV centers can also be manipulated with magnetic fields. This is the basis for a possible coherent interaction between a collection of NV centers with a flux qubit, forming an interesting hybrid quantum system, where the strong optical transitions of the NVs may enable an interface between superconducting qubits and light [5]. [1] G. D. Fuchs, V. V. Dobrovitski, D. M. Toyli, F. J. Heremans, and D. D. Awschalom Gigahertz Dynamics of a Strongly Driven Single Quantum Spin Science 326, 1520 (2009). [2] F. Grossmann, T. Dittrich, P. Jung and P. Hanggi, Coherent destruction of tunneling Phys. Rev. Lett. 67, 516 (1991).

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Sophia Yaliraki	Multiscale dynamics of biomolecular networks	
Yaroslav Zelinskyy	Current formation through a molecular junction: Theoretical studies of photoinduced switching effects	
Guimei Zhu	Network Evolution at different structure scales	Networks structure is considered as primary important factors responsible for system dynamics and functions well. Dynamics on networks, as the bridge between structures and functions, occur generally from micro- to macro- structural scales. Some measures of networks are proposed such as degree distribution, shortest pathway, graphlet distribution and fractal, but how to describe simultaneously the structural patterns at dierent scales is still an open and important problem. We map networks to a large molecular, the nodes and edges as atoms and the bonds between them, respectively. The eignstate modes from low to high energies are used as probes of the structural characteristics from macro- to micro- scales. We do the structure pattern analysis for yeast proteins interactions network and Barabasi-Albert model network, the structure pattern analysis could not only predict the unknown function proteins, but most important is it also conveys the evolution process of the structure patterns of the network which is the noteworthy things have not been discovered before.