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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.
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
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).
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.
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.
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.
Frank Großmann	1D Schrödinger equation with open boundaries for pumping potentials	Authors: Niklas Rohling and Frank Grossmann Institut für Theoretische Physik, Technische Universität Dresden, D-01062 Dresden, Germany 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.
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.
Nianbei Li	Understanding heat conduction of 1D coupled rotors in therms of single kicked rotor	
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.
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.
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.
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.
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)
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)
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.
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'.
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). [3] M. Wubs Instantaneous coherent destruction of tunneling and fast quantum state preparation for strongly pulsed spin qubits in diamond Chem. Physics 375, 163 (2010) [4] L. Childress and J. McIntyre Multifrequency spin resonance in diamond Phys. Rev. A 82, 033839 (2010)

		[5] D. Marcos, M. Wubs, J. M. Taylor, R. Aguado, M. D. Lukin, and A. S. Sorensen Coupling nitrogen-vacancy centers in diamond to superconducting flux qubits Phys. Rev. Lett. 105, 210501 (2010)
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.