DY 26 Brownian Motion and Kinetic Theory II

Time: Tuesday 16:15–18:15 Room: HÜL 186

DY 26.1 Tue 16:15 HÜL 186

On reaction-subdiffusion equations — •I.M. Sokolov[1], M.G.W. Schmidt[2], and F. Sagués[2] — [1]Humboldt-Universität zu Berlin — [2]Universitat de Barcelona

To analyze possible generalizations of reaction-diffusion schemes for the case of subdiffusion we discuss a simple monomolecular conversion $A \to B$. We derive the corresponding kinetic equations for local A and B concentrations. Their form is rather unusual: The parameters of reaction influence the diffusion term in the equation for an educt A, a consequence of the nonmarkovian nature of subdiffusion. The equation for a product contains a term which depends on the educt concentration at all previous times. Our discussion shows that reaction-subdiffusion equations may not resemble the corresponding reaction-diffusion ones.

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DY 26.2 Tue 16:30 HÜL 186

Stochastic resonance in a domain with two reflecting boundaries — •Elisabeth Paule[1], Th. Pletl[1], P. Chvosta[2], M. Schulz[1], and P. Reineker[1] — [1]Department of Theoretical Physics, University of Ulm, Albert-Einstein-Allee 11, 89069 Ulm, Germany — [2]Department of Macromolecular Physics, Faculty of Mathematics and Physics, Charles University, V Holesovickach 2, CZ-180 00 Praha, Czech Republic

We present our numerical results of a one-dimensional diffusion process of a particle in a linear time-dependent potential. The particle is moving in a domain with two reflecting boundaries. The corresponding external force consists of two parts, a time independent part pushing the particle to the right boundary and a harmonically oscillating part. We solve the Fokker-Planck equation (FPE) with the Finite-Element Method (FEM). From the numerical solution of the FPE we calculate the mean position of the particle for different diffusion coefficients and different strengths of the oscillating force. It is shown that the mean position is an oscillating function. In the stationary limit we regard the variation of the amplitude of the mean position with the diffusion coefficient for different strenghts of the external time-dependent force. The response of the system shows resonance like behavior for a range of the strength of the external oscillating force. There is a force strength for which this resonance like behavior dissappears.

DY 26.3 Tue 16:45 HÜL 186

Universal scaling in anomalous transport — •I. Goychuk[1], E. Heinsalu[1,2], M. Patriarca[1], G. Schmid[1], and P. Hänggi[1] — [1]Institut für Physik, Universität Augsburg, Germany — [2]Institute of Theoretical Physics, Tartu University, Estonia

Anomalous transport in tilted periodic potentials is investigated within the framework of the *fractional* Fokker-Planck dynamics and the underlying continuous time random walk (CTRW). The analytical solution for the stationary anomalous current is obtained in closed form. We also derive a scaling law relating the anomalous biased diffusion to the anomalous current which is universally valid for tilted periodic potentials. The agreement between analytical results and numerical simulations confirms our findings.

DY 26.4 Tue 17:00 HÜL 186

Hydrodynamic coupling of rotation and translation between two colloidal particles — •T. Gisler, S. Martin, M. Reichert, and H. Stark — Universität Konstanz, Fachbereich Physik, Fach M621, 78457 Konstanz

We use optical tweezers combined with fast video microscopy to measure the coupling between translation and rotation of two colloidal spheres with diameters of $3-4\,\mu$m. Imaging the birefringent particles under crossed polarizers allows us to determine the positions and orientations of both particles simultaneously. Cross-correlations between random displacements of one particle and orientational fluctuations of its neighbor allow us to quantify the translation-rotation coupling induced by hydrodynamic interactions. Our results are in good agreement with the theory in the creeping-flow limit (M. Reichert and H. Stark, Phys. Rev. E **69**, 031407 (2004)).

DY 26.5 Tue 17:15 HÜL 186

Anomalous diffusion in proteins — •Thomas Neusius and Jeremy C. Smith — Computational Molecular Biophysics Group, Interdisziplinäres Zentrum für wissenschaftliches Rechnen, Im Neuenheimer Feld 368, 69120 Heidelberg

Diffusion processes which show long time memory effects are discussed in many fields of physics. The subdiffusive behavior of a single protein mode was described recently in the framework of generalised Langevin equations with fractional noise [1].

The underlying microscopic dynamics leading to this specific kind of noise are yet to be completely understood. The characterisation of the emergence of anomalous diffusion by looking at different types protein modes will be undertaken. We assume that there are different categories which can be defined by their contribution to quanteties such as the mean square deviation or their degree of anharmonicity. As the anomalous diffusion is a property of the whole molecule, it is likely that only the modes involving a large number of atoms show strong deviations from the classical Brownian motion.

[1] S. C. Kou and X. Sunney Xie: Phys. Rev. Lett. **93** (2004) 18, p. 180603.

DY 26.6 Tue 17:30 HÜL 186

Random Walk Model with Waiting Times Depending on the Preceding Jump Length — •Vasily Zaburdaev — MPI for Dynamics and Self-Organization, Bunsenstr.10, 37073 Göttingen, Germany

In the present work the generalized continuous time random walk model with a coupled transition kernel is considered. The coupling occurs through the dependence of the waiting time probability distribution on the preceding jump length. The method, which involves the details of the microscopic distribution over the waiting times and arrival distances at a given point, is suggested for its description. In the particular case of coupling, when a waiting time is a simple function of a preceding jump length, a close analogy to the problem of a random walk with finite velocity is demonstrated. With its help an analytical solution for the generalized random walk model, including both effects (finite velocity and jump dependent waiting times) simultaneously, is found. Considered examples indicate a possibility to apply the developed approach to the biological problems where the random walk together with the recovery processes and the finite velocity are present, such as e.g. the foraging movements of animals or the motion of zooplankton.

DY 26.7 Tue 17:45 HÜL 186

On the Validity of the Peierls-Boltzmann Equation — •Mehmet Kadiroglu — D-49069 Osnabrück

Thermodynamic behaviour of closed quantum chains and rings is investigated by using the "Hilbert Space Average-Method"(HAM). In the context of heat conduction we are especially interested in whether or not the "Stoßzahlansatz" "which is crucial for the validity of the Boltzmann equation is justifiable for (small) quantum systems. To those ends we developed a modified "Peierls-Boltzmann-equation in which the "quasiparticles" are replaced by current-eigenstates. Our main aim is to decide whether this ansatz applies to heat transport in our finite quantum systems.

DY 26.8 Tue 18:00 HÜL 186

On a Non-Markovian Fokker-Planck equation — •Knud Zabrocki and Steffen Trimper — Martin-Luther-University Fachbereich Physik, 06099 Halle,

We consider a model for a probability distribution function p(x,t) which is subjected to the distribution function at a former time via a feedback coupling. As a consequence the behaviour of p(x,t) is changed drastically. Whereas for a long range feedback coupling, i.e. a coupling to the initial distribution function, the system offers non-trivial stationary solution, in case of a short time coupling this stationary distribution disappears. We demonstrate that this non-Markovian Fokker-Planck equation without a drift term is equivalent to a Fokker-Planck-equation with a drift term. Different initial distributions and their influence on the stationary solution in one dimension are analysed in detail. The investigation can be extended to higher dimensions. Depending on the initial condition and the dimension, the system reveals different drift terms and entirely different potentials. A further generalization is given by a kind of co-moving frame. In that case a particle, performing a random walk, is affected at a given time t by all processes taking place within a sphere of radius R = v t. For a non-zero velocity v the system exhibits three distinguished time regimes with complete different behaviour. The model could be applied for glasses and strongly inhomogeneous systems.