Polymers under Multiple Constraints

Special Event

Polymer- & Soft-Matter- Seminar/ Theorie Kolloquium

Wednesday,
26st June2013

at: 4.15 pm

VSP1 1.26

Von-Seckendorff- -Platz 1,
06120 Halle

Sonder-termin im Theorie-Kolloqui-um

Prof. Dr. Thomas Franosch

Friedrich-Alexander-Universität Erlangen-Nürnberg

"Persistent correlations in complex Transport – Brownian motion and beyond"

The pillars of all transport processes have been established in the molecular-kinetic interpretation of diffusion by Einstein and Smoluchowski. In modern terms the central limit theorem applies whenever dynamical correlations decay quickly.
Yet, already the preeiminent dutch physicist Hendrik Antoon Lorentz noted that this theoretical framework fails to account for subtle effects in Brownian motion and has to be completed. In the presentation I will introduce several model systems where persistent correlations emerge with macroscopic measurable consequences.

First, I discuss the Brownian motion of a suspended mesosized particle in a simple liquid and in particular the emergence of hydrodynamic memory via the coupling to the Navier-Stokes equations. High precision experiments have confirmed these effects for the first time recently and suggest to develop new ultrasensitive biophysical tools.

Even more drastic persistent correlations appear in the Lorentz model, originally introduced to describe electronic transport in crystals, nowadays the reference model for porous media and cellular crowding. There a particle explores a disordered matrix of frozen obstacles, such that at high scattering density a localization transition emerges. This phenomenon goes in hand with anomalous subdiffusive transport which can rationalized as a critical phenomenon. We analyze the behavior in terms of simulations, scaling theory, and a newly analytically developed theory based on a low-density expansion. Applying an external bias force, the system can be driven far from equilibrium such that linear response is no longer applicable. The results demonstrate the breakdown of the fluctuation-dissipation theorem at arbitrarily low fields. In particular the transport coefficients are no longer nonanalytic in the frequency, yet a new singular dependence on the field strength arises.