●c hemisch
○p hysikalische
g esellschaft

Gegründet im Jahre 1869 von H. Hlasiwetz, J. Loschmidt, J. Petzval und J. Stefan

EINLADUNG

zum Vortrag
von

Prof. Dr. Thomas Franosch

Institut für Theoretische Physik, Leopold-Franzens-Universität Innsbruck

Transport beyond Brownian motion

am
Dienstag, 21. April 2015, um 17:30 Uhr

Ort: Lise-Meitner-Hörsaal, Fakultät für Physik, Universität Wien,
1090 Wien, Strudlhofgasse 4 / Boltzmanngasse 5, 1. Stock

Barrierefreier Zugang: Boltzmanngasse 5, Lift, 1. Stock rechts über den Gang zum Hintereingang des Hörsaals

Abstract:

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 preeminent 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 ultra-sensitive 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 be 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 Applying an external bias force, the system can be driven far from equilibrium such that linear response is no longer applicable.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.
