Non-equilibrium dynamics of active agents and driven particles in microrheology

Wednesday 28th March - h 14:30
Polo Ferrari 1 - Room A205

Abstract:

The paradigm of virtually all transport processes in soft matter or biophysics systems is Brownian motion. However, often the constituents are highly anisotropic resulting in a non-trivial coupling between orientational and translational degrees of freedom.

In this talk I will introduce an exact solution of the Smoluchowski-Perrin equation for anisotropic diffusion exploiting a mathematical analogy to the quantum pendulum. Then the single-particle dynamics can be obtained as a superposition of suitable eigenfunctions of the Smoluchowski operator.

We discuss features emerging due to the interplay of particle anisotropy and translational motion and how they manifest themselves in the directly measurable intermediate scattering functions.

Next, we investigate the dynamics of a single active particle, i.e. an agent that undergoes self-propelled motion along an axis of orientation which slowly and randomly changes. Again the intermediate function can be elaborated analytically and reveals oscillatory behavior for intermediate wave numbers, in striking contrast to passive overdamped systems. We compare our results with recent dynamic differential microscopy measurements and demonstrate that our solution allows reliably extracting motility parameters.

Last we address the driven dynamics of tracer particle in a colloidal suspension of hard spheres upon switching on an external force. The force drives the system far from equilibrium and we monitor the time-dependent velocity response. Within a low-density expansion and computer simulations we show that linear response as encoded in the fluctuation-dissipation theorem becomes qualitatively wrong.