Prof. Dr. Thomas Franosch
Institut für Theoretische Physik, Universität Innsbruck

Non-equilibrium dynamics of active Brownian particles (ABP) - a paradigm in soft matter/biological physics

Various challenges are faced when animalcules such as bacteria, protozoa, algae, or sperms move autonomously in aqueous media at low Reynolds number. These active agents are subject to strong stochastic fluctuations that compete with the directed motion. Active particles have come into recent focus in statistical physics since they constitute simple but realistic models for systems far from equilibrium.

So far most studies consider the lowest-order moments of the displacements only, while more general spatio-temporal information on thestochastic motion is provided in scattering experiments. Here we derive analytically exact expressions for the directly measurable intermediate scattering function for a mesoscopic model of a single, anisotropic active Brownian particle relying on techniques familiar from elementary quantum mechanics.

The mean-square displacement and the non-Gaussian parameter of the stochastic process are obtained as derivatives of the intermediate scattering function. These display different temporal regimes dominated by effective diffusion and directed motion due to the interplay of translational and rotational diffusion which is rationalized within the theory.