UNIVERSITÄT DUISBURG ESSEN

Offen im Denken

Theorie-Kolloquium WS 2022/23

Fr 13.01.2023, 14:00-15:30

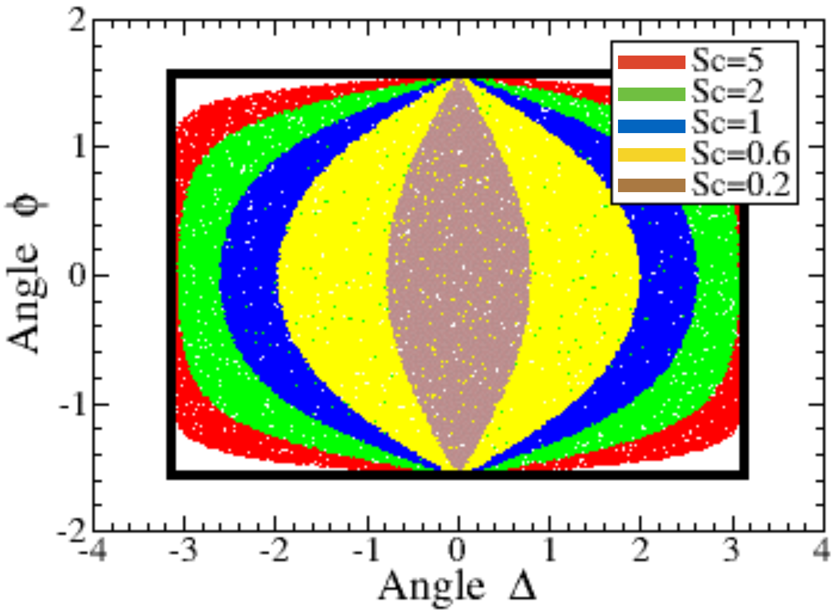
MC 351 & online (URL in E-Mail)

udue.de/TheoKoll

Scattering theory of active particles with social distancing: non-local closure and network noise

Prof. Dr. Thomas Ihle

Universität Greifswald



We consider self-propelled particles with velocity-dependent interactions where particles try to avoid each other. The particles undergo apparent Brownian motion, even though the particle's equations are fully deterministic and no explicit noise terms are included in the model. We show that the interactions lead to internal, dynamical noise which can be interpreted as the noise of a network with time-dependent topology. Starting from the exact N-particle Liouville equation, a kinetic equation for the one-particle distribution function is obtained. We show that the usual mean-field assumption of Molecular Chaos which involves a simple factorization of the N-particle probability leads to unphysical predictions. Going beyond mean-field by explicitly taking into account two-particle-correlations during interactions and using a first-principle, non-local closure of the BBGKY-hierarchy, we analytically calculate the scattering of particles. As a result we obtain explicit expressions for the colored network noise of an effective one-particle Langevin-equation and the corresponding self-diffusion. The predicted theoretical expressions for the relaxation of hydrodynamic modes and the self-diffusion coefficient are in excellent, quantitative agreement with agent-based simulations.