PHYSIK

PHYSIKALISCHES KOLLOQUIUM

UNIVERSITÄT DES SAARLANDES

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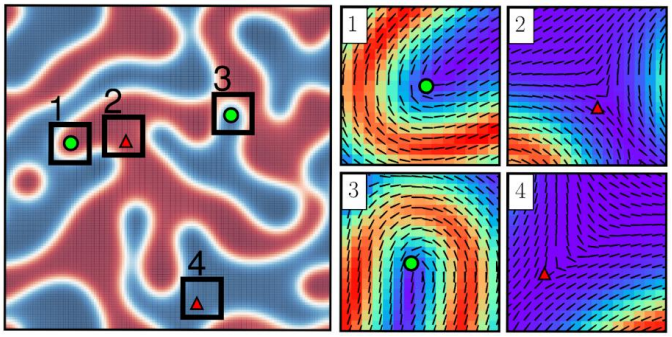
Hydrodynamics of classical and quantum active systems

Thursday, 22.01.2026, at 2.00 p.m. **c. t.**

Building C6.4, Lecture Hall II (00.9)

Active systems consume energy from their environment and can convert it into kinetic energy or work. Active behavior exists in many biological systems across different length scales and has been described, for instance, in the motion of bacteria and in the collective behavior of bird flocks. As such systems are inherently in nonequilibrium states, their physical description provides many new challenges and insights, and the research focus by now includes biological as well as synthetic active systems.

In this talk, I will discuss two examples of the hydrodynamic behavior of active systems. In the first part of the talk, we study entropy production in a classical model of active hydrodynamics, the Active Model H, which provides an effective description for active particles in a fluid. Simulating this model in the presence of noise, we show that the order parameter in the active turbulent phase develops topological defects, which act as local sources of entropy. We describe this phenomenon and present an effective analytical model for it.



In the second part of the talk, I will describe a quantum system which mimics flocking behavior, i.e., the collective motion of particles which is a hallmark of many classical active systems. We consider a system of two species of hard-core bosons moving in one dimension subject to mutual interaction and active dynamics. Describing the system using a Lindblad Master equation, we calculate its density correlation functions to show that quantum flocking is signaled by long-range quantum coherence and the transition to a superfluid state.

You can participate online via MS Teams: https://shorturl.at/FNvHU

Interested people are cordially invited.

Coffee and cookies are served at 2.00 p.m. in front of the Lecture Hall

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