Workshop Abstracts

Dynamics of Ratchet Gears in Active Matter Systems

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Active matter refers to a bath composed of self-propelling particles. Compared to systems at thermodynamic equilibrium, it is possible to extract work directly from active matter via ratchet effect. Previous studies have hinted universal features of this energy extraction principle for the case of ratchet gears powered by different types of active matter systems. Such features have been attributed to different biological/chemical/physical phenomena but with no concrete framework. Our goal is to find basic principles for such universal feature. In this talk, I will present experimental results on the rotational dynamics of a ratchet gear powered by a bath of vibrated granular chains. We found that the angular velocity of the gear is controlled by the number and speed of active granular chains in the trapping region. We have checked this result for very low to near jamming concentrations. Furthermore, except for near jamming concentrations, the lifetime of the active granular chains in the trapping region was shown to follow the tube model of Kudrolli. Finally, I will discuss a novel synchronization of the ratchet gears which is bath mediated due to the alignment of the active granular chains along the bounded region of the gears.

Discrete-Time Quantum Walks: an Efficient Framework for Transport Studies

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Abstract:

Discrete-Time Quantum Walks (DTQW) is a unitary map dynamical system originally proposed for quantum computing. Its discreteness in both time and space allows us to perform ultrafast numeric simulations of systems in nonlinear and disordered media and multiple interacting particles setups. We study Anderson localization in one-and two-interacting-particle DTQW and calculate localization length in various regimes. Further, we generalize the setup to include nonlinearity and study wave-packet spreading. We demonstrate persistence of subdiffusive spreading up to astronomical record-breaking times suggesting that the regime is universal asymptotic behavior. In the absence of disorder, we study almost-local soliton-like moving and steady nonlinear excitations.