Soft Living Active and Adaptive Matter

Exact coherent structures and transition to turbulence in a confined active nematic

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Abstract:

Active matter describes a class of systems that are maintained far from equilibrium by driving forces acting on the constituent particles. Here I will focus on confined active nematics, which exhibit especially rich flow behavior, ranging from structured patterns in space and time to disordered turbulent flows. To understand this behavior, I will take a deterministic dynamical systems approach, beginning with the hydrodynamic equations for the active nematic. This approach reveals that the infinite-dimensional phase space of all possible flow configurations is populated by Exact Coherent Structures (ECS), which are exact solutions of the hydrodynamic equations with distinct and regular spatiotemporal structure; examples include unstable equilibria, periodic orbits, and traveling waves. The ECS are connected by dynamical pathways called invariant manifolds. The main hypothesis in this approach is that turbulence corresponds to a trajectory meandering in the phase space, transitioning between ECS by traveling on the invariant manifolds. Similar approaches have been successful in characterizing high Reynolds number turbulence of passive fluids. Here, I will present the first systematic study of active nematic ECS and their invariant manifolds and discuss their role in characterizing the phenomenon of active turbulence.

Date:
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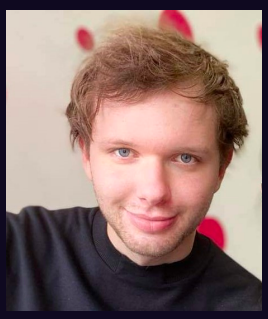
Time:
9:00 AM-10:15 AM (PT)

About the speaker:



Dr. Caleb Wagner is a Postdoctoral Research Associate at the University of Nebraska-Lincoln, working with Prof. Piyush Grover on the application of dynamical systems theory to active matter. Dr. Wagner's collaborators include Prof. Jae Sung Park (University of Nebraska-Lincoln) and Dr. Michael Norton (Rochester Institute of Technology).

Dr. Wagner is broadly interested in the theory of nonequilibrium matter, including active matter, and its implications for materials design and engineering. He holds a Ph.D. in Physics from Brandeis University, where he was advised by Prof. Aparna Baskaran. His dissertation was titled "Mathematics of Nonequilibrium Steady States in Dilute Active Matter"

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