PHYSICAL MATHEMATICS SEMINAR

Simple models of complex active materials

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ABSTRACT:

Active matter describes systems whose constituent elements consume energy to generate motion, and are thus intrinsically far-from equilibrium. I will describe computer simulations of two recently developed active matter systems. (1) Self-propelled colloids with repulsive interactions and no aligning interactions are a minimal model active matter system. We and others have shown that, even when particles experience only repulsive interactions, this system undergoes a phase coexistence that mimics the equilibrium phase separation of attractive colloids. I will present a simple kinetic theory that describes the dynamics of phase separation, resulting in a framework analogous to equilibrium classical nucleation theory. (2) Active nematics are liquid crystals which are driven out of equilibrium by energy-dissipating active stresses. The ordered nematic state is unstable to the proliferation of topological defects, which undergo birth, streaming dynamics, and annihilation to yield a seemingly chaotic dynamical steady-state. I will describe several types of computational models for active nematics motivated by experiments at Brandeis in which microtubule bundles driven by ATP-powered motor proteins, and a few surprising things we have learned about the behaviors of active nematics from analyzing simulation trajectories and experimental data. These include heretofore unknown broken-symmetry phases in which the topological defects themselves undergo orientational ordering, renormalization of elastic moduli by activity, and a remarkable insensitivity to topological constraints even under high confinement.

TUESDAY, MAY 1, 2018
2:30 PM – 3:30 PM
Building 2, Room 136

Reception following in Building 2, Room 290
(Math Dept. Common Room)

http://math.mit.edu/seminars/pms/

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