Physical Mathematics Seminar

Spontaneous flows in soft active matter

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ABSTRACT:

The laws of equilibrium statistical mechanics impose severe constraints on the properties of conventional materials assembled from inanimate building blocks. Consequently, such materials cannot exhibit autonomous motion or perform macroscopic work. Inspired by the remarkable properties of the biological cytoskeleton which is driven away from equilibrium by a conserved set of protein nanomachines, our goal is to develop soft active materials using animate energy-consuming building blocks such as molecular motors and microtubule filaments. Released from the constraints of the equilibrium, these internally driven gels, liquid crystals and emulsions are able to change-shape, crawl, flow, swim, and exert forces on their boundaries to produce macroscopic work. In particular, we describe properties of an active isotropic fluid that upon confinement, transitions from a quiescent to a spontaneously flowing state. We characterize the properties of the emergent self-organized flows as well as how the transition to a flowing state depends on the properties of the confining geometry. We also describe the unique dynamics of active nematic liquid crystals, whose complex streaming are powered by continuous creation and annihilation of oppositely charged disclination defects. Our results illustrate how active matter can serve as a platform for testing theoretical models of non-equilibrium statistical mechanics, developing a new class of soft machines and potentially even shedding light on self-organization processes occurring in living cells.

TUESDAY, APRIL 12, 2016
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/pms/

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