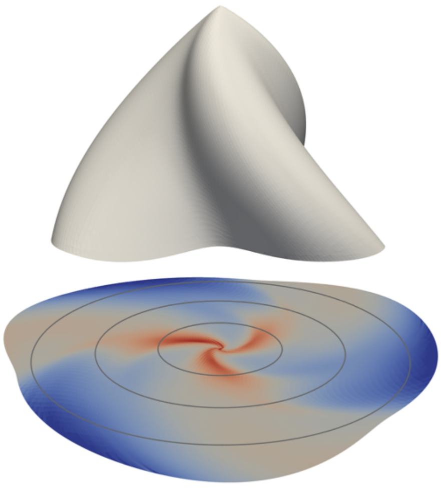
PHYSICAL MATH SEMINAR

Controlling active matter via spatially or temporally varying activity

Daniel Duffy

(University of Michigan)

ABSTRACT:



In active matter, energy injected at small length scales drives dynamics at larger scales. Varying this injection of energy across space or time can lead to particularly intricate or striking behaviour, holding great promise for design, functionality, and control. I will discuss these possibilities in two contexts, focusing on theory and numerics: First will be shape-programmed nematic sheets, which morph into curved surfaces upon activation by stimuli such as illumination, and have attracted interest for potential applications in fluidics and robotics. Complex shape changes are typically 'programmed' by patterning the nematic director (a material property), while the stimulus remains spatially uniform. A limitation of that paradigm is that typically only one target geometry can be attained as the stimulus varies. I will show that this limitation can be overcome by patterning the stimulus itself, enabling programming of continuous pathways through shape space. Second, I will explore confined polar active fluids, in which macroscopic flows are generated by self-propelled constituent particles. Remarkably, such fluids support propagating waves even in the overdamped limit; but how can we control those waves? I will characterize the excitation spectrum for a Toner-Tu fluid in a 2D disk, and explore its dependence on various parameters. I will then show that oscillatory activity can be used to parametrically drive a variety of excitations: a simple avenue for control of spatial patterning via temporal modulation.

Tuesday, April 21, 2026

2:30 PM – 3:30 PM

MIT Building 2, room 449

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