JOHNS HOPKINS
Center for Environmental
& Applied Fluid Mechanics

Friday, November 16, 2018
3:00 PM, 132 Gilman Hall

"*Turbulence and Pattern Formation in a Minimal Model for Active Fluids*"

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Active fluids, such as dense suspensions of bacteria or microtubules and molecular motors, display a fascinating range of dynamical states, including stationary patterns and turbulent phases. Active stresses exerted by the individual agents, along with their hydrodynamic interactions give rise to the emergence of mesoscale vortex patterns reminiscent of two-dimensional turbulence. Active fluids constitute interesting systems to study in their own right and may turn out to be useful in designing microfluidic devices.

In this presentation, we discuss how order and disorder emerge in active fluids. Mathematically, active fluids can be described with continuum models, which combine aspects of fluid dynamics and pattern formation. We present computational and theoretical results on turbulence and pattern formation in a minimal continuum model, which has been proposed by Wensink et al. [PNAS 109:14308 (2012)]. Adopting techniques from turbulence theory, we establish a quantitative description of correlation functions and spectra for active turbulence. We furthermore report on a novel type of turbulence-driven pattern formation far beyond linear onset: the emergence of a self-organized, dynamic vortex lattice state after an extended turbulent transient, which can only be explained taking into account turbulent energy transfer across scales. Our results therefore explore one route to self-organization in biological flows.