Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Vortex lattices and defect-mediated viscosity reduction in active liquids JONASZ SLOMKA, JORN DUNKEL, Massachusetts Institute of Technology — Generic pattern-formation and viscosity-reduction mechanisms in active fluids are investigated using a generalized Navier-Stokes model that captures the experimentally observed bulk vortex dynamics in microbial suspensions. We present exact analytical solutions including stress-free vortex lattices and introduce a computational framework that allows the efficient treatment of previously intractable higher-order shear boundary conditions. Large-scale parameter scans identify the conditions for spontaneous flow symmetry breaking, defect-mediated low-viscosity phases and negative-viscosity states amenable to energy harvesting in confined suspensions. The theory uses only generic assumptions about the symmetries and long-wavelength structure of active stress tensors, suggesting that inviscid phases may be achievable in a broad class of non-equilibrium fluids by tuning confinement geometry and pattern scale selection.

Jonasz Slomka
Massachusetts Institute of Technology

Date submitted: 27 Jul 2016 Electronic form version 1.4