Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Superfluid-like dynamics in active vortex fluids JONASZ SLOMKA, JORN DUNKEL, Massachusetts Inst of Tech-MIT — Active biological fluids exhibit rich non-equilibrium dynamics and share striking similarities with quantum fluids, from vortex formation and magnetic ordering to superfluid-like behavior. Building on universality ideas, we have recently proposed a generalization of the Navier–Stokes equations that captures qualitatively the active bulk flow structures observed in bacterial suspensions. Here, we present new numerical simulations that explicitly account for boundary and shear effects. The theory successfully reproduces recent experimental observations of bacterial suspensions, including a superfluid-like regime of nearly vanishing shear viscosity. Our simulations further predict a geometry-induced 'quantization' of viscosity and the existence of excited states capable of performing mechanical work. It is plausible that these results generalize to a broad a class of fluids that are subject to an active scale selection mechanism.

Jonasz Slomka
Massachusetts Inst of Tech-MIT

Date submitted: 06 Nov 2015 Electronic form version 1.4