Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Concentrated active suspensions: Kinetic theory, linear stability and numerical simulations BARATH EZHILAN, Department of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801, USA, MICHAEL SHELLEY, Courant Institute of Mathematical Sciences, New York University, New York, New York 10012, USA, DAVID SAINTILLAN, Department of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign, Urbana, Illinois 61801, USA — We study concentrated suspensions of self-propelled rod-like particles using a kinetic model which accounts for local hydrodynamic and steric interactions. We report a base state transition from an isotropic to a nematic orientation distribution beyond a critical effective volume fraction consistent with the Doi-Edwards theory for passive rod-like particles (Doi and Edwards 1986). We analyze the kinetic model linearized near the isotropic and nematic basestates and show that steric interactions have a destabilizing effect causing both pusher and puller suspensions to be subject to instabilities. These predictions from the linear theory are confirmed using fully nonlinear three-dimensional numerical simulations of the kinetic equations, which also demonstrate large-scale fluctuations of number density and nematic order parameter.

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Date submitted: 02 Aug 2012 Electronic form version 1.4