MAR17-2016-020254

Abstract for an Invited Paper
for the MAR17 Meeting of
the American Physical Society

Snakes on a plane: modeling flexible active nematics[1]

ROBIN SELINGER, Kent State University

Active soft matter systems of self-propelled rod-shaped particles exhibit ordered phases and collective behavior that are remarkably different from their passive analogs. In nature, many self-propelled rod-shaped particles, such as gliding bacteria and kinesin-driven microtubules, are flexible and can bend. We model these "living liquid crystals" to explore their phase behavior, dynamics, and pattern formation. We model particles as short polymers via molecular dynamics with a Langevin thermostat and various types of activity, substrate, and environments. For self-propelled polar particles gliding on a solid substrate, we map out the phase diagram as a function of particle density and flexibility. We compare simulated defect structures to those observed in colonies of gliding myxobacteria; compare spooling behavior to that observed in microtubule gliding assays; and analyze emergence of nematic and polar order. Next we explore pattern formation of self-propelled polar particles under flexible encapsulation, and on substrates with non-uniform Gaussian curvature. Lastly, we impose an activity mechanism that mimics extensile shear, study flexible particles both on solid substrates and coupled to a lipid membrane, and discuss comparisons to relevant experiments. Work performed in collaboration with Michael Varga (Kent State) and Luca Giomi (Universiteit Leiden.)

[1]Work supported by NSF DMR-1409658.