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BioPhysical Applications of Non-Equilibrium Dynamics of Flexible Self Propelled Rods TYLER THOMPSON, Otterbein University, JEFF MOORE, MEREDITH BETTERTON, MATT GLASER, CU Boulder — Interactions between the microtubule cytoskeleton and its associated proteins give rise to complex behavior that is essential to many cellular processes, including the self-assembly and organization of the cytoskeleton during mitosis. Experiments to observe microtubule organization have used the directed motor protein kinesin-1 to generate polar forces along microtubules to produce filament-gliding motility assays. At different microtubule densities and ATP concentrations, these active systems exhibit different phenomenological behaviors, such as flocking microtubule bundles and nematic liquid crystal phases. Additionally, steady-state structures that resemble ring-shaped spools of single or bundled filaments appear, which arise due to the finite persistence length of the filaments. These spools have also been observed in previous studies of motility assays with actin and myosin, but their genesis and stability are nevertheless poorly understood. In order to better understand the behavior of these systems quantitatively, we have developed simulations of gliding filaments on motility assays by modeling the filaments as wormlike chains that undergo steric interactions and experience an orientation-dependent force per unit length. In particular, we characterize the phase transition behavior between the isotropic flocking, nematic laning, and spooling phases as a function of filament density, persistence length, and driving. These simulations make predictions for the behavior of future motility assay experiments and can provide additional insights into cytoskeletal dynamics.

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