310f Collective Dynamics in Suspensions of Swimming Particles

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Direct simulations of large populations of hydrodynamically interacting swimming particles at low Reynolds number are performed. Each swimmer consists of a bead-rod dumbbell where the fluid drag is exerted, along with a phantom flagellum that exerts equal and opposite forces on the fluid and the dumbbell. Simulations with this model are performed in both infinite (periodic) and confined (slit) geometries. In both cases, results indicate that suspensions of these swimmers produce large scale coherent vortex motions and regimes of anomalous diffusion that are consistent with experimental observations. In the confined case, swimmers propelled from behind (like spermatozoa) cluster near the wall at low concentrations, but at higher concentrations a depletion layer is found whose thickness is much larger than the size of the swimmers.