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Three-Dimensional Pattern Formation in Flowing Suspensions of Swimming Particles AMIR ALIZADEH PAHLAVAN, DAVID SAINTILLAN, Department of Mechanical Science and Engineering, University of Illinois at Urbana-Champaign — Suspensions of self-propelled particles, such as swimming microorganisms, are known to undergo complex dynamics as a result of hydrodynamic interactions. Using the kinetic theory recently developed by Saintillan and Shelley ("Instabilities, pattern formation, and mixing in active suspensions", *Physics of Fluids* **20**, 123304, 2008), we investigate the three-dimensional pattern formation occurring in suspensions of active particles. Our numerical simulations confirm the results of the linear stability analysis of Saintillan et al., and the long-time nonlinear behavior is shown to be characterized by the formation of strong density fluctuations, which merge and break up in time in a quasiperiodic fashion. These complex motions result in very efficient fluid mixing, which we quantify by means of a multiscale mixing norm. The effects of an external shear flow on the pattern formation are also investigated using both simulations and a stability analysis.

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