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Pattern formation and instabilities in active suspensions: Kinetic theory and continuum simulations DAVID SAINTILLAN, MICHAEL SHELLEY, Courant Institute, New York University — We use kinetic theory and non-linear continuum simulations to study collective dynamics in suspensions of self-propelled particles. The dynamics are modeled using a continuity equation for the particle configurations, coupled to a mean-field description of the flow arising from the stress exerted by the particles on the fluid. Based on this model, we first investigate the stability of both aligned and isotropic suspensions. In aligned suspensions, an instability is shown to always occur at finite wavelengths, a result that generalizes previous predictions by Simha and Ramaswamy (2002). In isotropic suspensions, an instability for the active particle stress is also found to exist, in which shear stresses are eigenmodes and grow exponentially at long scales. Non-linear effects in these systems are also investigated using numerical simulations in two-dimensions. The results of the stability analysis are confirmed, and the long-time non-linear behavior is shown to be characterized by the formation of strong density fluctuations, which appear to be driven by the active stress instability.

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