253a Concentration Fluctuations in Dilute Suspensions of Orientable and Deformable Particles under Sedimentation

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Sedimentation processes of orientable particles such as rigid spheroids, and deformable particles such as viscous droplets, are subject to a concentration instability by which well-mixed suspensions become inhomogeneous. In this work we use numerical simulations to investigate the concentration fluctuations and the microstructure in such systems. A fast algorithm based on a point-particle approximation is developed that allows the simulation of realistic-size suspensions with various boundary conditions. The instability in the case of spheroids is adequately captured, and we show that the presence of walls leads to a wavenumber selection that is unobserved in periodic systems where the longest wavelength always dominates. Results are presented for the velocity and orientation statistics and show good agreement with experimental data on the sedimentation of fiber suspensions. The case of viscous droplets is addressed by a linear stability analysis in the small deformation regime, which demonstrates that such suspensions are also unstable to concentration fluctuations. Simulation results for viscous droplets confirm this analysis and show a similar mechanism for the wavenumber selection in finite containers.