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Segregation and Pattern Formation in a Rotating Suspension. TONY LADD, University of Florida, JONGHOON LEE, University of California-Santa Barbara — A rotating suspension of non-neutrally buoyant particles can be unstable to axial perturbations in concentration over a range of angular frequencies. Numerical simulations show that a highly regular pattern of particle density and fluid flow coexist in a non-equilibrium stationary state. Similar patterns were observed in laboratory experiments under equivalent conditions. We have discovered that the mean angular velocity of the particles is an order parameter, which distinguishes between a low-frequency segregated phase and a high-frequency dispersed phase, where the particles fill the whole volume uniformly. The order parameter is a function of a single dimensionless frequency, with a characteristic length that is the mean interparticle separation. As the rotational frequency increases, the particle distribution becomes more homogeneous, and the band structure disappears. Hydrodynamic diffusion stabilizes the suspension against centrifugal forces, allowing for a uniformly dispersed phase that can be used to grow three-dimensional cell cultures in an artificial microgravity environment.

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