

Dissipative Self-Assembly of Colloidal Suspensions in Microgravity



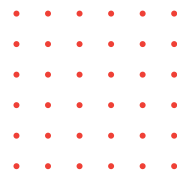
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I will describe experiments performed in the Microgravity Science Glovebox aboard the International Space Station. Because the gravitational Péclet number scales as the fourth power of aggregate size, even small density mismatches drive sedimentation on Earth once particles begin to cluster; microgravity removes this and allows direct observation of fully three-dimensional assembly. Across 96 flight test points spanning field strength, toggle frequency, and duty ratio, we find six characteristic structural regimes: structureless suspensions, an arrested gel-like network, sheets, ribbons, a spiky phase, and a transient fluid-fluid state. Quantitative image analysis of domain elongation, surface texture, and interaggregate separation yields a state diagram organized by a dissipative timescale, and a duty-ratio-weighted magnetostatic energy scale — axes suggested by the toggled-interaction theory of Sherman and Swan, and which also organize data from two earlier ISS campaigns. I will close with reflections on three ISS campaigns spanning more than twenty years — what microgravity can access, a few of the unique challenges, and what it is like to run an experiment through a crew member in orbit.