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Instabilities in the dynamics of neutrally buoyant particles THEMISTOKLIS SAPSIS, GEORGE HALLER, Massachusetts Institute of Technology — The asymptotic dynamics of finite-size particles is governed by a slow manifold that is globally attracting for sufficiently small Stokes numbers. For neutrally buoyant particles (suspensions), the slow dynamics coincide with that of infinitesimally small particles, therefore the suspension dynamics should synchronize with Lagrangian particle motions. Paradoxically, recent studies observe a scattering of suspension dynamics along Lagrangian particle motions. Here we resolve this paradox by proving that despite its global attractivity, the slow manifold has domains that repel nearby passing trajectories. We derive an explicit analytic expression for these unstable domains; we also obtain a necessary condition for the global attractivity of the slow manifold. Additionally, we show that the results are extended for the non-neutrally buoyant particles case. We illustrate our theoretical findings on inertial particle motion in a two-dimensional model of vortex shedding behind a cylinder in crossflow, on the three-dimensional steady Arnold-Beltrami-Childress flow, as well as to the realistic flow field of a hurricane.

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