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Under-Damped Active Matter via Levitation with Rotating Acoustics: Simulations BRYAN VANSADERS, MELODY LIM, VINCENZO VITELLI, HEINRICH JAEGER, University of Chicago — Many active model systems (flocks of birds, schools of fish) operate in under-damped inertial conditions. While colloidal systems provide models for over-damped active dynamics, there is a comparative lack of model systems for inertial active matter. Here, we investigate one such model system: sub-millimeter objects acoustically levitated in air. For unsteady acoustic fields with nontrivial mode shapes, levitated objects experience complex driving forces and torques. Furthermore, multiple levitated objects have secondary scattering interactions which drive aggregation. We apply the Lattice Boltzmann method (LBM) to conduct direct numerical simulations of objects levitated in a single-axis acoustic chamber. LBM simulation permits investigation of complex structure-fluid interactions including momentum transfer by acoustic wave scattering and viscous dissipation. We demonstrate how LBM simulation of levitated object-object interactions and trap-object interactions extends the range of investigation beyond that predicted by inviscid acoustic scattering from isotropic objects. Acoustic fields which carry angular momentum, as well as non-spherical levitated objects are investigated.

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