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Pushing and Pulling: Understanding and Controlling Forces on Particles near Oscillating Interfaces SIDDHANSH AGARWAL, MechSE, University of Illinois at Urbana-Champaign, BHARGAV RALLABANDI, Mechanical and Aerospace Engineering, Princeton University, DAVID RAJU, SASCHA HILGENFELDT, MechSE, University of Illinois at Urbana-Champaign — Oscillations of an interface in a fluid give rise to periodic flows that rectify into steady streaming. Particles near such an interface experience additional displacements beyond that of the fluid elements, which can be exploited in a variety of microfluidic applications, such as sorting or trapping. We quantify, in experiment and theory, the forces acting on microparticles on both the oscillatory time scale and the slower time scale of steady streaming. Time scale separation results in modified Maxey-Riley equations exclusively on the slow time scale, allowing for efficient calculation and direct physical interpretation of the forces experienced by the particles. It is found that particles are attracted or repelled depending on their size and density, as well as other parameters under experimental control. These forces are inertial in nature, but act much faster than previously discussed inertial forces in microfluidics. Experiments demonstrating sorting and trapping of particles in agreement with the theory are presented.

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