LadHyX Seminar – May 19th, 10:45

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Influence of particle geometry on hydrodynamic interactions in Stokes flow

In this talk, I will discuss two problems in zero Reynolds number flows, each illustrating how asymmetry in particle geometry influences the underlying physics. First, we'll look at the sedimentation of a single body in Stokes flow. Viscosity is often thought to damp motion, making settling seem uneventful; after all, spheres and ellipsoids just sink at their terminal velocities. But what happens if we break just one plane of symmetry in an ellipsoid? Surprisingly, this small change unlocks a range of complex behaviors, from simple settling and drifting to spiraling and even quasiperiodic fluttering. I'll introduce a minimal class of asymmetric bodies that capture this richness and explain how quasiperiodicity arises in their motion. Next, we turn to the collective effects of particle geometry on sedimentation. A one-dimensional lattice of sedimenting spheres is hydrodynamically unstable, leading to clustering. But what about settling discs? Here, an additional instability mechanism comes into play—one influenced by the drag anisotropy of discs and characterized by non-modal growth, reshaping how clusters form. I'll show how the dominant instability mechanism dictates the nature of the clusters that emerge. Together, these studies reveal how shape anisotropy fundamentally alters both individual and collective motion in viscous flows.