Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Effect of weak fluid inertia upon Jeffery orbits JONAS EINARSSON, Stanford University — We consider the rotation of small neutrally buoyant axisymmetric particles in a viscous steady shear flow. When inertial effects are negligible the problem exhibits infinitely many periodic solutions, the Jeffery orbits. We compute how inertial effects lift their degeneracy by perturbatively solving the coupled particle-flow equations. We obtain an equation of motion valid at small shear Reynolds numbers, for spheroidal particles with arbitrary aspect ratios. At small shear Reynolds numbers the preferred Jeffery orbit is tumbling for prolate spheroids, and log-rolling for moderately oblate particles (aspect ratio $\lambda > 1/7.3$). For thinner oblate particles both log-rolling and tumbling are stable, separated by an unstable limit cycle. [Einarsson, J., Candelier, F., Lundell, F., Angilella, J. R. and Mehlig, B., PoF 27 063301 (2015)] We solved this long-standing problem by considering the symmetries that constrain the solution. In this case the symmetries reduced the problem to only four scalar integrals. Here I introduce an alternative method that accounts for the symmetries and tensorial nature of the governing equations, enables perturbative calculation of Stokes' equations, and is suitable for computer algebra. [Einarsson, J., and Mehlig, unpublished (2016)]

Jonas Einarsson
Stanford University

Date submitted: 27 Jul 2016 Electronic form version 1.4