Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Rotational motion of a thin axisymmetric disk in a low Reynolds number linear flow VIKRAM SINGH, DONALD KOCH, Cornell University, GANESH SUBRAMANIAN, Jawaharlal Nehru Centre for Advanced Scientific Research, ABRAHAM STROOCK, Cornell University — The problem of a single particle motion at low Reynolds is one of the most fundamental problems of fluid mechanics. It is rather surprising that despite our deep understanding of particle motion at large aspect ratio we know very little about particles other than spheroids at small aspect ratio. In this work, motion of thin axisymmetric rigid particles with fore-aft symmetry in simple shear flow is investigated. We determine the scaling of the effective aspect ratio for a family of shapes given by, $y(\rho) = \kappa(1-\rho^2)^\alpha$ where α is a positive parameter, ρ is the radial distance in polar coordinates, $y$is the thickness of the particle, κ is the aspect ratio of the particle, and effective aspect ratio is defined as the aspect ratio of a spheroid having the same period of rotation as that of the particle. For an axisymmetric particle, effective aspect ratio can be determined based on the torques acting on the particle in two different orientations. Starting with the integral representation of Stokes flow, matched asymptotic analysis is performed to determine the scaling of the torque acting on a stationary particle in simple shear flow with κ as the small parameter. Using boundary element method simulations, the exact torques are obtained and the scaling of effective aspect ratio obtained from the analysis is verified.

Vikram Singh
Cornell University

Date submitted: 08 Aug 2012 Electronic form version 1.4