PHYSICAL MATHEMATICS SEMINAR

The Sedimentation of Flexible Filaments

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ABSTRACT:

The deformation and transport of elastic filaments in viscous fluids play central roles in many biological and technological processes. Compared with the well-studied case of sedimenting rigid rods, the introduction of filament compliance may cause a significant alteration in the long-time sedimentation orientation and filament geometry. A model is developed by balancing viscous, elastic and gravitational forces, and the filament dynamics are characterized by a dimensionless elasto-gravitation number. In the weakly flexible regime, a multiple-scale asymptotic expansion is used to obtain expressions for filament translations, rotations and shapes which match excellently with full numerical simulations. Furthermore, we show that trajectories of sedimenting flexible filaments, unlike their rigid counterparts, are restricted to a cloud whose envelope is determined by the elasto-gravitation number. In the highly flexible regime we show that a filament sedimenting along its long axis is susceptible to a buckling instability. A linear stability analysis provides a dispersion relation, illustrating clearly the competing effects of the compressive stress and the restoring elastic force in the buckling process. Preliminary results for suspensions of flexible filaments will also be discussed.

TUESDAY, MARCH 18, 2014
2:30 PM
Building E17, Room 136

Reception following in Building E17, Room 401A
(Math Dept. Common Room)

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