Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Toroidal Lagrangian Flow Structues in highly viscous fluids by moving bent rods[1] PAVEL CHTCHEPROV, ROBERTO CAMASSA, DAVID HOLZ, DAVID MARRON, JAMES MARTINDALE, RICHARD MCLAUGHLIN, LEANDRA VICCI, LONGHUA ZHAO, University of North Carolina, UNC NSF RTG FLUIDS GROUP COLLABORATION — Motile cilia play a large role in fluid motion across the surface of ciliates. Flows caused by the cilia move debris and mucus through mass beat patterns controlled by the motor proteins while rotating about the basal body that attaches the cilium to the cell surface. This study approximates the cilium as a slender body rotating about a point of contact of one of its ends in a viscous fluid. The bent rod sweeps out a virtual cone with a chord connecting both ends. The bend of the rod, the cone angle, the angle between the central axis to the normal plane, and the angle of rotation of the bent rod about its chord affect the flow patterns in a Stokes fluid. The slender body theory allows for an asymptotic solution of the Lagrangian trajectories and flow patterns caused by the precessing rod, which can be directly compared to experimental data. Altering the above parameters produces different toroidal flow structures. Using 3D stereo calibration, accurate quantified comparisons of epicyclic particle trajectories in short and long time are made against the model predictions.

[1]NSF

Richard McLaughlin
University of North Carolina

Date submitted: 10 Aug 2010 Electronic form version 1.4