Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Undulatory Swimming in Shear-Thinning Fluids: Flow Fields Power Consumption DAVID GAGNON, University of Pennsylvania, THOMAS MONTENEGRO-JOHNSON, ERIC LAUGA, University of Cambridge, PAULO ARRATIA, University of Pennsylvania — In this talk, we investigate the flow and dynamics of the undulatory swimmer Caenorhabditis elegans in shear-thinning fluids. Recent theoretical and numerical studies have shown that the cost of swimming, or mechanical power, for a 2D waving sheet is reduced in shear-thinning fluids. Here, we use velocimetry and tracking techniques to experimentally investigate this hypothesis using two methods: (i) an estimate of the mechanical power of the swimmer and (ii) the viscous dissipation rate of the flow field. We find the cost of swimming for C. elegans in shear-thinning fluids is reduced when compared to the cost of swimming in Newtonian fluids, scales with a fluids effective viscosity, and can be predicted using fluid rheology and simple swimming kinematics. These results, however, have a caveat: only a planar (2D) slice of the 3D flow field around swimmer is accessible for analysis. In order to better interpret our flow measurements, we compare our planar velocimetry to a full 3D boundary element method simulation. We find that nearly all deviations between experiments and simulations can be accounted for by a simple correction factor involving the out-of-plane velocity gradient, which can be computed directly from planar experimental data using incompressibility.

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Date submitted: 01 Aug 2016 Electronic form version 1.4