Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

The forward undulatory locomotion of Ceanorhabditis elegans in viscoelastic fluids AMY SHEN, University of Washington, XIALING ULRICH, Washington University in St. Louis — Caenorhabditis elegans is a soil dwelling roundworm that has served as model organisms for studying a multitude of biological and engineering phenomena. We study the undulatory locomotion of nematode in viscoelastic fluids with zero-shear viscosity varying from 0.03–75 Pa·s and relaxation times ranging from 0–350 s. We observe that the averaged normalized wavelength of swimming worm is essentially the same as that in Newtonian fluids. The undulatory frequency f shows the same reduction rate with respect to zero-shear viscosity in viscoelastic fluids as that found in the Newtonian fluids, meaning that the undulatory frequency is mainly controlled by the fluid viscosity. However, the moving speed V_m of the worm shows more distinct dependence on the elasticity of the fluid and exhibits a 4% drop with each 10-fold increase of the Deborah number De, a dimensionless number characterizing the elasticity of a fluid. To estimate the swimming efficiency coefficient and the ratio $K = C_N/C_L$ of resistive coefficients of the worm in various viscoelastic fluids, we show that whereas it would take the worm around 7 periods to move a body length in a Newtonian fluid, it would take 27 periods to move a body length in a highly viscoelastic fluid.

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Date submitted: 01 Aug 2013 Electronic form version 1.4