Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Micropropulsion and microrheology in complex fluids via symmetry breaking ON SHUN PAK, Department of Mechanical and Aerospace Engineering, University of California San Diego, LAILAI ZHU, LUCA BRANDT, KTH Mechanics, ERIC LAUGA, Department of Mechanical and Aerospace Engineering, University of California San Diego — Many biological fluids have polymeric microstructures and display non-Newtonian rheology. We take advantage of such nonlinear fluid behavior and combine it with geometrical symmetry-breaking to design a novel small-scale propeller able to move only in complex fluids. Its propulsion characteristics are explored numerically in an Oldroyd-B fluid for finite Deborah numbers while the small Deborah number limit is investigated analytically using a second-order fluid model. We then derive expressions relating the propulsion speed to the rheological properties of the complex fluid, allowing thus to infer the normal stress coefficients in the fluid from the locomotion of the propeller. Our simple mechanism can therefore be used either as a non-Newtonian micro-propeller or as a micro-rheometer.

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Date submitted: 25 Jul 2012 Electronic form version 1.4