Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Probing the rheology of viscous fluids using microcantilevers and the fluctuation-dissipation theorem[1] BRIAN ROBBINS, MILAD RADIOM, Virginia Tech, JOHN WALZ, University of Kentucky, WILLIAM DUCKER, MARK PAUL, Virginia Tech — A microscopic understanding of the rheology of fluids at high frequencies remains an important and open challenge. Current microrheology approaches include the use of micron-scale beads held in optical traps as well as micron-scale cantilevers. Typically, these approaches have been limited in their range of accessible frequencies and dynamic viscosities. In this talk we are interested in the high-frequency regime for very viscous fluids where one must include inertial effects and the frequency dependence of the viscous damping. We present experimental results of the noise spectrum in displacement of the tip of a microcantilever for a variety of fluids that cover a range of viscosities. Using analytical predictions based upon the fluctuation-dissipation theorem, we present an approach to quantify the density and viscosity of the fluid from measurements of the noise spectrum. We are particularly interested in exploring fluids much more viscous than water. We use insights from this study to explore the dynamics of an oscillating elastic object in a power-law fluid to probe the rheology of a non-Newtonian fluid at high frequency.

[1]NSF Award CBET-0959228

Brian Robbins
Virginia Tech

Date submitted: 01 Aug 2013 Electronic form version 1.4