Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Plug flow in a viscous freely-suspended film KARI DALNOKI-VERESS, MARK ILTON, MILES COUCHMAN, Department of Physics and Astronomy, McMaster University, Hamilton, Ontario, Canada, L8S 4M1, THOMAS SALEZ, MICHAEL BENZAQUEN, Laboratoire de Physico-Chimie Théorique, UMR CNRS Gulliver 7083, ESPCI ParisTech, PSL Research University, 75005 Paris, France, PAUL FOWLER, Department of Physics and Astronomy, McMaster University, Hamilton, Ontario, Canada, L8S 4M1, ELIE RAPHAEL, Laboratoire de Physico-Chimie Théorique, UMR CNRS Gulliver 7083, ESPCI ParisTech, PSL Research University, 75005 Paris, France — The flow of viscous polymer liquids supported by a solid substrate has been well characterized by a variety of experimental techniques. Previous studies found that the velocity profile within a flowing liquid film depends strongly on the friction at the liquid-substrate interface. For the case of low interfacial friction, liquid molecules can slide along the solid substrate. This is the "slip" boundary condition. Here we probe flow in a system with no interfacial friction: a viscous polymer film suspended at its edges. Using AFM, we measure the capillary-driven relaxation of freestanding polymer films with an initially stepped film thickness profile. The time evolution of the profile is consistent with plug flow. A freely-suspended viscous polymer film provides a physical realization of an idealized infinite slip boundary condition. Interestingly, in such a context, the profile evolution satisfies a diffusion-like equation, thus allowing for the use of a broad mathematical and physical toolbox by analogy.

Kari Dalnoki-Veress
Department of Physics and Astronomy, McMaster University, Hamilton, Ontario, Canada, L8S 4M1

Date submitted: 06 Nov 2015 Electronic form version 1.4