Abstract Submitted
for the DFD13 Meeting of
The American Physical Society

Flow rate–pressure drop relation for deformable shallow microfluidic channels[1] IVAN C. CHRISTOV, Theoretical Division & Center for Nonlinear Studies, Los Alamos National Laboratory, VINCENT COGNET, École Normale Supérieure de Cachan, HOWARD A. STONE, Mechanical & Aerospace Engineering, Princeton University — Laminar flow in devices fabricated from PDMS causes deformation of the passage geometry, which affects the flow rate–pressure drop relation. Having an accurate flow rate–pressure drop relation for deformable microchannels is of importance given that the flow rate for a given pressure drop can be as much as 500% of the flow rate predicted by Poiseuille's law for a rigid channel. Gervais et al. [*Lab Chip* **6** (2006) 500] proposed a successful model of the latter phenomenon by heuristically coupling linear elasticity with the lubrication approximation for Stokes flow. However, their model contains a fitting parameter that must be found for each channel shape by performing an experiment. We present a perturbative derivation of the flow rate–pressure drop relation in a shallow deformable microchannel using Kirchoff–Love theory of isotropic quasi-static plate bending and Stokes' equations under a "double lubrication" approximation (i.e., the ratio of the channel's height to its width and of the channel's width to its length are both assumed small). Our result contains no free parameters and confirms Gervais et al.'s observation that the flow rate is a quartic polynomial of the pressure drop.

[1]ICC was supported by NSF Grant DMS-1104047 and the U.S. DOE through the LANL/LDRD Program; HAS was supported by NSF Grant CBET-1132835.

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Date submitted: 28 Jul 2013 Electronic form version 1.4