Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

Viscous flow in a slit between two elastic plates ANNELINE CHRISTENSEN, KAARE JENSEN, Department of Physics, Technical University of Denmark — Soft plates immersed in fluids appear in many biological processes, including swimming, flying, and breathing. The plate deforms in response to fluid flows, yet fluid stresses are in turn influenced by the plate's deformation. We present a mathematical model examining the flow of a viscous fluid in a narrow slit formed by two rectangular elastic plates, and demonstrate a strongly nonlinear flow response. The volumetric flow rate first increases linearly with pressure; however, the bending of the plates causes the corners to approach. This in turn reduces the flow rate. In some cases, the corners meet and the slit no longer permits flow. Our model, which is based on low-Reynolds-number hydrodynamics and linear plate theory, yields insights into two competing effects: While the plate bending generally reduces the slit aperture, it also causes the two plates to move apart, thus increasing the gap. Relations to biomedical flows are outlined and potential applications to flow control in man-made systems are considered.

Anneline Christensen
Department of Physics, Technical University of Denmark

Date submitted: 10 Jul 2020 Electronic form version 1.4