Abstract Submitted
for the DFD19 Meeting of
The American Physical Society

3D vesicle microcirculation DHWANIT AGARWAL, GEORGE BIROS, Oden Institute for Computational Engineering and Sciences, University of Texas at Austin — We study numerically the problem of equilibrium shapes of three-dimensional vesicles in confined axisymmetric Poiseuille flow. We explore a range of the following relevant dimensionless parameters: 1) reduced volume (ν), defined as the ratio of volume of vesicle to the sphere of same area as vesicle, 2) viscosity contrast, λ, defined as the ratio of viscosities of internal and external fluids, 3) confinement ratio (C_n), defined as the ratio of vesicle diameter over channel width, 4) capillary number (C_a), measuring flow strength over membrane bending rigidity. We present a phase diagram of equilibrium shapes of vesicles, both with and without viscosity contrast. Our study reveals that slipper shape is the preferred equilibrium shape in low confinement ($C_n < 0.5$) while a transition to parachute shape takes place as C_a is increased. For high confinement ($C_n >= 0.5$), the force exerted by the confining walls dominates, causing the vesicle to mostly take axisymmetric shapes. Outward migration tendency due to higher viscosity contrast causes the shape transitions to occur at higher C_a when $\lambda = 5$ compared to the case when $\lambda = 1$, resulting in a phase diagram shifted towards higher C_a.

Dhwanit Agarwal
Oden Inst for Computational Engineering and Sci, Univ of Texas at Austin

Date submitted: 01 Aug 2019 Electronic form version 1.4