Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Shear-Driven Circulation Patterns in Lipid Membrane Vesicles FRANCIS WOODHOUSE, AURELIA HONERKAMP-SMITH, RAYMOND GOLDSTEIN, DAMTP, University of Cambridge — Recent experiments [C. Vézy, G. Massiera, and A. Viallat, Soft Matter 3, 844 (2007)] have shown that when a near-hemispherical lipid vesicle attached to a solid surface is subjected to a simple shear flow it exhibits a pattern of membrane circulation much like a dipole vortex. This is in marked contrast to the toroidal circulation that would occur in the related problem of a drop of immiscible fluid attached to a surface and subjected to shear. This profound difference in flow patterns arises from the lateral incompressibility of the membrane, which restricts the observable flows to those in which the velocity field in the membrane is two-dimensionally divergence free. We theoretically study these circulation patterns within the simplest model of membrane fluid dynamics. A systematic expansion of the flow field is developed for differing bulk fluid viscosities incorporating a non-zero membrane shear viscosity and curvature effects. It is shown how such studies can allow measurements of the membrane viscosity from flow field data. New experimental results utilising this method are discussed.

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Date submitted: 11 Nov 2011 Electronic form version 1.4