Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Reflection and refraction of flexural waves in membranes with complex geometry ARTHUR EVANS, University of California, Los Angeles, BASANTA BHADURI, RYAN TAPPING, GABRIEL POPESCU, University of Illinois, Urbana-Champaign, ALEX LEVINE, University of California, Los Angeles — Undulatory waves on membranes are studied in a variety of contexts including microrheology of red blood cell membranes, giant vesicles, and various cellular mimics, such as actin coated vesicles. While the fundamental understanding of undulatory dynamics in flat membranes is well known, the problem is significantly more interesting for waves on curved membranes, where geometry couples bending and stretching in the surface. In this talk we report on analysis of flexural wave dynamics in curved membranes and draw a useful analogy between the propagation of these waves and physical optics. We obtain an analog of Snell's law for the reflection and refraction of undulatory waves at interfaces at which the local mean and Gaussian curvature of the surface changes abruptly. In addition, we show that, due to the higher order derivatives in the force balance equation, bending waves on curved membranes generically exhibit characteristics associated with waves in classical optics, such as birefringence and total internal reflection. Using this latter insight, we analyze the experimentally observed spatial distribution of the amplitude of red blood cell membrane undulations, and show that one can understand their spatial structure in terms of the local geometry of the cell.

Arthur Evans
University of California, Los Angeles

Date submitted: 03 Aug 2012 Electronic form version 1.4