Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Draping Films: A Wrinkle to Fold Transition DOUGLAS HOLMES, Princeton University, ALFRED J. CROSBY, Universtity of Massachusetts Amherst — This work focuses on the wrinkle-to-fold transition in glassy and elastomeric thin films. In biological systems, the process of folding is critical to morphogenesis, defining such features as the neural folds in embryonic development. In this paper, we examine the deformation of an axisymmetric sheet and quantify the force required to generate a fold. A thin film draping over a point of contact will wrinkle due to the strain imposed by the point and the underlying substrate. The wrinkle wavelength is dictated by a balance of material properties and geometry, and scales with film thickness to the three-fourths power. At a critical strain the stress in the film will localize, causing hundreds of wrinkles to collapse into several discrete folds. We measure the energy of formation for a single fold and observe that it scales linearly with film thickness. We predict that the onset of folding, from a critical force or displacement, scales as the thickness to the one-fifth power. The folds act as disclinations in the film causing the stress in the film to increase, thereby decreasing the wavelength of the remaining wrinkles. The number of folds that form from wrinkle collapse appears to be constant over several orders of magnitude in film thickness and elastic modulus.

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Date submitted: 12 Jan 2010 Electronic form version 1.4