Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Thin sheets achieve optimal wrapping of liquids JOSEPH PAULSEN, VINCENT DÉMERY, BENNY DAVIDOVITCH, CHRISTIAN SANTANGELO, THOMAS RUSSELL, NARAYANAN MENON, Univ of Mass - Amherst — A liquid drop can wrap itself in a sheet using capillary forces [Py et al., PRL 98, 2007]. However, the efficiency of "capillary origami" at covering the surface of a drop is hampered by the mechanical cost of bending the sheet. Thinner sheets deform more readily by forming small-scale wrinkles and stress-focussing patterns, but it is unclear how coverage efficiency competes with mechanical cost as thickness is decreased, and what wrapping shapes will emerge. We place a thin ($\sim$ 100 nm) polymer film on a drop whose volume is gradually decreased so that the sheet covers an increasing fraction of its surface. The sheet exhibits a complex sequence of axisymmetric and polygonal partially- and fully- wrapped shapes. Remarkably, the progression appears independent of mechanical properties. The gross shape, which neglects small-scale features, is correctly predicted by a simple geometric approach wherein the exposed area is minimized. Thus, simply using a thin enough sheet results in maximal coverage.

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Date submitted: 14 Nov 2014 Electronic form version 1.4