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Geometry-driven folding transitions in floating thin films JOSEPH D. PAULSEN, Syracuse University, VINCENT DÉMERY, PCT-ESPCI, France, K. BUGRA TOGA, Eastman Chemical Company, ZHANLONG QIU, BENNY DAVIDOVITCH, THOMAS P. RUSSELL, NARAYANAN MENON, Univ of Mass - Amherst — When a thin elastic sheet is compressed, it forms wrinkles to gather excess material, while deforming the fluid or solid substrate by only a small amount. Upon further compression, the sheet may fold, in order to lower the mechanical energy of the system[1]. Here we demonstrate a folding transition that is independent of the mechanical properties of the sheet. We study the deformations of a thin polymer film that has an annular shape, floating on a planar air-water interface. By controlling the concentration of a surfactant outside the film, we vary the tension pulling on the outer boundary of the annulus. The sheet spontaneously folds at a threshold ratio of inner to outer surface tension that depends on the geometry of the sheet, but is independent of its bending rigidity. Our results are consistent with a simple geometric principle: the sheet adopts the unstretched shape that minimizes the interfacial energy of the exposed liquid[2]. Finally, we consider the application of this geometric principle to the folding of a floating indented film.

1. Pocivavsek et al., Science 320, 912 (2008).
2. Paulsen et al., Nature Materials, doi:10.1038/nmat4397 (2015).

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