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Domain Relaxation in Langmuir Films ANDREW J. BERNOFF, Mathematics, Harvey Mudd College, JAMES C. ALEXANDER, Mathematics, Case Western Reserve University, ELIZABETH K. MANN, Physics, Kent State University, J. ADIN MANN, Chemical Engineering, Case Western Reserve University, LU ZOU, Physics, Kent State University, JACOB R. WINTERSMITH, Physics, Harvey Mudd College — We report on an experimental, theoretical and computational study of a molecularly thin polymer Langmuir layer domain on the surface of a subfluid. When stretched (by a transient stagnation flow), the Langmuir layer takes the form of a bola consisting of two roughly circular reservoirs connected by a thin tether. This shape relaxes to the circular minimum energy configuration. The tether is never observed to rupture, even when it is more than a hundred times as long as it is thin. We model these experiments as a free boundary problem where motion is driven by the line tension of the domain and damped by the viscosity of the subfluid. We process the digital images of the experiment to extract the domain shape, use one of these shapes as an initial condition for the numerical solution of a boundary-integral model of the underlying hydrodynamics, and compare the subsequent images of the experiment to the numerical simulation. The numerical evolutions verify that our hydrodynamical model can reproduce the observed dynamics. They also allow us to deduce the magnitude of the line tension in the system, often to within 1%.

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