Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Large deflections of a hydrogel rod caused by internal phase separation MICHAEL S. DIMITRIYEV, PAUL M. GOLDBART, Georgia Institute of Technology, YA-WEN CHANG, Texas Tech University, ANTON SOUSLOV, Universiteit Leiden, ALBERTO FERNANDEZ-NIEVES, Georgia Institute of Technology — Hydrogels are soft materials that consist of a cross-linked polymer matrix capable of undergoing large volume changes via absorption of a solvent. As with binary mixtures, hydrogels can undergo a macroscopic phase separation transition to create a more swollen region and a less swollen one. We address this transition in the case of an initially swollen hydrogel, in a slender-rod geometry, possibly curved, which is heated to a temperature at which one would expect deswelling of the entire sample. However, the rapidity of the rise in temperature inhibits the system from expelling solvent through the rod's surface, so that re-equilibration takes place at fixed solvent volume. Owing to this constraint and the system's elasticity, the solvent-poor region fails to fully deswell, and the hydrogel partitions into an incompletely deswollen region and an excessively swollen one, determined by stress balance and a lever rule. Because the polymer network remains contiguous the rod undergoes a macroscopic shape change. When the partitioning is constant along the rod, the interface-orientation is a Goldstone mode that couples to the rods bending and twisting degrees of freedom and as a result, a large deflection of the rod occurs.

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Date submitted: 11 Nov 2016 Electronic form version 1.4