Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Curvature-Induced Capillary Interaction between Spherical Particles at a Liquid Interface[1] NESRIN SENBIL, CHUAN ZENG, BENNY DAVIDOVITCH, ANTHONY D. DINSMORE, University of Massachusetts Amherst — Capillary interactions among particles adsorbed at a fluid interface are important in a variety of natural and technological systems but still pose many mysteries. Capillary interactions induced by buoyancy, referred to as the"Cheerios "effect, have been studied for years. Here, we experimentally investigate how anisotropic interfacial shape affects capillary forces among millimeter-sized spheres. The Cheerios model predicts that particles with densities that are higher and lower compared to the fluids adsorbed at an initially flat interface will repel. Our experiments, however, clearly show that they can attract one another at the short range. We explain our results with a model, in which each sphere creates an anisotropic curvature at the position of the other sphere. To satisfy the constant contact-angle boundary condition, the interface is deformed with quadrupolar symmetry around each sphere. This quadrupolar deformation creates a short-ranged, attractive capillary force. The range of size and density ratios at which we observe a dominant short-range attraction is consistent with the model. Our results show how interfacial shape may be used to direct the assembly of interfacial particles.

[1]Funded by the NSF-supported MRSEC on Polymer at UMASS(DMR-0820506)and NSF CBET-0967620.

Nesrin Senbil
University of Massachusetts Amherst

Date submitted: 11 Nov 2011 Electronic form version 1.4