Abstract Submitted
for the DFD10 Meeting of
The American Physical Society

Surfactant-assisted spreading of an emulsion ZHENZHEN LI, MATTHIEU ROCHE, Mechanical and Aerospace Engineering, Princeton University, ARNAUD SAINT-JALMES, Equipe Biophysique, Institut de Physique de Rennes, France, HOWARD A. STONE, Mechanical and Aerospace Engineering, Princeton University — We studied experimentally the spreading dynamics of a drop of a surfactant-stabilized oil-in-water emulsion over the free surface of a layer of a solution of the same surfactant. The dynamics display three regimes. After the deposition of the emulsion drop, oil droplets are advected by a Marangoni flow, due to the difference in surfactant concentration between the emulsion and the liquid surface, and spread at the air/liquid interface. The oil droplets eventually stop, forming a dense ring, whose diameter is constant as long as oil droplets are transported by Marangoni flow. During this stage, oil droplets are moving rapidly on a surface with a low droplet concentration. Once the initial drop is empty, the ring collapses on itself, a phenomenon not yet reported experimentally to our knowledge. Spreading and retraction occur on a few hundred milliseconds while the ring stage lasts a few seconds. Using a laser sheet reflected by the surface of the liquid layer, we measured the shape of the surface and identified a jump of a few hundred microns in the layer thickness at the location of the ring. The existence of this jump points to hydrostatic pressure as the driving stress for retraction. We also show that this system shares many features with other jumps.

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Date submitted: 05 Aug 2010 Electronic form version 1.4