Weekly CEAFM Seminar: Fall 2015

JOHNS HOPKINS
Center for Environmental
& Applied Fluid Mechanics

Date: **Friday, December 4, 2015**

Time: 11:00 AM

Location: Gilman Hall # 132

Speaker: **Prof. Joelle Frechette** (ChemBe/HEMI - JHU)

Title: ***"Large Out-Of-Contact Elastohydrodynamic Deformation Due To Lubrication Forces"***

Abstract

Surface and interfacial phenomena in soft matter are profoundly affected by the mechanical compliance of the interacting materials and, as a result, lead to qualitatively different behaviors from those encountered in stiff materials. Hydrodynamic forces cause elastic deformation without physical contact (elastohydrodynamics or EHD). Elastohydrodynamic deformation during sliding of soft surfaces can cause lift and reduce friction. The deformation of an elastic boundary caused by drainage of fluid from a narrowing gap is analogous to the deformation of droplets or bubbles as they approach a rigid surface. However compliant solids can sustain higher pressures and do not break up or coalesce, leading to regimes absent in droplets or bubbles. A challenge in studying the coupling between elasticity and viscous forces has been with the simultaneous measurements of the hydrodynamic forces and of the surface profile, which is necessary to test theories, especially in for significant elastic deformation. Here we characterize the hydrodynamic forces and visualize the spatiotemporal evolution of the deformation in the drainage of fluid from a gap with an elastic boundary. We observe that elastic deformation prevents the surfaces from making contact via the formation of a dimple in the elastic film. The growth kinetics of the dimple follows a scaling derived for droplets and bubbles. We find excellent agreement between the experiments and lubrication theory combined with viscoelasticity, but also show systematic deviations that are attributed to the shear deformation associated with layering effects.