Abstract Submitted
for the DFD16 Meeting of
The American Physical Society

Effects of elasticity and surface tension on the spreading dynamics of a thin film under the influence of intermolecular forces. YUAN-NAN YOUNG, Department of Mathematical Sciences, NJIT, HOWARD STONE, Princeton University — The spreading dynamics of a thin layer of viscous Newtonian fluid between an elastic sheet and a wetting solid substrate is examined using the lubrication theory. On the wetting substrate an ultra thin film (precursor film) develops as a result of the intermolecular force between the fluid and the wetting solid substrate. Such a precursor film prevents the stress singularity associated with a moving contact line. Following the methodology by \citet{Glasner2003_PoF}, the effects of elasticity on the macroscopic contact line structure in the quasistatic limit are elucidated by an ordinary differential equation derived from an analysis of the energy and its dissipation. Similar to the case of a regular fluid interface with surface tension (capillary spreading), the elasto-capillary thin film profile also consists of a core at the center, an ultra thin film in the far field, and a contact line region where the core film profile connects smoothly to the precursor film. For capillary spreading, the precursor film transitions monotonically to the core film. Due to the interfacial elasticity, a spatial oscillation of film height in the contact line region is found. In addition, it is found that elasticity causes the sliding motion of the thin film: the contact angle close to zero as

Yuan-Nan Young
Department of Mathematical Sciences, NJIT

Date submitted: 04 Aug 2016 Electronic form version 1.4