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Theory of slope-dependent disjoining pressure with application to Lennard-Jones liquid films. TAEIL YI, HARRIS WONG, Louisiana State Unversity — A liquid film of thickness h $<$ 100 nm is subject to additional intermolecular forces, which are collectively called disjoining pressure Π. Since Π dominates at small film thicknesses, it determines the stability and wettability of thin films. Current theory derived for uniform films gives $\Pi = \Pi(h)$. This solution has been applied recently to non-uniform films and becomes unbounded near a contact line as h $\to$ 0. Consequently, many different effects have been considered to eliminate or circumvent this singularity. We present a mean-field theory of Π that depends on the slope h_x as well as the height h of the film.[1] When this theory is implemented for Lennard-Jones liquid films, the new $\Pi = \Pi(h, h_x)$ is bounded near a contact line as h $\to$ 0. Thus, the singularity in $\Pi(h)$ is artificial because it results from extending a theory beyond its range of validity. We also show that the new Π can capture all three regimes of drop behavior (complete wetting, partial wetting, and pseudo partial wetting) without altering the signs of the long and short-range interactions. We find that a drop with an unbounded precursor film is linearly stable.
[1] Wu & Wong, J. Fluid Mech. 506, 157 (2004)

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