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Wake and wave resistance on viscous thin films RENE LEDESMA-ALONSO, MICHAEL BENZAQUEN, THOMAS SALEZ, ELIE RAPHAEL, Gulliver UMR 7083, ESPCI, PHYSICO-CHIMIE THEORIQUE TEAM — The effect of an external pressure disturbance, which is displaced with constant speed along the free surface of a viscous thin film, is studied theoretically in the lubrication approximation in one- and two-dimensional geometries. In the comoving frame, the imposed pressure field creates a stationary deformation of the interface - a wake - that spatially vanishes in the far region. The shape of the wake and the way it vanishes depend on both the speed v and size a of the external source and the properties of the film: density ρ, air-liquid surface tension γ, shear viscosity μ, and film thickness h_0. The wave resistance, namely the force that has to be externally furnished in order to maintain the disturbance speed and the stationary wake, is analyzed in detail. For finite-size pressure disturbances, it increases with the speed, up to a certain transition value above which a monotonic decrease occurs. The role of the horizontal extent of the pressure field is studied as well, revealing that for a smaller disturbance the latter transition occurs at a higher speed. Eventually, for a Dirac pressure source, the wave resistance either saturates for a 1D geometry, or diverges for a 2D geometry.

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