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Thin films coating the interior of cylindrical substrates: from rivulets to dripping droplets FRANCOIS GALLAIRE, GIOELE BALESTRA, NICOLAS KOFMAN, EPFL, PIERRE-THOMAS BRUN, Princeton University, BENOIT SCHEID, ULB — A liquid film coated on the underside of a planar substrate is subject to the Rayleigh-Taylor instability so that its interface deforms into waves that lead to the formation of dripping droplets. When the substrate is curved, gravity not only acts as the destabilizing force at the origin of the instability but also as a stabilizing force originating in the progressive drainage of the film. As a consequence, a two-dimensional thin-film in a circular geometry is asymptotically stable to infinitesimal perturbations. Nevertheless, we have found that the system acts as a strong transient amplifier. A transverse instability appears for moderator Bond numbers (gravity over surface tension forces ratio). The liquid accumulates in equally spaced rivulets whose dominant wavelength corresponds to the most unstable mode of the classical Rayleigh-Taylor instability. On the other hand, when the Bond number is high, a two-dimensional lattice of droplets prevails. We investigate the characteristics of the rivulet flow, as well as the transition between the two instability types both theoretically and experimentally. A linear stability analysis based on lubrication equations is performed and the results are found to be in good agreement with experiments and numerical simulations.

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