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Pattern formation of a thin film flowing under an inclined plane¹ PIER GIUSEPPE LEDDA, GAETAN LERISSON, GIOELE BALESTRA, FRAN-COIS GALLAIRE, Laboratory of Fluid Mechanics and Instabilities, Ecole Polytechnique Federale de Lausanne, CH-1015 Lausanne, Switzerland — We discuss the pattern formation of a thin film flowing under an inclined planar substrate, combining theoretical, experimental and numerical results. The phenomenon is related to the Rayleigh-Taylor instability, in which one heavier fluid is placed above a lighter one. When an upper wall and the substrate inclination are considered, a variety of patterns are observed. The natural and forced dynamics of the flat film to spanwise perturbations and the resulting non-linear structures are studied; in both cases, spanwise-periodic, streamwise-aligned structures, called rivulets, arise. The impulse response of a flat film is numerically and experimentally studied. We analyze the linear response, which does not show any preferential direction; a weakly non-linear model highlights however the selection of the streamwise structures. The fully nonlinear evolution leads to a steady pattern characterized by fully saturated rivulets, the profile of which is analyzed in detail. A secondary stability analysis reveals the presence of a range of parameters in which only rivulets are observed, in agreement with the experimental observations. Outside of this range, lenses appear on the rivulets, which may eventually drip.

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