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Experimental analysis of evaporation-driven Bénard instabilities[1]

FABIEN CHAUVET, SAM DEHAECK, PIERRE COLINET, Laboratory TIPs (Transfers, Interfaces and Processes), Fluid Physics Unit, Université Libre de Bruxelles, Belgium — We study experimentally the spontaneous patterns induced by evaporation of a pure liquid layer into dry air. The liquid/vapour interface temperature is lower than the substrate temperature because of the energy consumption for the phase change. This temperature difference across the liquid layer generates surface-tension-driven convection and/or buoyancy-driven convection in the liquid, depending on the layer thickness. In practice, the volatile liquid is placed in a circular dish placed in dry air under ambient conditions. During the evaporation process, the convective patterns are observed using an optical Z-type Schlieren set-up. The evaporation rate and the layer thickness are estimated from liquid weight measurements using a precision balance. Several liquids and dish diameters/heights have been tested. As could be expected, the evaporation rate remains almost constant during time, while different convective patterns are observed when the layer thickness decreases. Their phenomenology and transitions are analysed, in relation with existing theoretical models.

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