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Numerical Study of a Hydrodynamic Instability Driven by Evaporation[1] SERGIO HERNANDEZ-ZAPATA, JULIO CESAR RUBEN ROMO-CRUZ, ERICK JAVIER LOPEZ-SANCHEZ, GERARDO RUIZ-CHAVARRIA, Facultad de Ciencias, UNAM
— The study of hydrodynamic instabilities in liquid layers produced by evaporation has several applications on industry and technology. In this work we study numerically the conditions under which a liquid layer becomes unstable when evaporation in the vapor-liquid interphase is present. The evaporation process follows the Hertz-Knudsen law (the evaporation rate is proportional to the difference between the saturated vapor pressure at the liquid layer temperature and the vapor partial pressure in the environment). Additionally to the usual boundary conditions on solid walls (for example, the non-slip condition for the velocity), we analyze the boundary conditions in the vapor-liquid interphase where the momentum and energy balances have to be taken into account and where the evaporation plays a crucial role. To solve this problem the linear theory of stability is used; that is, a small perturbation around the basic solution is applied (flow at rest and a temperature stationary field). The equations are solved using the Chebyshev pseudo-spectral method. The results are compared with the more usual Rayleigh-Bénard and Marangoni mechanisms as well as with some experiments carried out by our team.

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