Evolution of interfacial nonlinear structure due to of magnetic field on temporal development of R-T instability

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Abstract:

We have investigated the effect of magnetic field on the nonlinear growth of Rayleigh-Taylor (RT) instability induced two fluid interfacial structure. The magnetic field acts in a direction perpendicular to the wave vector and parallel to the plane of fluid interface. It is found that in the linearized case there is no effect of magnetic field on the instability scenario. However, the nonlinear theory, there exists a magnetic pressure in addition to the usual hydrodynamic pressure. As a result R-T instability driving pressure difference $g(\rho_h - \rho_l)y$ is changed by the inclusion of the magnetic pressure difference $\left(\frac{1}{2\mu}\right)(B_h^2 - B_l^2)$ [suffix h/l for heavier / lighter fluid]. It has been shown that the growth rate may be enhanced or depressed according to extra contribution is either positive or negative. It is also shown that surface of separation executes periodic undulation resulting from time lag in the temporal variation in B_h and B_l. It is interesting to note that these are entirely nonlinear effects and disappear in linear theory.