Kelvin-Helmholtz and Rayleigh-Taylor Instability of Two Superimposed Magnetized Fluids with Suspended Dust Particles

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The effect of a magnetic field and suspended dust particles on both the Kelvin-Helmholtz (K-H) and the Rayleigh-Taylor (R-T) instability of two superimposed streaming magnetized plasmas is investigated. The magnetized fluids are assumed to be incompressible and flowing on top of each other. The usual magnetohydrodynamic (MHD) equations are considered with suspended dust particles. The basic equations of the problem are linearized and the dispersion relation is obtained using normal mode analysis by applying the appropriate boundary conditions. The general dispersion relation is found to be modified due to the presence of the suspended dust particles and of the magnetic field. The effect of the magnetic field appears in the dispersion relation if three-dimensional perturbations of the system are considered. The general conditions of the K-H instability as well as the R-T instability are derived for the considered medium. The stability of the system for both cases is discussed by applying the Routh-Hurwitz criterion. Numerical analysis is performed to show the effect of various parameters on the growth rates of the K-H and R-T instabilities. Three different cases of the present configurations are considered and the conditions of instability are obtained. It is found that the conditions for the K-H and R-T instabilities depend on the magnetic field, on the suspended dust particles and on the relaxation frequency of the particles. The magnetic field and particle density have stabilizing influence, while the density difference between the fluids has a destabilizing influence on the growth rate of the K-H and R-T configurations.

Key words: Magnetohydrodynamics (MHD); Plasma Instability; Rayleigh-Taylor Instability; Kelvin-Helmholtz Instability; Suspended Dust Particles.