Landau damping of the dust ion-acoustic surface waves in a Lorentzian plasma

MYOUNG-JAE LEE, TAEJOON KIM, Hanyang University — The Lorentzian (kappa) velocity distribution function is employed to study the stability of dust ion-acoustic surface waves propagating on a boundary of semi-infinite plasma. We allow that the electrons and ions are Lorentzian but the dusts are cold. Then the dust ion-acoustic surface wave can be excited: the real and imaginary parts of the wave frequency $\omega = \omega_r + i\gamma$ are obtained as functions of $\delta = n_i/n_e$ (ion-to-electron mass ratio) as well as the normalized wave number $k_x\lambda_e$ where $k_x$ is the x-component of the wave number and $\lambda_e$ is the electron Debye length. The wave exhibits resonances and the resonant frequency is strongly dependent on the value of $\delta$. For a negatively (positively) charged dust particles, the phase velocity of the wave increases as $\delta$ increases (decreases). When $\delta = 1$, the result displays the phase velocity of a Maxwellian wave. The imaginary part of the wave frequency appears to be negative always regardless of the value of $\delta$. Such collisionless dissipation of the wave is known as the Landau damping. We also found that the damping is enhanced as $\delta$ increases (decreases) for a negatively (positively) charged dust particles.

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