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Stability of the ion-acoustic surface waves in a Lorentzian plasma[1]

TAEJOON KIM, Hanyang University, MYOUNG-JAE LEE[2] — We investigated the stability of ion-acoustic surface waves propagating on a boundary of semi-infinite Lorentzian (kappa) plasma. The real and imaginary parts of the wave frequency $\omega = \omega_r + i\gamma$ are obtained as functions of the normalized wave number $k_x\lambda_e$ where k_x is the x-component of the wave number and λ_e is the electron Debye length. The phase speed of the wave is found be decreased as the spectral index of the Lorentzian distribution function is decreased. In the long wavelength limit, the scaled phase velocity $(\omega_r/\omega_{pi})/k_x\lambda_e$ becomes $\sqrt{\mu_K}$ where ω_{pi} is the ion plasma frequency and $\sqrt{\mu_\kappa}$ is a constant. The wave displays the resonance at $\omega_r/\omega_{pi} = 1\Big/\sqrt{2}$ as expected as the case of Maxwellian plasma. The imaginary part of the wave frequency appears to be negative which exhibits the linear wave dissipation in a collisionless plasma called Landau damping. The maximum damping rate is obtained as $\lambda_{Max} = 0.14M_\kappa\sqrt{m/M}$ at $k_x\lambda_e = 0.44/\sqrt{\mu_\kappa}$ where M_κ is a kappa-dependent function, and m/M is the electrion-ion mass ratio. The damping of the wave disappears as $k_x\lambda_e \to \infty$.

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[2]Corresponding author

Myoung-Jae Lee
Hanyang University

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