Coupling of Solitary Ion-acoustic Waves and Electron Holes in Maxwellian Unmagnetized Plasmas

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Landau damping and nonlinear phase-space states are usually studied by considering immobile and uniformly distributed heavy positive ions, with agreement with observational and experimental measurements [1]. However, large time-scale phenomena may be affected by the motion of the heavy ion species. Indeed, although slow electrostatic waves can be related to electron holes in phase-space, their intensity and scales are large enough to allow coupling with the heavy ion dynamics, as shown by near-Earth observations [2], and simulations of fluid ion-acoustic solitons and slow electron holes [3].

In this work, a one-dimensional, unmagnetized, and electrostatic electron-ion plasma is simulated through a kinetic Vlasov-Poisson scheme in the nonrelativistic regime. The fully non-linear structures introduced in the plasma by the presence of mobile heavy ions, self-consistently developed from the initial perturbation, their effects on the electron dynamics, and the generation of solitary structures are discussed.

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