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The Effects of Electron Trapping by Electron-Ecoustic Waves Excited with Electron Beam

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Abstract : One-dimensional (1-D) particle-in-cell (PIC) electrostatic simulations are carried out to investigate the electrostatic waves, whose constituents are hot, cold and beam electrons in the background of motionless positive ions. In fact, the electrostatic modes excited are electron acoustic waves, beam driven waves as well as Langmuir waves. It is assessed that the relevant plasma parameters, for example, hot electron temperature, beam electron drift speed, and the electron beam density significantly modify the electrostatics wave's profiles. In the nonlinear stage, the wave-particle interaction becomes more evident and the waves have obtained its saturation level. Consequently, electrons become trapped in the waves and trapping vortices are clearly formed. Because of this trapping vortices and mixing of the electrons in phase space, finally, lead to electrons thermalization. It is observed that for the high-density value of the beam-electron, the solitary waves having a bipolar form of the electric field. These solitons are the nonlinear Brenstein-Greene and Kruskal wave mode that attributes the trapping of electrons potential well of phase-space hole. These examinations revealed that electrostatic waves have been exited in beam-plasma model and producing waves having broad-frequency ranges, which may clarify the broadband electrostatic noise (BEN) spectrum studied in the auroral zone.

Keywords : electron acoustic waves, trapping of cold electron, Langmuir waves, particle-in cell simulation
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