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Parametric Analysis of Electron Acoustic Solitary Waves in a Magnetized Plasma

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Recent observations from FAST, POLAR and CLUSTER have revealed localized electric field pulses at different regions of magnetosphere, including plasma sheet boundary layer, auroral acceleration region and the bow shock. It is well known that such narrow boundaries with large gradient in particle properties often generates ion and electron beams, spiky electric fields and wave growth, leading to large amplitude nonlinear electrostatic waves (ESW). They may be broadly categorized as ion mode and electron mode waves. Rapidly moving positive potential pulses have been observed by FAST and POLAR satellites in downward current region of auroral plasma and were found to be associated with electron beams. Such electron mode waves travel with a velocity of the order of electron drift velocity and are mostly interpreted as BGK electron phase space holes. The authors have previously shown that, for a restricted parameter space, there exists positive amplitude electron acoustic solitary wave solutions. The corresponding analytical estimation of the width-amplitude relation has been found to agree well with satellite observations. In the present work, a detail parametric investigations are carried out. A fully nonlinear solution of the electron acoustic solitary wave has been obtained by adopting the Sagdeev pseudopotetial technique. The plasma is assumed to be magnetized and traversed by the electron beam. Both single and multi-ion plasmas are considered with ion temperatures larger than electron temperatures (Ti>Te). The influence of different parameters on the shape, size and existence domain of the corresponding solutions is studied in detail. It has been observed that, both the beam and bulk temperatures of the electrons play crucial roles in determining the corresponding existence domain. It is also observed that a two ion temperature solution is more consistent with the satellite observations than a single ion solution.