Ion acoustic solitary waves in space plasmas having kappa velocity distributed electrons

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Electrostatic waves are often observed in the several regions of space plasma environments such as, the bow shock, magnetosheath, polar cusp and auroral field lines. Ion-acoustic waves are one of the possible mode to explain the observed solitary structures [1-2]. Various in-situ satellite observations reported the presence of excess energetic electron with high-energy tails. Their particle distribution deviates from the Maxwellian and are well modelled by kappa (κ)-like distributions [3]. To study the nonlinear evolution of ion acoustic solitary waves in magneto-plasmas having superthermal particles, we consider a four component plasma model consisting of Protons, Helium ions, a drifting electron beam and superthermal hot electrons. We have modeled the superthermal hot electrons by a kappa distribution function in our study [4]. We have derived the Korteweg-de-Vries-Zakharov-Kuznetsov (KdV-ZK) equation to study the characteristics of small amplitude ion acoustic solitons and have applied our theoretical work to model the solar wind observations made at 1 AU [5]. We have done a detailed parameteric study of the effects of nonthermality, obliquity and electron beam velocity on the ion acoustic solitons. We have found both slow and fast ion acoustic solitons in our study. The maximum electric field amplitudes of slow ion-acoustic solitons vary from (1.26 -2.59) mV/m for $\kappa = 2 - 10$. The calculated fast ion acoustic solitary electric field amplitudes are in the range of (0.43-0.51) mV/m for $\kappa = 2 - 10$ and is comparable with solar wind observation considered in our study.

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