Width Amplitude Variation of Electron Acoustic Solitary Wave

S. S. GHOSH[1]

[1]*Indian Institute of Geomagnetism, India*

In situ measurements of particles and fields of the Earth's auroral zone have revealed a reach variety of plasma phenomena on different spatial and temporal scales. One major aspects of them is the bursts of broadband electrostatic noise emissions (BEN) with frequencies from below the lower hybrid frequency (typically tens of Hertz) up to and higher than electron plasma and cyclotron frequencies (typically, a few kilohertz). Many detailed analysis of BEN have been performed using space-borne data from POLAR, FAST, GEOTAIL, and CLUSTER multi-spacecraft missions. Plasma wave measurements of GEOTAIL spacecraft revealed BEN emissions as a series of Electrostatic Solitary Waves (ESWs). While the low frequency part of the spectra is often interpreted as ion mode (ion acoustic) solitary waves, the time scale of the high frequency part indicates the involvement of electron dynamics.

Fast moving electron mode solitary waves are known to exhibit a positive amplitude structure. Several theories have been proposed to interpret their generations. Presence of energetic ions with temperatures higher than the electron temperature indicates the possibility of the electron acoustic solitary waves [1]. It is, however, consistently observed that, the taller the wave, the wider it is, which contradicts the familiar weakly nonlinear theory. Previously it has been shown that, for large amplitude ion acoustic solitary waves, width increases with increasing amplitude [2]. In the present work, a Sagdeev pseudopotential technique has been adopted to study the width amplitude variation of the electron acoustic solitary wave. The potential profile has been obtained by solving the following equation numerically

$$\frac{d\varphi}{d\eta} + \psi(\varphi) = 0 \qquad (1)$$

where φ is the potential, η is the spatio-temporal scale of the wave, and ψ is the Sagdeev pseudopotential. A comprehensive study has been presented using different models relevent for the auroral plasma..

Keywords: Solitary wave

References

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