

Electrostatic solitary waves in the vicinity of the terrestrial bow shock

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Nonlinear, small scale electric field structures are recognized as an ubiquitous phenomenon in space plasma. However, their role in the processes of energy, momentum, and charge redistribution is still unclear. Using Cluster EFW data we analyze a number of instances of uni/bi/tri-polar electrostatic solitary waves observed in the weakly magnetized foot region of a quasi-perpendicular shock to investigate their fundamental wave properties, generation mechanisms, significance in the plasma dynamics and their contribution to the overall of shock structure. The properties of the solitary waves (e.g., wave propagation direction, velocity, potential scale and amplitude) are experimentally derived by means of the phase-differencing method applied to two sets of parallel electric field components. The observed solitary waves are found to correspond to ion depletion structures such as BGK ion holes. The derived wave properties are compared with the predictions from analytical theory and numerical computations to study their excitation mechanisms.