ANALYSIS OF THE CHARACTERISTICS AND POSSIBLE GENERATION MECHANISMS OF ELECTROSTATIC SOLITARY WAVES OBSERVED BY CLUSTER FROM THE INNER MAGNETOSPHERE TO THE SOLAR WIND

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ABSTRACT

We review the characteristics of the Electrostatic Solitary Waves (ESW) observed by the Cluster Wideband (WBD) plasma wave receiver throughout its 4 by 19.5 RE polar orbit of Earth from the inner magnetosphere to the solar wind. We have uncovered a general trend for the amplitudes of the ESW to increase as the background magnetic field strength increases. This trend is consistent with the largest amplitudes (several tens of mV/m) being observed closest to Earth where the magnetic field strength is largest and the smallest amplitudes (few hundredths of mV/m) being observed farthest from Earth in the solar wind. It is also consistent with the ESW being BGK (Bernstein-Greene-Kruskal) mode according to recent theoretical investigations. No similar trend was uncovered for the time durations of the pulses associated with the ESW. However, we found that the magnetosheath ESW typically have significantly shorter time durations (several 10s of microseconds) than for those ESW found in all other regions of Cluster's orbit (few milliseconds). This suggests that the magnetosheath ESW may be generated by a different mechanism than that for the ESW in other regions. Furthermore, we concluded that the spacecraft are probably too far apart (few tens of km and greater) to detect propagation of any one ESW from one spacecraft to the next, most likely due to growth, decay or coalescence of the ESW over the distance from one spacecraft to the next. We examined some of the other wave and particle data during times when ESW were observed by Cluster WBD in the auroral region, in the magnetosheath and at the bow shock. Based on these data, we suggest possible generation mechanisms for the ESW.