SOLITARY POTENTIAL STRUCTURES OBSERVED BY THE WIDEBAND PLASMA WAVE RECEIVER ON THE CLUSTER SPACECRAFT

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The Wideband (WBD) Plasma Wave Receiver that is mounted on each of the four Cluster spacecraft has observed solitary potential structures in and around several regions and boundaries of Earth, including the magnetosheath, cusp, auroral zone, magnetopause boundary layer, plasmasheet boundary layer, and bow shock. The WBD instrument acquires waveforms of various plasma waves and structures using three separate bandpass filters covering the range 50 Hz to 77 kHz. It measures wave electric and magnetic fields using either one of two spherical double-probe electric antennas located in the spin plane, or one of two magnetic searchcoils located in the spin plane or along the spin axis. The waveforms are telemetered directly to a Deep Space Network ground-receiving antenna in real time, thus assuring extremely high time resolution even over wide frequency ranges.

The solitary potential structures that are the subject of this presentation generally appear in the WBD electric field time series as bipolar pulses, i.e., singular waveforms that have a half-sinusoid in one direction, either positive or negative, followed by a half-sinusoid in the opposite direction. Based on the duration of these pulses, which usually varies anywhere from about 16.7 microseconds up to 1 millisecond or greater, and comparison to previous measurements (see e.g., summary of Kojima et al. [1]), we have determined that these structures are most likely electron phase-space holes. The measured electric fields of these structures typically cover the range of a few hundredths of mV/m peak-to-peak up to 10 mV/m peak-to-peak, but these fields generally vary significantly by region.

The Fourier analysis of these structures observed simultaneously over long periods of time on more than one Cluster spacecraft can provide valuable insight into their generation region. In the magnetosheath, for example, the overall profile of these structures (onset, frequency extent, intensity) can be remarkably similar on two or more spacecraft separated by distances greater than 700 km during certain magnetic field orientations. The various spacecraft are not observing the very same structures at these times, but rather observing structures with similar characteristics that have either propagated to each

individual spacecraft along different field lines from a common source or been generated locally at each spacecraft. In either case, this suggests that the generation region must be very large and is probably located at or associated with the bow shock. Closer to Earth in the auroral zone at around L=6, we have observed solitary structures occurring in conjunction with balanced, counterstreaming cold electron beams, suggesting a nonlinear two-steam instability as a possible local generation mechanism.

Examples of solitary structures and their characteristics as determined from WBD data from several of the different regions will be presented and compared to measurements obtained by previous spacecraft. An emphasis will be placed on examples where data from more than one spacecraft are available in order to take advantage of the unique Cluster capability of multi-point measurements. Where necessary and possible, some supporting measurements from other Cluster instruments will be included.

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[1] H. Kojima, H. Matsumoto, and Y. Omura, "Electrostatic solitary waves observed in the geomagnetic tail and other regions," *Adv. in Space Res.*, vol. 23, pp. 1689-1697, 1999.