

How do counterstreaming electrons generate solitary waves? It has been shown by several theorists and simulators that electron beam instabilities, of which the two-stream instability is one, can adequately generate solitary waves, usually in the form of electron phase-space holes, with the characteristics of those observed in the magnetotail and auroral acceleration region (Omura et al., 1996; Goldman et al., 1999; Singh et al., 2000; Newman et al., 2001; Jovanović et al., 2002). Javanović and Shukla (2004) recently proposed a nonlinear model that provides a theoretical explanation for some of the electrostatic bipolar structures that have been observed in Earth's magnetosheath. This model is based on a drift-kinetic theory for electron phase-space vortices in magnetized space plasmas formulated in the frequency range of the lower-hybrid waves excited by the Buneman instability in the presence of an electron beam. The model accounts for the effects of the electron polarization, anisotropic electron temperature and ion mobility. The quasi-3-D electron holes have the form of either elongated cylinders oblique to the magnetic field, or spheroids. Thus, the significant presence of counterstreaming electrons observed in the magnetosheath for most of our events certainly bears investigation as a local source of generation of the solitary waves. Another possible local generation mechanism that needs to be explored is that of the electron acoustic mode. Ashour-Abdalla and Okuda (1986) proposed that electron acoustic waves in the distant magnetotail could be produced by an ion beam propagating along the magnetic field in the presence of two populations of electrons (cold and hot). The spectrum of these electron acoustic waves could extend above  $f_{pe}$  and appear broadband. Dubouloz et al. (1991) also proposed that the high

frequency part of the broadband spectrum that extended above  $f_{pe}$  and observed on the Viking satellite in the dayside auroral zone could be the result of electron acoustic solitons passing by the satellite. This was a theoretical investigation, but it points to the need to investigate this mode with respect to the solitary waves observed in the magnetosheath by Cluster since their spectral extent often exceeds  $f_{pe}$ . Whether a cold electron population necessary to excite electron acoustic solitons is present in the magnetosheath is still under investigation since it is often hard to identify such a population in the electron data in the magnetosheath due to other effects. One final consideration for the local generation of solitary waves involves their spontaneous generation out of the turbulence (Chen et al., 2003) that naturally exists in the magnetosheath. All of these possibilities for the local generation of solitary waves will be explored in greater detail in the future.

Finally, we note that Chen et al. (2004) have proposed a theory for understanding the ubiquity of solitary waves observed in different classes of collisionless plasmas, including the solitary waves observed in the magnetosheath. They obtained trapped particle solutions for 3D BGK electron and ion solitary waves, taking into account dynamics of both species. They derived from the solutions exact inequality relations that constrain the widths and amplitudes of the solitary waves, and the temperature ratio between electrons and ions. They suggest that the continuum of allowed parameter space of BGK waves is responsible for their ubiquity.