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Interball Statistics of Energetic Ions Upstream from the Bow Shock

K. Kudela (1), S.-W. Chang (2)

1. IEP SAS, Watsonova 47, 04353 Kosice, Slovakia
2. CSPAR, U. of Alabama, Huntsville, AL 35899, USA

The region upstream from the bow shock is populated by energetic ions of different characteristics (energy spectra, total flux, and anisotropy). Although there are many discussions in the literature on the origins of these ions, the relative contribution from each source is not well known. A statistical study of the upstream energetic ions observed by the Interball Tail spacecraft from August, 1995 through September, 2000 is being carried out to address the above question. In this data set, energetic ion distribution is often found to be nearly isotropic (diffuse events) and less than 3% of the time for highly anisotropic distribution. An investigation of the dependence of ion flux and spectral slope on the solar wind density and velocity, θ_{Bn}, and Kp index reveals different patterns for the lower and higher energetic ions. For the diffuse events, the lower energetic component is better organized by the solar wind parameters and θ_{Bn}. The spectral slope of ion energy spectrum shows some dependence on the solar wind velocity. These results are consistent with the Fermi acceleration at the quasi-parallel shock for solar wind ions. However, the higher energetic ion flux is less dependent on the solar wind parameters and bow shock geometry. When the energetic ion distribution is highly anisotropic, their flux becomes much better correlated with the Kp index. These results indicate that magnetospheric leakage dominates the higher energetic component. There are clearly indications that both shock acceleration and magnetospheric leakage contribute to the upstream energetic ions even for diffuse ion events. Their relative contribution is energy dependent.

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