

Understanding the Acceleration of Energetic Particles at the Termination Shock of the Solar Wind

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Voyager 1 observations of energetic particles during the crossing of the Termination Shock of the solar wind present a number of puzzles, and challenges to existing theory. For example, the spectral index of the accelerated particles downstream from the shock exhibits a remarkably constant spectral index, which is difficult to understand in terms of standard diffusive shock acceleration. Upstream from the shock there are beams of highly anisotropic energetic particles, with varying spectral shapes; diffusive shock acceleration also has difficulty in dealing with such large anisotropies. In this presentation we show that the observed, constant spectral index can be accounted for by a simple theory in which the pressure in the accelerated particles behaves according to the Rankine-Hugoniot relationship at the shock. The upstream beams result from leakage across the shock from a downstream spectrum with constant spectral index; the varying spectral shapes upstream are due only to velocity dispersion. It is also shown that the beams do not have an appreciable effect on the shock structure. The implications of this theory for the Termination Shock for acceleration in the heliosheath is also discussed.