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Evidence for Two Energetic Particle Sources at the Termination Shock

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During the period of unusual enhancements in the intensities of low energy ions observed by Voyager 1 beyond 85 AU, the energy spectra appear to have two components. Upstream of the termination shock, low energy ions (<10 MeV/nucleon) stream along the magnetic field and have significant variations in intensity and spectral slope. Their power law spectrum often shows no evidence of modulation at the lowest energies. This suggests a nearby source region of termination shock particles (TSPs) connected to Voyager along the interplanetary magnetic field. At intermediate energies (~10 to 60 MeV/nucleon), the helium spectrum is relatively steady and consistent with that of anomalous cosmic rays (ACRs) with modulation increasing with decreasing energy. This indicates that the ACR source is a remote region of the termination shock not connected to Voyager along the magnetic field. This distinction between the TSP and ACR sources was confirmed when Voyager 1 crossed the termination shock at 94 AU.

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