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Acceleration of galactic electrons at the solar wind termination shock and their journey beyond

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Abstract content
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Prior to traversing the heliosheath and finally crossing the threshold at the heliopause into the local interstellar medium, Voyager 1 detected spurious dual-peaked increases in low-energy (2.5-14 MeV) electron intensities in the vicinity of the solar wind termination shock. Since the termination shock is a known site for diffusive shock acceleration, it is considered likely that it is the mechanism responsible for creating the aforementioned intensity features. To explore this notion, a numerical cosmic-ray modulation model accounting for the effects of diffusive shock acceleration is implemented. The model is equipped with a new heliopause spectrum, constructed from observations from both Voyager 1 and satellite-borne detectors, such as PAMELA, and employs diffusion coefficients that are able to account for the remarkable decline of electron intensities inward across the heliosheath. The spectral features of diffusive shock acceleration are studied and the dependence of this mechanism on the shock compression ratio, electron drifts, and diffusion is illustrated. The features of re-accelerated galactic electrons exhibit that diffusive shock acceleration may easily account for the magnitude of the spurious intensity increases observed by Voyager 1, while their narrow spatial extent may be reproduced by simulating turbulent, low-diffusion conditions at the termination shock. The global progression of electron intensities, and their distribution with energy, is recreated along the complete Voyager 1 trajectory in the outer heliosphere.

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