

The effect of Alfvén-wave transmission at CME-driven diffusive shock waves.

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Gradual solar energetic particle (SEP) events are known to be correlated with coronal mass ejections (CMEs) and soft X-ray flares. Particle spectra at a CME-driven shock often exhibit a power law to certain energies, then roll over exponentially beyond. However, there are some gradual SEP cases where the double-peaked intensity time profiles is observed. The current acceleration model attributes the double-power-law phenomena to some effective “loss term” in the test-particle transport equation. Based on these observations, we introduce a non-perturbation particle acceleration model taking into account the effect of Alfvén-wave to these CME-driven shocks. Thus, the new diffusive shock model predicts that the energy spectrum of the accelerated ions is tied of the upstream cross helicity which is an important parameter deciding the double-power structure of the SEP events. We study the effect of Alfvén-wave transmission on the CME-driven shock geometry and shock compression ratio, provide a good agreement results with the typical gradual SEP events observed by Ulysses.