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First Principle Modeling of Energetic Storm Particles

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The origin and cause of solar energetic particles (SEPs) has been one of the most important topics in the field of space weather research. Energetic storm particle (ESP) event is a subset of SEP events, which is haracterized as proton flux enhancement of the relatively low energy range (<10 MeV) associated with interplanetary shock arrivals at the Earth. Here we perform the first principle modeling of ESP and quantitatively compare the results with in-situ observations, using the self-consistent interlocked simulation code developed by Sugiyama & Kusano (2009). In this paper we focus on the coronal mass ejection event on 13 Dec 2006. As the input parameters for the interlocked simulation, fundamental shock parameters of the plasma beta, Alfven mach, and shock angle are given from a global solar wind simulation of Kataoka et al. (2009). As a result, it is found that proton flux and spectral index of ESP event can be quantitatively reproduced by the interlocked simulation, which is driven by the realistic shock parameters without injection particles. We suggest that ESPs can be originated from thermal solar wind plasma accelerated by the passage of interplanetary shocks.

Keywords: SEP, CME, shock, particle acceleration