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A Model for SEP Escape

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Magnetic reconnection in the solar atmosphere is believed to be the driver of most solar explosive phenomena. Therefore, the topology of the coronal magnetic field is central to understanding the solar drivers of space weather. Of particular importance to space weather are the impulsive Solar Energetic particles that are associated with some CME/eruptive flare events. Observationally, the magnetic configuration of active regions where solar eruptions originate appears to agree with the standard eruptive flare model. According to this model, particles accelerated at the flare reconnection site should remain trapped in the corona and the ejected plasmoid. However, flare-accelerated particles frequently reach the Earth long before the CME does.

We present a model that may account for the injection of energetic particles onto open magnetic flux tubes connecting to the Earth. Our model is based on the well-known 2.5D breakout topology, which has a coronal null point (null line) and a four-flux system. A key new addition, however, is that we include an isothermal solar wind with open-flux regions. Depending on the location of the open flux with respect to the null point, we find that the flare reconnection can consist of two distinct phases. At first, the flare reconnection involves only closed field, but if the eruption occurs close to the open field, we find a second phase involving interchange reconnection between open and closed. We argue that this second reconnection episode is responsible for the injection of flare-accelerated particles into the interplanetary medium. We will report on our recent work toward understanding how flare particles escape to the heliosphere. This work uses high-resolution 2.5D MHD numerical simulations performed with the Adaptively Refined MHD Solver (ARMS).

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