Fractal Reconnection and Stochastic Particle Acceleration induced by a Prominence Eruption

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Abstract

Prominence eruptions in Solar flares are observed in association with intermittent high energy particle generation which is observed as footpoint hard X-ray brightening and super energetic particle (SEP) events in the interplanetary space. High energy particle generation is thought to be by acceleration inside or at around the reconnection current sheet below the flux rope and by shock acceleration near the propagation front of a prominence eruption or a coronal mass ejection (CME). These are strongly related to prominence eruption dynamics. Here we performed 2D/3D MHD simulations and test particle simulation and revealed the following aspects. First, a current sheet is formed just below the flux rope and becomes thinner and thinner during the eruption. The current sheet with guide filed forms small multiple plasmoids inside and becomes turbulent. Locally enhanced electric field and trapping of particles inside the turbulent magnetic field are favorable for the stochastic particle acceleration. Second, a prominence eruption forms a current sheet at the propagation front to reconnect with the surrounding coronal fields. This connects a closed flare arcade and coronal open field lines, enabling accelerated particles to escape into the interplanetary space. Furthermore, multiple shocks are intermittently generated at around the reconnection point, propagating through the flux rope to the interplanetary space. At that time, escaping particles pass through the multiple shocks and accelerated intermittently. In this presentation, we will show our simulation results and compare them with recent observations such as SDO and Hinode.

Keywords: CME/priminence eruption, MHD, Reconnection, Particle acceleration, Shock Wave, Space Weather, SEP

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