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Plasmoid ejection and associated Particle acceleration in a Solar Flare

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The Soft X-ray Telescope on board Yohkoh revealed that the ejection of X-ray emitting plasmoid is sometimes observed in a solar flare. It was found that the ejected plasmoid is strongly accelerated during a peak in the hard X-ray emission of the flare. Recently multiple plasmoid ejections have been observed in a solar flare. Each of them is associated with an impulsive burst of hard X-ray emission, indicating that plasmoid ejection may be related to particle acceleration mechanism in a solar flare. Here we propose that nonthermal electrons are efficiently accelerated by the first-order Fermi process at the fast shock, coupled with the dynamics of multiple plasmoid ejections. Multiple plasmoids collide with a oblique fast shock, which is naturally formed below the reconnection site. The accelerated particles are trapped in a plasmoid and reflected at the shock front due to the magnetic mirror upstream of the fast shock. As a plasmoid passing through the shock front, the trapping distance becomes shorter and shorter, driving the first-order Fermi acceleration until it becomes electron larmor radius. To investigate the particle energy spectrum, we performed 2.5 dimensional resistive MHD simulation of plasmoid ejectins and testparticle simulation. We showed that particles can be more efficiently accelerated during the plasmoid ejections, especially at the current sheet and the fast shock.

Keywords: Solar Flare, Particle Acceleration, Magnetic Reconnection, Plasmoid Ejection, MHD simulation, test particle simulation