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Multiple-Scale Physics of Coronal Mass Ejection

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Coronal mass ejections (CMEs) are always involved in the disruption of the large scale magnetic structures in the corona. The disruption of the coronal magnetic field results in the severe stretching of the coronal magnetic field that roots in the photosphere, and thus the formation of a magnetically neutral current sheet (CS), separating two magnetic fields of opposite polarity. Magnetic reconnection taking place inside the CS converts the released magnetic energy into heat and the kinetic energy of the plasma that account for the solar flare and the associated CME, respectively, and as well as into the kinetic energy of the energetic particles that are accelerated either by reconnection in CS or by fast mode shock driven by energetic CME. In this process, the CS works as the central engine that continuously pumps the energy to heat the flare region, and to help CME escape from the Sun. Manifestations of disrupting features of various macro scales observed in the eruption are thus related to one another through the CS, and are governed by the magnetic reconnection process inside the CS. On the other hand, the CS itself is an assembly of micro processes and the related structures, which include magnetic islands or plasmoids, slow mode shock, vortices of the plasma, as well as the consequences of interactions among these structures. These structures play an important role in enhancing the dissipation and allows magnetic reconnection to occur at a reasonably fast rate is a fairly thick CS. In this work, we are going to display prominent features of various structures observed in the solar eruption and numerical experiments, and to discuss their roles in the eruption, together with the associated magnetic reconnection process.

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Note: Abstract should be in 1 page.