The Role of Magnetic Reconnection in the Genesis and Development of Major Solar Eruptions

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Coronal mass ejections (CME) / eruptive flares are the largest and most energetic form of solar activity and are the drivers of the most destructive space weather throughout interplanetary space. Understanding the physical origin of these giant magnetic explosions and their propagation in the heliosphere is absolutely essential for any first-principles based space weather capability. Furthermore, these well-observed events offer the best opportunity to study the fundamental physics of magnetic field and plasma interactions; in particular, the key processes of magnetic reconnection and particle acceleration. We describe how magnetic reconnection is responsible for the energy buildup that leads to CMEs/flares, how it drives the explosive energy release, and how it controls the propagation of the event. Reconnection turns out to be especially important for understanding the escape of high-energy particles into the heliosphere. The implications of our results for interpreting observations from present missions, such as Hinode and SDO, and for future missions, such as Solar-C, will be described.