Magnetic Source Regions of Coronal Mass Ejections

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The majority of flare activity arises in active regions which contain sunspots, while Coronal Mass Ejection (CME) activity can also originate from decaying active regions and even so-called quiet solar regions which contain a filament. Two classes of CME, namely flare-related CME events and CMEs associated with filament eruption are well reflected in the evolution of active regions. The presence of significant magnetic stresses in the source region is a necessary condition for CME. In young active regions magnetic stresses are increased mainly by twisted magnetic flux emergence and the resulting magnetic footpoint motions. In old, decayed active regions twist can be redistributed through cancellation events. All the CMEs are, nevertheless, caused by loss of equilibrium of the magnetic structure. With observational examples we show that the association of CME, flare and filament eruption depends on the characteristics of the source regions:

the strength of the magnetic field, the amount of possible free energy storage,

the small- and large-scale magnetic topology of the source region as well as its evolution (new flux emergence, photospheric motions, cancelling flux), and

the mass loading of the configuration (effect of gravity). These examples are discussed in the framework of theoretical models.

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