Triggering of Solar Magnetic Eruptions on Various Size Scales

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A solar eruption that produces a coronal mass ejection (CME) together with a flare is driven by the eruption of a closed-loop magnetic arcade that has a sheared-field core. Before eruption, the sheared core envelops a polarity inversion line along which cool filament material may reside. The sheared-core arcade erupts when there is a breakdown in the balance between the confining downward-directed magnetic tension of the overall arcade field and the upward-directed force of the pent-up magnetic pressure of the sheared field in the core of the arcade. What triggers the breakdown in this balance in favor of the upward-directed force is still an unsettled question. We consider several eruption examples, using imaging data from the SoHO, TRACE and Hinode satellites, and other sources, along with information about the magnetic field of the erupting regions. In several cases, observations of large-scale eruptions, where the magnetic neutral line spans few x 10,000 km, are consistent with magnetic flux cancelation being the trigger to the eruption's onset, even though the amount of flux canceled is only ~few percent of the total magnetic flux of the erupting region. In several other cases, an initial compact (small size-scale) eruption occurs embedded inside of a larger closed magnetic loop system, so that the smaller eruption destabilizes and causes the eruption of the much larger system.
In this way, small-scale eruptive events can result in eruption of much larger-scale systems.

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