Geophysical Research Abstracts
Vol. 21, EGU2019-5194, 2019
EGU General Assembly 2019

The Birth of a Coronal Mass Ejection

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The Sun's atmosphere is frequently disrupted by coronal mass ejections (CMEs), coupled with flares and energetic particles. In the standard picture, the coupling is explained by magnetic reconnection at a vertical current sheet connecting the flare loops and the CME, with the latter embedding a helical magnetic structure known as flux rope. As it jumps upward due to instabilities or loss of equilibrium, the flux rope stretches the overlying coronal loops so that oppositely directed field is brought together underneath, creating the current sheet. However, both the origin of flux ropes and their nascent paths toward eruption remain elusive. Here we present an observation of how a stellar-sized CME bubble evolves continuously from plasmoids, mini flux ropes that are barely resolved, within half an hour. The eruption initiates when plasmoids springing from a vertical current sheet merge into a leading plasmoid occupying the upper tip of the current sheet. Rising at increasing speed to stretch the overlying loops, this leading plasmoid then expands impulsively into the CME bubble, in tandem with hard X-ray bursts. This observation illuminates for the first time a complete CME evolutionary path that has the capacity to accommodate a wide variety of plasma phenomena by bridging the gap between micro-scale dynamics and macro-scale activities.