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Thermodynamic MHD Simulation of the 2000 July 14 "Bastille Day" Eruption

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The "Bastille Day" event that occurred on 2000 July 14 is one of the most extensively studied solar eruptions. It originated in a complex active region close to disk center and produced an X5.7 flare, a fast halo CME, and an intense geomagnetic storm.

Accurate numerical simulations of such events, in particular the matching of parameters relevant for space weather such as the CME velocity and magnetic orientation, require a realistic model of the large-scale magnetic field and plasma environment into which the eruption propagates and interacts, as well as a modeling of the pre-eruptive configuration and eruption initiation that are as realistic as possible.

Here we present an MHD simulation of the Bastille Day event that complies with these requirements. We first produce a steady-state MHD solution of the background corona that incorporates realistic energy transport ("thermodynamic MHD"), photospheric magnetic field measurements, and the solar wind. In order to model the pre-eruptive magnetic field, we then insert a stable, elongated flux rope that resides above the highly curved polarity inversion line of the active region. Finally, we produce the eruption by imposing photospheric flows that slowly converge towards the polarity inversion line. In this presentation we describe our method, compare the simulation results with the observations, and discuss the challenges and limitations involved in modeling such complex and powerful eruptions.