MHD Simulation of a Sigmoid Eruption of Active Region 11283

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Current magnetohydrodynamic (MHD) simulations of the initiation of solar eruptions are still commonly carried out with idealized magnetic field models, whereas the realistic coronal field prior to eruptions can possibly be reconstructed from the observable photospheric field. Using a nonlinear force-free field extrapolation prior to a sigmoid eruption in AR 11283 as the initial condition in a MHD model, we successfully simulate the realistic initiation process of the eruption event, as is confirmed by a remarkable resemblance to the SDO/AIA observations. Analysis of the pre-eruption field reveals that the envelope flux of the sigmoidal core contains a coronal null and furthermore the flux rope is prone to a torus instability. Observations suggest that reconnection at the null cuts overlying tethers and likely triggers the torus instability of the flux rope, which results in the eruption. This kind of simulation demonstrates the capability of modeling the realistic solar eruptions to provide the initiation process.

See https://dl.dropboxusercontent.com/u/96898685/Eruption_AR11283.gif for an animation.