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Observations from Hinode and SDO of a Twisting and Writhing Start to a Solar-filament-eruption Cascade

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We analyze data from SDO and Hinode of a solar eruption sequence of 1 June 2011 near 16:00 UT, with emphasis on the early evolution toward eruption. Ultimately, the sequence consisted of three emission bursts and two filament ejections. SDO/AIA 304 Ang images show absorbing-material strands initially in close proximity that over ˜20 min form a twisted structure, presumably a flux rope with ˜10ˆ29 ergs of free energy that triggers the resulting evolution. A jump in the filament/flux rope's height (average velocity ˜20 km/s) and the first burst of emission accompanies the flux-rope formation. After ˜20 min more, the flux rope/filament kinks and writhes, followed by a semi-steady state where the flux rope/filament rises at (˜5 km/s) for ˜10 min. Then the writhed flux rope/filament again becomes MHD unstable and violently erupts, along with rapid (> 50 km/s) ejection of the filament and the second burst of emission. That ejection removed field that had been restraining a second filament, which subsequently erupts as the second filament ejection accompanied by the third (final) burst of emission. Magnetograms from SDO/HMI and Hinode/SOT, and other data, reveal several possible causes for initiating the flux-rope-building reconnection, but we are not able to say which is dominant. Our observations are consistent with tether-cutting reconnection initiating the first burst and the flux-rope formation, with MHD processes initiating the further dynamics. Both filament ejections are consistent with the standard model for solar eruptions. NASA supported this work through its Heliophysics program.

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