Multiwavelength Observations of Helical Kink Instability as a Trigger of Solar Flare and CME in AR NOAA 11163

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Abstract

We present multiwavelength observations of helical kink instability as a trigger of a coronal mass ejection (CME) that occurred in active region NOAA 11163. The CME was associated with an M3.5 limb flare. SDO/AIA observations suggest the development of helical kink instability in the erupting prominence, which implies a flux rope structure of the magnetic field. A brightening starts below the apex of the prominence with its slow rising motion (_˜100 km s–1) during the activation phase. A bright structure, indicative of a helix with _˜3-4 turns, was transiently formed at this position. The corresponding twist of _˜6π-8π is sufficient to generate the helical kink instability in a flux rope according to recently developed models. A slowly rising blob structure was subsequently formed at the apex of the prominence, and a flaring loop was observed near the footpoints. Within 2 minutes, a second blob was formed in the northern prominence leg. The second blob erupts (like a plasmoid ejection) with the detachment of the northern prominence leg, and flare intensity maximizes. The first blob at the prominence apex shows rotational motion in the counterclockwise direction in the plane of sky, interpreted as the unwinding motion of a helix, which erupts to give the CME. RHESSI hard X-ray (HXR) sources show the two footpoint sources and a loop-top source during the flare. We found RHESSI HXR flux, soft X-ray flux derivative, and CME acceleration in the low corona correlate well, which is in agreement with the standard flare model (CSHKP). We also discuss the possible role of ballooning as well as torus instabilities in driving the CME. We conclude that the CME and flare were triggered by the helical kink instability in a flux rope and accelerated mainly by the torus instability.

Keywords: Prominence, Solar Flare, Coronal Mass Ejection

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