Nature of Prominences and their role in Space Weather
Proceedings IAU Symposium No. 300, 2013
B. Schmieder, J.-M. Malherbe & S. T. Wu, eds.

doi:10.1017/S174392131301168X

Recurrent filament eruptions and associated CMEs

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Abstract. We investigate the violent events in the cluster of two active regions (ARs), NOAA numbers 11121 and 11123, observed on 11 November 2010 by the Solar Dynamics Observatory (SDO). Within one day the magnetic field intensity increased by 70% with the emergence of new groups of bipoles in AR 11123, where three filaments are seen along the complex inversion line. The destabilization of the filaments led to flares and CMEs. The CMEs around 08:24 UT and 17:00 UT are directly related to the partial eruption of one filament in the new AR, as shown by a topology computation and analysis. The other CMEs on this day are due to either other ARs or to the destabilization of the global magnetic configuration of the two ARs. This conclusion can be only reached by using the three eyes of SOHO, STEREO and SDO.

Keywords. Sun: active region, Sun:magnetic field, Sun: CME, Sun: filament

1. Active regions observed by SDO and THEMIS

AR 11123 emerged rapidly within the following negative polarity of AR 11121 from 9 to 11 November 2010. It consisted of several bipoles that formed a nest by 11 November (Fig. 1, left). Several flares accompanied by filament eruptions occurred in the two active regions. In the center of AR 11121 a long filament was oriented NW-SE, while in AR 11123 two well-identified small filaments erupted at the time of the flares (Fig. 1, center), i.e. 07:15 UT and 15:54 UT. A magnetic topology analysis (Fig. 1, right) showed that the flare ribbons overlaid the quasi-separatrix layers (QSLs; Mandrini *et al.* 2013).

2. CMEs on 11 November 2010

According to the SOHO/LASCO CME Catalog, six CMEs occurred on 11 November 2010. The AR complex was nearly at S21W00 (Fig. 2, left). Associations between the addressed filament eruptions and the cataloged CMEs are not straightforward from Hα, SDO/AIA, and SOHO/LASCO data. On this date, STEREO-A and -B were $\sim$90° away from the Sun-Earth line, and thus able to observe the AR complex on the solar limb. A systematic joint analysis of multiple viewpoint data provided by SDO, SOHO, and STEREO yielded the associations summarized in Table 1. The first column is the first CME observation by SOHO/LASCO, position angle (PA) and speed (V) are projected values listed by the Catalog, and flare time is the GOES start time. A CME at 00:12 UT is not listed because it is unlikely related to the AR complex. The CME at 08:24 UT by SOHO/LASCO (Fig. 2, center), seen from the STEREOs, is well associated with a small filament eruption from AR 11123 and with the 07:15 UT flare. The SOHO/LASCO CMEs

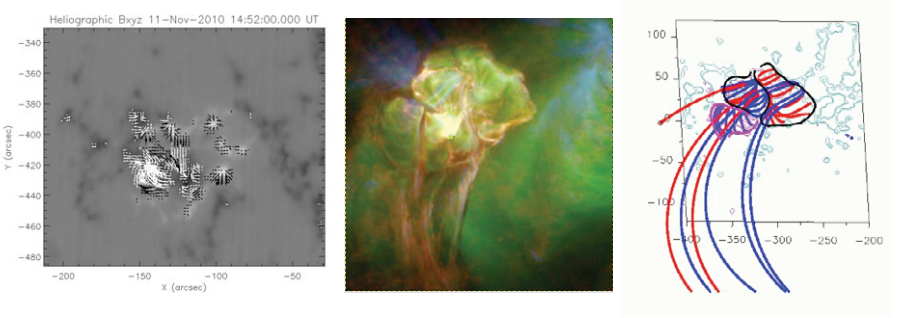

Figure 1. AR 11123: (*left*) Vector magnetogram of the emergence of nested bipoles (THEMIS/MTR), (*center*) Filament eruption and bright ribbons at 07:28 UT (SDO/AIA 304-171-211Å), (*right*) Topology showing the QSLs and field lines computed from both sides.

at 11:00 and 17:00 UT only left some traces of material moving high in the corona as viewed in the STEREO EUVIs images. The CME at 14:00 UT, seen from the STEREOs, agrees with the eruption of the filament crossing AR 11121. The CME at 20:12 UT is directly related to AR 11124.

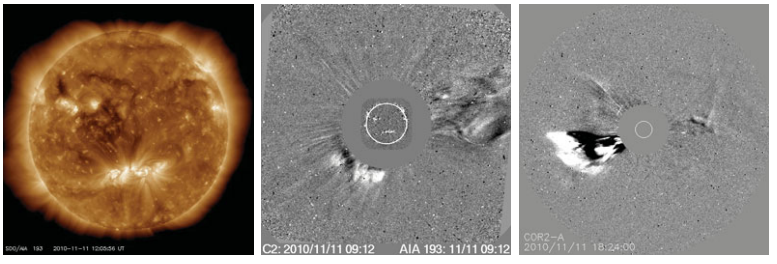

Figure 2. (*left*) Full disk SDO/AIA 193 Å showing the AR complex towards the south. (*center*) The SOHO/LASCO CME of 08:24 UT seen to the SE at 09:12 UT. (*right*) The SOHO/LASCO CME of 17:00 UT, here from the quadrature perspective of STEREO COR2-A at 18:24 UT.

Table 1 : CMEs and their sources.

CME (UT)	PA (deg)	V(km s^{-1})	Flare (UT)	Source
08:24	147	250	07:15	small filaments in AR 11123
11:00	142	315	10:12	high above AR 11121 + AR 11123
14:00	150	266	12:58	large central fil. in AR 11121
17:00	PH	419	15:54	high above AR 11121 + AR 11123
20:12	112	155	19:23	AR 11124

3. Conclusion

The analysis of the CME sources shows the importance of observations from the quadrature perspective of STEREO. Most of the CMEs on this day arose from global instability in the AR complex. They appear completely differently from the STEREOs and LASCO, very impressive from a sideway view and weak events with LASCO (Fig. 2).

Reference

Mandrini C., Schmieder B., Démoulin P., & Guo Y. 2013 *Solar Physics*, in press.

https://doi.org/10.1017/S174392131301168X Published online by Cambridge University Press