Solar Activity and its Magnetic Origin
Proceedings IAU Symposium No. 233, 2006
V. Bothmer & A. A. Hady, eds.

doi:10.1017/S1743921306002262

Coronal and H_α dimmings associated with an CME on 2001 September 28

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Abstract. We report the eruption of a small filament on 2001 September 28. Followed by a two-ribbon flare, the eruption was associated with a partial halo coronal mass ejection. During the eruption, coronal bipolar double dimmings were formed on the regions of opposite magnetic polarities. The optical counterparts of the coronal dimmings, i.e., the H_α dimmings, were clear and showed similar appearance and consistent development. A remarkable fact is that the two dimmings were preceded by impulsive EUV and H_α brightenings at the flare's rise phase, suggesting that the eruption can be explained by the tether-cutting model.

Keywords. Sun: activity, Sun: coronal mass ejections (CMEs), Sun: filaments, Sun: flares

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We used H_α center-line data from Kanzelhohe Solar Observatory (KSO), EUV, magnetogram and white-light coronagraph data from TRACE, SOHO/EIT, MDI and LASCO. Fig. 1 shows the evolution of the event. The eruptive small filament ("F") was located to the north of AR 9628 (S18W36) on 2001 September 28 and its eruption led to an X-ray class M2.4 flare with start, peak and end time at 09:34, 10:14 and 10:50 UT, respectively (also see Figs. 2a and 2b). The flare was consisted of two main ribbons ("MFRs"), which were spatially coincided with the footpoints of the post-flare loops, "PFLs". During the eruption, coronal bipolar double dimmings, "D1" and "D2", were formed near the two ends of the erupted filament (Fig. 1d). They were located on the regions of opposite magnetic (Fig. 1b) and showed similar shapes in 171 Å, 195 Å, 284 Å and 304 Å (also see Figs. 2d and 2f). Their optical counterparts, the H_α dimmings (Jiang *et al.* 2003), were clearly discernible and showed consistent evolution (Fig. 2e). The appearances of the dimmings in lines forming in the temperature range from 4×10^4 K to several 10^6 K suggested that they were resulted from a density loss instead of a temperature decrease of the coronal plasma. A striking characteristic of the dimmings is that they were preceded by short-lived, rapid flarings in EUV and Ha during the rise phase of the flare (see Figs. 2e and 2f). This indicated that the dimming formation possibly involved in the chromosphere evaporation and the eruption may be explained by the tether-cutting model (Yurchyshyn *et al.* 2004). Recently, similar flarings before dimmings were also found by Toma, *et al.* (2005). The above surface activities were closely associated with a partial halo CME with a width of 198^o and a center position angle of 200^o. By applying first(second)-order polynomial fitting to height-time plot of the CME front (Fig. 2c), the average speed (acceleration) is 665 km s^{-1} (5.7m s^{-2}), and the extrapolated onset time is 09:36 (09:24) UT, which is very close to the GOES flare start time (09:34 UT).

Acknowledgements

The work is supported by the NSFC under grants 10573033.

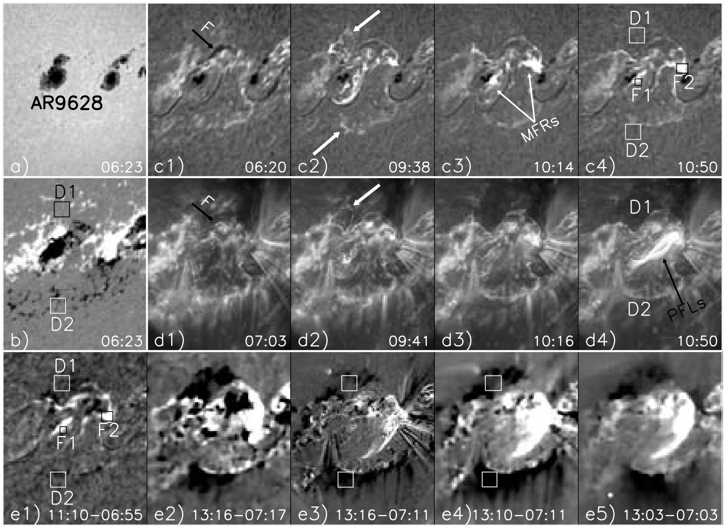

Figure 1. MDI intensity image (a) and magnetogram (b). KSO H_α (c) and TRACE 171 Å (d) images, and H_α (e1), EIT 304 Å (e2), TRACE 171 Å (e3), EIT 195 Å (e4) and EIT 284 Å (e5) difference images. D1 and D2 mark the two dimming, and the thick white arrows indicate the rapid flarings. The field of view is $380'' \times 460''$.

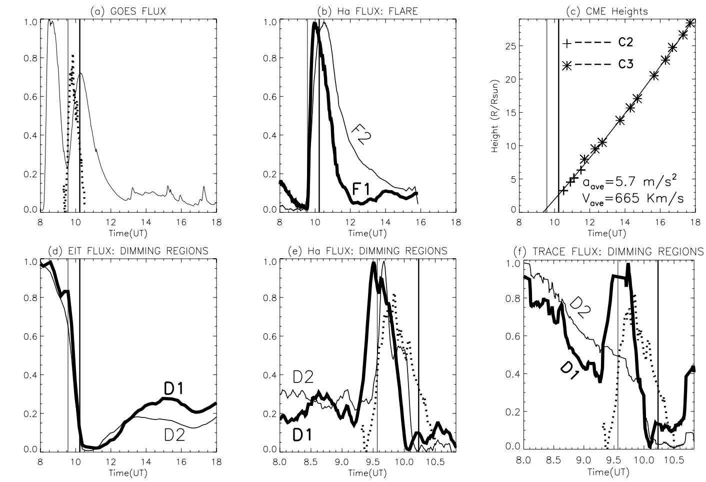

Figure 2. (a) Time profiles of GOSE-8 soft X-ray (the solid lines). (b) H_α line center intensity in the boxes F1 and F2 inside the two main flare ribbons (see Fig. 2b). (c) Height of the CME front as the function of time. (d) The EIT 195 Å, (e) H_α and (f) TRACE 171 Å light curves in the boxes D1 and D2 centered on the two dimming regions (see Fig. 1), which are computed from the intensity integrated and normalized over these regions. In (a), (e) and (f), the derivative of GOES soft X-ray profiles is plotted (the dashed lines). The two solid vertical bars indicate the duration of the flare rise phase.

References

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https://doi.org/10.1017/S1743921306002262 Published online by Cambridge University Press