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Study of Filament Eruption and its Relationship to a CME on 2003 August 25

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Abstract. By means of multiwavelength data, we study the eruptions of two filaments and the relationship between the first filament eruption and a subsequent CME. The main results are: (1) The disturbances of the two filaments showed different features, indicating that their eruptive mechanisms were possibly different. (2) A subsequent CME was well correlated with the first eruption in both time and space.

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

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It is well known that CMEs are closely associated with filament eruptions and flares (Hudson & Cliver (2001)). On 2003 August 25, two filaments, ‘F1’ and ‘F2’ successively erupted at the boundary of NOAA AR 100442 (S09E40). The F1 eruption was accompanied by an X-ray class C3.6 two-ribbon flare, and then a CME was observed to span the eruption region. Using H_α data from Yunnan Astronomical Observatory (YNAO), EUV and white-light coronagraph data from TRACE and SOHO/LASCO, we find that the eruptive processes of F1 and F2 were different. It seemed that the F1 eruption, the flare and the CME could be regarded in a same eruptive process framework.

The F1 and F2 were located on the neutral polarity inversion zone at the boundary of AR 100442. Their general eruptive processes are showed by the H_α and TRACE 171 Å images in Figure 1. The F1 started to erupt at about 02:10UT. By 02:32UT, it completely disappeared in H_α (Figure 1(*a2*)) but can be visible in TRACE 171 Å image (Figure 1(*c2*)). The two-ribbon flare with start, peak and end times at about 02:30, 02:59 and 03:35 UT (see Figure 2((*a*))) occurred in the course of the F1 eruption. Its two ribbons, ‘R1’ and ‘R2’, clearly showed spreading motion. When the R1 came near the F2, the F2 became instable and then erupted. The detailed H_α movie shows that the activation state and eruption processes of F1 and F2 were obviously different. The F1 first became darker and thicker, then bifurcation appeared in its body, and finally it showed a whiplike eruption. However, one part of the F2 first disappeared, then the rest part underwent horizontal axial motion, and eventually it erupted wholly. The different eruption processes probably indicated the different eruption mechanisms. We also note that the F1 eruption was possibly associated with new emerging magnetic flux in the photosphere as shown by MDI magnetograms, whereas the F2 eruption was obviously correlated with the separate motion of the flare ribbons as a result of the F1 eruption and the possible interaction between F2 and the R1.

After the F1 eruption and the flare, the CME was first seen in the field of view of the LASCO C2 at 03:26 UT. Figure 1(*d*) shows the CME situation at 04:26 UT. Using TRACE/171 Å images and the measures of Seiji Yashiro, we plot the projection heights of F1 and CME front in Figure 2((*a*)). The filament started to rise about one hour before the occurrence of the flare ribbons, and reached a velocity of several tens of km s^{-1}. After the flare onset (around 02:30 UT), however, it was rapidly accelerated to over 200 km s^{-1} and reached at least 500 km s^{-1} when it moved beyond the TRACE field of view around

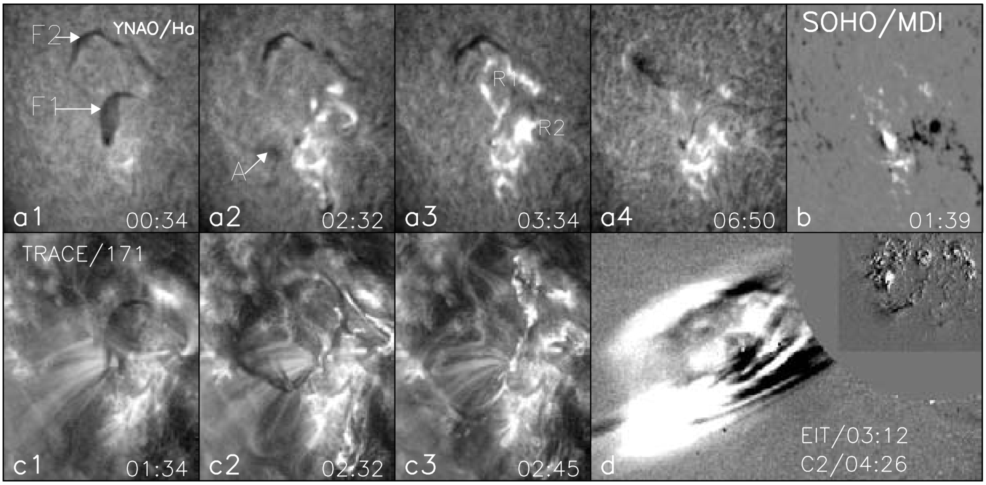

Figure 1. YNAO H_α images (a1-a4), MDI magnetogram (b), TRACE 171 Å images (c1-c3) and a composite image of inner 195 Å with outer LASCO C2 difference images (d).

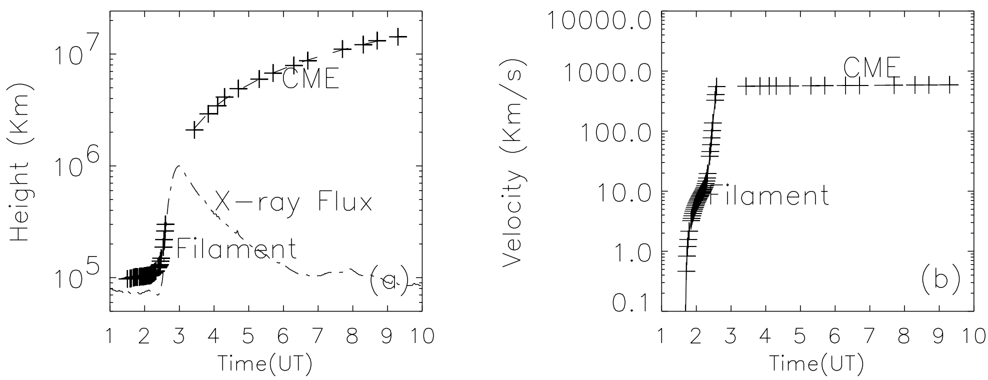

Figure 2. (a) GOES-8 soft X-ray flux (dash dot line), F1 and CME height (b) The velocity of F1 and CME front.

02:35 UT. The velocities of F1 and CME are shown in Figure 2((*b*)). Obviously, the CME front velocity was basically a constant, and the average acceleration from a second-order fit was only about 1.5 m s^{-2}. However, the F1 height and velocity profiles show a fast acceleration during the impulsive phase of the flare. Thus, the major acceleration of the CME should take place at its early stage (Zhang, *et al.* (2001)). It seems that the F1 eruption, the flare and the CME could be regarded in a same eruptive process framework (Wang *et al.* 2003).

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