

The CME dynamics associated to the prominence eruption of December 2, 2003

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Abstract. We report on a complex study of a typical large W-limb CME event occurring on December 2, 2003 in the vicinity of AR 0508. It is associated with a prominence eruption which has been observed with the Pic du Midi Ha flux coronagraph as well as in EUV by both the SOHO/EIT and the Coronas/SPIRIT space telescopes. The eruption started with the emergence of a fast expanding loop between 9 and 10 UT, followed by a heating and an acceleration of the erupted material and resulted in three-part CME observed by LASCO after 10:50 UT. A temporal analysis of the prominence motion and the EUV dimming light curve have shown that both the frontal structure and the core of a CME were initiated simultaneously with the peak of the X-ray C7.2 flare. The total mass of the prominence including the H α filament and EUV filament channel is close to the mass of the core but significantly less than the total CME mass.

Keywords. Sun: corona, Sun: coronal mass ejections (CMEs)

We report on a large W-limb event, which occurred on December 2, 2003, 9-14h (hereafter UT), in the vicinity of an old multi-polar region 10508. The prominence eruption was observed in H α with the HACO coronagraph, in EUV with SOHO/EIT and CORONAS-F/SPIRIT telescopes. The associated CME was observed later with the LASCO C2 and C3 white-light coronagraphs. Two weeks before a large two-part filament was seen to the North of NOAA AR 10508 in H α as well as in EUV (EUV filament channel - EFC). In H α the filament has a full length of 250 Mm, a width - 10 Mm and a volume - $2 \cdot 10^{28}$ cm³. Following Heinzel et al. (2003), for measured $\tau \sim 1$ we estimated the neutral hydrogen density $n_1 = 1.6 \cdot 10^{10}$ cm⁻³, electron (H-ion) density $n_e = 1.7 \cdot 10^{10}$ cm⁻³, and the mass of the H α filament $M_H = 2 \cdot 10^{15}$ g. The total mass including the EFC (Aulanier&Schmieder 2002, Heinzel et al. 2003) was then $M_F = 3 - 4 \cdot 10^{15}$ g.

On December 2 after 09:10 the prominence was seen in H α with the HACO coronagraph at Pic du Midi observatory (Romeuf et al. 2006) as a luminous object due to UV and EUV excitation of hydrogen by radiation of corona and chromosphere (Henzel&Rompolt, 1987). At 09:13 a new fast expanding loop emerged in the center of AR 508 and destabilized the prominence. Fig.1 shows the most important stages of this process seen in HACO (a-c) and EIT 195 Å (d-f) as well as integrated light curves in H α (in the 250-270⁰ sector), 195 Å (the same sector) and in X-rays (GOES). The brightness of the prominence first increased in H α (maximum at 09:35) due to growth of turbulence (see Gontikakis et al. 1997), then decreased in H α and increased locally in EUV due to heating process. At 09:48 (which coincides with the maximum of the C7.2 flare) the

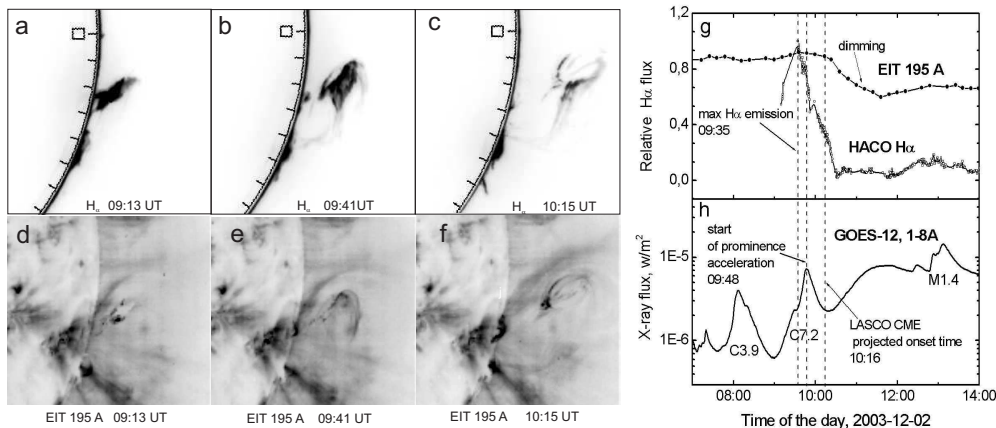


Figure 1. Dynamics of eruptive prominence of December 2, 2003. (a-c) H α HACO images. (d-f) EIT 195 Å images at the same times. (g) Total brightness light curves in H α and EUV 195 Å integrated over the sector 250-270°. (h) X-ray GOES flux

prominence began to accelerate and move outward with the hottest part directed to the Sun.

The three-part CME appeared in the LASCO C2 after 10:50. As a result of the CME development, the streamer seen before at the periphery of the region, deflected to the South, and its brightness increased. At the distances from 4 to 25 R_{\odot} the frontal structure moved with a near constant velocity of 1393 km/c, the core - with a velocity of 942 km/s. The estimated C2 masses with correction for the streamer brightness (which is equivalent to the mass $2 \cdot 10^{15}$ g) are: for the frontal structure $6 \cdot 10^{15}$ g, for the core - $4.6 \cdot 10^{15}$ g. The total C3 CME mass at 13:42 (25 R_{\odot}) is $1.5 \cdot 10^{16}$ g.

To study the CME initiation we analyzed the EUV dimmings in 175 (SPIRIT) and 195 Å (EIT) using earlier developed image pre-processing and dimming photometry procedures (Chertok et al. 2004, Chertok&Grechnev 2005, Slemzin et al. 2006). The drop of intensity in the dimming area relative to the total solar flux before the eruption was about 7% in 195 Å and 4.5% in 175 Å bands. The intensity in the dimming area started to decrease at the time of the prominence activation and the maximum of X-ray flare, so we can conclude that all three processes: initiation of the CME frontal structure, initiation of the core and X-ray flare occurred simultaneously within the temporal resolution of the EUV observations (12-15 min).

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