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Filament Disparition Brusque and CME – September 25–26, 1996 Event

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Abstract.
During the September 1996 campaign of multi-wavelength observations with the SOHO (SUMER, CDS, EIT, MDI, LASCO) and Yohkoh (SXT) spacecraft, the HAO Mauna Loa Solar Observatory Chromospheric Helium Imaging Photometer and the Nobeyama radioheliograph, a filament disparition brusque (DB) associated with a Coronal Mass Ejection (CME) was observed. The timeline of this complex event, which lasted for tens of hours, shows that the CME had started before the DB of a filament, while the main "bubble" of the CME was probably launched hours after the DB from the so-called "zipper" region. All these suggest that a general reorganization of large-scale fields was taking place on the Sun, and both the DB and the CME were symptoms of this.

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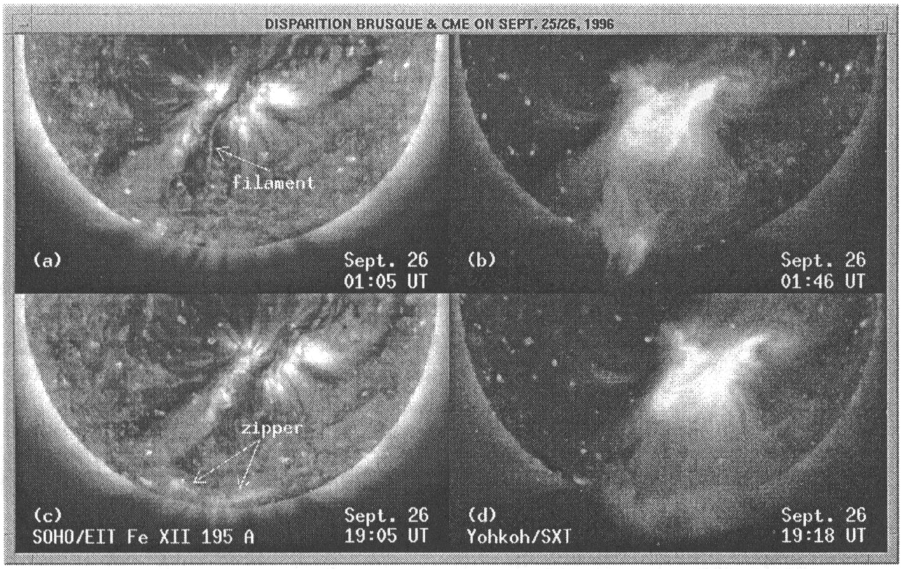

Figure 1. Partial images showing the (a, c) EUV and (b, d) soft X-ray images of the AR during the event including the DB of the filament and the evolution of the 'zipper' structure.

1. Observations

On September 25–26, 1996, a face-on CME event occurred (van Driel et al. 1998) in the dispersed bipolar remnant of active region (AR) NOAA 7986 during its central meridian passage. A long filament lay along the magnetic inversion line reaching South as far as the polar crown (Figure 1a). At the polar crown the inversion zone turned westward forming a so-called switchback, which is a favourable configuration for CME activity (McAllister et al. 1998). Linear force-free magnetic field line extrapolations (Figure 2) show that the coronal (X-ray) arcade overlying the filament channel was more sheared in the Northern part ($\alpha \approx 1.4 \times 10^{-2} Mm^{-1}$) than in the Southern part of the AR ($\alpha \approx 1.0 \times 10^{-2} Mm^{-1}$). During the hours prior to the DB, flux emergence and cancellation took place at different locations along the filament channel accompanied by coronal activity (X-ray bright points, loop brightenings, even cusp structures). Filament disturbances (movement at the Southern end) started after 21 UT on September 25, leading to the disappearance of the filament in He 10830Å by 23:45 UT (White et al. 1998). It is noteworthy that the filament was observed longer (20–30 min) in absorption in microwaves at Nobeyama.

In soft X-rays (SXRs) observed by Yohkoh/SXT a transient cusp-like structure appeared as early as 22:07 UT, when the filament disturbance had started, but the filament had not erupted yet. The X-ray cusp structure might indicate the presence of a primary reconnection involving larger-scale (e.g., polar crown) fields in the high corona prior to the filament eruption as suggested by Antiochos (1997, private communication).

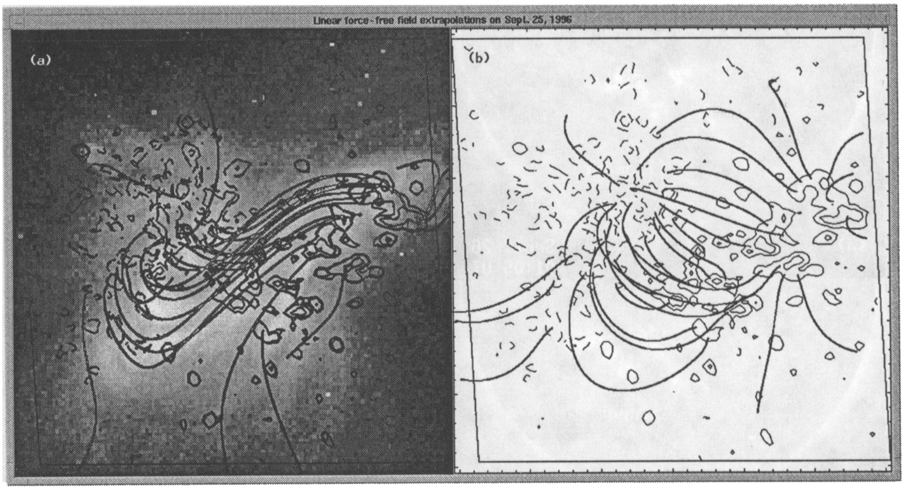

Figure 2. (a) Linear force-free field extrapolations of a SOHO/MDI magnetogram (September 25, 01:41 UT) with $\alpha = 1.0 - 1.4 \times 10^{-2} Mm^{-1}$ (decreasing from N to S) show a good agreement with the observed coronal loops (Yohkoh/SXT, 01:43 UT), while (b) the potential field lines do not match the observations.

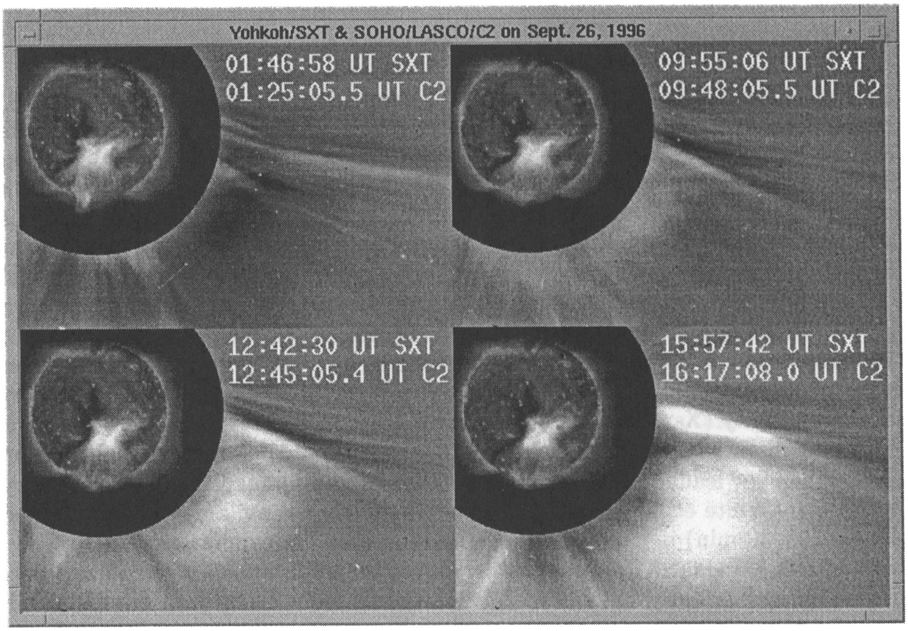

Figure 3. Co-aligned Yohkoh/SXT and SOHO/LASCO C2 images show the evolution of lower coronal structures and the CME.

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Only the southern part of the filament outside of the AR disappeared, while the filament inside the AR underneath the sheared coronal loops was only heated, thus appearing in emission in three SOHO/EIT wavelengths (in the Fe lines, cf. Figure 1a) and in SXRs (as observed between 00:24–01:46 UT, cf. Figure 1b). In SXRs cusped arcade formation started immediately after the DB (23:46 UT, Figure 1b) followed by an arcade formation along the polar-crown part of the switchback inversion zone (Figure 1d). The latter event was named 'zipper' and it was observed for tens of hours in all four EIT wavelengths as a growing chain of bright points, which were apparently the footpoints of an arcade of loops observed in SXRs (Figure 1c, d).

The SOHO/LASCO images (Figure 3) showed a CME moving outward over several days. The "primary" CME appeared as a "ragged front" between 23:25 and 01:25 UT. The CME spanned almost 140° in position angle (PA) and was centered at PA=205°. There were several dark and bright loops (non-concentric) embedded in the ragged front, and the height-time measurements for an early feature indicate a gradual acceleration through the C2 and C3 fields with a final speed measurement at 29 $R_\odot$ of about 420 km s^{-1}.

The latter "bubble" became visible in the C2 field of view only at about 09 UT, or nine hours after the DB of the filament (Figure 3). We should keep in mind, that this was a face-on CME event, therefore, projection effects may play an important role in this late appearance of the "bubble" believed to contain the erupted filament. On the other hand, the filament eruption along the N-S part of the switchback was followed by a coronal arcade formation along the connecting E-W part of the switchback inversion zone. Thus, it is possible that the main "bubble" of the CME was *not directly* linked to the filament DB, but to the "zipper" arcade along the polar crown. The filament eruption was more probably linked to the "primary" CME which appeared as a "ragged front" between 23:25 and 01:25 UT above the South pole.

2. Conclusion

This CME was a complex event lasting for tens of hours in which multiple events of activity appeared, suggesting that a general reorganization of large-scale fields was taking place on the Sun. Both the DB and the CME were symptoms of that.

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