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CONTRIBUTED POSTER

The initiation of a Coronal Mass Ejection as observed by STEREO/EUVI.

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Abstract: This study examines different stages of a Coronal Mass Ejection's (CME) initiation in NOAA Active Region (AR) 10980, observed on January 2, 2008 by STEREO's Extreme UltraViolet Imager (EUVI) at 171Å. We identify a first phase consisting of an upward motion, which at $1.58R_\odot$ reaches the velocity of $70 \pm 4kms^{-1}$. Those measurements are extrapolated to later time frames to examine whether this initial acceleration drives the CME's propagation later on. We also identify the flux-rope within the CME. During the CME formation, there are observations of adjacent loops inclining towards and eventually disappearing into the main body of the CME. At the later phase of the initiation, some moving blob-like structures appear beneath the developing CME envelope. We measured the propagation speeds of these blobs. These blobs could be indications of mass unloading beneath the CME that may contribute to the kinematic behaviour of the event.

1 Evolution of CME

1.1 Height-Time Evolution of CME

We study the ascending phase of a CME on January 2, 2008, from 07:33:00 UT, when it started accelerating, until 09:11:00 UT, when it exited EUVI's FoV, with a cadence of 2.5 min. A polynomial fit to the height-time measurements, gives that the CME's front point during that time frame evolves according to:

$$h(t) = -1.4 \times 10^{-7} t^3 + 0.0135t^2 - 9.18t + 938036 \quad (1)$$

where h is in km, t in seconds and t=0 is 07:33:00 UT. From the 2-point derivative on the data, we find the velocity to be:

$$v(t) = 1.2 \times t^2 + 5.0 \times 10^{-3} t - 1.7 \quad (2)$$

where v is in kms^{-1} and t in seconds. Then, the derivative of the velocity gives the acceleration as a function of time, which is:

$$a(t) = 3.3 \times 10^{-3} t + 3.5 \quad (3)$$

where a is in ms^{-1}. The height and velocity measurements as a function of time are presented in Figures 1, respectively.

The last height measurement was taken at 09:11:00 UT. At that point the CME has reached a height of 1.58 $R_\odot$ with velocity $70 \pm 4kms^{-1}$. Zhao et al (2010) has measured the subsequent evolution of this CME, afterwards of 10:00:00 UT. By extrapolating our velocity results at 10:00:00 UT, we get $v_{extrapollation} = 140 \pm 8kms^{-1}$, whereas the results of Zhao et al (2010) indicate a velocity v $200kms^{-1}$. This discrepancy, yields a further phase of acceleration of the CME between the end of our measurements and the beginning of those in Zhao et al (2010).

1.2 Flux Rope Ascendance behind the CME

Underneath the ascending CME loops, at 09:01:00UT, a more intensively emitting region starts to appear. This region, becomes fully visible at 09:21:00 UT, and can be identified as an ascending

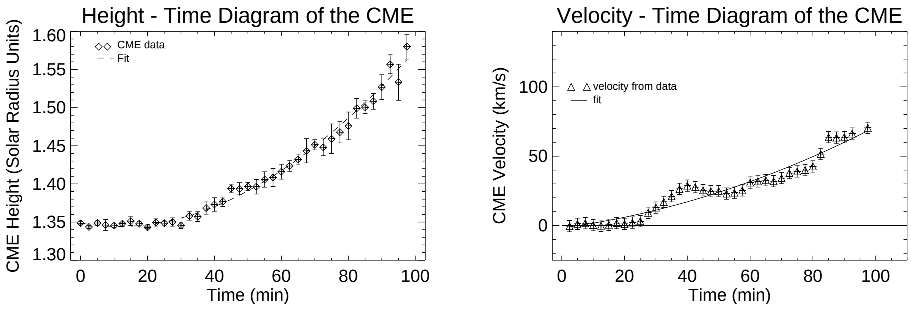

Figure 1: *Left:*CME height-time diagram. A polynomial fitting function is over-plotted. *Right:*Velocity-time diagram. Each point corresponds to the 2-point derivative on height. The time scale in both plots is the absolute time of the event, with t=0 set to be 07:33:00 UT

new magnetic flux-rope. Though the first observations of this structure are unclear, height-time measurements of the loop's edge give an initial speed of $82.2 \pm 15.6kms^{-1}$, and an acceleration which is $-0.086 \pm 0.029kms^{-1}$. The flux-rope initially seems to rise rapidly from the photosphere with a decelerating rate (from 09:01:00 UT until 10:00:00 UT). Afterwards, it is observed to untwist and continues to rise slowly.

1.3 Mass Outflow Indications

Beneath the rising CME envelope, afterwards of 09:21:00 UT, there is an observable increase in the brightness of certain features. The features vary in length from dot-sized to extend linear structures and move along or within the strands of a filament overlying the photospheric neutral line. Due to the viewing geometry, the blobs were not visible from STEREO-A, so the measurements were taken only from STEREO-B. In order to correct the projection effects, we assumed that the flow's plane is the same with the one of the CME.

We measured three moving blobs, with average velocities $179(8)kms^{-1}$, $141(6)kms^{-1}$ and $85(4)kms^{-1}$. As the appearance of these blobs coincides with the rise of the flux-rope, we believe that they contribute to the rise of the CME because they may indicate mass evacuation from the rising structures.

2 Conclusions

We report *Extreme UltraViolet Imager (EUVI)* observations at 171Å by *STEREO* of the very early initiation of the January 2, 2008 CME. We present the corresponding height-time and velocity-time diagrams during the first 100 minutes of the CME, indicating that the CME reached a speed of about 100 km/s at the end of the approximately 2 hours interval of its initiation.

These observations of the initial phase of the CME up to about 1.58 solar radii are **complementing recent observations for the subsequent acceleration and propagation of the same partial halo CME** by SoHO and STEREO in the inner Heliosphere, up to 60 solar radii, to much higher speeds of more than 800 km/s (Zhao et al, 2010). We also followed the evolution of an emerging flux tube beneath the CME, which may be related to the triggering of the eruption.

Fast moving blob-like structures appear along the CME flanks and could be interpreted as mass unloading of cool and dense chromospheric plasma from the rising CME fluxrope.. The reported results, in combination with those of Zhao et al (2010), **provide a full coverage of a particular CME**, from its initiation at the base of the Corona up to 1.58 solar radii and then up to 60 solar radii. The reported results will be useful for an improved theoretical understanding of these violent events of the solar atmosphere.

References

[1] Zhao X.H., Feng X.S., Xiang C.Q. Liu Y., Li Z., Zhang Y., Wu S.T., Ap.J. 714, 1133-1141 (2010)