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MULTI-INSTRUMENT OBSERVATION OF A FILAMENT ERUPTION AND ASSOCIATED CME DEFLECTION

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Abstract. We present the results from the investigation of a filament eruption, occurring in the southern solar hemisphere on October 18, 2017. The event was observed in the field-of-view of Atmospheric Imaging Assembly (AIA) onboard the Solar Dynamics Observatory (SDO) and STEREO A observatory and was associated with a halo CME. The CME displayed a strong non-radial motion towards the pole. The eruption started behind the limb, from a circular filament, close to the disk center.

We studied the eruption kinematic, using data from EUVI STEREO A. Additionally, the latitudinal offset of the CME with respect to the erupting filament in the LASCO field-of-view was examined.

1. INTRODUCTION

One of the most studied phenomena in solar physics is the eruption of solar prominence or filament, if seen on the disk. They are frequently associated with coronal mass ejections (CMEs). The erupted material can be observed as a bright core of CMEs (Munro et. al (1979); Schmieder et. al (2013); Seki et. al (2021) , and references cited therein). During the CME propagation in the interplanetary space a deflection from the radial direction can be observed in some cases (for example: Zuccarello et. al (2012); Koleva et. al (2024). To comprehend the geoeffectiveness of solar eruptions, it can be essential to investigate the deflection of filament eruption and CMEs.

In this work we present the study of a filament eruption that occurred in the southern solar hemisphere on October 18, 2017. The event was associated with a halo coronal mass ejection and was observed from two space observatories. Here we focused on the associated CME and its offset from the radial propagation. The used data and observations from two points of view are introduced in Section 2. Section 3 provides our results and the short summary is given in Section 4.

2. DATA AND OBSERVATIONS

The prominence eruption (PE) occurred at the southern solar hemisphere between 03:36 UT and 06:02 UT on October 18, 2017 in the AIA/SDO field-of-view (FOV). The eruption was associated with a halo CME, observed by SoHO/LASCO coronograph. The CME displayed a strong non-radial motion towards the pole. The source region of the eruption was located behind the limb and was registered by STEREO A observatory.

For the current study we used data from the following sources:

1. Solar Dynamics Observatory (SDO): We used data from Atmospheric Imaging Assembly (AIA: Lemen et. al 2012) on board the Solar Dynamics Observatory (SDO: Pesnell et. al 2012) in 304 Å channel.

2. Large Angle Spectroscopic Coronagraph (LASCO): To study the associated CME and its non-radial motion, images obtained by the Large Angle and Spectrometric Coronagraph (LASCO) (Brueckner et al. 1995) onboard the Solar and Heliospheric Observatory (SOHO; Domingo et al. 1995) were also analyzed. LASCO has two working coronagraphs, namely, C2 and C3 that observe the Sun in white light from 2.5 to 30 $R_{\odot}$.

To determine the CME position angle (PA) we also used the CME Catalog available online at the Coordinated Data Analysis Workshop (CDAW) Data Center (Yashiro et al. 2004; Gopalswamy et al. 2009) and the measuring tool therein.

3. Solar Terrestrial Relations Observatory Ahead (STEREO A): The filament eruption behind the limb was analyzed by observations in the 304 Å channel of the Extreme Ultraviolet Imager (EUVI) onboard STEREO Ahead (A) spacecraft (STEREO A: Kaiser et. al 2008).

3. RESULTS

Two distinct perspectives were used to examine the observed eruption and related CME. The results from our analysis are presented as follows:

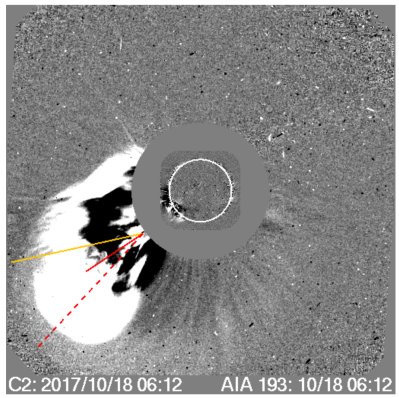

Figure 1: SOHO/LASCO/C2 and AIA/SDO 193 Å composite image at 06:12 UT. The initial PE direction is indicated by a yellow line. The CME PA at 05:48 UT and 06:12 UT are shown by red and dashed red lines, respectively.

3. 1. SDO FOV

The eruption started in AIA FOV at 03:36 UT at PA of 108° and was associated with a halo CME. The CME first appearance at the LASCO/C2 field of view was at 05:48 UT and had a linear speed of 1576 km/s. The initial PA of the PE is taken from the Catalog of Prominence Eruptions compiled from SDOs Atmospheric Imaging Assembly in the 304 Å passband (Yashiro et al. 2020).

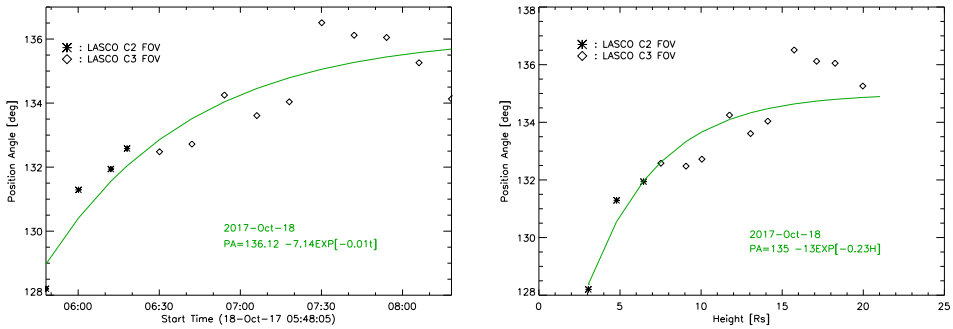

Figure 2: *left:* Variation of the position angle of CME nose as a function of time. Stars and diamonds represent measurements, respectively from C2, and C3 coronagraphs of SOHO/LASCO. *right:* CME PA at various heliocentric distances.

During the next 2 hr and 36 min, the CME nose and the prominence underwent a significant poleward deflection to PA of about 137°. Figure 1 shows the latitudinal offsets between the initial PE direction (indicated by a yellow line) and the CME PA at two different time. The PA offset between the initial PE location and the CME nose was 29° to the pole.

In Figure 2 the variation of the position angle of CME core and nose as a function of time (*left*) and heliocentric distances (*right*) are presented. The measurements were made in the FOV of LASCO/C2 and LASCO/C3 coronagraphs. The solid lines are the fit to data points. It is evident from the figure that non-radial motion gradually decreased and stopped at about 10 $R_{\odot}$.

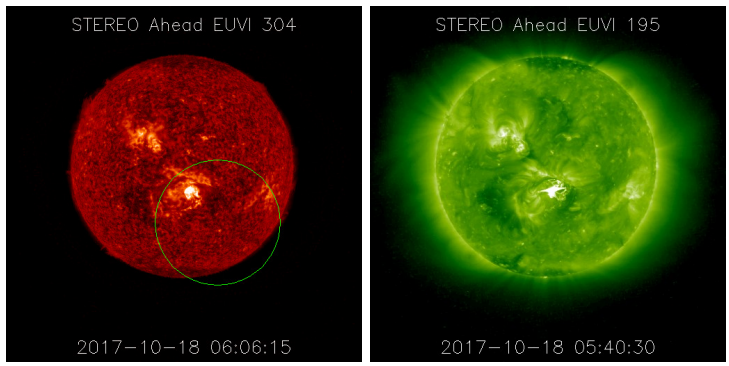

Figure 3: Images from EUVI A in the 304 Å channel (*left*) and 195 Å channel (*right*), showing the filament eruption and the flare. The green circle marks the filament eruption.

3. 2. STEREO A FOV

The source region of the eruption was located behind the limb and was well observed by STEREO A observatory. At the time of observation the separation angle of the STEREO A spacecraft with Earth was 125.617°.

In quet state the filament behind the limb represented a circular filament and was linked to the solar flare (Figure 3).

In Figure 4 two snapshots of eruption evolution as observed in 304 Å channel from EUVI instrument onboad the STEREO A observatory are presented.

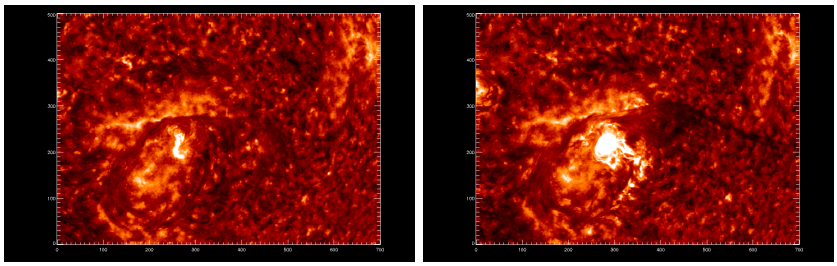

Figure 4: Eruption evolution as observed in EUVI A in the 304 Å channel at 05:23 UT (*left*) and 06:11 UT (*right*).

4. SUMMARY

We analyzed the filament eruption, occurring in the southern solar hemisphere on October 18, 2017. The event was observed by the Solar Dynamics Observatory and STEREO A observatory and was associated with a halo CME and solar flare. The CME displayed a strong non-radial motion towaths the pole.

We focused mainly on the latitudinal offset between the prominence location and CME propagation. PA offset between the initial PE location and the CME nose was 29° to the pole. The deflection stopped at about 10 $R_{\odot}$.

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