Coronal and Stellar Mass Ejections
Proceedings IAU Symposium No. 226, 2005
K. P. Dere, J. Wang & Y. Yan, eds.

doi:10.1017/S174392130500058X

Four Corona Mass Ejections and their Associated Surface Activity Observed on 26 October 2003

Xingming Bao[1], Hongqi Zhang[1], and Jun Lin[2]

[1]National Astronomical Observatories of China, Chinese Academy of Sciences, Beijing 100012, China
email: baoxm@sun10.bao.ac.cn

[2]Harvard-Smithsonian Center for Astrophysics, 60 Garden Street, Cambridge, MA 02138, USA

Abstract. Four coronal mass ejections (CMEs) occurs successively from the solar disk near the west limb on October 26, 2003. They, together with the associated activities of the solar surface, were observed by various instruments both in space and on ground, such as the Large Angle and Spectrometric Coronagraph Experiment (LASCO), the Extreme Ultraviolet Imaging Telescope, and the Michelson Doppler Imager on board the *Solar and Heliospheric Observatory,* as well as the Huairou Solar Observing Station and the Big Bear Solar Observatory. These four events start with a filament eruption that manifests a two-ribbon flare in a spotless region, destroyed a helmet streamer, and give rise to an X1.2 flare in the active region AR0484. We notice that these eruptions occur either in active region, or in quiescent region, or in the region without any precursors. The time profiles of the CME (filament) heights show that the main acceleration takes place within one solar radius ($R_\odot$) from the solar surface, and that all the CMEs almost propagate at constant speeds as they appear in the field of view of LASCO C2. We conclude that the most dynamical process of each of these CMEs happens at the altitudes lower than one $R_\odot$ from the surface. Among the four activities, the fourth one comes from AR10484 and shows the largest speed projected on the sky plane, which is about 1500 km s^{-1}; and the first filament shows the largest acceleration, $\sim$ 50 m s^{-2}.

Keywords. Sun: activity, coronal mass ejections, filaments, flares

1. Introduction

Both observations and theories suggest that CMEs be involved in the reorganizations of large scale magnetic fields in the corona, be closely related to the eruptive activities (e.g., solar flares and eruptive prominences) on the solar surface (see Forbes 2000; Priest & Forbes 2000; Lin et al. 2003 for reviews), and often be related to disruptions of helmet streamers over the solar limb (e.g. Raymond 2003 and the references therein).

A series of eruptions occurring on October 26, 2003 provides us a set of nice samples that allows us to investigate various CMEs discussed above: two CMEs starting with the eruptive prominences in the spotless region, a CME from an active region, and a CME that develops from a helmet streamer and has the magnetic structure of the helmet streamer as one of its legs. We give the results deduced from these data in next section, discuss our results and finally summarize this work in Section 3.

2. Results

The active region AR0484 is located on the west solar disk (N10, W50) on 2003 October 26 . A long filament and a short filament, which are denoted as F1 and F2 respectively,

stayed at southwest to AR0484. Filament F1 erupts at 00:12 UT and gives rise to a CME, of which the leading edge enters the field of view (FOV) of LASCO C2 at 01:30 UT, and a two-ribbon flare starts to develop from 01:48 UT at the location where F1 used to sit. As both CME1 and the associated two-ribbon flare are in progress, filament F2 begins to take off at around 01:25 UT. The eruption of F2 yields a CME with a complex double-loop structure that enters FOV of LASCO C2 from 5:00 UT and also leads to a two-ribbon flare very close to the previous one.

The third CME undergoes with the destruction of a helmet streamer located at position angle $\sim 45^\circ$ and is north to the previous two CMEs. In the processes of CME1 and CME2, the helmet streamer is slightly deflected. Unlike the other CMEs that grow from the helmet streamer (Raymond 2003), CME3 of the present case spans around 90° over the north pole and the helmet streamer consists of the legs of the corresponding expanding arcade. Due to the projection effect, the real span of CME3 must be wider than 90°. Because it is a slow CME, no apparent surface activity can be correlated to CME3.

The fourth CME is obviously related to AR10484. EIT 195 movie shows a series of successive precursors starting from 11:00 UT until 16:48 UT when an eruption-like activity occurs in the region south to AR0484, then a significant brightening in EIT 195 commences at 17:24 UT when an X1.2 flare is observed. Correspondingly, a CME front begins to appear in FOV of C2 at 17:54 UT.

The height-time profiles of the four CMEs and the eruption of the long filament have been plotted. The four CMEs show a nearly constant velocity after appeared in LASCO C2 and the first filament shows the largest acceleration, ~ 50 m s^{-2} before appeared in LASCO C2.

3. Discussions and Conclusions

We have selected four CMEs in this study with various origin and propagation which appeared above the west limb on October 26, 2003. Though the four CMEs are not enough to account for characters of all CMEs, we believed that the four CMEs represent various CMEs, either with different origins or without, in active region or in quiescent region, speed ranging from 200km/s to nearly 2000km/s. We try to link the eruptive phenomenon occurred in difference height to a single physical process by using the data from chromosphere to out corona. The height-time profile show that most CMEs propagate in a nearly constant speed since it appeared in C2. The height-time curve of filament and its derived velocity-time and acceleration-time curve show a significant acceleration ($50\,\mathrm{m/s^2}$) within $1\mathrm{R}_\odot$. This reveal that the dynamical process of eruptive events mainly happen within 1 $R_\odot$ (from solar disk).

Our study suggests that the CME related to the disruption of streamer maybe caused by impact of CMEs leading edge originated beside streamers and may pull out large mount of plasma which trapped within their closed loop. Our study suggests that such a CME belongs to a different class of CMEs to those associated with flare and filament eruption, both in triggering mechanism and propagation.

References

Forbes, T. G. 2000, *J. Geophys. Res.* 105, 23153

Lin, J., Soon, W., & Baliunas, S. L. 2003, NewA Rev., 47, 53

Priest, E. R. & Forbes, T. G. 2002, A & A Rev., 10, 313

Raymond, J. C., Ciaravella, A., Dobrzycka, D., Strachan, L., Ko, Y.-K., Uzzo, M., & Raouafl, Nour-Eddie 2003, ApJ, 597, 1106

https://doi.org/10.1017/S174392130500058X Published online by Cambridge University Press