Some Properties of prominence eruption associated CMEs during 1996-2009

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Abstract. Solar prominences can be viewed as pre-eruptive states of coronal mass ejections (CMEs). Eruptive prominences are the phenomena most related to CMEs observed in the lower layers of the solar atmosphere. We have made a comprehensive statistical study on the CMEs associated with prominence eruptions. We have examined the distribution of CMEs speed and acceleration for prominence eruptions associated CMEs. We also examine the speed-acceleration correlation for these events and there is no correlation between speed and acceleration. The mean angular width is almost similar to normal CMEs. The number variation during solar cycle of prominence activities is similar to the sunspot cycle.

Keywords. Sun; coronal mass ejections; prominence eruptions;

1. Introduction

CMEs are often seen as spectacular eruptions of matter from the Sun, which propagate outward through the heliosphere and often interact with the Earth's magnetosphere (Hundhausen 1997; Mittal & Narain 2010 & references there in). It is well known that these interactions can have substantial consequences on the geomagnetic environment of the Earth, sometimes resulting in damage to satellites (Mittal *et al.* 2010. The "classical" structure of a CME consists of three parts and one of these parts, a bright core, is the remnant of an eruptive prominence (Crifo *et al.* 1983; Illing & Hundhausen 1985; Hundhausen 1999 and Gopalswamy *et al.* 2006, Mittal & Narain 2010).

2. Data and results

Over the past 14-years the SOHO/LASCO instrument has been detecting CMEs. The LASCO instrument (Brueckner *et al.* 1995) consists of three coronagraphs C1, C2 and C3 that span the fields of view 1.1-3$R_\odot$, 2-6$R_\odot$S and 4-30$R_\odot$, respectively. The height-time data of CMEs used in this study are taken from the online SOHO/LASCO CME catalogue (http://cdaw.gsfc.nasa.gov/CME_list). The Prominence Eruption data has been taken from Nobeyama Radioheliograph; which detect 396 events during the period. The distribution of Prominence Eruption associated CMEs has been shown in Figure 1. It seems that the peak of the histogram occur at 350 km s^{-1}; where the tail of large speeds is very short. The overall median (average) speed 447 (511) km s^{-1}; respectively. Figure 2 is the histogram of apparent angular width for the period 1996–2009. The average width from the 14–year data for Prominence Eruption associated CMEs (390) is 670 and the median width is 550. Figure 3 is the histogram of CME acceleration for the period 1996–2009. It is clear from this figure that a majority (55%) of Prominence Eruption associated CMEs are decelerated, about 12% of them move with little acceleration and the
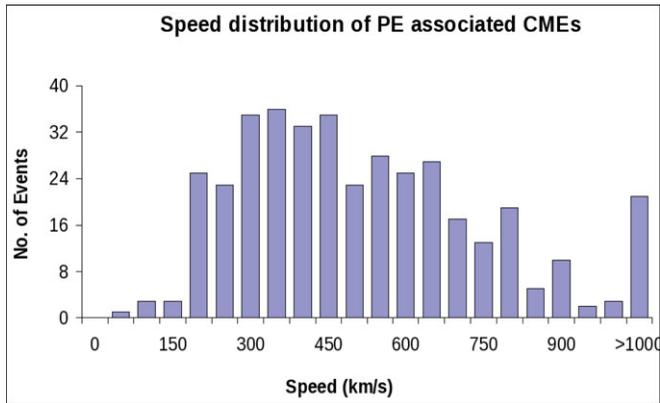
146

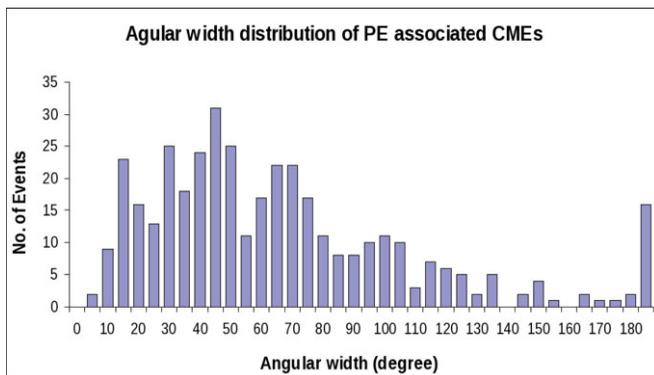**Figure 1.** Histogram shows the speed distribution of Prominence Eruption associated CMEs during 1996-2009.

Figure 2. The width distribution of SOHO/LASCO Prominence Eruption associated CMEs from 1996 to 2009. The last bin shows all CMEs with width ¿1800, which amounts to 5-6% of all Prominence Eruption associated CMEs.

remaining 33% have positive acceleration. Thus Prominence Eruption associated CMEs have clear bias towards deceleration. Figure 4 shows a scatter plot between the measured acceleration, a (in m s^{-2}) and speed, V (in km s^{-1}) of Prominence Eruption associated CMEs for which the acceleration estimate was possible.

Figure 5 exhibits total CMEs and Prominence Eruptions. It is clear from the figure that the solar maximum peak occurs at the year 2000 and 2002. Occurrence rate of Prominence Eruptions follows the solar cycle variation whereas CMEs occurrence rate does not follow the solar cycle variation.

3. Conclusion

In this paper, I have made a comprehensive statistical study on Prominence Eruption associated CMEs from 1996 to 2009. During the period 1996-2009 more than 14000 CMEs observed by SOHO/LASCO, whereas Nobeyama Radioheliograph detect 396 Prominence Eruption events, out of which 390 Prominence Eruptions are associated with CMEs.

1. Figure 1 shows that the Prominence Eruption associated CMEs have median (average) speed 447 (511) km s^{-1}. The number of CMEs having speeds greater than 1000 km s^{-1} is quite small (5-6%).
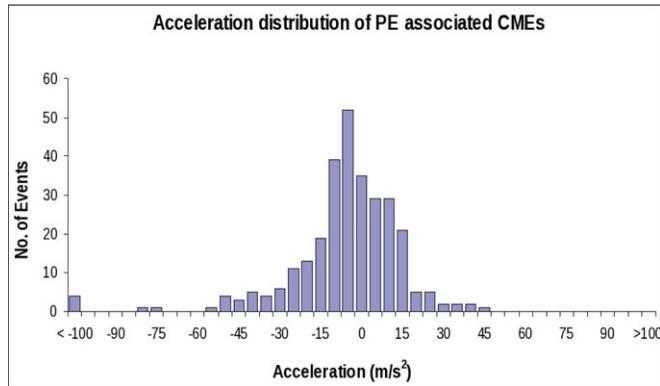
Figure 3. Histogram of acceleration of Prominence Eruption associated CMEs, showing clear bias towards deceleration.
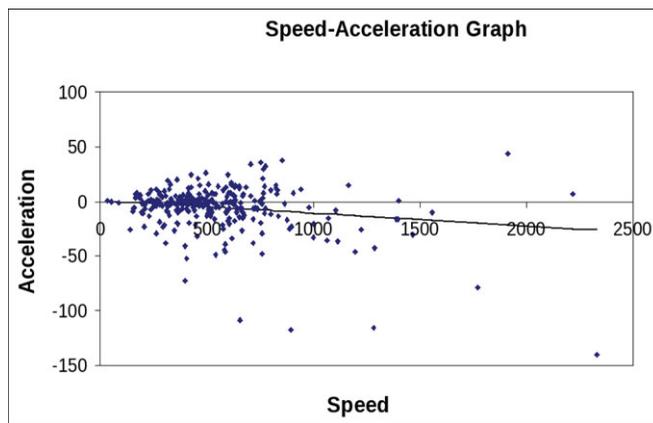

Figure 4. Acceleration as a function of speed of Prominence Eruption associated CMEs from 1996 to 2009. The acceleration has a large scatter, but there is a clear trend that the fast CMEs decelerate, while slow CMEs accelerate.

2. The average width for Prominence Eruption associated CMEs (390) is 670 and the median width is 550.

3. The acceleration distribution shows a conspicuous peak near -5 m s^{-1}, about 55% have negative acceleration, 33% have positive acceleration and the remaining 12% have very little acceleration. The Prominence Eruption associated CME distribution is biased towards deceleration.

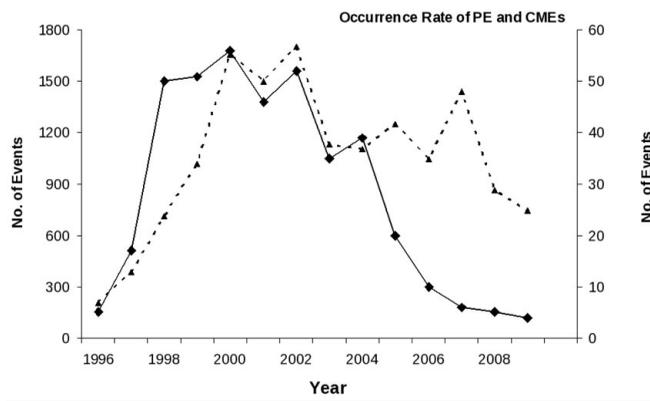4. Rate of Prominence Eruptions varies with solar cycle.

Acknowledgement

Figure 5. Comparison between annual CME occurrence rate and Prominence Eruptions from 1996-2009.

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