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ORIGINAL ARTICLE

Characteristics of CMEs associated with solar flares and DH type II radio bursts based on source position

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Abstract We studied the characteristics of Coronal Mass Ejections (CMEs) associated with solar flares and Deca-Hectometric (DH) type II radio bursts, based on source position during 23rd solar cycle (1997–2007). We classified these CME events into three groups using solar flare locations as, (i) disk events (0–30°); (ii) intermediate events (31–60°) and (iii) limb events (61–90°). Main results from this studies are, (i) the number of CMEs associated with solar flares and DH-type IIs decreases as the source position approaches from disk to limb, (ii) most of the DH CMEs are halo (72%) in disk events and the number of occurrence of halo CMEs decreases from disk to limb, (iii) the average width and speed of limb events (164° and 1447 km s^{-1}) are higher than those of disk events (134° and 1035 km s^{-1}) and intermediate events (146° and 1170 km s^{-1}) and (iv) the average accelerations for disk, intermediate and limb events are -8.2 m s^{-2}, -10.3 m s^{-2} and -4.5 m s^{-2} respectively. These analysis of CMEs properties show more dependency on longitude and it gives strong evidence for projection effect.

Keywords Coronal mass ejection · Solar flares · DH-type II radio bursts

1 Introduction

Coronal mass ejections (CMEs) from the Sun are among the main heliospheric disturbances. The Earth- directed CMEs are important for space weather research since they can produce severe geomagnetic storms. CMEs which produce type II radio emission in the decametric–hectometric (DH) wavelengths (1–14 MHz) are known as DH CMEs or radio-rich CMEs (Gopalswamy et al. 2000, 2001a, 2002). Gopalswamy et al. (2005) studied the properties of the general population of CMEs compared with those of CMEs associated with metric, DH and m-to-km type II bursts during the year 1997–2004. Sharma et al. (2008) studied the properties of radio rich CMEs without dividing the samples for the years 1997–2006. Gopalswamy et al. (2008) reported the properties of radio-quite (RQ) and radio-loud (RL) coronal mass ejections which are fast and wide (FW). They reported that RQ CMEs are not associated with type II radio bursts in the metric and DH wavelengths, while the RL CMEs are associated with metric or DH type II bursts. Hence we are interested to study DH type II bursts based on source position which are more geoeffective.

The longitudinal (eastern and western hemisphere) dependence of the coronal mass ejection occurrence was investigated by Hildner et al. (1976) for 110 CMEs, observed during 227 days of Skylab operation (May 1973 to February 1974). Gopalswamy et al. (2001b) analyzed separately, a subset of limb CMEs associated with DH-type II radio bursts and identified that the speed of the limb CMEs is higher than the CMEs occurring far from the limb, because the limb events are not subjected to projection effects. The study of CMEs from the limb are important since they are the drivers of large geomagnetic storms (Rodriguez et al. 2009). Pappa Kalaivani et al. (2010) studied the characteristics of DH CMEs during the period 1997–2005 by dividing into two categories as DH CMEs (All) and DH CMEs (Limb). In the present work, instead of taking all the DH CMEs, we considered only longitude CMEs since the knowledge of the longitude where CMEs preferentially occur could be useful when we forecast the occurrence of

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