

Coronal Dimming And Waves Observed In Flare-Associated CMEs

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The relationship between solar flares and coronal mass ejections (CMEs) is still an active area of research. It is studied from various aspects. Our goal is to understand the importance of magnetic reconnection in launching CMEs and that of magnetic field environment of the flaring regions to determine how eruptive flares are. We have studied the association of solar flares during 2007-2009 with CMEs, using primarily extreme-ultraviolet (EUV) and inner coronagraphic images from the Solar Terrestrial Relations Observatory (STEREO). While energetic CMEs tend to accompany a flare, flares with relatively high soft X-ray intensity for the extended solar minimum conditions are often found without an associated CME, even though the underlying photospheric magnetic field is strong and complex. In contrast, some of the regions hosting flare-associated CMEs have weak photospheric field, sometimes not even classified as active regions because of no sunspots. Out of several signatures in low coronal images previously raised as proxies for CMEs, large-scale dimming that persists for at least an hour is found to be a sufficient condition. Waves in EUV images, on the other hand, may not necessarily signal an appreciable CME that is still clearly observed beyond, for example, 5 R_{sun}, unless the concurrent dimming is substantial. This suggests that waves detected in EUV images may have more than one origins. We present the result of the survey and discuss a number of well-observed cases focusing on the properties of the flares and CMEs with respect to the extents of dimming and wave.