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A CME and Related Phenomena on 2003 October 26

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Abstract.
We present the observational results of the solar bursts on the band of 1-80 GHz (NORH) associated with both a CME and a flare on Oct. 26 2003. This event shows two parts of radio bursts in the time profile. The first part is associated with an X1.2 flare. However, the following part seams related to both the flare and the CME, as the radio emission is enhanced while the Hα is decreasing. Thus, these two parts of radio bursts may originate from different physical processes, i.e., flare and CME shock. A primary study is performed on the difference between this two parts.

Keywords. Sun: flares, CMEs, radio radiation

1. Introduction

Solar radio microwave type IV bursts are generally thought to be produced by gyro-synchrotron radiation from energetic electrons trapped in the loops (e.g. Dulk 1970). It is widely accepted that magnetic reconnection is responsible for the acceleration of electrons during solar flares. The microwave type IV bursts are the radio bursts of solar flares above the frequency of 1 GHz. On the other hand, the CME shock is thought to be one of effective acceleration mechanism for the energetic electrons in the interplanetary space. It is an interesting question whether the shock can accelerate electrons in the corona in the initial phase? In this paper, we analyze a solar radio burst which takes place in association with a solar flare and a CME on 2003 Oct. 26. We try to seek the evidence of electrons acceleration from the CME shock in the corona.

2. Observations

The data include radio emission data observed by NORH, CME pictures by LASCO, Hα images by HUAIROU, and soft X-ray flux by GOES10. Figure 1 shows the time profiles of soft X-ray emission, solar radio emission at 19 GHz and Hα emission. The time profile of radio bursts can divided into two parts, the first from 06:10 to 06:35 UT, and the second from 06:40 to 7:35 UT (Tan *et al.* 2004). The start and end times of the radio bursts are defined respectively as the times when the intensity rises above and falls below 1.3 times the average intensity before the bursts. It is clear that the second part is much more intensive than the first one. Especially, the last peak in the second part is 3 times bigger than the maximum peak in the first part.

The soft X-ray is relatively gradual, which suggests that the coronal temperature (more exactly, the emission measure) is relatively stable when the radio emission changes

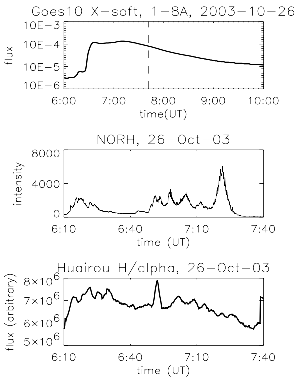

Figure 1. Top: soft X-Ray time profile from GOES10 on Oct. 26 2003. Middle: solar radio bursts from NORH on 34 GHz. Bottom: Hα emission from Huairou.

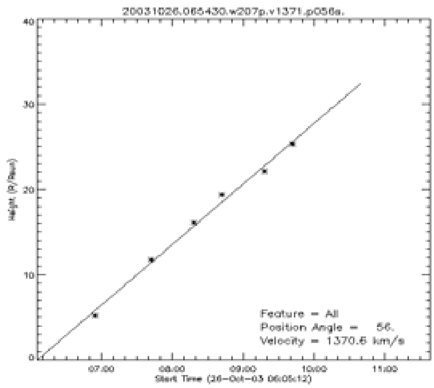

Figure 2. Linear extrapolation back to solar surface (photosphere) of CME event at 06:15 UT.

rapidly. On the other hand, this flare shows an Hα time profile with also two parts. The Hα intensity gradually decreases with time, especially during the second period, while the radio bursts shows a peak 3 times more intensive than the peak in the first part.

Figure 2 shows speed of the third CME event on 2003 Oct. 26. There are in total 6 CME events on that day (Bao *et al.* 2004). This CME is closely related to the flare, because EIT observations show a brightening in the corona during the flare. Later on, LASCO first detected this CME at 06:54 UT. Using linear extrapolation back to the solar surface, this CME event is estimated to start at 06:15 UT, which seams later than the flare.

3. Discussion

The radio bursts on 2003 Oct. 26 show two parts in the time profile. The first part is closely associated with the flare. In the second part, the radio emission increase significantly while the Hα emission decreases gradually. The increasing radio emission suggests that there are much more energetic electrons than before. However, the decreasing Hα intensity implies a gradual cooling of the chromospheric material. So the question is where the energetic electrons originate and contribute to radio emission. It is likely that the electrons are accelerated during the CME event. We propose that both the flare and the CME shock accelerate the electrons during the second part of radio bursts. In comparison, the CME shock may play the main role in the electron acceleration for this radio event (e.g. Caroubalos *et al.* 2004).

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