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On the Initial Phase of Solar Radio Burst Event on 23 September 1998

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Abstract. On 23 September 1998 there was a 3B/M7.1 flare event starting at 06:40 UT with more than 100 minute duration radio bursts of 1134 sfu peak flux at 2840 MHz and accompanying a CME. In this paper, the event is analyzed with the data observed by Beijing Astronomical Observatory (BAO), OSRA-Tremsdorf (AIP) and SSRT-ISTP. In particular, we compare the fine structures (FS) during the triggering phase revealed in different regimes and discuss their implications.

1. Introduction

It is well-known that microwave emission from solar active regions provides a way to diagnose the flare primary-energy release processes (Bastian et al. 1999). The radio dynamic spectra of fast FS's in microwave bursts offer a significant means helpful for us to understand the initial processes of solar flares. Especially, for the 3B/M7.1 flare event at 06:40 UT on 23 September 1998, we are interested in dynamic phenomena (shocks and beams), which are on the radio spectra indicated by the frequency drifts (Kundu, 1965, Kruger, 1979, Bastian et al. 1999).

2. Observations and Discussions

The observational material used was taken by the "Solar Radio Broadband Spectrometers" in the ranges 1-2 GHz and 2.6-3.8GHz of BAO with 20 MHz/100 ms and 10 MHz /8 ms resolutions, respectively (Fu et al. 1995); the swept-frequency spectrographs in the ranges 40-90, 100-170, 200-400 and 400-800 MHz, with a sweep rate of 10 s^{-1} at Tremsdorf of AIP (Mann et al. 1992); and the 2-d inter-

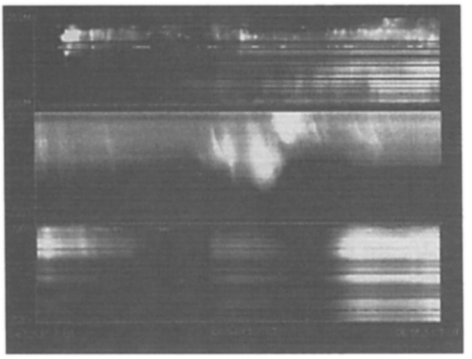

Figure 1. The radio dynamic spectrograms during 06:52:31.7 - 06:55:51.7 UT by 40-800MHz (AIP), 1-2 and 2.6-3.8 GHz (BAO) spectrometers.

ferometer images around 5.7 GHz with about 21″ spatial resolution from SSRT of ISTP (Smolkov et al. 1986).

On 23 September 1998, there was a 3B/M7.1 flare occurred in the active region NOAA 8340 at N18 E09 of solar disk, and radio bursts at many frequency bands have been recorded. *Solar-Geophysical Data* (Nos. 650 and 651, Pt.I, No.655, Pt.II) registered the following event: Hα 3B flare occurred from 06:43UT to 09:36 UT reached its maximum at N20 E09 at 07:01UT; GOES SXR M7.1 flare started at 06:40UT, reached its maximum at 07:13UT and decayed to half-peak flux at 07:31; the radio burst at 2840 MHz started at 06:20UT and ended at 08:09UT with 1134 sfu peak flux at 07:01UT.

The radio dynamic spectrogram with 100 ms temporal resolution in the metric frequency 40-800 MHz range by OSRA-Tremsdorf observed the metric type II burst in the range from 280 MHz to the exterior of 40 MHz at about 06:56 UT to 07:19 UT, which correspond to the accompanying CME event. During the initial phase around 300 MHz metric wave FS's were observed. The very first signature which was possibly causally related with the main event was between 06:52:07 and 06:52:08 UT around 300MHz. It can be seen that the frequency drift was mainly negative as shown in Figure 1.

Figure 1 also shows the radio dynamic spectrograms at 1-2 and 2.6-3.8 GHz with 20 MHz/100ms and 10 MHz/8ms spectral/temporal resolutions by BAO during the same time duration. It can be seen that in 1-2GHz there were also some right-polarized components occurred even earlier than $\sim$ 06:52:50 UT but with positive frequency drift of about 200MHz/s. These right-polarized emission actually started from 06:51:40 UT. If these correspond to the pre-flare phase of the flare, the reconnection might take place in the range between 400MHz to 1000MHz. The slow positive frequency drift around 06:54:20 UT of about 50MHz/s may be related to the initial phase of the CME process (Kliem et al 2000). In the 2.6-3.8 GHz range there were also type III-like burst and DCIM.

The 2-d images of the radio burst at $\sim$ 5.7 GHz by SSRT of ISTP during the beginning of the flare shows that in the intervals of about 06:43:10 UT, 06:46:19 UT and 06:47:47 UT, three rapid FS's have been recorded as shown

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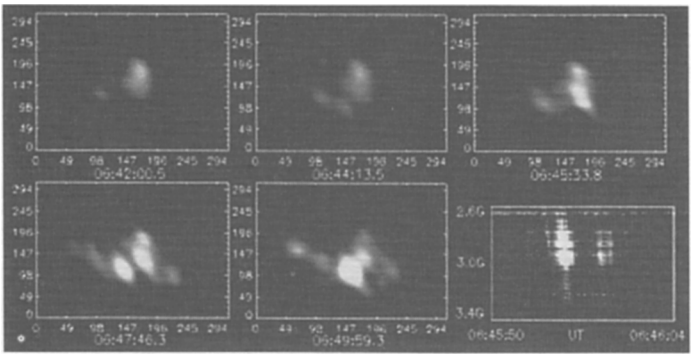

Figure 2. The 2-d images of radio sub-second FS sources by SSRT, and the dynamic spectrogram of FS in 2.6-3.4 GHz with 8ms resolution (BAO).

in Figure 2. The first two events were sets of sub-second pulses not correlated with hard X-rays, whereas the last event showed moving "plasmoids" (or waves) in space. Around 06:45:54-59 UT, the 2.6-3.8 GHz spectrometer with 8 ms resultion observed type-III like FS with a positive frequency drift of about 710 MHz/s, shown in Figure 2 as well. If these fine structures were relevant to the initial phase of the flare-CME process, we might imagine that the sub-second FS's in 5.7 GHz revealed lower part of the large-scale loop whereas the type III like burst in 2.6-3.1 GHz showed downward beam from reconnection region.

In summary, the radio FS's during the initial phase revealed in different regimes may be relevant to the triggering of the flare. The radio FS's in 1-2 GHz and 2.6-3.8 GHz showed positive frequency drift whereas in 40-800 MHz range showed negative frequency drift, suggesting that the reconnection region may be in the range between 400 to 1000 MHz.

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