Journal of The Korean Astronomical Society
29: S331 ~ S332, 1996

AN ANALYSIS ON THE RARE SUBTYPES OF THE FAST SOLAR RADIO ACTIVITY

R. X. Xie and M. Wang
Yunnan Observatory, Chinese Academy of Sciences, Kunming 650011, China

ABSTRACT

We present 3 rare subtypes of the FFSs observed with high temporal resolution at 4-frequency (1.42, 2.13, 2.84 and 4.26 GHz). The various FFSs occurred during the main and post-flare phase can demonstrate that coronal nonthermal electron acceleration/injection may go through the whole development process of flares, and deduce that there may exist the re-forming of loop-like structures in the post-flare phase, and the complex multi-type magnetic strutures in corona.

I. INTRODUCTION

From the radio fast fine structures (FFSs) we may extract the most information of flare micro-structure of time and space (Aschwanden and Gudel, 1992). The observations and theories of radio ms spikes up to 1996 were summarized (Benz, 1986). The observations of FFSs in the centimetric and decimetric range were summarized (Allaart et al., 1990; Gudel and Benz, 1988). However, there may be many types of FFSs that will be confirmed by the observations in the future. This paper only exhibits 3 rare subtypes of radio FFSs, which are typical events obtained with Yunnan Radio Synchronous Observational System.

II. INSTRUMENTS

The observational system is composed of 4 radio telescopes. A computer is supported by the common software to make real-time synchronous observation with a sampling period of 1 ms. The software makes use of the common preset criteria that is to check the numbers of excess threshold in ms data and automatically distinguish the activity of radio emission, and deposit the data on hard disk for off-line process (cf. Xie et al., 1989).

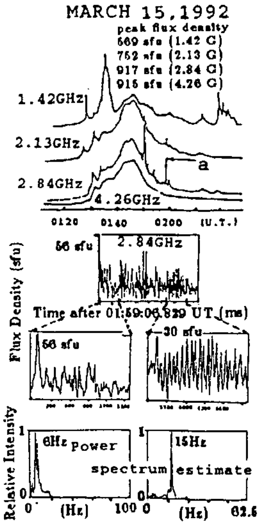

Fig. 1.— (top) The time profiles of radio large burst with the time constant of 1 s. (middle) The millisecond fine structures for 8 s at 2.84 GHz corresponding to the arrow a marked in the top figure, and the plots of enlarged time scale corresponding to the interval marked by the dashed lines in the upper figure. (bottom) The two plots of power spectra estimate at 2.84 GHz corresponding to the plots enlarged time scale.

III. DESCRIPTION OF SUBTYPES

(a) Narrowband Period-Varing Fast Pulsations (Fig.1)

The peculiar pulsations occurred in the decaying phase of large radio burst at 2.84 GHz. The appearing lasted 2—4 seconds. The pulsational period evolved from long to short with time going, i.e., from 167 ms to 67 ms. These period-varing fast pulsations may be caused by the oscillatory wave–particle interactions, (Aschwanden et al., 1990).

(b) Wideband Slowly Shifting Pulsations (Fig.2)

These pulsations began in the impulsive phase of a small type II-like radio burst at 4.26, 2.84 and 2.13 GHz respectively. Total duration of pulsations is about 50 seconds. It appears as a slow frequency drift. The mean drifting rate is about -100 MHz/s. The pulsational periods contain 16 s for three frequencies, also 2.8 s, 5.3 s and 4.8 s successively.

This wideband frequency drifts in microwave range may be regarded as plasma radiation from shocks, moving upwards in small dense loops (Bruggmann et al., 1990).

(c) Microwave Patch-Like Structure (Fig.3)

The patch-like occurred in the impulsive phase of radio burst at four frequencies. There are some diffuse patch-like superimposed on the continua emissions. They appear as the different durations, intensities and shapes. The duration of individual patch is 0.5—2.5 s. The total duration is 16 s. The bandwidth is of ¿= 1.42 GHz. This may be interpreted in terms of the plasma

DECEMBER 26, 1991

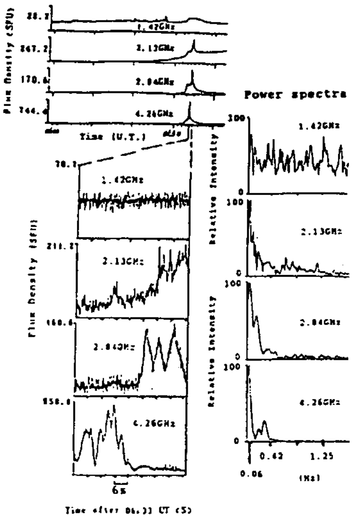

Fig. 2.— (upper-left) The time profiles of radio burst with the time constant of 1 s. (lower-left) The millisecond fine structures corresponding to the interval marked by dashed lines in upper figure. (right) The plots of power spectra estimate of the millisecond fine structures at four frequencies corresponding to the lower-left figure.

MARCH 22,1991

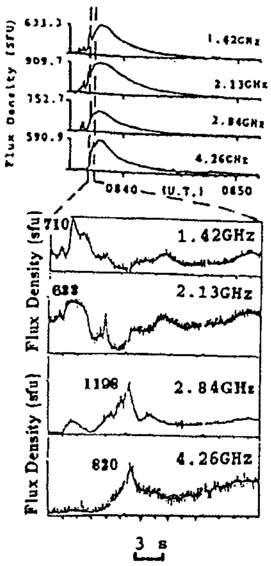

Fig. 3.— (upper) The time profiles of radio burst with the time constant of 1 s. (lower) The millisecond fine structures for 24 s at four frequencies corresponding to a interval marked by the sold lines in upper figure.

or maser emission (Bruggmann et al., 1990).

The different subtypes of FFSs may be produced through the different radiation process at the different altitude of solar atmosphere (Trottet, 1986). Thy reflect the multiplicity of radio FFSs.

Notes on the figures: the confidence levels in all plots are about three times as large as rms error of background noise.

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