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LARGE QUASI-PERIODIC LONG-TERM SOLAR RADIO PULSATIONS AT SHORT DECIMETRIC WAVELENGTH

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ABSTRACT

The long quasi-periodic (several tens of seconds) pulsations were observed at short decimetric wavelength (1.42 and 2.00 GHz). Here, we introduce the features (about bandwidth, periodicity, amplitude and relative amplitude) of these pulsations, then give the discussion about them.

I. INTRODUCTION

The solar radio pulsations were observed at decimetric wavelength in 1960s. So far pulsations have been observed in the meter, decimeter, microwave and X-ray frequency range. Generally, the periods of the pulsations are in the range of 0.1–50 s, the bandwidths of the pulsations are rather broad ($\Delta\nu/\nu >= 1$), the relative amplitudes are generally less than 50broad band s-pulsations at meter and decimeter have been investigated extensively (Rosenberg,1970). The general model is that the radial oscillations of magnetic flux tubes modulate synchrotron radiation emitted by trapped electrons (Rosenberg, 1970; McLean et al., 1971). The research of pulsations emphasizes on the s-pulsations, the pulsations with long or short periods have not been studied thoroughly. In this paper, we will introduce an event with long quasi-periodic pulsations and give the discussion about them.

II. OBSERVATIONS AND DATA ANALYSES

The solar radio synchronous observational system of 4-frequency high-time resolution of Yunnan Observatory is composed of 4 radio telescopes and a microcomputer. This system can make real-time synchronous observation with a sampling period of 1 ms and a sampling accuracy of 12 bits. On July 30, 1990, we observed a large radio burst associated with H-α flare and X-ray burst (Fig. 1). From 0738–0743 UT, pulsations (Group 1) only occurred at 1.42 G. ¿From 0747–0801 UT, pulsations (Group 2a at 142 G; Group 2b at 2.00 G) occurred simultaneously (Fig. 2). We measured the period, amplitude and relative amplitude of these pulses and found two traits as follows: (1) The period of Group 1 is less than the one of Group 2a. (2) The pulses of Group 2a rather exactly correspond to the ones of Group 2b. Generally, the period, amplitude and relative amplitude of 1.42 G are larger than that of 2.00 G.

III. DISCUSSION

The radio pulsations have an intimate relation with the physical parameters and the magnetic structures of the corona. The models about the manifold pulsations are varied. We consider that the pulsations superimposing on the background of a type IV burst can be explained by the gyrosynchrotron emissions modulated by MHD oscillations in the corona. Several features are discussed:

(a) The Bandwidth

Pulsations first occurred only at 1.42 G, after about 5 minutes, they occurred simultaneously at 1.42 and 2.00 G. But at 2.84 and 4.00 G, no pulsations were observed throughout. Our observations were carried out by single-frequency instruments, so we can only affirm that the bandwidth of the pulsations from 0747–0801 UT is larger than 600 MHz.The broad band pulsations suggest the possibility of gyrosynchrotron emission. We can propose that the periodic variations of the magnetic field first appeared on the upper layer of the corona, then moved down to the lower layer and drove the pulsations at 2.00 G.

(b) The Periodicity

The average period of Group 1 is 27.5 s, less the one of Group 2a (41 s). The similarity of Group 2a and Group 2b suggests that the pulsations at these two frequency were driven by the same periodically disturbing source.In addition, the period of Group 2a is larger than the one of Group 2b (average period at 1.42 G is 41 s, at 2.00 G is 37 s). According to the fast kink mode (Roberts, 1984): $\tau = cL\sqrt{N}/B$ (where τ: period of pulsation; c: constant; L: length of loop; N: electron density inside the loop; B: magnetic field strength), we consider that the difference of N and B in various layers of corona results in the different periods.

(c) The Amplitude and Relative Amplitude

We try to find the relation among the period, amplitude and relative amplitude. Finally, we find that the duration $\Delta T(s)$ was independent on the amplitude ΔI, but ΔT was roughly related to the relative amplitude $\Delta I/I$ (at 1.42 G, $\Delta I/I$ = 1.81 ΔT - 21.3 (linear correlation coefficient: 0.79, see Fig.3) at 2.00 G, $\Delta I/I$ = 2.32 ΔT - 56.6 (linear correlation coefficient: 0.82, see Fig.4) This relationship is different from the result at millimeter wavelength (Correia and Kaufmann,

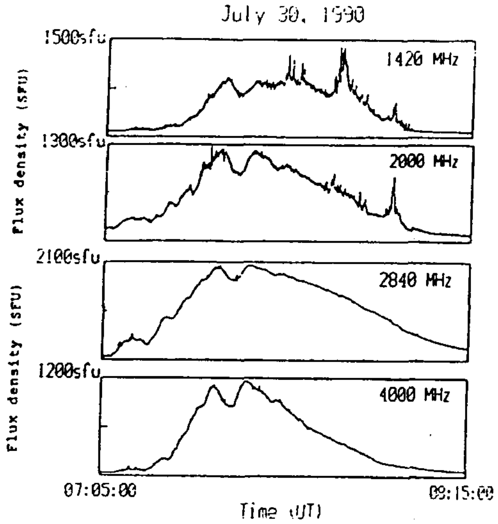

Fig. 1.— The time profiles of the radio burst on July 30, 1990.

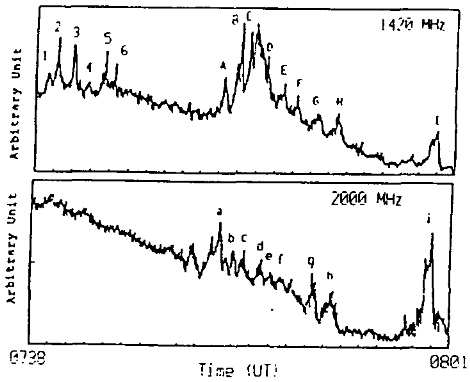

Fig. 2.— The time profiles of the pulsations.

1987). Therefore, we can suggest that the mechanisms of decimeter and millimeter are different.

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