FINE STRUCTURES IN SOLAR RADIO BURSTS AT A 21 cm WAVELENGTH AND PULSATION MODULATION

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Abstract. The solar burst of 13 July, 1986 at 21 cm wavelength was recorded with a time constant of 8 ms. In the course of the burst lasting for about 40 min there appeared distinct stages of the burst's evolution. They consisted of the pattern of energy release in flares which was proposed by Sturrock et al. (1984). There were pulsations with periodicities of 0.178 and 4 s superimposed on the flux density. The pulsations were quasiperiodical with features of almost unchanged mean periods. The relative amplitude of the pulsation modulation changed with the phase of the burst; in general, it reached 10–20% in the rising phase. The possible mechanisms of pulsations are discussed and some plasma parameters of oscillation sources are deduced.

1. Introduction

The present classification of radio bursts is based on the morphology over a large time-scale. However, observations with high-time resolution have found many phenomena and a wealth of fine structures, contrary to any known classification pattern. It seems that the fine structures are closer to the essence of the processes in flares. Obviously, research into the fine structures in bursts (flares) opens a new field in solar-flare physics. Spike emission and pulsation phenomena are two important aspects, and the possible relationships between them are also important objectives for further research.

The quasiperiodic oscillations in flares have recently become very noticeable, because they not only reflect the conditions and evolution of parameters in active regions, such as plasma density, magnetic field strength, particle speed, and so on, but also the mutual effect and coupling between beams of moving particles in active regions and various lower frequency waves (such as the Alfvén wave, ion-acoustic wave, etc.). Furthermore, these effects influence and modulate the magnetic fields of the source regions and the physical characteristics of the acceleration regions, thus the emission characteristics of the source regions are strongly influenced. As early as the 1970s, McLean et al. (1971) and Rosenberg (1970) found that a strong shock wave on the solar disk often stimulates quasiperiodic oscillations of magnetic loops and type II radio bursts. Since 1980s, Spruit (1982), Edwin and Roberts (1983), Roberts, Edwin, and Benz (1984), and Zhao et al. (1990), have analysed wave modes in a slender flux tube and the characteristic speeds of free modes in the coronal tube, considering standing and propagating oscillations in detail. They pointed out that a kind of quasiperiodic oscillation with the

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time-scale of an acoustic wave and another with that of an Alfvén wave can be generated in a loop by impulsively stimulating and propagating. It causes strong modulation in the loop and intensely influences the emission characteristic of the active regions.

In this paper, the complete event data with fine structures and quasiperiodic modulation in the emission recorded at Yunnan Observatory with 8 ms sampling continuously at 21 cm wavelength are described.

2. Observations and Morphological Characters

2.1. Observations

The equipment used to obtain the data introduced by Gong et al. (1989) is with a 10 m diameter dish and a system sensitivity of 0.2 s.f.u. (τ = 8 ms) at 1426 MHz frequency. The time profile of the 13 July, 1986 event at 21 cm wavelength is shown in Figure 1.

![Figure 1](image1.png)

Fig. 1. The time profile of the 13 July, 1986 event at 21 cm wavelength.

It contains event I (01:00–01:05 UT) and event II (01:46–02:25 UT). Figure 2 shows the fine time profile of event II at 1426 MHz. Figure 3 shows the time profile of event II at 1000, 2000, 3750, and 9400 MHz (by courtesy of Dr. S. Enome, Toyokawa Observatory).

![Figure 2](image2.png)

Fig. 2. The fine-time profile of event II at 1426 MHz.