DECAMETRIC STORMS OF TYPE III BURSTS

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The results of determination of positions and velocities both usual Type III burst and microburst sources at decameter wavelengths are presented.

The radiotelescopes (such as UTR-2) with high sensitivity allow to carry out investigations of weak Type III bursts (microbursts) with brightness temperatures $T_B \leq 10^8$ K. These investigations are very interesting because the well known hypotheses of exitation don't explain both Type III bursts and microbursts simultaneously.

The microbursts were reported first by Kundu *et al.* [3]. Their observations were made at Clark Lake at four frequencies between 38.5 and 73.5 MHz. The properties of microbursts were confirmed by Subramanian *et al.* [4] approximately in the same frequency range.

These observations showed that the microbursts are low temperature continuation of usual Type III bursts. But their frequency drift rate is well below that obtained from the well known expression for the range $0.1 - 10^3$ MHz [1]:

$$df/dt = -0.01 f^{1.84}. \tag{1}$$

Below we present results and analysis of observations at decameter wavelengths of eight Type III noise storms.

Observations were made in various years of the solar activity cycle at six frequencies in the range from 10 to 25 MHz using UTR-2 telescope. Radiometers with dynamic range 40db could detect both microbursts and usual Type III bursts. Angular sizes of the bursts were calculated by means of empirical dependence of angular size on frequency $\theta = 10^{3.05} f^{-1.14}$ [2, 5]. In our case, the flux densities of microbursts with brightness temperatures $T_B \simeq 10^7$ K are equal to $S_{25} \simeq 1\, s.f.u.$ at 25 MHz.

The electron beam velocity v_b calculated from frequency drift of Type III bursts depend on two alternative possibilities: the bursts are generated in the average corona or in the coronal streamers.

For definition of burst source location the power laws of electron density ($N_e = N(\rho)$) dependence on the height $\rho = R/R_\odot$ for the corona and the several models of coronal streamers were obtained in frequency range 5–25 MHz

$$N_e = N_0 \rho^{-m}. \tag{2}$$

In our calculations the relative errors were less than 10% for all approximations.

The value m is of $m = 5.2$ both for the minimum and the maximum corona models, and $\log N_0$ are equal to 7.9 and 8.1, respectively. The values of m and $\log N_0$ for different streamer models are $2.4 \leq m \leq 4.1$ and $7.87 \leq \log N_0 \leq 7.97$.

For density dependence (2) we have the power law of frequency drift rate on frequency

$$\log df/dt = b_0 + b_1 + \log f, \tag{3}$$

where

$$b_1 = 1 + 2/m, \tag{4}$$

$$b_0 = \log\left(0.22 \times \frac{\beta}{1 - \beta cos\theta} \times \frac{m}{(3.1 \cdot 10^7 N_0)^{1/m}}\right), \tag{5}$$

$\beta = v_b/c$, and θ is the helio longitude of the active region. Flux densities and frequency drift rates were determined for 250 bursts in the range of $10 - 25$ MHz detected in various years of the solar activity cycle.

Using the obtained frequency drift rate we calculated values b_0 and b_1 from Equation (3) by the least square method and then we derived value m from Equation (4) for all bursts.

The analysis of the obtained data allowed us to state that the value $m \approx 2.8$ in the years near the maximum of the solar activity cycle (207 bursts) and $\bar{m} = 4.8$ near the minimum one (24 bursts). These results allow to make the following conclusions:

– the Type III burst sources in the years near maximum of the solar activity cycle are located into streamers;

– value of frequency drift rate calculated according to Equation (1) is higher that for the observed rates and this error increases at high frequencies.

Burst source velocities were calculated by Equation (5) assuming $\log N_0 = 7.9$ and $\theta = 0$. Relative velocities of burst sources β were obtained for the burst flux densities in the range $0.2 - 20\, s.f.u$. It turned out that $0.18 \leq \beta \leq 0.23$, *i.e.*, differences between the velocities of electron beams that generate usual Type II bursts and microbursts are not small.

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