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Simultaneous observations of solar sporadic radio emission by the radio telescopes UTR-2, URAN-2 and NDA within the frequency range 8-42 MHz

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Abstract

From 25 June till 12 August 2011 sporadic solar radio emission was observed simultaneously by three separate radio telescopes: UTR-2 (Kharkov, Ukraine), URAN-2 (Poltava, Ukraine) and NDA (Nancay, France). During these observations some interesting phenomena were observed. Some of them are discussed in this paper.

1. Introduction

Using of radio spectrometers [1] of new generation on the radio telescopes UTR-2, URAN-2 and NDA allowed to observe and to analyze such phenomena in solar radio emission as type II bursts, type IV bursts, S-bursts, type III-like bursts, U- and J- bursts and others at decameter wavelengths [2]. Simultaneous observations by these radio telescopes will give an opportunity to study properties of these bursts and others in a wide frequency band.

2. Observations

Simultaneous observations of solar radio emissions were carried out from July 25 to August 12, 2011. Three radio telescopes UTR-2 (Kharkov, Ukraine), NDA (Nancay, France) and URAN-2 (Poltava, Ukraine) took part in this observational campaign. The radio telescope UTR-2 used only four sections (the total effective area was about 50,000 sq.m). NDA radio telescope and the radio telescope URAN-2 have 30,000 sq.m and 28,000 sq.m, respectively. UTR-2 and URAN-2 were equipped by DSPZ with high frequency (4kHz) and time resolutions (100ms). The Robin spectrometer installed at NDA had the frequency resolution of 7 kHz and the time resolution of 100ms. Both Ukrainian radio telescopes registered radio emission in the frequency band 8-32 MHz. At the same time the radio telescope NDA carried out observations at the frequencies 28-42 MHz. So we have superimposed frequency band that gives an opportunity to compare data from different radio telescopes. Besides we have the unique opportunity to observe simultaneously solar radio emission in a wide frequency range from 8 MHz to 42 MHz. During the observational campaign the active regions NOAA 1260, NOAA 1261 and NOAA 1263 were very active and practically the whole solar radiation activity was connected with an activity of these regions. On 25th of July 2011 the active region NOAA 1260 appeared on the eastern limb and on 10th of August 2011active region NOAA 1263 was placed on the western limb. There were 4 CME's observed by SOHO and STEREO on August 2, 3, 9, 11 at a time of daily (approximately from 06:00 to 14:00 UT) radio observations. In all these days we observed type II bursts followed by type IV bursts. On August 9, 2011, approximately at 08:13 UT (Fig.1) the type II burst, which propagated from high to low frequencies, was observed. Before type II bursts there was storm of type III bursts (from 8:05 to 8:10 UT) of small durations (to1s) with frequency drift rates 4-6MHz/s and high polarization 40-60%. The usual type II burst, which began at 8:13UT with drift rate about 30kHz/s, was probably superimposed on the type II burst with herring-born structure, which practically did not drift on the frequency. Polarizations of usual type II burst and type II burst with herring-born structure were high (up to 80%) but different signs. It can be understood if suppose that we observed radio emission from different parts of the shock: the usual type II burst from the part, which propagated outward the Sun, and the type II burst with herring-born structure was associated with shock, which moved parallel to the solar surface. For the first time on August 1, 2011 we observed two type II bursts whose tracks of radio emission were crossed. Moreover one of them had positive drift rate and other had negative one. It means that shocks associated with these bursts moved in opposite

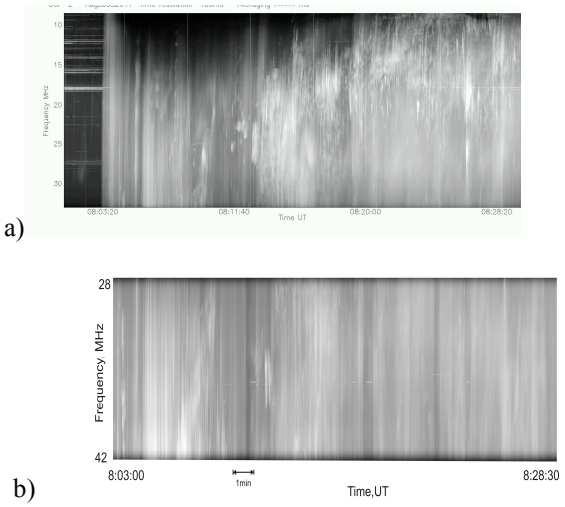

Figure 1: Type II with preceding group of type III bursts observed by UTR-2 (a) and NDA (b) radio telescopes.

directions, one shock moved outward the Sun and other shock toward the Sun.

We observed also some groups of type III bursts with frequency ratio about 1:2:3. In these trios the first and the second components are type IIIb bursts and only the third components were usual type III bursts. The first components had the largest drift rates and they were shortest. At the same time the third components were the slowest and had the largest durations.

Figure 2: The example of group of type IIIb and type III bursts as three harmonic components.

Interesting event was observed on August, 4, 2011 (Fig.3). It reminds type I bursts, which observed usually as well-known bursts at higher frequencies 50-100 MHz. Decameter type I burst was registered at 29 MHz. It continued about 2 minutes and had the frequency band about 2 MHz. It also consisted of a lot of elementary bursts – spikes with durations about 1-2s. Their polarizations were very high, up to 80%.

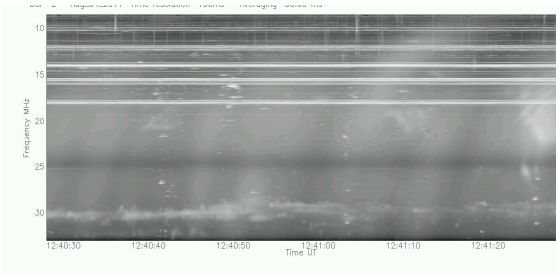

Figure 3: Decameter type I burst at 29 MHz.

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