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Distributions of solar drift-pair bursts in frequency from decameter radio observations

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Statement of the Problem: Solar drift-pair (DP) bursts are one of interesting manifestations of solar activity. Observed during the solar storms of type III bursts, they demonstrate a very simple form on dynamic radio spectra as two short components separated in time, often the second component being the full repetition of the first. As is well known, type III bursts are produced by the accelerated electrons propagating along open magnetic field lines in solar corona. However, no each storm of type III bursts leads to any DP. The role of electron beams in the generation of DPs remains unclear. Solar DPs are detected by ground-based instruments at decameter and meter wavelengths, but each individual DP occupies only a limited bandwidth in the frequency range. The bursts drift in frequency, and their frequency drift rate can be both negative and positive (so-called the forward and reverse DPs), from -2 MHz/s to 6 MHz/s [1]. Besides, there are cases of vertical DPs, which occur simultaneously in all the frequencies within their bandwidth. It is difficult to interpret them by means of a moving source, as any exciting agent responsible for such bursts would travel with velocities faster than velocity of light [2].
Methodology & Experimental Orientation: New features of modern low-frequency radio astronomy allow us to study the empirical properties of DPs more deeply than ever before. Our results are based on the recent radio data (during 10-12 July of 2015) obtained with help of the UTR-2 radio telescope at frequencies 9-33 MHz with the time resolution of 50 ms and the frequency resolution of 4 kHz. We have identified 301 DP bursts in which 209 events were forward (FDP), and the rest were reverse (RDP).
Results & Significance: According to the data, the occurrence of FDPs decreased at high frequencies, whereas the number of RDPs had an opposite tendency, they rarely occured at lower frequencies. During the observational session, at 20-25 MHz almost the same amount of FDPs and RDPs could be found. Unfortunately, the full distributions, characterizing the occurrence of FDPs and RDPs over frequency, are truncated due to limitations on the frequency bandwidth available for observations by our instrument. Nevertheless, by the statistical analysis of experimental data we have recovered the probabilistic distributions. If the plasma mechanism is responsible for emergence of DPs, a possible interpretation of their properties is that FDPs and RDPs originate from different (probably overlapping) regions in solar corona. Moreover, the study indicates that FDPs can be detected below the ionosphere cutoff by using solar space-based observatories provided that their receivers on board would have appropriate sensitivity and frequency-time resolution. In this regard, it will be promising to perform thorough observations of RDPs with new low-frequency ultra-wideband radio telescopes (such as GURT, MWA, LWA, LOFAR) covering a more frequency range of solar radio emission where DPs occur.

[1] Ya.S. Volvach, A.A. Stanislavsky, A.A. Konovalenko, A.A. Koval, V.V. Dorovskyy, Advances in Astronomy and Space Physics, Vol. 6, No. 1, p. 24-27 (2016)/DOI 10.17721/2227-1481.6.24-27
[2] G. Thejappa, PhD thesis, Bangalore University, 1988.