URSI GASS 2020, Rome, Italy, 29 August - 5 September 2020

First joint solar radio observations with UTR-2 and LOFAR Bałdy station

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In the report we present the results of the joint test observations with UTR-2 (Ukraine) and LOFAR Bałdy station (Poland), hereinafter LOFAR. The observations with radio telescopes UTR-2 and LOFAR were performed in the adjacent frequency bands 8 – 32 MHz and 10 – 90 MHz (low band part) respectively. During the observations the time and frequency resolutions equaled 100 ms and 4 kHz for UTR-2 and 1 s and 195 kHz in a case of LOFAR. For the comparison and analysis we choose more than ten Type III bursts which were clearly visible on the dynamic spectra obtained with these two radio telescopes (Figure 1). From the Figure it is visible that Type III burst (according to LOFAR data) starts at frequency about 70 MHz and can be traced down to 20 MHz. At the same time, according to UTR-2 data, this burst starts at frequency 32 MHz and cut off at frequency about 10 MHz. Thus, joint use of these two radio telescopes gives us an opportunity to trace and to study the parameters of Type III bursts in the continuous frequency band 8 – 90 MHz.

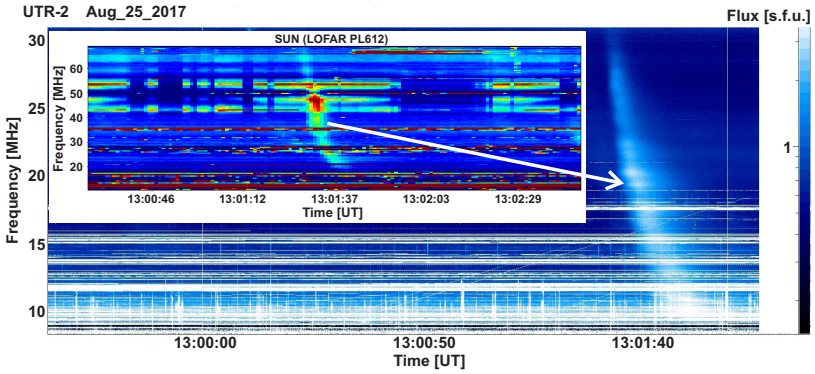

Figure 1. Type III bursts observed on 25 August 2017 with UTR-2 and LOFAR radio telescopes.

As a result of analysis we obtained the durations and drift rates for the chosen Type III bursts. We showed, as well as in [1], that the durations increase and the drift rates decrease towards the lower frequencies. Thus, based on the example of Type III burst presented on the Figure 1, these features are clearly visible. Taking into account the errors of measurements, caused by low time resolution of LOFAR, the duration of the burst at frequencies 60 MHz, 30 MHz, and 15 MHz is about 3 s (upper limit), 3.6 s, and 10 s respectively. At the same time its drift rate at 68 MHz is roughly -10 MHz/s and at 14 MHz is about -0.5 MHz/s. Such drift rates correspond to the velocity of the fast electron beam of about 0.1c.
In the scope of this report we also show that the dependency of the drift rate on frequency is different for each analyzed Type III burst and can be approximated with linear or power dependency - $df/dt \sim f^p$, where the index p varies from 1 to 2.1. From the obtained dependencies it follows that most likely the fast electron beams responsible for the generation of Type III bursts propagate through the coronal plasma with different parameters, *e.g.* density and temperature, and with slightly different velocities.

References

[1] D. J. McLean, N. R. Labrum, *"Solar radiophysics : studies of emission from the sun at metre wavelengths"*, Cambridge (Cambridgeshire), New York : Cambridge University Press, 1985.