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Observations of 2014-July-25 type II solar radio burst with a medley of spectral features

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Type II solar bursts are well known to be the primary radio signatures of coronal shock waves driven by powerful solar eruptions, i.e. flares or coronal mass ejections (CMEs). Solar spectrograms manifest them as lanes of emission slowly drifting from high to low frequencies over time. Occasionally, type II bursts have complex spectral morphology (e.g., band-splitting, herringbone structure, break, bump) [1] and at the same time may include a fine structure in the form of short-duration, narrow-band sub-bursts. It has been recently revealed that type II burst fine structure is likely due to background electron density perturbations in the solar corona [2]. Solar coronal plasma, being an inhomogeneous and turbulent medium, affects the propagation of a shock wave through it. Thus, type II burst fine structure plays an important role in studying of coronal turbulence, since the size distribution of density inhomogeneities (via its spectral index) can be obtained by using the power spectral density (PSD) analysis of sub-bursts [2].

In this study, we report a complex event from radio observations on July 25, 2014 which included several type II solar bursts. We have examined solar dynamic spectra with high temporal and frequency resolutions recorded by Ukrainian radio facilities, namely Ukrainian T-shaped Radio telescope, model 2 (UTR-2; 8-33 MHz) and Giant Ukrainian Radio Telescope (GURT; 8-80 MHz). The first type II burst consists of fundamental and harmonic components having band-splitting, herring-bone structure, and spectral break. These particular spectral features together in type II solar bursts are rarely observed. We estimate size scales of the turbulent density irregularities with the PSD analysis of particular herringbones of the burst. Besides, there is a group of type II radio bursts including three drifting lanes with their onsets coinciding in time with the spectral break of the first type II burst. Spectral break feature itself implies that a shock wave responsible for type II burst interacted with a coronal streamer [1]. On the other hand, the CME-streamer interaction has been suggested as a possible mechanism which generates type II bursts [3]. Thus, we provide direct observational evidence supporting this concept. The possible scenarios of the CME-streamer interaction and positions of radio-emitting sources within the shock wave are considered.

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