Shadow effects in the Jovian decameter emission

G. Litvinenko [(1)], A. Konovalenko [(1)], V. Zakharenko [(1)], I. Vasilieva [(1)], M. Panchenko* [(2)],V. Shaposhnikov [(3)], Ph. Zarka [(4)], and H.O. Rucker [(5)]
(1) Institute of Radio Astronomy, Kharkov, Ukraine, http://rian.kharkov.ua
(2) Space Research Institute, Graz, Austria, http://iwf.oeaw.ac.at
(3) National Research University High School of Economics, Nizhny Novgorod, Russia
(4) LESIA, Observatoire de Paris, UMR CNRS, Paris, France
(5) Commission for Astronomy, Austrian Academy of Sciences, Austria

Extended Abstract

So-called “shadow effects” or "bursts in absorption" (structures where the signal intensity depleted to the level of the galactic background) in the dynamic spectra of the Jovian decameter emission (DAM emission) are not very often observed events, and this is one of the reasons why their physical origin still is not clear studying. Analysis of the effects has minor interest and only a small number of researchers engaged a detailed study of them [1]. In our opinion, the study of even such rare effects is important for understanding both the physical processes in the Jupiter radio emission sources and astrophysics in whole.

The analysis of the observational characteristics of the different types of shadow effects in the Jovian DAM emission obtained by UTR-2 radio telescope is presented. Examples of various observed shadow events are illustrated: L- component of Jupiter decametric emission, which contains many formless absorption structures of various lengths that locate randomly over the dynamic range (8 ÷ 24 MHz) and have the negative frequency drift (-0.1 MHz/s ÷-8 MHz/s); various combination of L- and S- component of DAM radiation which give in the result the absorption effects (periodic structure, non-periodic structure, S-burst on the front edge of shadow, S-burst on the end edge of shadow) and so on. All marked events are very weak, so for their detection the high-sensitivity, noise stability antenna systems and advanced receivers with high time-frequency resolution need to be used. The UTR-2 radio telescope has the effective registration systems with high frequency and temporal resolutions (antenna effective area is 100 000 m^2, frequency resolution 12 kHz, time resolution 0.25 ms, dynamic range 70 dB) [2].The dynamic range of the used receiving equipment was in order higher than the observed signal level, that allow us to be sure that the obtained effects really belong to the Jovian DAM emission. The following parameters were studying: time-frequency scale for effect appearance, frequency bandwidth and time duration for simple event, variation of the burst width over the time axis, radiation intensity dependence in the time-frequency plane, sign and value of frequency drift, absorption depth**.**

To interpret various types of shadow events the several possible theoretical mechanism of the Jovian decametric emission have been considered, such as the result of interaction between the electrons bunches responsible for the S- and L-emissions, a nonlinear feedback mechanism for generation of Jovian S-bursts and the shadow events, DAM generation in the Jovian ionosphere due to the plasma instability driven by electrons with a loss-cone distribution function.

References

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