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Analysis of various quasi-periodic structures of linearly drifting S-bursts in sporadic decameter radiation from Jupiter

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Jovian sporadic decameter non-thermal radio emission (DAM) is an extraordinary astrophysical phenomenon, which manifests itself in the form of an unusual frequency-time patterns in the dynamic spectra. The dependence of the short component of DAM emission (S-bursts) appearance on its Galilean satellite Io position makes S-radiation an excellent tool for diagnosing the Io-Jupiter electrodynamic circuit as well as for obtaining information about the plasma conditions in the upper ionosphere and lower magnetosphere of the planet. In the work the results of studying spectral parameters of the various quasi-periodic structures on the dynamic spectra of Jupiter's decameter emission, consisting of linearly negative drifting S-bursts, are reported. All studied data have been recorded in 2004−2021 years with using the high-sensitivity, noise immunity antenna systems of the Ukrainian telescope UTR-2 and digital broadband receivers with high frequency-time resolution [1].

The peculiarity of our work is that the long series of data obtained for individual observation sessions are analyzed. It was shown that during one session and for one source, different types of quasi-periodic structures consisting of S-bursts with negative linear frequency drift can be observed. Long continuous measurements of the decameter emission of Jupiter (up to 4 hours) made it possible to trace the continuous change of the Jovian radiation features during the full time of the planet's culmination. Studied events can be both narrow-band and wide-band, have different repetition periods, different duration, be located in different parts of the spectrum, etc. As it was shown in work [2], most of the observed Jupiter's DAM radiation is modulated. It is assumed that the S- and L-components of emission interact with each other in the form of modulation processes. It also should be noted that different effects can appear in dynamic spectra depending on the scale of visualization, i.e., indirectly, on the frequency-time resolution of the obtained data. It was first identified in detail: 1. Two fast negative linearly drifting S-burst sequences (~ 20 MHz/s) with a time shift of units of milliseconds and a frequency shift of fractions of megahertz always have a narrow frequency band (1 ÷ 3 MHz) and almost completely correlate with each other. Such events are located in the high-frequency part of the observational spectra of the Jovian DAM emission (20 ÷ 35 MHz). Bursts in the upper and lower frequency spectral ranges are differ in intensity and time scales at the instantaneous frequency. Sequences of S-bursts in the lower frequency range of are more intense and their spectral envelope in time tends to the time capability of the receiving equipment (~ 1 ms). 2. The broadband quasi-periodic sequence of S-bursts, which is located in the high-frequency part of the spectrum (~ 35 ÷ 39 MHz), transforms in the lower part of the range into a continuous narrow-band radiation with interspersed absorption effects which are an exact continuation in the frequency domain of individual S-events with the frequency drift of ~ 25 MHz/s. 3. In some case the different sequences of S-bursts occupying the same frequency and time range can have a significantly different value of negative frequency drift. Such a difference is especially well visible with the visualization scale increasing.

References

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