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# Mixed time-frequency patterns of Jovian S- and L-bursts at high resolution, wide band, and sensitivity

Mixed time-frequency patterns of Jovian S- and L-bursts at high resolution, wide band, and sensitivity

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Jovian decametric (DAM) S-bursts are powerful pulses of radio emission presumably generated within the magnetic field flux tube connecting Jupiter with its innermost satellite Io. In the time-frequency plane, the S-burst patterns are distinguished from much slower L-type ones by both the characteristic time scale of a narrow band receiver output signal (milliseconds compared to seconds in the case of L-emission) and mostly negative frequency drift across a frequency band of several MHz. It should be however noted that the classification of Jovian DAM spectral patterns into two types only appears to be a very rough approximation to versatile morphology observed during typical noise storms. Very often S- and L-type emissions are interweaved in spectrograms (see, Fig.1) that makes classification into two types difficult, if possible at all, leading many authors to the necessity of suggesting new types of Jovian DAM radiation, such as N-emissions [1], slow- and fast-drift shadow events [2,3], tilted V-patterns [4], modulation lanes [5], trailing edge emissions [6] etc.

Many observational features of the both types of DAM emission can be explained within a model of cyclotron maser pumped by a loss-cone distribution of velocities in the upstream flow of electrons [7]. Many aspects remain however unclear, e.g., why the emissions have a pulsed character and how extremely complicated spectral patterns are formed.

In this paper we report the results of recent analyses of DAM emissions recorded in 2004-2008 at the world most sensitive decameter array UTR-2 equipped with a digital waveform recorder [8] at the back end. The baseband recording enables one to study the spectral patterns with very fine time and frequency resolutions thus providing means for analyzing S-bursts of arbitrary complexity. On the other hand, wide operation band (20 MHz) of the receiver and array permit the analysis to be performed simultaneously at different frequencies where various spectral patterns occur. With such powerful tools, we could study the amplitude fluctuations down to the time scales of microseconds as well as develop new methods of detecting coherent segments in the waveforms corresponding to S- and L-emissions of various spectral shapes. Depending on the instantaneous bandwidth and morphology of the frequency drifting S-burst patterns, we identified two general classes of S-burst events that could be called wide- and narrow-band S-bursts. The bursts of the former type could be attributed to trains of Alfven waves [9,10] triggering those of the latter type having a narrower instantaneous bandwidth and slower frequency drift rate.

The analysis is then focused on the coherent properties of subpulses detected at microsecond time scale resolution that had been initially attributed to the latter class of events only [11]. Finally we demonstrate that at microsecond-scale resolution there is now difference between emissions of different types demonstrating signatures of cyclotron maser amplification. Despite the fact that most of the observed spectral patterns could be generated by a maser amplifier, the reason for their discrete pulsed character at the millisecond time scale still remains to be found.

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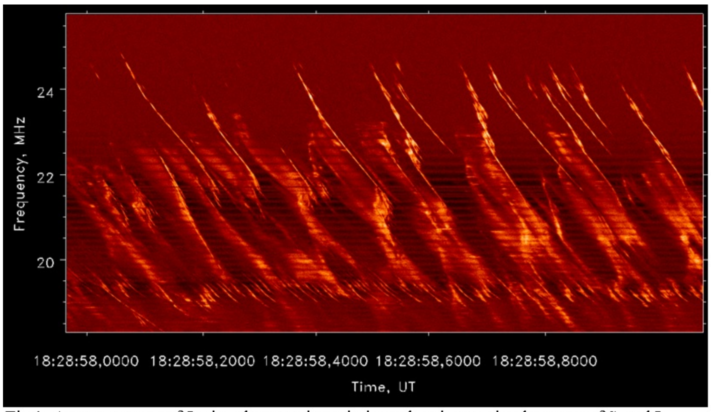


Fig.1. A spectrogram of Jovian decametric emissions showing a mixed pattern of S-and L-bursts. Observed at UTR-2 array on March 13, 2004