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PPS02-P02 Room:Convention Hall Time:May 24 17:00-19:00

Modeling micro structure of Jovian S-bursts

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Jupiter is known as the strongest source of decametric (DAM) radio emissions in the Solar system. The emissions occur during events called radio storms lasting from tens of minutes to few hours. The radio storms are well predictable, since their occurrence correlates well with certain range of Jupiter rotation phases and orbital positions of Jovian innermost moon Io. The control of radio emissions from Io can be explained by the combination of such factors as strong Jovian magnetic field, fast rotation of Jupiter (much faster than that of Io's orbital motion) and presence of plasma along Io's orbit sputtered by numerous volcanoes on its surface.

Crossing of Jovian magnetic field lines by Io causes about 400 kV voltage across the moon by electromagnetic induction that leads to acceleration of electrons in its vicinity. The electrons perform cyclotron motion propagating along magnetic field lines towards Jupiter. As they approach Jupiter, some of them are reflected at corresponding mirror points due to increasing value of the magnetic field. However, part of electrons that penetrates deeply into Jovian atmosphere is lost due to collisions that leads to a deficit of certain pitch angles in the electron distribution of the upstream and can pump electromagnetic waves to grow by the cyclotron maser instability (CMI) mechanism.

The above macroscopic picture explains many observational features of DAM emissions, but does not account for complex morphology of time -frequency patterns often present in spectrograms. First, the emissions can be roughly divided into two classes called S- and L-bursts, depending on their characteristic time scales: order of seconds for L(Long) ones and order of milliseconds for S(Short) ones. Furthermore, spectrograms of S-emission events present us with perplexing variety of spectral patterns, from simple linearly drifting in frequency bursts to extremely complicated shapes, which can hardly be interpreted within a framework of a simple CMI model.

An attempt to look at S-bursts with sub-microsecond time resolution had been performed in [1,2] aimed at understanding the very basic details of the emission mechanism. It had been suggested in [2] that two classes of models, of amplifier and generator type, can serve as prototypes of linear wave growth and saturated plasma wave instability, correspondingly. The final conclusion of paper [2] derived from the analysis of several simple linearly drifting bursts stated that only the former mechanism could account for the observed characteristics of S-bursts. It remains, however, unclear whether such type of model can be used for explaining the generation mechanism of other, more complicated bursts, as well as whether linear wave growth is never saturated in simple linearly drifting bursts.

In this work, we perform a more systematic study of the Jupiter radio emission waveforms recorded at world largest DAM array UTR-2 on March 15, 2005, with the purpose of validating the amplifier model for a larger set of S-bursts with different properties. First, we analyze several simple linear S-bursts and search for waveform segments with apparent saturation that could be attributed to generator model (Fig.1). We attempt then to interpret the found segments with amplifier model all the same. For this purpose, we perform a numerical simulation of amplifier-type signals trying to reconstruct the found saturating waveforms. Finally, we interpret such waveform segments in terms of characteristic time of autocorrelation function and fluctuating instantaneous bandwidth in the selected S-bursts. We also present the analysis of several S-bursts displaying a complex pattern in the time-frequency plane checking for its consistency with the amplifier-type model.

References
[1] Carr, T. D., and F. Reyes, JGR 104, 25127 (1999).
[2] V. B. Ryabov et al., JGR 112, A09206 (2007).

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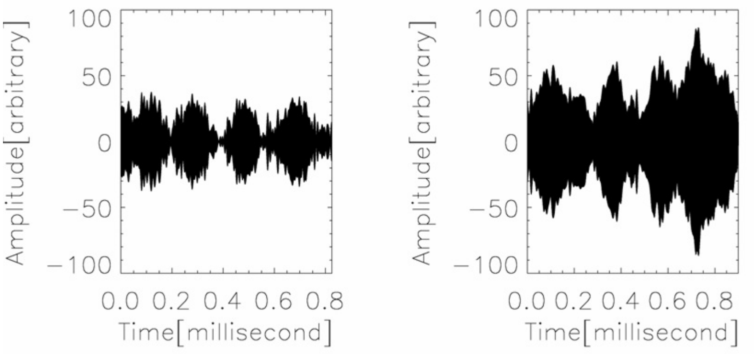

Fig 1. Examples of S-bursts: waveforms of amplifier (left) and generator (right)