On the origin of quasi harmonic structures in the dynamic spectra of Jovian decametric emission

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Jupiter is the most powerful planetary source of electromagnetic radiation in the solar system after the Sun, extending from the X-ray to the radio-frequency range. Decameter radio emission is an unique phenomenon having extremely various time-frequency structures on the dynamic spectrum. In particular, a structure in the form of quasi-harmonic bands of increased and decreased brightness, drifting synchronously in time, was observed on the dynamic spectrum [1,2]. This structure is very similar to the structure found in the spectrum of the broadband kilometer radio emission of Jupiter (bKOM) during the flight of the Cassini spacecraft and to the "zebra structure" (ZP) in solar radio emission.

The most acceptable theory for the generation of the ZP in the solar radio emission is based on the double plasma resonance effect (DPR) at the electron cyclotron harmonics [3]. According to this theory, in an inhomogeneous magnetic trap filling the weakly anisotropic plasma, which satisfies the condition of weak anisotropic for electrons, $f_{pe} \gg f_{Be}$ (f_{pe} and f_{Be} are Langmuir and cyclotron frequencies of electrons, accordingly), the plasma waves are excited at the frequency of upper hybrid resonance, $f_{UH}^2 \approx f_{pe}^2$, due to the electrons with unstable velocity distribution. In the regions where Langmuir frequency coincides with the electron cyclotron harmonics $f_{pe} \approx sf_{Be}$ (s is the harmonic number) the level of excited plasma waves strongly increases. The plasma waves couple with low-frequency oscillations or are scattered by ions. These processes result in the appearance of electromagnetic radiation with spectrum which has the form of quasi-harmonic stripes. However, in the most of the Jovian magnetosphere, including in the regions of decameter and kilometer radiation generation, the plasma is strongly anisotropic, $f_{pe} \ll f_{Be}$, and the DPR effect at the electron cyclotron harmonics is not realized. In the same time, the condition of weak anisotropy for ions, $f_{pi} \gg f_{Bi}$ (f_{pe} and f_{Be} are plasma and cyclotron frequencies of ions, accordingly) is fulfilled in these regions. In paper [4] the model based on the DPR at the ion cyclotron harmonics is proposed. This approach permitted the authors of the model to explain all the main properties of the zebra structure in the Jovian kilometer radiation. In this paper, a model for the generation of decameter radio emission of Jupiter with a quasi-harmonic structure in the dynamic spectra based on the DPR effect on ion cyclotron harmonics is considered. The necessary source parameters for the explanation of main observed properties of the dynamic spectra are discussed. It is shown that the required parameter values do not contradict our knowledge of the conditions in the lower magnetosphere of Jupiter.

References

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