Double plasma resonance and fine spectral structure of solar radio bursts

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The growth rate of plasma waves in presence of accelerated electrons depends on the relation between the plasma and cyclotron frequencies. The growth rate significantly increases when the local plasma frequency is close to a harmonic of the cyclotron one, i.e. the double plasma resonance (DPR) is realized. This phenomenon may be responsible for the formation of the bursts with zebra pattern. However, as have been shown by Winglee and Dulk (1986), the excitation of plasma waves on DPR is not effective for electron distributions of loss-cone type. This is considered to be one of the main arguments in favor of alternative mechanism connecting zebra pattern with whistler waves.

In this work we perform a theoretical investigation of generation of upper-hybrid waves by anisotropic electrons under the conditions which are typical for the active regions of solar corona: the cyclotron frequency is far less than the plasma one, the plasma temperature and the accelerated electrons energy correspond to the observed values. In contrast to Winglee and Dulk (1986) the possibility of realization of DPR for the loss-cone type electron distribution has been shown. The modulation depth of the radio emission intensity increases with an increase of the loss-cone pitch-angle boundary and when the electron beam becomes more monoenergetic, while the modulation depth decreases with an increase of the cyclotron harmonic number. Since the growth rate of whistlers is significantly less than for upper-hybrid waves, the relaxation of electron beam and the generation of radio emission must be determined by plasma waves. On the basis of obtained results some events with zebra pattern are interpreted.

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