The electron cyclotron resonance heating (ECRH) is widely used in the toroidal devices and planned for application in ITER. Its concept is based on the linear theory. However, during the last decade the anomalous scattering of pump microwaves was discovered in presence of a non-monotonic density profile in the X2-mode ECRH experiments [1]. This effect was explained in [2] by excitation of low-threshold two-plasmon parametric decay instability (PDI) possible due to a localization of upper hybrid (UH) daughter waves at the local maximum of the density profile. On the basis of the proposed mechanism the PDI was analyzed and the level of its saturation due to a cascade of UH waves decays was determined. The theory explains quantitatively the anomalous backscattering observed in [1] as a result of a nonlinear coupling of different daughter waves. The proposed scenario predicts a substantial anomalous absorption of pump power (5%-20%), which is however far from being total.

In this paper the effect of strong anomalous absorption of microwaves in the ECRH experiments in toroidal devices is reported. It was discovered in the course of detailed investigation of the low-power-threshold two-plasmon PDI saturation. It is shown that there are two most important mechanisms, the cascade of low-threshold secondary decays and the pump depletion, leading to the transition of primary instability to the saturation regime. The cascade of secondary decays giving rise to the secondary UH and ion Bernstein waves continues until the generated UH wave remains trapped at the local maximum of the density profile. The power threshold of parametric excitation of the non-trapped UH wave appears not to be overcome. Under the experimental conditions when the number of secondary decays is odd this effect dominates over the pump depletion and is responsible for the saturation of primary instability at a lower level [2]. As it is disclosed in the present paper, in the opposite case of the even number of secondary decays the pump depletion turns to be mostly responsible for the saturation of primary instability at much higher level than in the case of the odd number of secondary decays. In this case the efficiency of anomalous absorption jumps up to the level bigger than 60% and strongly modifies the power deposition profile.