

P4.1076 Possibility of anomalous emission at half-integer pump wave frequency harmonics in the X2 ECRH experiments

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See full abstract here

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A while ago it was revealed theoretically [1,2] that in presence of a non-monotonic plasma density profile, originating due to the magnetic island or the density pump-out effect at on-axis electron cyclotron resonance heating (ECRH), the low-power-threshold absolute two-upper-hybrid (UH)-plasmon parametric decay instability (TPDI) of a pump microwave can occur in the hundred-kilowatt X2 ECRH experiments. Its excitation leads to the generation of both UH waves localized in the vicinity of the local maximum of a plasma density profile and of the non-trapped UH waves. Depending on the dominating saturation mechanism (the cascade of secondary decays or the pump depletion) from 10% up to more than 60 % of the pump power can be transferred to the daughter UH waves as a result of TPDI. This instability manifests itself in anomalous backscattering effect [3] leading to emission of radiation at frequency down-shifted by several GHz in respect to the pump wave. According to the theory [1] reproducing the frequency spectrum and intensity of the backscattering signal, this emission is generated due to nonlinear coupling of parametrically excited UH plasmons.

In the present paper we consider a possibility of anomalous emission in X2 ECRH experiments of electromagnetic waves possessing a larger frequency shift, namely, of the pump frequency half-integer harmonics. As a substantial fraction of the pump power can nonlinearly be deposited into the different daughter waves, trapped in the vicinity of the local maximum of non-monotonic density profile and non-trapped ones, one could expect the strong emission of electromagnetic waves at half the pump wave frequency in the high-magnetic field-side direction. This is due to the linear mode-conversion of the non-trapped UH waves into the extraordinary waves propagating inwards at the UH resonance. The corresponding radiation temperature is estimated in the paper. It is also shown that the nonlinear coupling of the daughter UH waves with the pump could lead to the measurable level of the plasma emission at the 3/2 harmonic of the pump, in the way similar to that occurring in the laser driven inertial fusion experiments [4].

[1] E.Z. Gusakov and A.Yu. Popov, *Physics of Plasmas* 23, 082503 (2016) [2] E.Z. Gusakov, A.Yu. Popov, A.N. Saveliev *Physics of Plasmas* 25, 062106 (2018) [3] E. Westerhof, S. Nielsen, J.W. Oosterbeek et al., *Phys. Rev. Lett.* 103, 125001 (2009) [4] E.Z. Gusakov, *Sov. Tech. Phys. Lett.* 3, 504 (1977)

Presenter: GUSAKOV, E.Z. (EPS 2019)

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