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Anomalous Absorption and Emission in ECRH Experiments Due to Parametric Excitation of Localized UH Waves

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The extraordinary pump wave two-plasmon decay instability TPDI is analyzed under conditions when only one of the parametrically driven upper hybrid (UH) waves is trapped in the vicinity of the density profile local maximum. It is shown that under these conditions the excitation of absolute TPDI is possible due to a finite width of the microwave pump beam. Its threshold and growth rate are determined. The pump depletion and the secondary decay instability of the localized UH wave are considered as the most likely moderators of primary TPDI and clarify their role in its saturation. We also estimate the pump power fraction gained anomalously throughout the two-UH-plasmon decay. The general consideration is accompanied in the paper by the numerical analysis performed for the experimental conditions typical of the off-axis X2-mode ECRH experiments at TEXTOR. Based on the proposed model the radiance temperature of electromagnetic waves emitted in the high-field-side direction at the frequency close to half the pump frequency is estimated. 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, as it happens in the laser driven inertial fusion experiments.
The parametric excitation of trapped UH waves in the O1-mode ECRH experiments is discussed as well. The threshold in this case is shown to be higher (several hundred kW depending on the plasma parameters) than for the X2-mode scenario whereas the growth rate is large enough (in the range of 107 s-1) to expect the non-linear saturation of the instability.

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