Observing parametric decay instability effect in lower hybrid heating and current drive experiments in the FT-2 tokamak

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Over a period of time we have been investigating the influence of lower hybrid waves on plasma parameters in the FT-2 tokamak, such as electron and ion heating, current drive, and processes which improve energy confinement in the center of the plasma column [1, 2]. We have confirmed that parametric decay instability (PDI) effect complicates the use of lower hybrid waves for current drive in the high density plasma [3]. The PDI process lies in the fact that the pumping wave with the wave number transmits energy to two newly formed waves with the wave numbers , where decay condition reads as , and, hence, lowers the hybrid heating and the current drive efficiency. For this reason, fundamental problem is the understanding of the physical mechanism of PDI process aiming to the efficiency enhancement of the lower hybrid heating and the current drive in tokamaks.

Development of new diagnostic methods was additional motivation for this research. We have installed and successfully tested complex diagnostic device for observing low frequency oscillations on the FT-2 tokamak. Therefore, we can observe dependence between low frequency plasma density oscillations and the pumping wave. The pumping wave frequency was ~900 MHz with power up to 160 kW in the following experiments. Oscillation spectra in frequency range higher and lower pumping wave were obtained, which shows that PDI for different plasma densities could occur in different parts of plasma column (in different regions, for different local value of magnetic field). Obtained dependence of daughter waves amplitude on plasma density, Fig. 1. We have measured spectra for different pumping wave power and densities of hydrogen and deuterium (isotopic effect).



Fig. 1. The normalized intensity peaks of the “red” wing of spectrum of LHW pump wave *f0* = 920МHz measured by RF probe at LFS for different densities <*ne*> of H/D plasma.

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References

1. S.I. Lashkul, A.B. Altukhov, A.D. Gurchenko et al. Nucl. Fusion 55 (2015) 073019
2. S.I. Lashkul, A.Yu. Stepanov, A.B. Altukhov et al. EPJ Web of Conferences 149, 03012 (2017)
3. V.N.Budnikov, M.A.Irzak, E.R.Its et al. Proc. of the 22st EPS Conf on Cont. Fus. and Pl.Phys., Bernnemous, 1995, p.IV, 385-387.