ion cyclotron emission properties in ohmic discharges in tuman-3m tokamak

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In ohmic and co-NBI discharges in TUMAN-M tokamak ion cyclotron emission (ICE) was detected in both deuterium and hydrogen [1]. Ohmic ICE exist throughout the whole discharge and are of special interest, as the mechanism of their generation is unclear. Fast magnetic probes from both low field side and high field side were able to distinguish oscillations with several harmonics of main plasma isotope ion cyclotron frequency. Similar observations were carried out on DIII-D tokamak [2].

During the pellet injection experiments it was observed that after pellet evaporation ohmic ICE intensity significantly drops, and after the exit from H-mode, initiated by pellet, ICE intensity returns to initial level.

It is possible to assume that observed oscillations are excited as a result of ion cyclotrone drift instability [2, 3]. According to this theory, oscillations with IC frequency are being excited if criterion  (1)

is satisfied, where  is characteristic density change scale, **i – ion cyclotrone radius, *V*A – Alfven velocity [2, 3]. It is interesting to determine the localization of ICE excitation to understand the connection between ICE properties and plasma parameters.

Applying the criterion (1) to the TUMAN-3M discharges with observed ohmic ICE activity, it is possible to construct spatial distribution «map» of ICE excitation in TUMAN-3M. According to this analysis, the most strong ICE drive is localized at low field side periphery, which is not always in agreement with experimental magnetic probe array observations.

In the discharges with pellet injection evaporation of the pellet creates strong perturbation of density and ion temperature gradients, which affects the satisfaction of criterion (1). Evolution of plasma parameters under the effect of pellet evaporation was modeled using ASTRA code for experimental parameters of discharge with pellet injection and ohmic ICE activity. Modeling results show that pellet evaporation initiates LH-transition with steep peripheral density gradient; in deeper area density gradient becomes more flat, and satisfaction of criterion (1) terminates. Modeling results are in agreement with experimental observations: after the pellet evaporation ohmic IC oscillations intensity significantly decreases and stops until backwards HL-transition.

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References

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