identification of mode structure of high-frequency perturbations in the TUMAN-3M tokamak

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High-frequency magnetic field perturbations in TUMAN-3M tokamak are typically detected in two frequency ranges: 0.6–2.1 MHz – alfven oscillations and 6–13 MHz – ion-cyclotron emission (ICE). Alfven oscillations (AO) are observed in ohmically heated plasma, in absence of fast ions; frequency of the registered AO is the same for all the magnetic probes i.e. it does not depend on the probe location. ICE is observed both in ohmic regime and in neutral beam injection (NBI) phase of TUMAN-3M discharges [1, 2]. In NBI-heated plasma the ICE frequency usually corresponds to ion-cyclotron (IC) resonance frequency of minority ions at the axis of the discharge. For example, during mixed beam (deuterium – 60%, hydrogen – 40%) injection in deuterium plasma, ICE is registered at the frequency ~12–13 MHz corresponding to IC resonance for protons in the core region. On the contrary, when the same mixed beam is injected in hydrogen plasma, the emission is observed at ~6–7 MHz corresponding to IC resonance for deuterium ions also close to the plasma axis. Frequency of the ohmic ICE corresponds to IC resonances for main plasma ions near the periphery. Ohmic ICE is detected during most part of the tokamak discharge and its frequency depends on location of the magnetic probe which detects this emission (see Belokurov A.A. et al «Ion cyclotron emission properties in ohmic discharges in TUMAN-3M tokamak», this conference).

Magnetic field perturbation in TUMAN-3M is measured by the array of 16 magnetic probes evenly spaced along the poloidal circumference. In contrast to ohmic ICE, ICE associated with NBI-heating is detected by all the probes at the same frequency, which makes it possible to determine the poloidal mode numbers *m* of the oscillations. Results of *m* identification for AO and NBI ICE are reported. Mode numbers of the perturbations were determined by spatial Fourier transform in cylindrical approximation. Use of cylindrical approximation is justified by an absence of a pronounced asymmetry of magnetic field perturbation in the direction of major radius. In the case of AO, the modes with *m* = 1–3 prevail over ones with higher m-numbers [3]. This observation confirms the conclusion about central location of AO [4]. It also complies with the model of shock mechanism of AO excitation associated with reconnection of magnetic field lines during sawtooth crash, since in this case low *m* should be observed [5]. For NBI ICE *m* = 0–4 are determined, that along with central location distinguishes NBI ICE in TUMAN-3M from NBI ICE usually observed on other tokamaks [1].

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References

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