Ion cyclotron emission properties in NBI-heated TUMAN-3M plasma

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Ion cyclotron emission (ICE) in routinely registered in many tokamaks. It was recently observed in the TUMAN-3M tokamak [1, 2] in ohmically and neutral beam injection (NBI)-heated regimes in D and H plasma. This presentation describes some characteristic features of NBI-induced ICE observed in TUMAN-3M, with emphasis on spectral structure of the emission. In contrast to many other observations, ICE frequency ω_{ICE} in the TUMAN-3M NBI scenario corresponds to a core location of a radiating body, close to the plasma center. In NBI-heated plasma, ICE generation is usually explained by the presence of fast particles (beam ions or fusion charged products) with high transversal kinetic energy. In the TUMAN-3M, high energy charged fusion products are not confined due to the low toroidal field (B_T=1 T) and small size (R/a = 0.55 m / 0.25 m) of the tokamak and could not effectively excite ICE. NBI in the TUMAN-3M is performed in co-current tangential direction; as a result the fast ions with high transversal energy are born predominantly in the plasma periphery and then move to the core plasma along drift trajectories. Among these trajectories, a class of potato-like ones features the strong deviation from magnetic surface. This kind of trajectories looks beneficial for central ICE generation, as they have long vertical part located close to plasma center; particle drifting along this vertical part spends a longer time in a region of constant toroidal field, i.e. constant ω_{ICE}. Thus, these particles could be a possible candidate for central NBI ICE excitation in the TUMAN-3M. This model reproduces qualitatively well other important features of NBI ICE observed in the deuterium plasma in TUMAN-3M, such as frequency line splitting (fine structure) and ICE frequency dependence on beam energy. The former is explained by the presence of different energy components ($1/2E_0$, $1/3E_0$ etc) in the beam, in addition to main energy E_0; the latter ensues from (a weak) dependence of location of vertical part of the trajectory on the fast ion's energy.

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References

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