Direct measurements of plasma potential and GAM in the OH and ECRH plasmas in the T-10 tokamak

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Mean radial electric field or electric potential is one of the key parameter affecting plasma transport and turbulence. Potential oscillations, i.e. zonal flows and their high-frequency counterpart, the Geodesic Acoustic Modes (GAMs) are considered as a possible mechanism of the plasma turbulence self-regulation. It has been realized recently that both GAM and Beta induced Alfven Eigenmodes (BAE), having low, but not zero $m$ and $n$ in potential perturbation, may have the same frequencies and properties. In the T-10 tokamak, both mean potential and GAM/BAEs have been studied by the heavy ion beam probing (HIBP) in the core plasmas and multipin Langmuir probes in the edge.

The regimes with Ohmic, on-axis and off-axis electron cyclotron resonance heating (ECRH) were studied ($B = 1.5–2.4$ T, $I_p = 140–250$ kA, $n_e = (0.6–3) \times 10^{19}$ m$^{-3}$, $P_{EC} < 1.2$ MW). The recent advances in the HIBP allow us to get the local data in several spatial points simultaneously, and make the correlation analysis. The radial profile of the core OH plasma potential presents the negative potential well, the more deep for higher plasma densities. The $T_e$ increase due to ECRH makes the potential well shallower with a formation of slightly positive edge for low densities.

It was shown that potential oscillation associated with GAM has poloidal mode number $m = 0$ and radially homogeneous structure. In contrast to the theoretical expectations, $f_{GAM/BAE} \approx \sqrt{T / m_i / R}$, the radial distribution of frequency $f^{-exp}$ is almost uniform, while the GAM amplitude shows a tendency to increase slightly towards the plasma centre. GAMs are more pronounced during ECRH, when the typical frequencies were seen in the narrow band from 22 to 27 kHz for the main peak and 25-30 kHz for the higher frequency satellite peak. GAM characteristics and limits of GAM existence were investigated as functions of density, magnetic field, safety factor and ECRH power. The GAM suppression due to the density increase was specifically analyzed.

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