Characterization of the electric potential profile in ECRH and NBI plasmas on TJ-II stellarator

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The direct measurements of an electric potential and its fluctuations in a core plasma are of a primary importance for the understanding of the mechanisms of the confinement improvement in toroidal plasmas and the role of the electric field in plasma confinement.

Heavy Ion Beam Probe diagnostics is used in TJ-II stellarator to study directly the plasma electric potential with a good spatial (up to 1cm) and temporal (up to 2 μs) resolution. The singly charged heavy ions Cs^+ with energies up to 125 keV are used to probe the plasma column from the edge to the core. On and off ECR heated plasmas (P_{ECRH}= 300 - 600kW) were studied.

The significant improvement in the beam control system and the acquisition electronics leads us to the increase of the possibilities of the diagnostics. The most crucial one is the extension of the signal dynamic range, which allows us to have the reliable profiles from the plasma center to the very edge [1].

Low density (n = 0.3-0.5×10^{19} m^{-3}) ECRH plasma in TJ-2 is characterized by positive plasma potential, φ(0) = + 600 - + 400 V. At higher densities the minor area of the negative electric potential appears at the edge. This area increases with the density, finally makes potential fully negative. This tendency is affected by ECRH power and deposition area. The NBI plasmas are characterized by negative electric potential in the full plasma column from the center to the edge, φ(0) = – 300 – 400 V.

These results show the clear link between plasma potential, temperature, density and particle confinement.

[1] A. Melnikov et al., Fusion Science and Technology (2007), Vo 51, N 1, P 31.