Radial electric fields and confinement in the TJ-II stellarator

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Plasma potential profiles have been investigated in a sequence of different configurations with floating and biased limiters and at different densities in ECRH plasmas (P_{ECRH} = 300 kW, n = 0.5 – 1.1 x 10^{13} cm^{-3}) in the TJ-II stellarator. Heavy Ion Beam (HIBP) measurements were done with 125 – 140 kV Cs^+ beam.

Plasma potential profiles and neoclassical predictions. Measured radial profiles of plasma potential show that the potential increases up to 1 kV near the magnetic axis in low density plasmas. Whereas positive radial electric fields have been observed at low ECRH density plasmas ($n < 10^{19}\, m^{-3}$) at higher densities negative radial electric fields have been measured at $\rho \approx 0.2 – 0.8$. The positive values of radial electric field (50 V/ cm) measured by the HIBP system at low density plasmas are of the order of the neoclassical estimations.

Plasma potential during limiter biasing experiments. The influence of limiter biasing on plasma confinement has been investigated. Edge ($\rho \approx 0.8$) as well as core ($\rho \approx 0.2$) plasma potential are modified at two different time scales. In the fast time scale (10 – 100 microseconds) plasma potential changes of about 100 V both at the edge and core regions after limiter biasing. In the slow time scale (about 1 – 10 ms) plasma potential modifications are linked to the plasma density evolution with $\Delta\Phi$ up to 400 V. Evidence of improved confinement regimes induced by limiter biasing has been observed.

Dynamic behavior of the core plasma potential in TJ-II flexible heliac A dynamic behavior with fast drops (about 50 μs) in plasma potential has been found in magnetic configurations with a presence of a low order rational magnetic surfaces in the core plasma. The transient behaviour in plasma potential occurs about 20 – 50 μs before density perturbations in the plasma core region. These results show the leading role of radial electric fields in the bifurcation properties in stellarators plasmas.