Application of canonical profiles model for description of density evolution during ECRH in T-10 tokamak

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The evolution of density profile in series of ECRH shots of T-10 tokamak was simulated. These shots have the current *I* = 0.2 MA, magnetic filed *B* = 2.3 T, and unsteady plasma density, which was varied in the range ‾*n* = 2.5 – 4.5 × 1019 m–3. For the first group of shots, ECRH switch-on was at the steady state phase of discharge, and for the second group, ECRH switch-on was during the density ramp-up. Behavior of the line-averaged density in shot #66021, when ECRH switch-on was at *t* = 0.4 s, i.e. during the density ramp-up produced by steady gas puffing is shown by dashed line in Fig. 1. We see that after start of ECRH the particle confinement is deteriorated and the density grow is saturated.

Figure 2 presents comparison of the experimental dimensionless gradients of density and pressure -*Rn*′/*n* and -*Rp*′/*p* correspondingly in different time instants near the ECRH start, with gradients of canonical profiles of density and pressure -*Rnc*′/*nc* and -*Rpc*′/*pc* correspondingly. We see that before ECRH switch-on (*t* = 0.39 s) the intersections of abovementioned curves ρ*n* and ρ*p* (hatched circles) are placed in the region  ~ 0.5 (for density) and  ~ 0.4 (for pressure). After ECRH switch-on (*t* = 0.415 s) the pressure profile is peaked, and the intersection point *p* disappears. However, the density profile practically conserved and the intersection point *n* stays as previously. This pattern allows us to obtain the criterion of transition from high confinement of particles to low confinement and return. If *p* begins to fulfill the condition*p* < 0.35 – 0.4, then the particle confinement is degraded. The greater ECRH power, the lower confinement.

We upgraded the transport model of canonical profiles for plasma density [1, 2] as described in [2]. As input data we use results of interferometer measurements after Abel inversion. They are shown in Fig. 1 as dashed line together with results of modeling. Here the solid line describes the evolution of line-averaged density, obtained by integration of calculated density profiles. Thin lower line designates the root-mean square (RMS) deviations *d*2*n* of calculated density profiles from experimental ones.



Fig. 1. Fig. 2.

References

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