Simulation of plasma density in transient regime on the T-10 tokamak

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We present analysis of the density profile evolution and its simulation for the Ohmic T-10 shot #55259. The shot parameters are: current *I* = 0.2 MA, toroidal field *B* = 2.5 T, the line-averaged density in this transient shot was varied in the range ‾*n* = 2.5 – 4.5×1019 m-3. Behaviour of line-averaged density during the studied time interval is shown in Fig. 1 by dashed line. The density evolution may be divided in four phases. During phases A and D the density experienced a free decay. During the phase B the gas puffing occurs, and during phase C the density profile is reorganized with possible weak gas puffing. We see that the particle confinement during phases A and D is low and during phase C is high. Transition from low to high confinement occurs during phase B. Figure 2 presents comparison of dimensionless gradients -*Rn*′/*n* of experimental density profiles at different phases of shot with the gradient of canonical density profile -*Rnc*′/*nc*. We see that at phases with low confinement (A and D) the experimental curves lie above the canonical curve, and phases with high confinement the experimental curves intersect the canonical one. This picture allows us to obtain the criterion of transition from low to high confinement and back.

These modifications were introduced into the canonical profiles transport model [1]. As initial experimental data we used the density profiles measured by an interferometer and processed by Abel inversion. Results of calculations are presented in Fig. 1. Here the upper solid line describes the evolution of line-averaged density obtained by integration of calculated density profiles. The solid lower curve describes RMS deviation of calculated density profiles from experimental ones. We see that the deviation is not exceeding 10%.

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| Fig. 1. Evolution of line-averaged density with gas puff off (A and D) and on (B and C); experimental (dashed line) and calculated (solid line); d2n is deviation of calculation from experiment. | Fig. 2. Dimensionless density gradients at different phases of discharge and the canonical gradient. |

References

1. Dnestrovskij Yu.N., Self-organization of hot plasma, Springer Verlag, 2014.