Fast processes within the canonical profiles transport model

Yu.N.Dnestrovskij, S.E.Lysenko, K.N.Tarasyan, S.V.Cherkasov

ABSTRACT

of report to the Kiev International Conference

Recent experiments confirmed that the energy transport in tokamaks is determined not only by the slow diffusion time, but some collection of fast times. Most spectacular are experiments with cooling of the plasma edge by ablation of impurities or gas puffing. In these experiments both two facts are paradoxical, they are quick change of the plasma behavior at far distances from the point of the influence, and heating of the plasma centre as a response to cooling at the edge. The time delay of the response, $\tau_d \approx$ 1-3 ms, is in 1-2 orders of magnitude less than the energy confinement time τ_E, and in 2-3 orders less than the skin time of the current redistribution, τ_s.

In this paper we try to describe these experiments using the Canonical Profiles Transport Model (CPTM). We revised the basic suggestions of the model, and include an additional equation with the fast time τ_c. This equation describes the evolution of canonical profiles which previously were assumed to be steady state. The main point of modified model is a revision of the boundary conditions for canonical profiles. Previously we supposed that the form of canonical profiles depends only on the values $\mu_0=\mu(0)$ and $\mu_a=\mu(a)$, where $\mu=1/q$. In the new model we used the Ohm law at the plasma edge as a boundary condition for the canonical profile of $\mu_c(r)$. As a result, $\mu_c(r)$ becomes depending on the value and the profile of the real electron temperature $T_e(r)$ near the boundary. The change of the $T_e(r)$ profile near the edge leads to redistribution of the $\mu_c(r)$ profile over the whole plasma cross section during the time τ_c, and, as a consequence, to apparent change of heat diffusivities χ_e and χ_i. The developed model is used for description of experiments conducted on tokamaks TEXT, TFTR, and T-10. Calculations are reasonably reproduced the experimental values of increments ΔT_e and spatial profiles of these increments.