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EFFECTIVE MODEL OF TURBULENT DYNAMICS AND THE RESULTING TRANSPORT PROCESSES IN TOKAMAK CORE PLASMAS *)

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Relatively simple while rather effective dynamic model of plasma turbulence and the resulting transport processes in tokamak core plasmas is discussed. The model is based on the special set of nonlinear weakly dissipative adiabatically reduced MHD-like equations, which self-consistently describes both turbulent plasma fluctuations and the resulting non-diffusive transport of plasma thermal energy, toroidal momentum, and density. A family of computer codes CONTRA [1, 2] has been developed on the bases of this model those allow us to self-consistently simulate rather complex scenarios of plasma evolution with different transient regimes at sufficiently long times those are comparable with or longer than the plasma energy confinement time. One of the most important features of the model revealed in the simulations is the tendency to maintain plasma near turbulent-relaxed states with the pressure profiles those are close to the "canonical" pressure profiles observed in many tokamak experiments [1, 3]. Further the simulations have revealed the crucial influence of the SOL region on the energy confinement time of the core plasmas. Under the assumption that the classical longitudinal electron thermal conductivity is the dominant mechanism of heat losses from the SOL, the simulations of transient regimes with different ECR heating power have shown such dependence of the plasma energy confinement time on the heating power input, which is in good agreement both with the experiments in T-10 and with the scaling of the stationary H mode in ITER [4]. A conceptual proposal for stationary thermal energy peaking in discharges with enhanced safety factor q_b at the plasma edge has been suggested on the basis of the above results [5]. The results of simulations at macroscopic times for some other complex scenarios with a fast turn on and turn off the ECR heating, as well as scenarios with sawtooth oscillations are also presented [1]. The results obtained demonstrate fast nonlocal responses of the resulting transport processes to the fast changes in external power inputs and are in reasonable agreement with experiments in various tokamaks.

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