study of the energy transport coefficient in self-organized tokamak plasma [[1]](#footnote-1)\*)

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Numerous experiments carried out in different tokamaks (with divertor and limiter plasmas) have shown that in all observed regimes (except of the ITB regions) normalized pressure profile was the same regardless of the device sizes and plasma heating methods [1]. Existence of the self-consistent pressure profile results from self-organization of the turbulent plasma. Linear flux-gradient relations cannot describe non-local transport phenomena observed in self-organized plasma. In this work the non-equilibrium thermodynamical approach is applied to description of self-organized plasma [2]. This approach implies the existence of the self-consistent plasma pressure profile corresponding to the minimum of free energy. Relaxation of the pressure profile distorted by the external impact can be described by Smolukhovski equation.

Experiments with impurity gas puffing in OH and ECRH regimes carried out in the T-10 have shown that energy confinement depended on the radiation losses at the plasma periphery. Stored energy first rises with increase of the radiation losses and then reaches the saturation level Wsat. Similar dependence of the energy confinement time on the plasma density (neo-Alkator scaling) is also related to the increase of the radiation losses with density rise [3].

Relaxation of the perturbed pressure profile is described by the energy balance equation [2] with transport coefficient κ = θ(χ0+χ1). The first term χ0 corresponds to the minimum value of the transport coefficient in case of the self-consistent heating power profile. The second term χ1(Γ1) depends on the heat flux Γ1 disturbing the plasma pressure profile. Growth of the radiation power results in decrease of the heat flux Γ1 in the cooling region, so transport coefficient in the plasma periphery decreases until it reaches the minimum value κ = θχ0. Hence stored energy rises and achieves the saturation level Wsat. The dependence of the Wsat on the plasma parameters is defined by the factor θ~p0β0/qL.

In this work the coefficient χ0 is evaluated in regimes with saturated level of the stored energy Wsat. It was shown that transport coefficient χ0 is constant in magnitude in the wide region of the plasma section (8 cm < r < 21 cm).

References

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