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STATISTICAL ANALYSIS OF SIMILARITY OF ELECTRON TEMPERATURE AND DENSITY PROFILES AT QUASI-STATIONARY STAGE OF DISCHARGES IN GLOBUS-M2 TOKAMAK *)

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Statistical analysis [1] of the similarity of plasma parameter profiles (electron temperature T_e, density n_e, and pressure p_e) at the stage of quasi-stationary plasma current (flat-top) in the JET tokamak showed a high degree of plasma self-organization and confirmed the hypothesis [2] (and its verification in [3–7]) about the existence of universal normalized profiles (UNP) of plasma parameters obtained by normalizing the profiles to their characteristic values – in the center of the plasma column or the average value for most of the plasma volume (in the region $\rho \le \rho_{max} = 0.5–1$, where ρ is the normalized minor radius as the flux coordinate of the magnetic surface). It is shown in [1] that even large jumps of $T_e(\rho, t)$, up to 100% in amplitude, caused by the switch-on of auxiliary heating, can be described using UNP.

It is of interest to conduct a similar analysis based on data from other machines. In this work, data on T_e and n_e obtained by Thomson scattering diagnostics [8, 9] at the quasi-stationary stage of the discharges in the Globus-M2 tokamak [10], which, unlike JET, is a compact spherical tokamak, are analyzed. A database of the same type as in [11] was used, where the presence of a universal relation $T_e(\rho) = \text{const}\, n_e(\rho)^{1,65}$ at the quasi-stationary stage of discharge in Globus-M2 was shown.

In this report it is shown that the relative standard deviation of the normalized profile $T_e(\rho, t)$ from its time-averaged values for a given ρ, $\sigma_{Te}(\rho, \rho_{max})$, does not exceed 10% in most of the discharges when $\rho_{max} = 0.8$ and $\rho = 0{,}1–0{,}7$, but $\sigma_{Te}(0.9, \rho_{max})$ reaches more than 20%. The values of $\sigma_{Te}(t, \rho_{max})$, describing the averaged over ρ deviation for a given t, do not exceed 10% in most of the considered time points. For $n_e(\rho, t)$ profiles, the degree of universality of the normalized profiles is approximately the same. Using the SvF method of balanced identification [12], the accuracy of the representation of $T_e(\rho, t)$ as the product of two functions of only one variable – time and coordinate – was found.

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