Thermal energy confinement time scaling with I_p and B_T in Globus-M H-mode.

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The presentation is devoted to the thermal energy confinement study at the compact spherical tokamak Globus-M. Globus-M had major radius R = 0.36 m and minor radius a = 0.24 m (R/a ~ 1.5). The lower-null magnetic configuration is characterized by moderate elongation k~1.7 and triangularity δ~0.35. Special feature of the Globus-M tokamak is the extremely high input heating power density: ~0.6 MW/m^3 in pure ohmic heating (OH) and ~2.5 MW/m^3 under auxiliary heating by neutral beam injection (NBI). The range of temperatures achieved in Globus-M is $<T_{i,e}>$= 0.2 – 0.4 keV that leads to higher values of collisionality ν^*=0.03-0.4 and normalized ion gyroradius ρ^*~ 0.02-0.04 than in MAST and NSTX. The present study was performed in both OH and NBI heated H-mode plasmas. H-mode is the usual operational mode in Globus-M at moderate density range n_e>2-2.5·10^{19} m^{-3}. The regression fit of the database indicates strong τ_E dependence on both plasma current I_p and toroidal magnetic field B_T, while the dependence on n_e and absorbed power was similar to the conventional scaling IPB98(y,2). The original technique for calculating the absorbed power using both NUBEAM [1] and 3d fast-ion tracking algorithm [2] is discussed. Obtained profiles of the absorbed power were used to estimate electron and ion heat diffusivity using ASTRA simulation. It was found that the electron heat diffusivity is strongly affected by the plasma current and the toroidal magnetic field. The $B_T\tau_E$ dependence on ν* is found be similar to the one in NSTX and MAST, while q dependence is stronger than on MAST, but weaker than in ITER scaling.

1. *A. Pankin et al., "The tokamak Monte Carlo fast ion module NUBEAM in the National Transport Code Collaboration library", Comp. Phys. Comm. 159 (2004) 157.*
2. *Bakharev N.N. et al., Fast particle behaviour in the Globus-M spherical tokamak // Nucl. Fusion – 2015. – T. 55 – 55043023.*