Contribution ID: **41**

Type: **oral**

Thermal energy confinement at the Globus-M spherical tokamak and first results from the Globus-M2 experiments

Monday, 28 October 2019 16:25 (35 minutes)

The presentation is devoted to the thermal energy confinement study at the compact spherical tokamaks Globus-M and Globus-M2. Experiments were performed under auxiliary heating using neutral beam injection (NBI) in plasma with lower null magnetic configuration (major radius R = 0.35 m, minor radius a = 0.21-0.22, elongation ~1.9, triangularity $\delta \sim 0.35$) for the ranges of plasma current and toroidal magnetic field: Ip=0.12-0.25 MA, BT=0.25-0.5 T. It have been shown that energy confinement time (τE) dependence on BT is very strong, while the τE dependence on plasma current Ip is significantly weaker than IPB98(y,2) scaling predicts: $\tau E \sim I_p^{(0.48\pm0.21)} B_T^{(1.28\pm0.12)}$. The improvement of τE was mostly by electron heat diffusivity decrease with toroidal field rise, while the ion heat diffusivity was in line with neoclassical theory predictions. The first NBI experiments were carried out at the Globus-M2 for the increased range of plasma current and toroidal magnetic field: Ip =0.25-0.3 MA and BT = 0.7 T. During NBI heating (D-beam, 28 keV, 0.8 MW) the plasma total stored energy measured by the diamagnetic coil increased more than twice (in comparison with the Globus-M results). Diamagnetic measurements were confirmed by the kinetic (electron and ion temperature profiles) measurements. Thermal energy confinement time was estimated by 1.5D ASTRA transport modeling while the beam absorbed power was derived using two codes: NUBEAM code and 3D fast ion tracking algorithm. The obtained τE values are higher than those predicted by IPB98(y,2) and are in good agreement with the Globus-M scaling.

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Session Classification: Session O2