Toroidal magnetic field increase in the Globus-M spherical tokamak

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Globus-M spherical tokamak (ST) was a compact machine (R ≈ 36 cm, a ≈ 24 cm, plasma-wall distance of a several centimeters) with toroidal magnetic field B_{tor} = 0.4 T and unique features such as high normalized Larmor radius ($\rho^* = \rho / a$) and high heating power density. This year a new Globus-M2 ST with the same vacuum chamber, 2.5 times increased B_{tor} and I_p, and upgraded heating and diagnostic systems will be launched. A significant expansion of the experimental parameter range will provide an opportunity to get closer to the operating conditions of the compact fusion neutron sources (CFNS) and, hopefully, answer the question, if the pros of the ST configuration outweigh the cons when used as a basis for a CFNS .

In the final Globus-M experimental campaign [1] B_{tor} and I_p were raised by 25% up to 0.5 T and 250 kA respectively. As a result an overall improvement in plasma performance was observed. Plasma total stored energy and energy confinement time grew by about 30% in the discharges with density up to $6 \cdot 10^{19} m^{-3}$. D-D beam-plasma neutron rate increased significantly at the same NB heating power. The main reasons for this effect, in order of importance, are the electron temperature rise and the fast ion confinement improvement. Decrease of first orbit, sawtooth-induced and TAE-induced fast ion losses was recorded. Energy confinement time growth proportional to toroidal magnetic field was observed. Acquired in the experiments energy confinement time scaling and power decay length scaling, based on the Langmuir probe measurements, were in a reasonable agreement with scalings, based on MAST [2] and NSTX [3] data.

References:

1. Minaev V.B. et al. 2017 Nucl. Fusion 57 066047
2. Valovic M. et al 2009 Nucl. Fusion 49 075016
3. Kaye S M et al 2006 Nucl. Fusion 46 848–57