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The Influence of Toroidal Magnetic Field Growth on Plasma Performance in the Spherical Tokamak Globus-M/-M2

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Globus-M was a compact spherical tokamak with unique features such as plasma column tightly fitted into the vacuum vessel and high NB heating power density. The toroidal magnetic field in it was limited to 0.5 T. Globus-M2 is an upgraded version of Globus-M machine with substantial increase of engineering parameters (the toroidal magnetic field up to 1 T, the plasma current up to 0.5 MA). The goal of the scientific program is to achieve the improved plasma performance with sub-fusion temperature value and collisionality much less than unity in compact geometry and to get closer to the operating conditions of the compact fusion neutron sources. The first plasma experiments ought to be started in 2018.

In the final Globus-M experimental campaign the toroidal magnetic field and the plasma current were raised by 25% as compared with routine parameters. As a result an overall improvement in plasma performance was observed. The plasma total stored energy and the energy confinement time grew by about 30% in the discharges with moderate density. D-D beam-plasma neutron rate increased significantly at the same heating power. The main reasons for this effect, in order of importance, are electron temperature rise and fast ion confinement improvement. Decrease of first orbit, sawtooth-induced and TAE-induced fast ion losses was recorded. The energy confinement time growth proportionally to the toroidal magnetic field was observed. The energy confinement time and power decay length scalings, acquired in the experiments, are in a reasonable agreement with MAST and NSTX data. The experiments were continued on the Globus-M2 tokamak with substantially increased values of the toroidal magnetic field and the plasma current.

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