Fast ion confinement in Globus-m and Globus-m2

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ICRH and NBI results in the Globus-M tokamak (plasma current is 250 kA, toroidal magnetic field is 0.4 T) were analyzed. Modeling for Globus-M2 [1] (plasma current and magnetic field will be increased 2.5 times) was performed.

Unique 100 kW H minority ICRH experiment has been performed in Globus-M earlier [2]. During the ICRH ion temperature increased from 180 to 320 eV. Fast ion losses were detected. Experiment revealed that the maximum confined energy is 15±5 keV. Modeling showed that energy of the accelerated particles couldn’t exceed 16 keV, which is in a good agreement with the experiment. Modeling showed that in Globus-M2 trapped particles with energies up to 100 keV will be confined.

Main mechanisms of the fast ion losses during NBI were investigated. For 18 keV injection experimental results were in a good agreement with the modeling [3]. Most particles were lost due to the first orbit losses and total power losses were 40% for the hydrogen beam and 65% for the deuterium beam. During the 26 keV hydrogen beam injection total power losses increased up to 70%. For the 26 keV deuterium beam experimental estimation of the losses was impossible because of the nonclassical energy spectrum of the fast ions. Modeling showed that total power loss increased up to 90%. Nonclassical shape of the spectrum aroused due to the sawtooth oscillations, which led to the additional 20% power losses of the fast ions. In the absence of the sawtooth oscillations Alfven eigenmodes were observed. A way to decrease orbital and sawtooth-induced losses without changing magnetic field and plasma current is to increase distance between the plasma and the tokamak wall on the lower field side. Increasing the plasma-wall distance from 3.5 to 7 cm during 26 keV deuterium injection reduces orbital losses two times and total losses to 65%. Modeling showed, that the increase in the magnetic field and plasma current will cause more than 10 times decrease in orbital losses. Sawtooth-induced and Alfven losses will be sufficiently decreased too.

Thus, fast ion confinement will be sufficiently improved in Globus-M2 so ion temperature and neutron rate will be increased significantly.

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Literature

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