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INTEGRAL MODELING OF PLASMA TORQUE TRANSPORT IN THE SPHERICAL TOKAMAK GLOBUS-M2 *)

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In experiments on the spherical tokamak Globus-M2 (large radius R=0.36 m, small radius a=0.24 m, aspect ratio R/a~1.5 and elongation k~1.8-2) when heating the plasma using 2 neutral beam injectors (NBI) of high-energy atoms, the mode with hot ions [3] was achieved, in which CXRS diagnostics [1, 2] (active charge exchange spectroscopy) recorded toroidal plasma rotation velocities of up to 190 km/s.

The study of torque transport requires an integrated approach, which includes solving the transport equation with a given torque transfer coefficient, and the right side of the equation incorporates the external torque resulting from neutral particle injection. To calculate the latter, the Monte Carlo code NUBEAM [4] is used. This code calculates the trajectories of fast particles in a tokamak.

During the caclulations, it was discovered that the speed of toroidal rotation and the radial electric field can have a significant impact on the distribution function of fast particles, as well as the neutron flux. In this regard, it was necessary to develop a program that allows us to collaboratively solve transport equations and calculate the process of decelerating fast ions.

This report presents the results of a study torque transport on the Globus-M2 spherical tokamak using the combined ASTRA [5] and NUBEAM codes. The study focuses on two discharges: #42155, which had a low plasma rotation speed (up to 10 km/s) and one injector, and discharge #41585 in hot ion mode, which involved the injection of two beams and a rotation speed of up to 190 km/s.

The joint solution of the two codes was fond to converge. The torque from collisions with fast particles, as well as from the interaction of the fast particle current and the magnetic field, has a noticeable effect on the plasma rotation speed. The neutron flux may be underestimated by 15% if the plasma rotation speed is not taken into account.

The experiments were conducted at the Unique Scientific Facility "Spherical tokamak Globus-M," which is incorporated in the Federal Joint Research Center "Material Science and Characterization in Advanced Technology." Within the framework of the state contracts, the task included the preparation of heating systems (0034-2021-0001) and diagnostic systems (0040-2019-0023) for the tokamak.

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