Energy confinement in the Globus-M spherical tokamak

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The empirical scaling laws (s) are the most reliable in predicting the parameters of future fusion facilities, despite the success of recent investigations in numerical simulation of small-scale plasma instabilities responsible for losses of heat and particles from the magnetic trap. The international ITER database obtained for tokamaks with a large aspect ratio is inapplicable to predict energy confinement time (τE) both in fusion and in thermonuclear neutrons source based on the spherical tokamak (ST) concept. Operation in large β (plasma pressure to magnetic field pressure ratio) values area, as well as strong toroidal plasma rotation and a large part of trapped particles cause other types of small-scale instabilities in ST plasma. This leads to sufficient distinctions in scalings for τE both in engineering parameters and in dimensionless physical quantities areas. Data obtained from foreign ST are in a good compliance with each other, but these tokamaks have almost the same parameters. The experiments on ST Globus-M tokamak showed favorable dependence of τE on magnetic field of facility and plasma collisionality for a wider range of spherical tokamak operational parameters. Heat transfer simulation in electronic and ionic channels for NBI reveals proximity of heat transfer in ionic channel to neoclassical one. Heat transfer in electron channel is abnormal, with electron thermal diffusivity significant decreasing at increase of both plasma current and magnetic field. Engineering τE scaling for compact spherical tokamak was obtained in a wide range of plasma current (0.1–0.25 MA), toroidal magnetic field (0.25–0.5 T), plasma density (2–
6 1019 m–3) and absorbed power (0.25–0.75 MW). The numerical experiment demonstrated strong influence of plasma collisionality on improvement of energy confinement in electron channel.

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