plasma electron conductivity in the expander of the gas dynamic trap

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The presented work is part of the fundamental research on the implementation of a controlled thermonuclear reaction in open-type magnetic traps. The interest in such systems is defined by the development of powerful neutron sources, which are necessary, in particular, to control hybrid fusion-fission reactors, and, with further development, the creation of purely fusion reactors for energy production. The main parameter from the point of view of applications is the energy efficiency of the system, which rapidly increases with increasing electron temperature. One of the factors limiting the electron temperature is the high thermal conductivity of the plasma along the magnetic field lines, which is determined by a number of complex kinetic processes in the expanders — regions of the expanding magnetic flux behind the magnetic plugs. The main goal of the work is to study this loss channel in detail and determine the conditions under which these losses could be suppressed to levels acceptable for thermonuclear applications of open-type magnetic traps.

This work is a continuation of the cycle of experimental studies at the GDT facility to determine the key dependences of the plasma confinement efficiency on the expander parameters. In previous works [1, 2] experimental results describing the electric potential in the Debye layer near the surface of the plasma absorber and the average electron energy along the longitudinal coordinate, as well as determining the effect of the neutral gas density in the expander on the plasma parameters in the central part of the trap were presented.

The present work is devoted to measuring the plasma potential along the entire length of the expander using an emissive Langmuir probe, as well as studying the power fluxes incident on the surface of the plasma absorber and their dependence on the residual gas density and other plasma parameters. These data will make it possible to complete the theoretical model currently being developed, which describes the kinetics of processes in the expander.

References

1. E. Soldatkina, et al. Physics of Plasmas 24, 022505 (2017).
2. E. Soldatkina, et al. Zvenigorod International Conference on Plasma Physics and Controlled Fusion, Book of Abstracts 2018, p. 69.