High-pressure plasma jet source for sustaining of GDT target plasma material balance

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For the effective operation of axisymmetric open traps with a population of hot ions (with an energy of ~10 keV), such as The gasdynamic trap (GDL) and the GDML planned on its basis, it is necessary to maintain a population of relatively cold target plasma (with an energy of ~ several hundred eV). Without the target plasma, the development of kinetic instabilities occurs in the GDL [1], and it is impossible to maintain electrical contact with the electrodes of the MHD instabilities suppression system necessary for the operation of this system [2]. Since the confinement of the target plasma occurs in a highly collisional mode, the loss cone in the phase space is always filled and the target plasma leaves the trap during the gas-dynamic time. Thus, without sufficient feeding of the target plasma material balance in open traps, the steady-state plasma confinement with thermonuclear parameters is impossible.

In this paper we consider the source of a plasma jet for transverse injection of plasma into an open trap. To penetrate the plasma into the trap during injection perpendicular to the magnetic field lines, the pressure of the plasma jet must be of the order of the magnetic field pressure of the trap. This imposes requirements on the minimum energy density of the plasma jet.

The plasma jet was created and accelerated by Marshall's gun. This method is well established on tokamaks [3], and has been tested on open traps [4]. The velocity and density of the plasma jet were measured. Velocity was measured by optical time-of-flight diagnostics, density was measured by interferometry. It is shown that the obtained parameters of the jet are sufficient for penetration into the magnetic field of GDL. The parameters of the plasma source were optimized.

References

1. I.A. Kotelnikov, I.S. Chernoshtanov, V.V. Prikhodko. Electrostatic instabilities in a mirror trap revisited. Physics of Plasmas v. 24, p. 122512 (2017). DOI: 10.1063/1.5013059.
2. A.D. Beklemishev, P.A. Bagryansky, M.S. Chaschin, E.I. Soldatkina, (2010) Vortex Confinement of Plasmas in Symmetric Mirror Traps, Fusion Science and Technology, 57 4, 351–360, DOI: 10.13182/FST10-A9497
3. Abramova K.B., Voronin A.V., Gusev V.K. et al., (2005) Injection of high-density plasma into the Globus-M spherical tokamak. Plasma Phys Reports 31 721–729
4. T. Asai et al., 2017 Nucl. Fusion 57 076018