DOI: 10.34854/ICPAF.52.2025.1.1.030

HYDROGEN INJECTION FROM A COAXIAL PLASMA ACCELERATOR INTO A GAS DYNAMIC TRAP ALONG A MAGNETIC FIELD *)

Kolesnikov E.Yu.

Budker INP, Novosibirsk, RF, E.Yu.Kolesnikov@inp.nsk.su

Experiments on maintaining the material balance of plasma using a coaxial plasma accelerator (CPA) [2], also known as the Marshal gun, were continued at the Gas Dynamic Trap (GDT) [1] facility at the Budker INP SB RAS.

The GDT is an axisymmetric mirror trap with a two-component plasma. Fast ions with an average energy of about 10 keV are formed by injection of neutral atoms into a target plasma with an ion temperature of about 200 eV and a density of 10^{13} cm^{-3}. In addition to capturing neutral beams, target plasma is also necessary to stabilize instabilities during plasma discharge. The target plasma is held in collision mode and constantly flows out through magnetic plugs. Plasma injection from the CPA is designed to solve the problem of maintaining the material balance of the target plasma.

The CPA creates a plasma jet with a particle density of 10^{15}-10^{16} cm^{-3} and a directional velocity of about 100 km/s. The discharge duration in the CPA is less than 100 microseconds, the typical discharge current is 50-100 kA. The CPA was installed in the GDT end expander. Injection was carried out through a magnetic plug along the magnetic field of the GDT. According to the results of experiments with the injection of hydrogen and deuterium, it was shown that, firstly, the plasma jet penetrates through the magnetic mirror plug of the GDT, secondly, injection from the CPA leads to an increase in the capture of beams of neutral atoms (Fig. 1, left), thirdly, the plasma at the same time retains MHD stability, and fourthly, it is possible not only to maintain, but also to create a target plasma using injection from a CPA (Fig. 1, right).

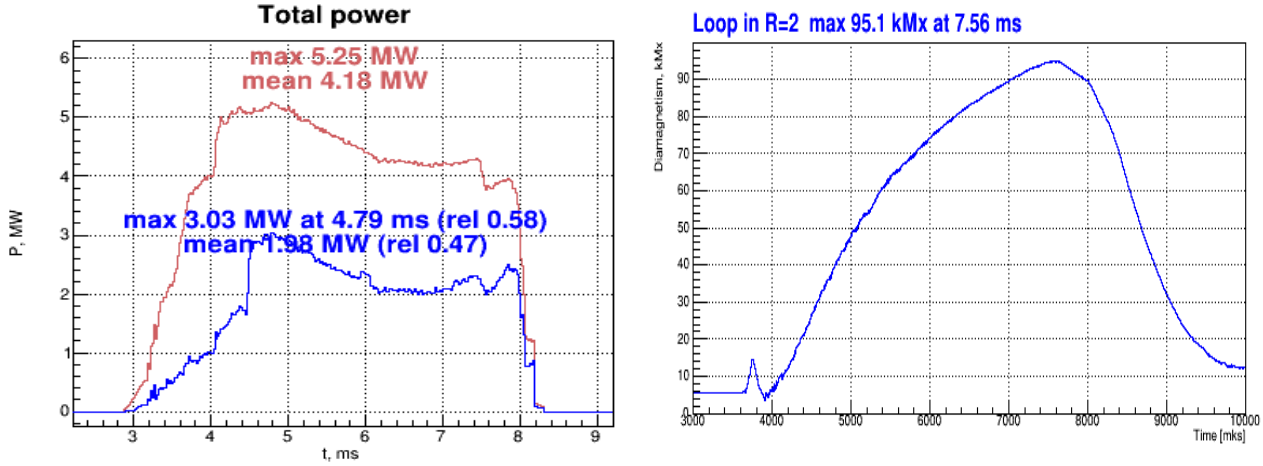

Figure 1. On the left is the full injection power (upper curve) and the power trapped in the plasma (lower curve) in the plasma replenishment mode. Injection from the CPA at 4.5 ms. On the right is an example of plasma creation using injection from a CPA in 3.7 ms. The diamagnetism of the plasma created after injection from the CPA is shown.

References

[1]. A.A. Ivanov, V.V. Prikhodko. Gas dynamic trap: Resent results and prospects. UFN, т. 187, № 5, p. 547-574 (May 2017). DOI: 10.3367/UFNr.2016.09.037967

[2]. Morozov A.I. Introduction to plasmadynamics 2nd ed. PhysMathLit, 2008.

*) abstracts of this report in Russian