PLASMA POTENTIAL CONTROL In the GOL-NB AXISYMMETRIC MULTIPLE-MIRROR TrAP [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2023.50.2023.1.1.019

Polozova P., Batkin V., Beklemishev A., Ivanov I., Kuklin K., Kurkuchekov V., Postupaev V., Rovenskikh A.

Budker Institute of Nuclear Physics of Siberian Branch Russian Academy of Sciences, inp@inp.nsk.su

GOL-NB is an open axial-symmetric multiple-mirror trap. It is consists of a central trap, which is 2.3 meters long, two multiple-mirror solenoids of 3 meters in length and two expander tanks of a plasma flux. Two neutral beam injectors are being used for target plasma heating [1]. The total power of the neutral injection is up to 1MW.

Plasma in the GOL-NB is inclined to MHD flute instability because of features of the facility. Such kind of perturbation is one of the most dangerous of instabilities so far as it is characterizes by the large increment. The reason of flute instability includes in a fact that the point of minimum of a magnetic field on the axis of the trap is a saddle point. It means that the magnitude of a magnetic field rises along the axis to the mirrors, starting from the minimum point, and decreases transversely to axis. One of the most effective ways to eliminate this type of unstable perturbations is a vortex confinement. The point is in applying a potential to electrodes, which is in contact with plasma. Potentials must be variable, depending on radius of magnetic line, so that it causes differential rotation of plasma because of the interaction with a radial electric field. The frequency of rotation depends on radius of magnetic tube and on applied potential. Thereby we can prevent the further development of flute perturbations; therefore, we hinder plasma from being thrown on the wall of a trap.

Some part of flute perturbations can be suppressed by line-tying effect [2] and, in addition, by the finite Larmor radius effect [3]. However, FLR effect cannot stabilize the whole potential perturbations when plasma has a low β parameter. In fact, GOL-NB plasma is such one. To solve this problem, the vortex confinement method is being studied on the GOL-NB facility. In this work we use Rosenbluth-Longmire criterion to assess plasma steadiness. The curvature of magnetic lines is used as a key variable parameter.

At this stage of work a system of chamber electrodes and limiters with appropriate controlled power supplies were designed and created, as well as the commissioning in GOL-NB facility were made. Amplitudes and characteristic frequencies of local plasma potential perturbations were studied, depending on the plasma dumps and limiters voltage supply. Diagnostic system that is being used in this work contains electrostatic probes and Mirnov coils.

The report presents the scheme of plasma potential control system device and research results of the behavior of plasma parameters depending on the experimental scenario and the magnitude of potentials applied to plasma dumps and limiters.

References

1. Postupaev V.V., Yurov D.V. Simulation of the reference scenario for the operation of the GOL-NB multiple mirror trap // Plasma Physics. - 2016. - T. 42. - No. 11. - S. 966-977.
2. Ryutov D. D. et al. Magneto-hydrodynamically stable axisymmetric mirrors //Physics of Plasmas. – 2011. – Т. 18. – №. 9. – С. 092301.
3. Rosenbluth M. N., Krall N. A., Rostoker N. Finite Larmor radius stabilization of" weakly" unstable confined plasmas. – General Dynamics Corp., San Diego, Calif., 1962. – №. GA-2371.

1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/Mu/ru/BA-Polozova.docx) [↑](#footnote-ref-1)