Physical commissioning of the GOL-NB multiple-mirror trap [[1]](#footnote-1)\*)

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The solution of the problem of obtaining a plasma with reactor parameters in an open trap requires the development of physics and technology for substantial suppression of particle and energy losses along the magnetic field to the end walls. One of the possible ways to achieve this goal is to use specialized multiple-mirror sections of the magnetic system with periodic modulation of magnetic induction along the axis [1,2]. At a sufficiently high collision rate *ν*\* ~ 1 (where *ν*\* = λ*/l* is the ratio of the ion free path length to the corrugation period) in such a system, a friction force arises between the populations of locally-trapped and transient particles, which reduces the losses from the trap. The theory of multiple mirror confinement is well developed, but there is a need for experimental verification of this confinement scheme [3].

The GOL-NB [4] was proposed as a part of the physical program for creating the GDMT next-generation open trap [5]. The magnetic system of the total length of about 10 m includes a 2.5 m long central gas-dynamic trap with a field in the center *B*(*z*=0) = 0.3 T; adjacent high-field sections with *B*max = 4.5 T, which can be configured either as solenoids or as multiple-mirror systems with 13 corrugation periods with *l* = 22 cm and its depth *R*mm = 1.4; and also tanks of magnetic flux expanders containing the end plasma receivers. Low-temperature start plasma with *n* ~ (1 - 10) × 1019 m-3 and *T* ≈ 5 eV is created using an arc source located in one of the end tanks. Plasma heating in the central trap will be done with neutrals injection (two 25 keV, 0.75 MW beams). The duration of plasma existence 3 - 5 ms is determined by the power supply of the magnetic system. GOL-NB reuses part of the infrastructure and high-field coils from the GOL-3 facility. The device is designed so that the main losses are along the magnetic field. Calculations of the energy balance predict an increase in the plasma pressure in the trap by several times at switching from the solenoidal to the multiple-mirror configuration of the high-field sections; demonstrating this is the main scientific task of GOL-NB.

The modular design of the GOL-NB magnetic system enabled start of physical experiments in an incomplete configuration without a central trap. At this stage, the technology of transporting a highly collisional cold plasma flow through the high-field section was tested. It was experimentally demonstrated for the first time [6] that at *ν*\* << 1, the corrugation of the magnetic field does not affect the plasma flow, as predicted by theory. At the beginning of 2020, GOL-NB was assembled in full configuration. The presentation will discuss the start plasma parameters in the central trap, methods of its stabilization, and the first results on the neutral beams injection in the solenoidal configuration.

References

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