MEASURING THE DYNAMICS OF THE POPULATION OF FAST IONS IN A PLASMA AT THE GOL-NB FACILITY [[1]](#footnote-1)\*)

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The GOL-NB facility [1] is a linear axisymmetric open trap with multiple-mirror sections for plasma confinement. The main purpose of the experiments carried out on this facility is to study plasma confinement in a multiple-mirror (periodically modulated along the axis) magnetic field. The GOL-NB facility consists of a central trap (mirror cell) 2.5 m long with a field at the center B = 0.3 T and coupled to it sections of a strong field about 3 m long each with B = 4.5 T. The plasma in the facility is created by a plasma gun located in an expander at one of the ends of the facility and is heated by injection of beams of fast hydrogen atoms. Two injectors [2] with a total power of 1.1 MW inject beams of fast atoms with an energy of 25 keV into the plasma, forming a population of fast ions in the central section.

Passing through the plasma, beams of fast atoms are partially ionized due to collisions with electrons and ions of the plasma, and the resulting fast ions are captured by the magnetic field of the facility. The trapped ions oscillate along the facility axis between the stopping points (coinciding with the injection points) and gradually transfer their energy to the plasma electrons due to elastic collisions. Another important effect leading to the loss of fast ions is charge exchange on a neutral gas. The presence of a neutral gas in the vacuum chamber and its penetration into the plasma lead to the loss of fast ions due to resonant charge exchange, which reduces the plasma heating efficiency.

The main tool for fast ion diagnostics at the facility is the charge exchange neutral analyzer [3] located at one of the injection points. The analyzer has 11 energy channels that register neutrals in the range from 5 to 25 keV. The analyzer signals are interpreted by comparing the measured signals with those expected for a given model distribution function of fast ions and determining the parameters of this distribution function. In addition, the analyzer makes it possible to directly measure the lifetime of ions in plasma from the decay of the neutral flux after the injection is turned off.

The paper proposes a model distribution function of fast ions, which is described by one parameter - the ratio of the power transferred from ions to plasma electrons and the power of charge exchange losses. The resulting model agrees well with the experimental data and makes it possible to study the dynamics of the effective power of plasma heating by neutral beams during the injection process, as well as to consider the effect of neutral gas accumulation in the system on the lifetime of fast ions.

References

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2. V. Batkin et al., Neutral beam injectors for the GOL-NB facility // AIP Conference Proceedings 1771,030004 (2016)
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1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/Mu/ru/AI-Gorohovskiy.docx) [↑](#footnote-ref-1)