Collective Thomson scattering on the GDT [[1]](#footnote-1)\*)

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1,2A.L. Solomakhin, 2M.E. Viktorov, 2E.D. Gospodchikov, 1A.S. Zaytsev, 2L.V. Lubyako, 2A.G. Shalashov, 1,2D.V. Yakovlev

1Budker Institute of Nuclear Physics, Novosibirsk, Russia, A.L.Solomakhin@inp.nsk.su
2Institute of Applied Physics, Nizhny Novgorod, Russia, ags@appl.sci-nnov.ru

The gas-dynamic trap (GDT) is a prototype of a thermonuclear neutron source for materials science, afterburning of radioactive waste and a hybrid nuclear thermonuclear reactor [1]. Neutrons in the GDT are obtained as a result of the thermonuclear fusion reaction in collisions in a population of hot ions, which are formed during the capture of powerful neutral beams by target plasma. The neutron production is determined by the distribution function of hot ions. Further prospects for the development of such a neutron source concept are associated with an increase in the neutron flux. However, an adequate theoretical model for the retention of hot ions in the GDT is still lacking, and the available numerical codes are free of significant drawbacks. Therefore, the urgent task of directly measuring the distribution function of hot ions in an experiment on the GDT.

A proven method for measuring the ion distribution function is the collective Thomson scattering (CTS) method. This method is widely used in other thermonuclear facilities [2]. On an open trap, CTS will be applied for the first time. A 54.5 GHz gyrotron, which is now used to create and additional plasma heating in the GDT, will serve as a radiation source. In the current configuration for introducing radiation into the plasma, the gyrotron beam crosses the plasma outside the region where hot ions are located; therefore, it is supposed to transfer the radiation input to the center of the GDT. The scattered radiation will be received at two different points, which will restore the distribution function along the longitudinal and transverse velocities of the ions. Since the power of the scattered radiation is eight orders of magnitude lower than the power of the main radiation, and the frequency shift is several hundred MHz, a very important question is the filtering of the useful signal.

At this stage, a conceptual diagnostic project has been developed, as well as the required parameters for the design of measurements of the GDT and the gyrotron, which will be used as a radiation source. Using a Keysight UXR0594A 59 GHz bandwidth oscilloscope, the radiation spectra of the gyrotron are studied as a function of the parameters of its power supply system and plasma radiation in various GDT operating modes in the region of the assumed reception of scattered radiation. Also in this area, the total scattered radiation level at the gyrotron frequency was measured using a calorimeter.

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References

1. A.A. Ivanov and V.V. Prikhodko 2013 Plasma Phys. Control. Fusion 55 063001
2. D. Moseev et al 2019 Rev. Sci. Instrum. 90 013503
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVII/Mu/ru/AQ-Solomakhin.docx) [↑](#footnote-ref-1)