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

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On the gas dynamic trap (GDT), which is one of the largest open traps with subthermonuclear plasma parameters, a system for recording the spectra of collective scattering of gyrotron radiation was created [1]. The diagnostics based on measurements of such spectra makes it possible to restore the distribution function of the population of suprathermal (hot) ions, as well as to control the development of microinstabilities in the GDT plasma.

The GDT is positioned as a prototype of a thermonuclear neutron source for materials science, afterburning of radioactive waste, and a hybrid fusion-fission reactor [2]. Further prospects for the development of such a concept of a neutron source are associated with an increase in the neutron flux. The yield of neutrons in such a source is provided by the interaction of ions from the high-energy part of the distribution function. However, there is still no adequate theoretical model for the confinement of hot ions in GDTs, and the available numerical codes are not without significant shortcomings. Therefore, the problem of directly measuring the distribution function of hot ions in an experiment at the GDT is of current interest.

The radiation source for diagnostics is a powerful 450 kW/54.5 GHz gyrotron, whose radiation is injected into the GDT plasma in the central section of the trap using an oversized corrugated waveguide and a quasi-optical two-mirror system [3]. The radiation scattered by plasma fluctuations is collected by two quasi-optical three-mirror systems from two directions corresponding to the longitudinal and transverse fluctuation wave vectors. The collected radiation is fed through a system of oversized rectangular waveguides to two highly sensitive radiometers specially designed for this task. To protect against gyrotron radiation, each of them is equipped with an attenuator, an electronic shutter based on a PIN diode, and an eight-resonator notch filter tuned to the gyrotron frequency. The filtered scattered radiation is shifted in frequency to the low-frequency region using a mixer and a local oscillator based on a Gunn diode, amplified and recorded by a Tektronix MSO54 digital oscilloscope with a bandwidth of 0-500 MHz. Further, these data are processed digitally, and spectra are obtained, from which the ion velocity distribution function will be restored.

The system is fully assembled, and the first experiments on recording the spectra of collective scattering by the GDT plasma of the gyrotron radiation were carried out. The measurement technique has been worked out, and for the first time scattering signals from thermal fluctuations of the plasma associated with the motion of hot ions have been recorded [4]. Scatterings from nonthermal plasma fluctuations caused by the development of microinstabilities have also been registered.

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References

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