ENErgy and particle flux measurement system for the gdt experiment [[1]](#footnote-1)\*)

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In recent years magnetic mirror traps have shown significant improvement of the confined plasma parameters [1] and can now be considered for further development into the next generation devices – a neutron source or a fusion reactor. Despite that, the question of magnitude of longitudinal heat losses from thermonuclear-grade mirror traps remains open.

In theoretical works [2,3] authors demonstrate that the heat flux out of a mirror trap in case of plasma in direct contact with a cold end plate can be significantly lowered compared to the classic (Spitzer) conductivity limit. The reason for that is the ambipolar potential barrier forming between the mirror and the plasma absorber that prevents cold electrons from returning from the expander to the confinement area. Moreover, in theory, the energy removed from the trap by one ion-electron pair should not exceed 8Te.

This theory was first verified in 1996 at the Gas Dynamic Trap (GDT) experiment with low plasma parameters (Te = 20 eV) [4]. In the modern iteration of the GDT the electron temperature of 200 eV can be achieved by neutral beam injection (NBI) and up to 900 eV by NBI combined with electron-cyclotron resonance heating. A series of experiments was conducted in 2016 in which the mean electron energy in the expander and the potential jump in the Debye sheath along the plasma absorber were measured [5]. To complete the theoretical model describing the processes in the mirror trap expander the magnitude of energy removed by one ion-electron pair should be determined, as well as its dependence on various parameters.

In order to do these measurements a diagnostic system able to measure particle flux and energy from plasma across the whole surface of plasma absorber was developed, produced and fine-tuned. The system consists of 21 sets of detectors, spaced out across the absorber in a shape of a cross. Each set includes a pyroelectric bolometer, an ion flux detector and a full current detector. Such system can be used to measure spatial distribution of energy removed by an ion-electron pair as well as to estimate the secondary emission coefficient. The latter is a key factor influencing the processes in the mirror trap expander.

The current work presents the first results obtained with the new diagnostic system.

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