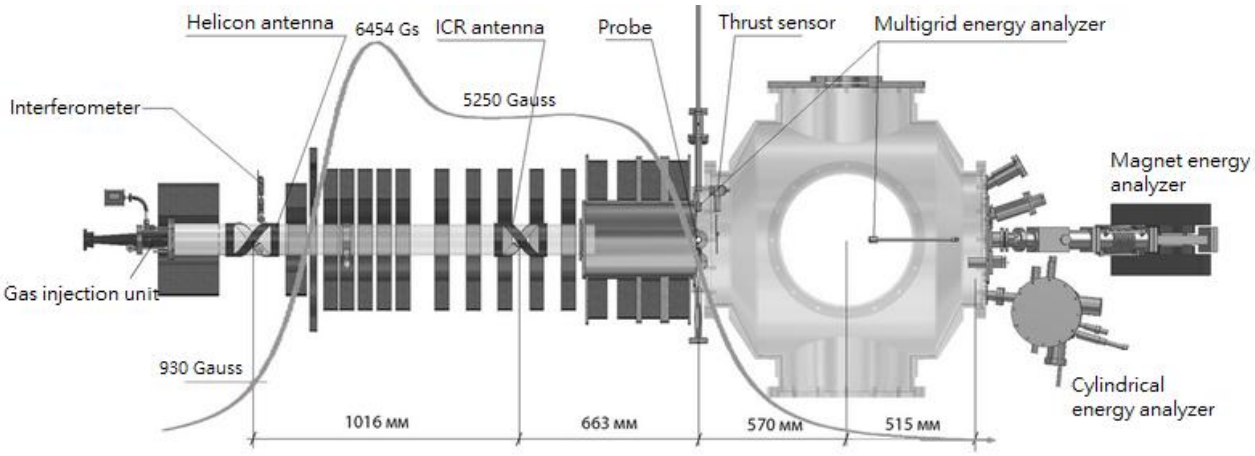
DOI: 10.34854/ICPAF.52.2025.1.1.169

ION-CYCLOTRON HEATING AT THE PS-1 FACILITY — A MODEL OF AN ELECTRODELESS PLASMA ROCKET ENGINE *)

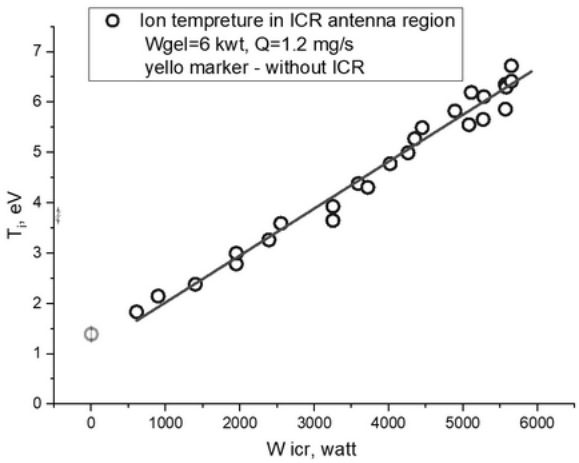
Yanchenkov S.V., Kutuzov D.S., Orlov M.Yu., Shurovskiy D.O.

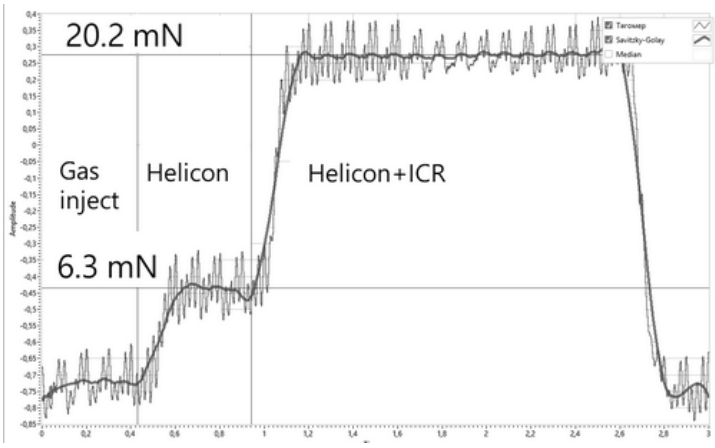
NRC "Kurchatov institute", Moscow, Russia, yanchenkov_sv@nrcki.ru

The aim of the PS-1 installation is to study the physical principles underlying the Electrodeless Plasma Rocket Engine (EPRE), and to develop EPRE technologies and operating modes. The PS-1 is a linear flow-through installation consisting of four areas: the working gas inlet area, the helicon plasma source area, the ion-cyclotron resonance (ICR) heating area, and the magnetic nozzle. Plasma is generated and heated in a quartz tube placed in a magnetic field on the installation axis. Two helical antennas twisted in opposite directions are mounted on the quartz tube: a helicon antenna and an ICR antenna. A high-frequency generator with a power of up to 10 kW at a frequency of 13.56 MHz is used to generate plasma. The density of the generated plasma reaches $2 \cdot 10^{19}$ m^{-3}. In the area where the magnetic field is constant and reaches 0.52 T, the ion component of the plasma is heated up in multiple times, by means of a high-frequency generator with a frequency of 2 MHz and a power of up to 10 kW. The flow rate of the working gas (helium) varied from 0.8 to 1.5 mg/s.



The thrust was measured using a strain gauge-based thrust sensor. By means of the emission spectroscopy method an increase of the ion temperature component was observed directly in the ICR antenna area. The increase in ion temperature during ICR heating reached sixfold values compared to the helicon source; the measured thrust increase reached threefold values.





*) abstracts of this report in Russian