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POWERFUL NEGATIVE ION SOURCE WITH A LARGE EMISSION AREA STUDY *)

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As part of the project high-energy atom injector development, at the Budker Institute of Nuclear Physics of the Siberian Branch of the RAS, an atomic injector of the MeV energy range for heating is being developed. It is based on the acceleration and neutralization of a negative hydrogen ions beam. The design of the BINP high-voltage injector includes several innovative components, important for injector operation stability and overall efficiency. It includes a multi-aperture long-pulse surface-plasma negative ion source, a single-aperture accelerator, a neutralizer, and a separator. The report describes the results of work carried out in 2024 to obtain plasma in the 9A source [1] and study its characteristics.

The source is designed to produce a beam of 9A, 120 keV in pulses with a duration of 20 s. The features of the source are: using of four RF drivers to irradiate the large emission area; a 142 aperture ion-optical system, enforced pumping system with 1000 m^3s^{-1} cryopump. Inductively driven RF discharges (4 MHz, power up to 60 kW each) are excited by external antennas in four RF drivers [2]. The drivers are mounted on the rear flange of the expansion chamber at an angle of 26° to the source axis. This arrangement of the drivers improves the plasma density distribution near the negative ion emitter electrode. The dipole magnetic field required to suppress accompanying electrons is generated by permanent NdFeB magnets mounted near the emitter electrode. To enhance the generation of negative ions, cesium is supplied to the surface of the emitter electrode. Negative ions are extracted through a 142 aperture three-electrode ion-optical system and accelerated to an energy of 120 keV. The design emission density of negative ions is more than 30 mA/cm^2.

The report will present the results of measured characteristics of the source RF system and the plasma near the emitter electrode.

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*) abstracts of this report in Russian