PROJECT AND FIRST test RESULTS OF A POWERFUL neutral beam injector 80 KEV 1 MW, 1 SEC FOR PLASMA HEATING IN TOKAMAK [[1]](#footnote-1)\*)

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In order to heat the plasma in a tokamak, the injector of a megawatt beam of deuterium atoms with 80 keV particles energy at a 1 second duration was designed, manufactured, and undergoes the first tests. This injector is designed for plasma heating in a COMPASS tokamak (Prague, Czech Republic). The injector is a further development of fast atoms sources series developed in the Budker Institute [1-3]. The injector provides a beam of deuterium atoms with 22A extracted current in ion-optical system (IOS) at a voltage of 80kV.

Traditionally used are three and four electrode IOS, each of which has its own advantages: a large extracted current in the first case and a remarkably small angular divergence of the beam in the second one. A feature of this project is the design of the IOS, which allows the use both 3 and 4 electrode beam formation schemes in one ion source. The transition from the tetrode to the triode IOS is carried out by changing the plasma grid and removing the extracting grid of the tetrode.

Another distinguishing feature of the project is the arrangement of the beam duct with a removable calorimeter-beam absorber. Such a scheme means that a calorimeter designed for a full-scale beam (and so it have quite significant dimensions) is present in the beam duct only at the stage of initial full-scale beam tests. After the full-scale tests, the calorimeter is removed to reduce the length of the beam duct. This reduces significantly the beam broadening during the transportation to the entrance port of the tokamak. For testing and conditioning shots, it is enough to have a simple and compact retractable calorimeter designed for a beam of reduced duration. This small calorimeter is constantly present in the beam duct.

The relatively high (80 keV) energy of the beam particles in a megawatt atomic beam means the increased power and gas evolution in the residual ions dump. To ensure the vacuum conditions in the beam duct, a high-speed differential cryogenic pumping system is used.

References

1. Yu.I. Belchenko, V.I. Davydenko,. P.P. Deichuli, et al. Studies of ion and neutral beam physics and technology at the Budker Institute of Nuclear Physics, SB RAS. PHYSICS-USPEKHI, v. 61, No 6, pp. 531-581, 2018.
2. A. Sorokin, V. Belov, V. Davydenko, P. Deichuli, A. Ivanov, A. Podyminogin, I. Shikhovtsev, G. Shulzhenko, N. Stupishin, and M. Tiunov, “Characterization of 1 MW, 40 keV, 1 s neutral beam for plasma heating”, Review of Scientific Instruments 81, 02B108 (2010).
3. P.P. Deichuli, A.V. Brul, G.F. Abdrashitov et.al., “Power neutral beam injector with tunable particles energy - first tests”, Abstracts, Plasma Physics and Technology, vol. 5, no. 1/2018.

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