PLASMA HEATING IN PLM-M DEVICE [[1]](#footnote-1)\*)

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The PLM-M plasma linear multi-cusp [1] is built on the basis of the existing PLM device (NRU "MPEI") [2] for the purpose of full-scale testing of materials, mock-ups and prototypes of the wall and divertor of future thermonuclear reactors. The installation makes it possible to obtain plasma with parameters capable of providing plasma loads on materials corresponding to the reactor ones.

A tantalum cathode was used to form a plasma discharge in the PLM-M device. The cylindrical anode with an inner hole of 35 mm is made of copper and fixed on a steel ring, which provides heat dissipation to the water-cooled chamber. Plasma heating is carried out due to the process of stepwise ionization by electron impact of atoms of the plasma-forming gas (helium). The electron current density required for the stepwise ionization process is achieved due to electron thermal emission from the cathode. Cathode heating power - up to 2 kW. The emission current of the cathode reaches up to 30 A. An important feature of the discharge is the generation of plasma near the axis of the plasma chamber, which makes it possible to minimize plasma losses, reduce thermal loads on the chamber walls, and use sources in a stationary mode. Spectroscopic measurements of the intensity of the spectral lines of atomic helium have been carried out. The obtained estimates of the electron temperature were 1–3 eV. The electron density reached 5 x 1018 m– 3. The estimated density of the heat flux to the plasma facing surface is 2–4 MW/m2.

In order to increase the plasma parameters in the PLM-M device, a additional stationary RF heating system using a helicon antenna was developed and manufactured. The additional RF heating system consists of a helicon antenna, an RF power supply, a matching system, and a cooling system. The design of a helicon antenna was proposed to ensure a stationary mode of operation. The maximum input power is 4 kW and the frequency is 27.12 MHz. The quartz glass is placed inside the antenna to avoid the direct contact between antenna and plasma, to maximize the absorbed power by plasma. A matching system was manufactured, which consists of two vacuum variable capacitors with a nominal capacity of 20 to 1000 pF. This system can provide guaranteed operation over a wide range of load impedances. It is expected that with the optional RF heating system it is possible to to obtain an electron temperature above 10 eV, electron density (1-10) ∙ 1019 m−3 with a magnetic field on the axis up to 0.03 T.

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References

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2. V.P. Budaev et al. Nuclear physics and engineering, 2018, vol. 9, №. 3, p. 127-138
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLIX/Mu/ru/CB-Chan.docx) [↑](#footnote-ref-1)