Komplex for IOn Cyclotron plasma heating and current drive At the L-2M stellarator [[1]](#footnote-1)\*)

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RF plasma heating in the range of ion cyclotron frequencies using fast magnetosonic waves (FMSW) is a common method for additional plasma heating in toroidal magnetic traps. From the point of view of the efficiency of the FMSWs excitation and heating, quadrupole antennas demonstrated the best results [1, 2]. This is because such antennas make it possible to excite FMSWs with the required toroidal and poloidal wave numbers, and considerably reduce the amplitudes of the excited parasitic surface waves and cylindrical modes with low longitudinal wave numbers. In this case, the heating of the scrape-off-layer and peripheral plasma layers can be considerably reduced, and, accordingly, the flow of impurities into the plasma becomes less.

For experiments on ICR plasma heating and current drive in the L-2M stellarator, the quadrupole antenna was created and manufactured. It consists of four current strips located in two adjacent sections of the stellarator vacuum chamber, spaced from each other by a distance of 22.5 cm along the axis of the plasma column. The width of each current strip is 7.5 cm, and the surface area is 2.5 dm2. The plasma-facing surface of each strip repeats the shape of the separatrix surface. It is spaced from the separatrix by 1 cm. There is no electrostatic shield protecting the current strips. Power is supplied to each strip from the generator using the separate RF feeder. Due to this, depending on the phase shift between the voltages applied to the individual strips of the antenna, it is possible to excite the FMSWs with different toroidal and azimuthal modes. The report considers different schemes for powering the antenna system. For these schemes, the toroidal and azimuthal spectra of antenna radiation are presented and the scheme is chosen, which is best for plasma heating and current drive in the L-2M stellarator. Based on the results of previous experiments [2], it is expected that in the experiments on ICR heating of D+H plasma, the power radiated by the quadrupole antenna will be approximately *P* = 200 kW.

The diagnostic complex is also considered of the system for ion cyclotron plasma heating at the L-2M stellarator. It consists of the instrument measuring the powers of incident and reflected waves in the RF feeder and the set of magnetic probes. The diagnostic complex presented will make it possible to measure the phase velocities and spectral composition of the excited FMSWs, as well as to determine the conditions under which the plasma heating and current drive will be maximum.

In addition, the results are presented from measuring the radiation resistance of one of the quadrupole antenna strips in the ECRH experiments (*P*ECRH = 200 kW, *n*e = 1.8⋅1019 m−3).

References

1. Bobkov V., Aguiam D., Baruzzoetet M. et al., Nucl. Mater. Energy **12**, 1194 (2017).
2. V.A. Batyuk, G.S. Voronov, E.F. Gippius, S.E. Grebenshchikov, N.P. Donskaya, K.S. Dyabilin, B.I. Il’yukhin, I.A. Kovan, L.M. Kovrizhnykh, A.I. Meshcheryakov, I.E. Moroz, I.S. Sbitnikova, V.N. Sukhodolskii, and I.S. Shpigel, Plasma Phys. Rep. **13**, 143 (1987).
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLIX/Mu/ru/BT-Meshcheryakov.docx) [↑](#footnote-ref-1)