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STUDY OF THE POSSIBILITY OF GENERATING LONG-FOCUS ION BEAMS ON THE HIGH VOLTAGE TEST BENCH FOR THE HEAVY ION BEAM PROBE DIAGNOSTICS OF THE T-15MD TOKAMAK ^{*)}

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Heavy ion beam probing (HIBP) is a unique plasma diagnostics technique that allows local direct measurements of the electric potential of high-temperature plasma over the entire plasma cross-section [1]. HIBP diagnostics is currently under development for the T-15MD tokamak [2].

To probe the plasma of T-15MD, the ion beam must have a high intensity and a focal distance in the range of 3-5 m. It is necessary to focus the beam precisely at the sample volume during the plasma experiment. The possibility of obtaining beams with a given focal length is studied on a high-voltage test bench of the HIBP injector of the T-15MD tokamak [3].

The beam properties are determined by the parameters of the ion optics system. The beam intensity depends on the source heating power P_{fil} and the extraction voltage U_{extr} , while the focal length depends on the combination of the extraction, focusing U_{foc} , and accelerating U_{beam} voltages. The accelerating voltage also determines the beam energy.

Four wire sensors are used to determine the position of the focus position on the test bench. The beam deflected from the axis by the field of deflecting plates, hits the wires of the sensors, exciting a current in them. By knowing the deflection angle of the beam from the axis and the distance between the wires, the diameter of the beam can be obtained. From the data on the beam diameter in three or more positions along the beam axis, the beam focus and its shape can be unambiguously determined. For example, at $U_{\text{beam}} = 75$ kV, $U_{\text{extr}} = -580$ V, $U_{\text{foc}} = -3$ kV and $P_{\text{fil}} = 24$ W, the beam has a diameter of 2.6 mm at the distance of 1.2 m from the injector and 36.8 mm at 3.6 m from the injector, thus the focus point is around 1–1.4 m, later the beam starts to diverge.

The dependence of the beam properties on the voltages at the electrodes of the ion optics system of the HIBP injector is investigated. The possibility of the control of the beam focus during the plasma experiment is considered. The results obtained can be used for HIBP and Beam Emission Spectroscopy (BES) diagnostics of the T-15MD tokamak.

References

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