powerful 10 MW neutral beams injection system for plasma heating and stabilization in magnetic traps

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The power neutral beams are widely used for plasma heating and stabilization in magnetic traps [1–3]. The important requirement here is total injection power - see for example [2]. In installations with a relatively small magnetic field and in magnetic traps where the high total current of the trapped ions required the high injection power must be provided with less energy and therefore at high injected current [3].

This report describes the experience of operation of neutral injection system with a total power of 10 MW composed of 6 same-type ion sources. The accelerating voltage of injectors 15–20 keV, the extracted ion current 150 A (up to 170A). Pulse duration 10 ms, in the modification – 30 ms, a particles type – hydrogen or deuterium. To ensure the extracted current of 150 A, the plasma source with addition of plasma jets from 4 arc generators is used. Beam formation system is the 3-electrode accelerating ion-optical system with multislit structure [3].

The injection system actively used in the experiments now. Plasma arc generators with a powerful compact discharge as a plasma source provides the low (less than 10%) molecular fraction in the beam. The content of the main component (hydrogen or deuterium atoms of the full energy) is about 90%. Angular beam divergence is 11 mrad in a direction along the slits of the ion optical system and 30 mrad across the slits. Respectively, the radial profile of the atomic beam is elliptical. At a distance of 2.7 m (near the entrance port of plasma machine), the beam cross-section is characterized by Gaussian beam radius of 4.5 cm and 8.5 cm along and across the slits, respectively. In the experiment, the ion sources are oriented so that the elongated size of the ellipse directed along the axis of the plasma magnetic trap.

A series of experiments demonstrated the high reliability of the injection system. Preparing an increase of total injection power up to 14 MW by increasing the number of injectors from 6 to 8, and the injection pulse elongation from 10 to 30 ms.

References

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