Measurement and Experiment Research on Backstream Electrons for High Current Ion Source of EAST-NBI

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Neutral beam injection is one of the main auxiliary heating methods in controllable nuclear fusion experiment. Two positive ion sources are adopted in a EAST-NBI beamline [1,2]. And the long pulse and high power operation is the certain requirement not only for the EAST-NBI but also for the other heating NB device. However, during the beam extraction for ion source, the positive ions are accelerated by the extraction system, whereas electrons speed up reversely. The high-energy electrons will hit on the electron dump, causing a large energy deposition. According to previous research, when beam power is 3.5 MW, the average power density deposited on electron dump is around 4.4 MWm^{-2}, which reflects the energy of accelerated backstream electrons indirectly [3-4].

Due to the beam profile is distributed unevenly in the real condition, so the peak power of the electrons is even higher, which may cause great burden for the heat-load component. In order to obtain the real distribution of the backstream electrons in different working conditions, a backstream electrons beam profile measurement system based on thermocouple has been developed. As the ion source operates at high potential, optical fibers were adopted to isolated high/low voltage area. According to analysis of temperature signals, the electron power distribution profile can be obtained at different operating parameter of ion source. Results show that the beam profile of backstream electron presents near Gaussian distribution. It can not only guide EAST-NBI ion source to operate safely and steadily, lay a foundation for increasing heat transfer capacity via structure optimization on electron dump, but also have great meaning for the beam optics optimization on accelerating grids in future work.

Reference

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