THE PERFORMANCE OF NEUTRAL BEAM INJECTION ON HL-2A

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HL-2A NBI with total neutral beam power of 4MW at beam energy of 45-55keV is composed of two beamlines which are located at the torus in tangential direction injection at angle of 57° . One of the two beamlines in which four ion sources are equipped for each has been operated successfully since 2007.

The beam characteristics of each ion source are investigated in an ion source platform. The e-fold divergence of the beam is measured with Faraday cup array located 3.26m downstream from the ion source. The minimum beam divergence of 1.06° at extracted current of 13 A has been achieved at high voltage of 34.8 kV. It is observed that the beam divergence is very sensitive to high voltage applied the accelerator if ion beam current is invariant[1]. The proton ratio up to 65% at the ion current of 19.6A with the extraction voltage of 39.6kV is obtained, which is measured with an image spectrograph by Doppler shift effect of Balmer-α-radiation spectrum emitted from fast hydrogen atoms [2]. Ion beam power of 0.8MW for each source has been achieved in the platform successfully. In the beamline, a colorimeter with water cooling pipes is located at near the injection port, downstream from these ion sources to measure the total beam power profile. At the beam energy of 35 keV for four ion sources sustaining ~0.4 s with beam current of ~14 A for each source, total neutral beam power is about 0.7MW.

In 2009 NBI experiment campaign, deuterium atomic beam with neutral beam power of 0.75MW at its energy of 36keV has been injected into the torus. The H-mode discharge has been observed using NBI and ECRH on HL-2A. The central ion temperature of 2.7 keV has been obtained with the line-average density of 1.5×10^{19} m^{-3} at neutral beam power of 0.6MW with beam energy of 35 keV. The fishbone instability and giant sawteeth are easily excited during NBI.

[1] Zou G Q, Lei G J and Jiang S F et al 2009 Chin. Phys. Lett. 26 082901
[2] Yu L M, Lei G J and Cao J Y et al 2010 Chin. Phys. Lett. 27 042901