§44. Beam Fueling Using Perpendicular Neutral Beam Injection in LHD

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In 10^{th} experimental campaign of LHD, the perpendicular neutral beam injection (P-NBI) mounted two positive ion sources additionally, and the total port through power and beam current increased up to 6MW and 150A, respectively. This neutral beam with the low energy (40keV) and the high beam current mainly heats ions in the target plasmas and significatly contributed to the progress of the high ion temperature experiments in 10^{th} campaign. In addition, such high current beams also become a particle source in the plasma, and are useful to control of the plasma density and it'd profile.

In LHD, the density profile tends to be hollow in particular high electron temperature plasmas. However the plasma with peaked density profile shows higher confinement properties than that with hollow profile. So the density control is considered to be one of key issues for confinement improvement in LHD. From the point of view, the investigation of beam fueling properties and trying to control of density profile were performed using P-NBI in 10^{th} experimental campaign.

The beam fueling experiments using P-NBI was performed in N-NBI heated plasmas of LHD, and the beam current was scanned by changing the number of ion sources used for beam production under the same condition of gas operation of P-NBI. The density increases with beam injection of P-NBI were observed, which is shown in Fig. 1. The rate of density increases during the injection of P-NBI is proportional to the beam current injected to the plasma, which is shown in Fig.2, and beam fueling rate was obtained ~$3\text{x}10^{16}\text{m}^{-3}\text{A}^{-1}$ for the target plasma with the averaged density of $7\text{x}10^{18}\text{m}^{-3}$. The particle confinement time estimated by beam fueling rate is ~0.5 sec, which is almost same value estimated by the density decay after pellet injections. The density profiles were compared in various beam current cases, which are shown in Fig. 3. The rate of density increase shows flat profile. This can be explained by the beam deposition profile. The beam deposition has a flat profile in these low density plasmas. Further investigations, such as in higher density region and a combination with pellet injection, are necessary for the development of density control method.

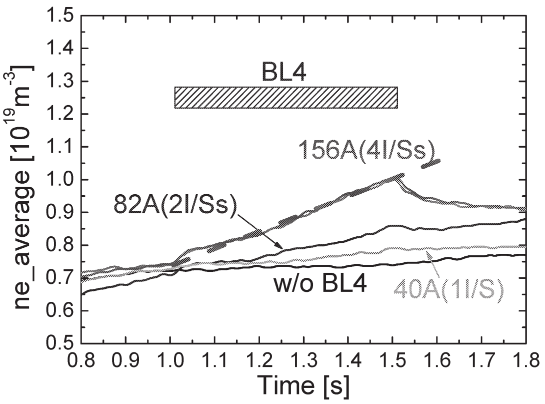

Fig. 1 The averaged density traces under some beam currents conditions.

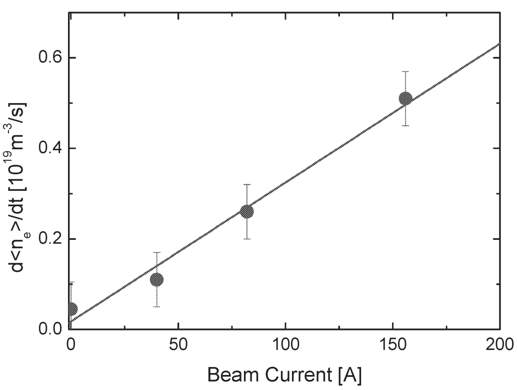

Fig. 2 The density increase rates as a function of beam current.

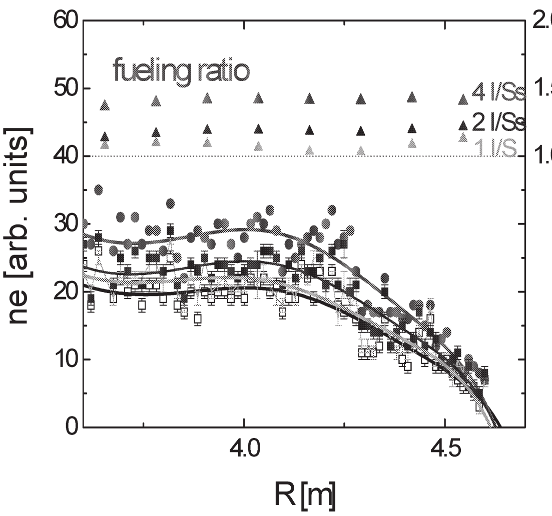

Fig. 3 The profiles of the plasma density and the fueling rate due to the P-NBI.