

§9. Upgrade of Radial Neutral Beam Injection System on LHD

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To extend the parameters of plasmas on the Large Helical Device (LHD), the radial Neutral Beam (NB) injection system was upgraded in 2010. A radial-NB injector was newly installed at the 1-O port of LHD. The injector consists of four positive-ion based ion sources, which are designed to extract the Hydrogenic-ions of 75A at 40keV and 60A at 80keV. Figure 1 shows the schematic drawing of the injector. The focal point of each ion-sources are placed at 11.55m away from its beam extraction electrode. The point correspond to the axis of the $R_{ax}=3.6\text{m}$ magnetic configuration of LHD plasmas. The vertical pivot point of the ion sources is placed at the same point to the focal point, while that in the horizontal direction was set at 9.27m away from the electrodes in order to minimize the horizontal width of the injection port without significant orbit loss of deposited beam ions by the NBs in LHD plasmas.

The injection history of the new radial NB is shown in Fig.2. Its injection power reaches its nominal value of 6MW with the first 2000 shots, which correspond to the first one month of the LHD experiment. We have tried to increase the beam energy up to 60keV to demonstrate the voltage holding ability of the injector during the LHD experimental cycle.

The maximum injection energy was achieved at the energy of 45 keV, this is due to the electrode gap setting of the ion-sources. The maximum beam current of 75A was achieved with the optimum beam condition at the energy of 50keV. The energy dependence of neutralization efficiency shifts the optimum energy to 45keV from 50keV. By reducing the gap distance of the electrodes, it is expected to reduce the optimum beam energy down to 40keV and to increase the Port-through power greater than 6MW. This will be testified during the experimental cycle of 2011.

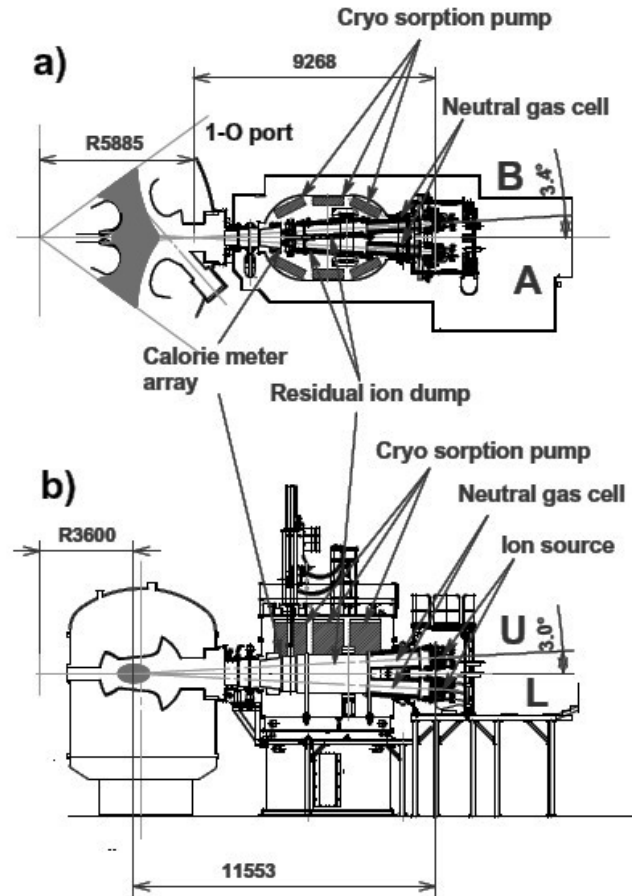


Fig.1 Schematic drawing of the radial-NB injector at the 1-O port of LHD. (a) The horizontal and (b) the vertical view of the injector.

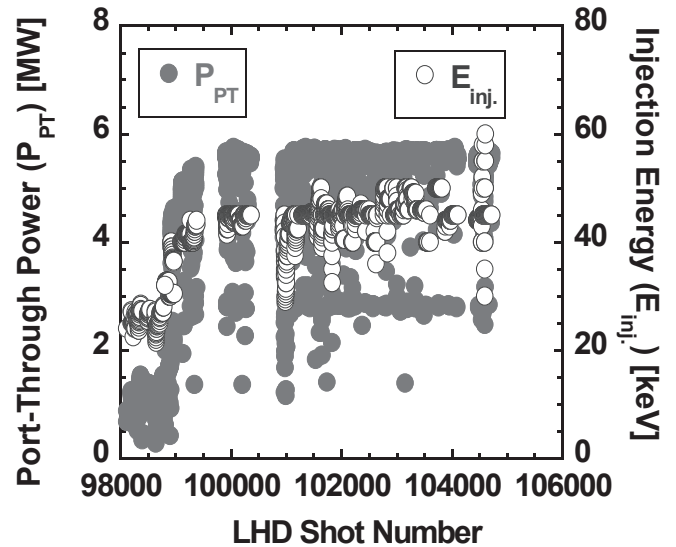


Fig.2 Injection history of the radial-NB at 1-O port. The closed circles(●) show its injection port-through power and open circles show its energy.