§6. Impact of ICRH-discharge Conditioning on Realization of High-T_i Plasmas in the LHD

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In the 15th experimental campaign of the LHD, high T_i plasma was obtained by the wall conditioning using the ICRH discharge. In the operation in combination with the ICRH-discharge conditioning, the central ion temperature of 7 keV has been achieved and has exceeded the previous record of 6.4 keV.

Figure 1 shows the time history of (a) the partial pressure of H_2, (b) He in the experiment, (c) and (d) the expanded waveform and (e) T_{i0} and the line-averaged-electron density in a series of discharges. The spikes observed in fig. 1 (a)-(d) correspond to the plasma discharges. Two-hour titanium gettering was done before the experiments. The ICRH-discharge conditionings with the maximum-pulse duration of 12 s, in which the NBs were not injected, were carried out in #111167-111196 and #111216-111238. The main gas in the high T_i discharges was H_2, on the other hand He was mainly used in ICRH-discharge conditioning due to the effective minority heating by ICRH. Figure 2 shows the radial profiles of (a) T_i, (b) n_e and (c) the ion heating power normalized by n_e for #111165 and #111199 at t = 4.74 s, when the maximum T_{i0} was obtained.

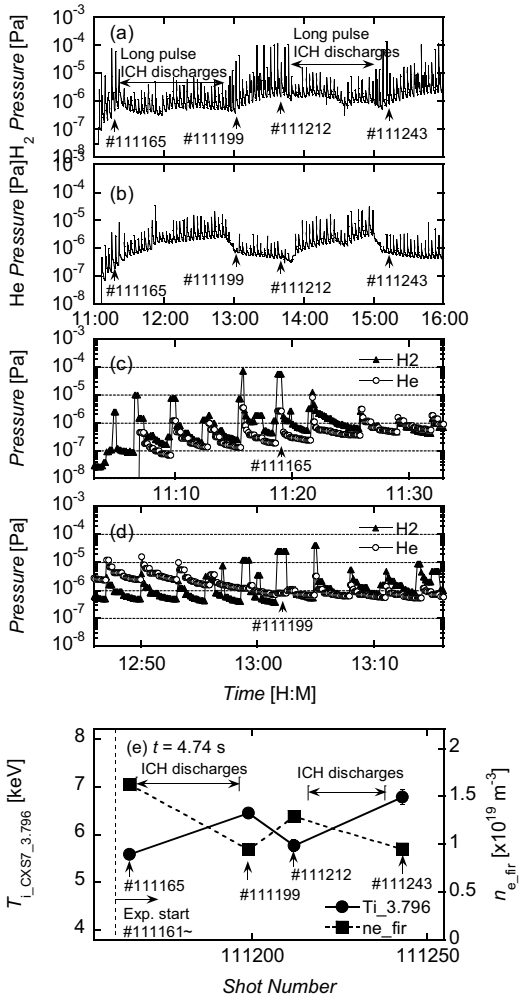

Fig. 1. The time history of (a) the partial pressure of H_2, (b) He in the experiment, (c) and (d) the expanded waveform and (e) T_{i0} and the line-averaged-electron density in a series of discharges.

In #111165 the achieved T_{i0} was below 6 keV. The n_e profile formed the hollow shape implying the large-particle recycling from the wall. After that 30 discharges of ICRH was carried out and then the lower electron density with the parabolic profile and the T_{i0} exceeding 6 keV were obtained. As shown in fig. 1 (c) and (d), the partial pressure of H_2 and He during the discharge of #111165 were lower than those of #111199 even the partial pressure of He just before the discharge was larger because He was used as the working gas for the ICRH-discharge conditioning. This represents the decrease of the outgassing from the wall, namely decrease of the neutral-particle recycling. However the preferable condition for high T_i maintained only a few discharges. In #111212, the attained T_{i0} got below 6 keV due to the degradation of the wall condition. Then 23 discharges of ICRH was done resulting that the decrease of the neutral pressure, the parabolic profile of n_e and the T_i exceeding 6 keV were obtained again (#111243).

The increase of T_{i0} after the ICRH-discharge conditioning is considered mainly due to the increase of the NB-heating power per ion at the core region by the decrease of n_e as can be seen from fig. 2, not the improvement of the ion-heat transport.

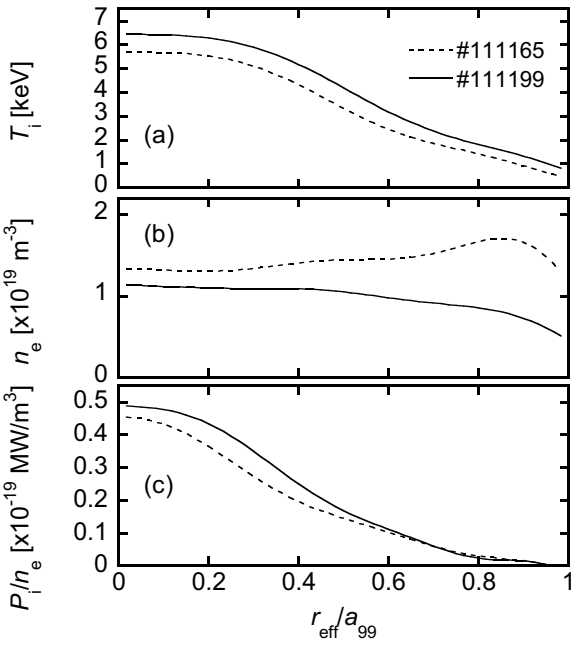

Fig. 2. The radial profiles of (a) T_i, (b) n_e and (c) P_i/n_e for #111165 and #111199 at t = 4.74 s.