§ 1. Increase of Central Ion Temperature After Carbon Pellet Injection in Ne-Seeded NBI Discharges

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High $T_i(0)$ of up to 5keV, which was measured using a crystal spectrometer[1], was successfully obtained under a neutral beam injection power, P_{NBI}, of 8 MW in Ne-seeded discharges and a linear relation was found between the $T_i(0)$ and P_i/n_i [2-4], although the hydrogen amount could not be sufficiently reduced. On the other hand, a carbon pellet having a high melting point was injected as an alternative way to modify the density profile and to increase the P_{abs} at the plasma center using a newly installed impurity pellet injector[5]. Spherical and cylindrical carbon pellets (size: 0.5-1.0mm) have been injected into NBI discharges.

A typical result for the large pellet ($1mm^{\phi}x1mm^{L}$) injection is shown in Fig.1 (right). The carbon pellet was injected in the Ne-seeded discharges. Waveforms of the Ne-seeded NBI discharge without carbon pellet are also traced in Figure 1 (left) for comparison. Both discharges are carried out for the R_{ax}=3.60m configuration. The density of n_e=0.4-0.5x$10^{13}cm^{-3}$ is produced mainly by the puffed neon and recycled hydrogen. A $T_i(0)$ of 3keV is sustained during the Ne-seeded discharge (see Fig.1 left). When the carbon pellet is injected, the $T_i(0)$ gradually increases and reaches 5keV. The lack of T_i data after the pellet injection is caused by a decrease in ArXVII emission due to the sudden T_e drop.

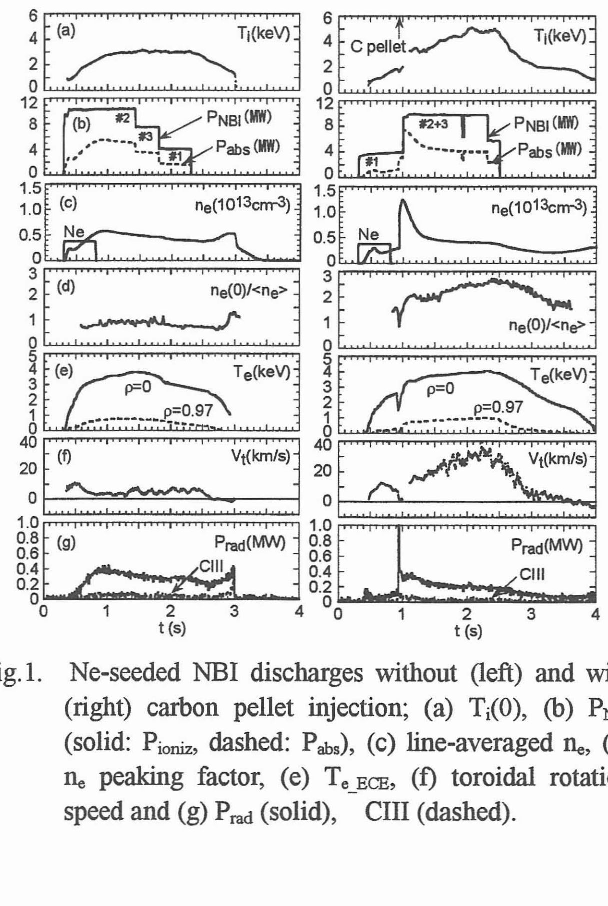

Fig.1. Ne-seeded NBI discharges without (left) and with (right) carbon pellet injection; (a) $T_i(0)$, (b) P_{NBI} (solid: P_{ioniz}, dashed: P_{abs}), (c) line-averaged n_e, (d) n_e peaking factor, (e) T_{e_ECE}, (f) toroidal rotation speed and (g) P_{rad} (solid), CIII (dashed).

In low-density discharges, the beam-ion slowing-down time becomes quite long because of the high beam energy and the beam-stored energy becomes also very large. The heat flux from the beam ions strongly influences the pellet ablation[6]. Therefore, the NBIs #2 and #3 are injected just after the pellet injection in order to avoid ablation at the outer plasma region and to achieve a central particle deposition. This was very effective in increasing the $T_i(0)$. The density profiles are shown in Fig.2. The density peaking factor increases up to ~2.5 after carbon pellet injection, whereas it is around 1 for the Ne-seeded discharge. Due to the density peaking, the central toroidal rotation speed, V_t, is largely increased and reaches 35km/s, which corresponds to 12% of the carbon thermal velocity. The $T_i(0)$ continuously increases, whereas the P_{abs} becomes constant after t=1.5s. Improvement of the ion transport, at least at the plasma center, is expected. Ion transport analysis is currently underway, based on the estimation of H, C, and Ne ion densities in both discharges.

References

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6) S.Morita *et al.*, Nucl.Fusion **42** (2002) 876.

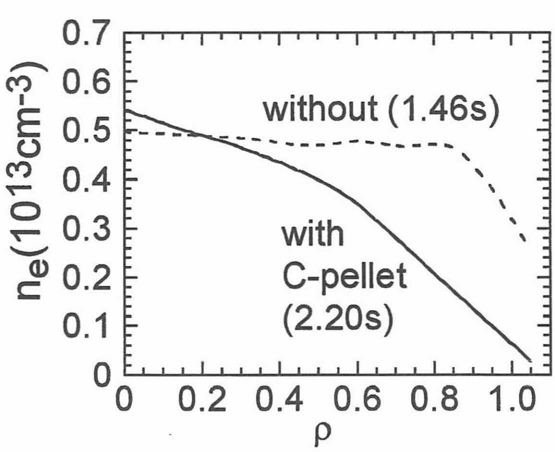

Fig.2. Electron density profiles without (dashed line) and with (solid line) carbon pellet.