§2. On the Degradation of Ion-temperature at High-Ti LHD-plasmas with Carbon Pellet Injection (I)

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An achievement of high temperature plasmas is one of the most important missions on the Large Helical Device(LHD) project to demonstrate the ability of realizing reactor relevant plasmas by helical devices. On LHD, the high ion temperature plasmas are achieved with Carbon pellet injection scenario, where the highest ion temperature is obtained after a few hundred millisecond of the pellet injection. One of the problems of this scinario is the high ion temperature plasmas are achieved tentatively and the temperature starts to degrade after reaching its maximum value as shown in Fig.1.

To clarify the cause of the degradation, whether it is due to the change of the heating powers of fast-ion produced by neutral beam injection (NBI) or due to that of confinement properties of bulk-ions, a code which calculates the correction factors of the heating power profiles by FIT3D-code, which assumes steady state condition, was developed. In the code, changes of plasma parameters, such as electron densities and temperatures, during the slowing-down process of those fast-ions are taken into an account and the heating powers are corrected. In Fig.2, the corrected ion heating powers at each normalized radii are shown for the same discharge shown in Fig.1. A carbon-pellet is injected at around t=3.85s and the electron densities are increased after the injection. This enhances the deposition rate of NB injected ions. Since the slowing-down time of fast-ions produced by the tangential-NB to the buk-ion temperature is about 300 ms at the center, the bulk-ion heating power is gradually increasing up to t=4.2s. On the other hand, the central ion temperature reaches its maximum value at t=4.04s and degrades.

This result clearly shows that the ion temperature degradation at high-ion temperature discharges with carbon-pellet injection is not due to the degradation of heating power and indicates that it is due to the change of confinement properties.

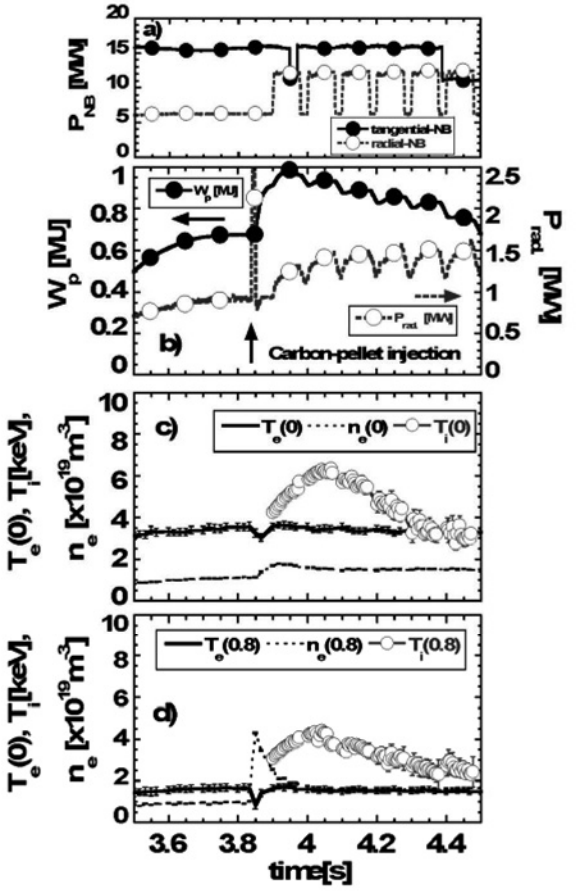

Fig.1 Typical wave forms of (a)Port-through powers of tangential-NB(●), radial-NB(○), (b)plasma stored energy(●), radiation power(○), (c) electon tempearature(solid lines), ion tempearature(○), electron density (dashed lines) for of high-Ti discharges at the center(r/a=0) and (d) those at the edge(r/a=0.8) with carbon-pellet injection.

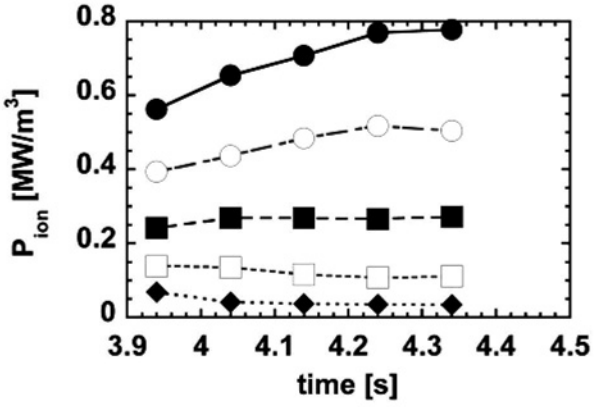

Fig.2 Corrected ion heating powers at r/a=0.1(●), 0.3(○), 0.5(■), 0.7(□) and 0.9(◆).