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

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The degradation of ion-temperature is one of the great concerns at the high ion temperature discharge on LHD. From the analysis on the temporal behavior of ion heating power, it was indicated that the degradation is due to the change of confinement property during the discharges[1].

In Fig.1(b), the temporal behavior of heat flux at r_{eff}/a_{99}=0.573 are plotted against the ion temperature gradient at the same location. Slopes of lines from the origin to these plotted points reflect thermal diffusion coefficients at the location. In this discharge, the carbone pellet was injected at t=3.85s and the central ion temperature reaches its maximum value of 6.4keV at t=4.04s. As shown in the figure, confinement of bulk-ions are improving until t=4.04s and degrades after the timing.

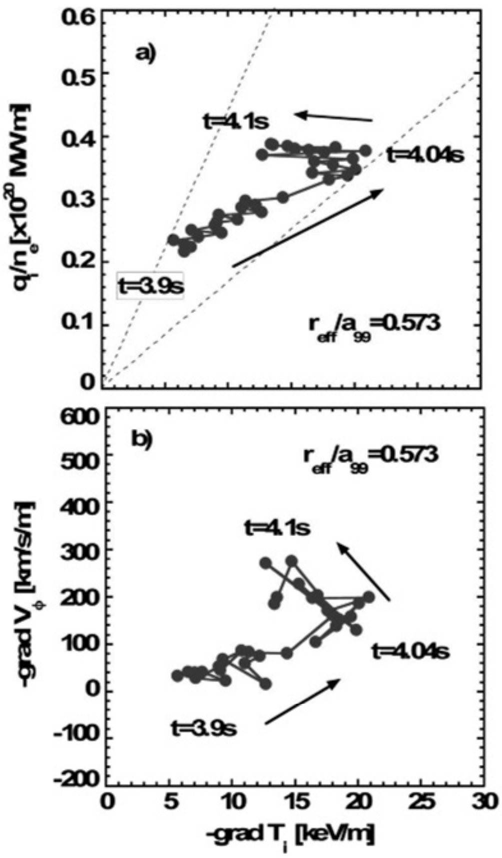

Fig.1 Typical relationship between (a) temporal behavior of ion temperature gradient and heat flux, and that between (b)ion temperature gradient and velocity shear of toroidal flow at r_{eff}/a_{99}=0.573for the discharge of #101911.

What is interesting is the relationship between the temperature gradient and the velocity shear. As shown in Fig.1(b), the velocity shear keeps increasing when the temperature gradient is decreasing. This results indicates that the flow shear is not responsible for the confinement improvement and degradation of high-Ti discharges using carbon pellet injection on LHD and are consistent to the result in Ref.[1].

To investigate the mechanism of confinement improvement/degradation, we have applied second carbon-pellet injection at the degradation phase of ion temperature. In Fig.2(a), the temporal behavior of ion temperatures for single and double pellet injection cases are shown. The first pellet was injected at t=3.88s and the ion temperature reaches to its maximum value at around t=4.04s for both cases. For the double pellet injection case, the 2nd pellet was injected at t=4.14s. The ion temperature was recovered after the 2nd pellet injection and reached to its 2nd maximum at t=4.24s. During this recovery phase, a significant difference between these two discharges wer fond in intensities of carbon Charge eXchange (CX) emission lights. On the other hand, a similar trend was found in the plots of the CX-emission intensities against ion temperature gradients. This result indicates that carbon impurities might be responsible for the confinement properties of high-Ti discharges on LHD.

[1] K.Ida,et.al., NF**49**(2009)095024

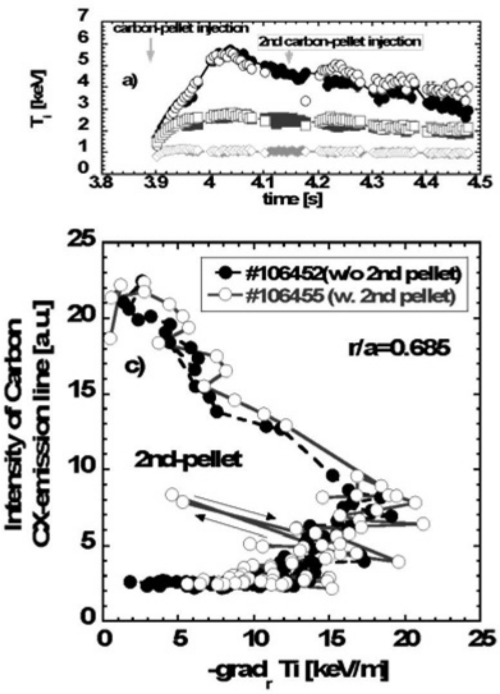

Fig.2 (a)Temporal behavior of ion temperatures for single pellet injection(closed symbols) and double pellet injection(open symbols) at r_{eff}/a_{99}=0.28(●/○), 0.65(■/□), and 0.91(◆/◇). (b) Relation ship between temporal behavior of ion temperature gradient and intensities of carbon charge exchange emission lights.