§18. Ion Heating by ECRH through the Equipartition Process in the Large Helical Device

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In fusion reactors, external electron heating is supposed to be used for the plasma start up and the auxiliary heating. Also the burning plasma is mainly heated by alpha particle as electron heating. Thus we must clarify how much T_i is realized through the energy equipartition process under the electron heating dominant situation in order to construct an operation scenario and to predict plasma parameters in prototype fusion reactors. In the 18th experimental campaign of the LHD, the ion heating effect by the energy equipartition was investigated using high power ECRH.

Target plasma was sustained by a perpendicular NBI (3.8 MW) and on-axis ECRH was superposed in stepwise up to 4.8 MW. Figure 1 shows the radial profiles of (a) T_e and n_e, and (b) T_i for the moderately high n_e plasma. The solid and the open symbols represent the data with 4.8 MW ECRH (4.64 s) and those without ECRH (4.94 s), respectively. The profiles of n_e were approximately same on these two times. Not only T_e but also T_i clearly increased in whole plasma region during ECRH beam injection. The parabolic shape of T_i profile was not changed by ECRH but the central T_i value increased from 1.6 keV to 2.0 keV.

Figure 2 shows (a), (b) the n_e dependence of T_e and T_i increment by ECRH, and (c) the relation between the increment of the central ion pressure and that of the equipartition heat flux. Increase of T_i by ECRH was observed in all n_e condition produced in the experiment. The increment of T_i increased up to n_e ~2.5x10^{19} m^{-3} and was saturated in higher n_e plasmas. The central ion pressure was found to be expressed as a function of the 0.5 power of the equipartition heat flux. In the future work, the change of the ion heating power of the injected NBI due to the change of T_e will be evaluated and the ion heating effect by the equipartition heat flux will be clarified.

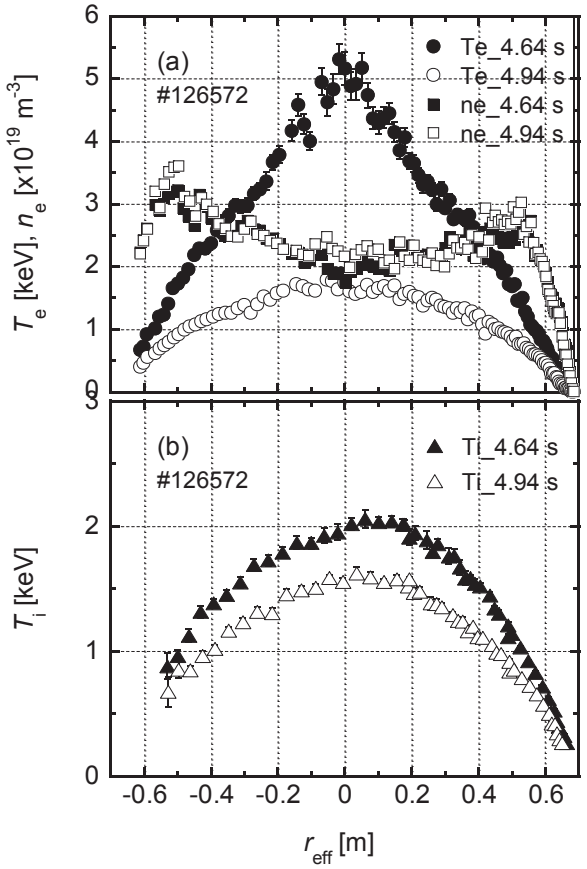

Figure 1. The radial profiles of (a) T_e and n_e, and (b) T_i for the moderate high n_e plasma.

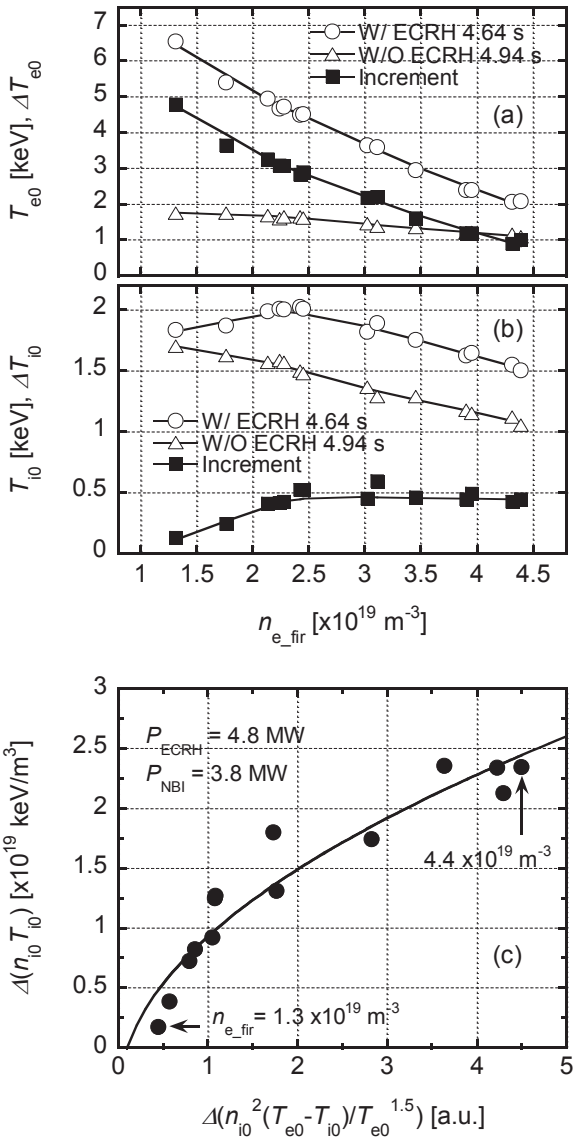

Figure 2. (a), (b) the n_e dependence of T_e and T_i increment by ECRH, (c) the relation between the increment of the central ion pressure and that of the equipartition heat flux.