§13. Ion Temperature Measurement in High Power Heating Operation in CHS

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The highest ion temperature of $T_i(0)\sim$1keV in CHS was previously achieved in so-called high Ti mode operation with one heating neutral beam in Higashiyama-site[1]. After moving to Toki-site, the conditioning and tuning of the two beam lines for co-injection have been carried out and now we can utilize routinely the total injected beam power of 1.5MW. The spectroscopic measurements of the beam density profile and the divergence angle[2] were also done for the impurity density profile measurements by the charge exchange spectroscopy (CXS)[3]. New operation regimes extended to high beta regimes and high Ti regimes with this increased power are expected. Figure 1 shows the time evolution of the plasma parameters in high power heating operations with ECH(53GHz, 140kW), NBI#1(40keV, 600kW) and NBI#2(30keV, 700kW). The magnetic configuration is the standard one with the vacuum magnetic axis position of R_{ax}=92.1cm and the toroidal magnetic field strength of B_t=1.76T at the center of the vacuum chamber. Figure 2 and Figure 3 show the ion temperatures measured with CXS. The central temperature reaches 800eV when the plasma was heated by two beams, while the temperature in the identical density phase is only 600eV when heating with one beam. This dependence on the power suggests the $P^{-0.5}$ dependence of the ion energy confinement time in L mode. In several factors to attain the high heating efficiency and the improved ion energy confinement suggested from past experiments, the peaked density profile and the strongly negative radial electric field seem to be important. In past experiments[1,4], superposing ECH often causes the flattening of the density profile and makes the radial electric field to be small or positive and the resultant ion temperature becomes low. Therefore higher ion temperatures in plasmas heated by two beams can be expected with appropriate operations to keep the peaked density profile and the negative radial electric field.

Reference

[1] Ida,K., Osakabe,M., et al., Nucl.Fusion 39, 1649 (1999)
[2] Nishimura,S., Ida,K., Osakabe,M., Ann.Rep.of NIFS, p.198 (Apr.1997-Mar.1998)
[3] Nishimura,S., Ida,K., et al., Ann.Rep.of NIFS, p.293 (Apr.2000-Mar.2001)
[4] Ida,K., Kondo,K., et al., Phys.Rev.Lett.76, 1268 (1996)

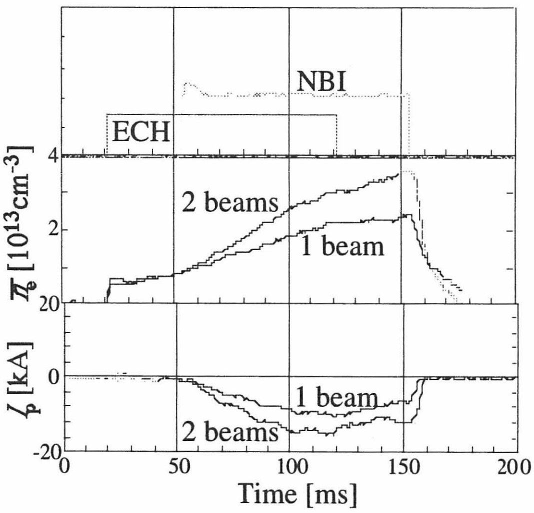

Fig.1 Heating scheme and the time evolution of electron density and plasma currents

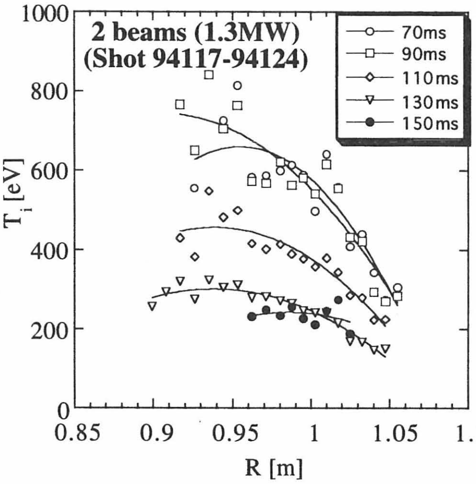

Fig.2 The measured ion temperature in the plasma heated by the 2 beams.

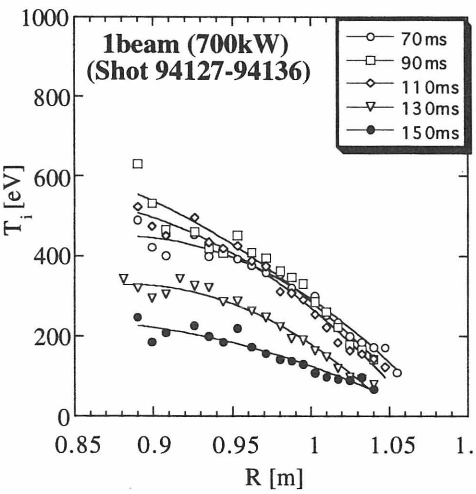

Fig.3 The measured ion temperature in the plasma heated by 1 beam.