§12. Ion Temperature Profile Measurements with Television Charge-Exchange Spectroscopy (TVCXS) in Heliotron-E

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The television charge-exchange spectroscopy (TVCXS) [1] has been installed to Heliotron-E device to measure ion temperature and poloidal rotation velocity profiles. Two poloidal arrays (40 channels each) and one toroidal array (40 channels) are arrange at the entrance slit of Czerny-Turner spectrometer and all the spectra are measured with television frame CCD coupled with image intensifier (ICCD camera). The output of the ICCD camera is NTSC video signal with the frame rate of 60Hz. (time resolution of 16.7ms). The video signal is digitized with ADC (Lecroy 6810) and analyzed with the VAX workstation (VS3200).

The ion temperature profiles are measured using the charge-exchange reaction between the fully ionized carbon and the neutral hydrogen of neutral beam with the energy of 25 keV and the power of 0.5MW. The charge exchange line emission of carbon (CVI, n=7-6, 343.37nm) is measured in this experiment. Figure 1 shows the ion temperature profiles for low and high electron density for NBI heated plasma with 3MW total input power with the magnetic field of 1.9T, major radius of 2.16m. Here data of two optical fiber nearby are averaged (effective spatial resolution is 20 channels) to increase the signal to noise ratio for the improvement of the quality of data. The ion temperature increases up to 0.7keV as the electron density is decreases to 2.3 x $10^{19}m^{-3}$. This is contrast to the results of CHS that the ion temperature stays in constant for the wide range of the electron density from 1.8 to 6.3 x $10^{19}m^{-3}$[2].

Figure 2 shows the ion temperature as a function line averaged electron density for the several shots with the constant magnetic field of 1.9 T and NBI power of 3MW. When the electron density is decreased below 2 x $10^{19}m^{-3}$ the central ion temperature starts to decrease, which is due to the poor beam deposition and/or poor energy confinement in the low electron density plasma. The highest central ion temperature has been observed for the line averaged electron density of 2 - 3 x $10^{19}m^{-3}$ and 0.8 keV. The high ion temperature experiment with NBI plus ECH will be done in future.

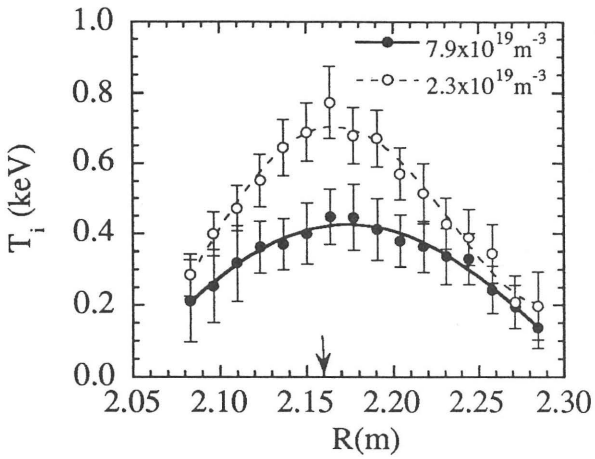

Fig. 1. Ion temperature profiles measured with TVCXS for various line averaged electron density in Heliotron-E.

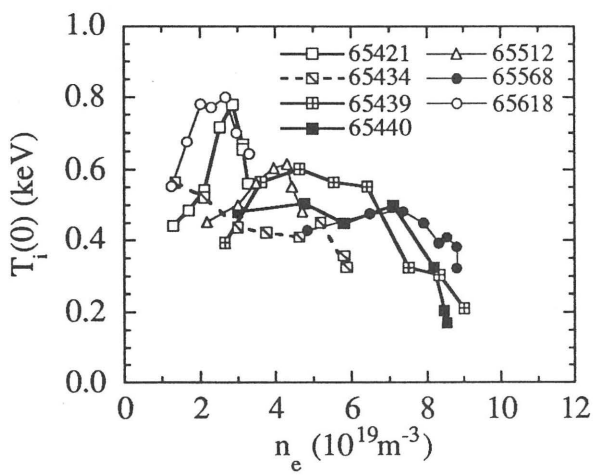

Fig. 2. Central ion temperature as a function of line averaged electron density in Heliotron-E

1) Ida, K., Hidekuma, S., Rev. Sci. Instrum. **60**, (1989) 867.
2) Ida, K., Yamada, H., Iguchi, H., Hidekuma, S., Sanuki, H., Yamazaki, K., and CHS Group, Fluids **B 4**, (1992) 1360.