§20. Ion Temperature Measurements with FNA for ICRF Heated Plasmas

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A fast neutral particle energy analyzer (FNA) and a charge exchange spectroscopy (TVCXS) were used for obtaining ion temperatures of ICRF heated plasmas in CHS. In the experiments without neutral beam injection which normally give higher temperatures with relatively lower plasma densities, FNA is important diagnostics which gives information of ion temperature as well as high energy ion tail structures.

Figure 1 shows time traces of selected plasma parameters for a discharge with ICRF heating. Fundamental resonance heating of 53 GHz ECH was applied at first and ICRF wave heating was applied after short interval with deuterium gas including hydrogen minority. The U-antenna was used with about 200 kW input power as depicted in the figure. The fast neutral flux from the plasma increased when the ICRF heating was applied. Though the measurement angle of FNA is scannable, the perpendicular neutral flux was measured for most discharges. The central ion temperature (Ti) is obtained by log-fitting the ion energy spectrum in the range of Ti to 6 times Ti. The time variation of Ti is plotted in the bottom window of Fig. 1. Titanium gettering was used for the wall conditioning, but it was not sufficient to make stationary ICRF heating. The ion temperature (and also plasma energy) decreased with the increased radiation in the discharge.

Figure 2 shows the ion energy spectrum integrated over the time window 70 to 90 msec. Five succeeding shots are used for getting full spectrum because the energy range of single shot spectrum is limited: 16 channels with E_{max}/E_{min} = 2.66. The high energy tail was observed which has an equivalent Maxwell temperature 770 eV and the tail to bulk component ratio 1.9 %. Since the FNA in CHS is of the E-field deflection type, separate evaluation of D and H particle is not possible.

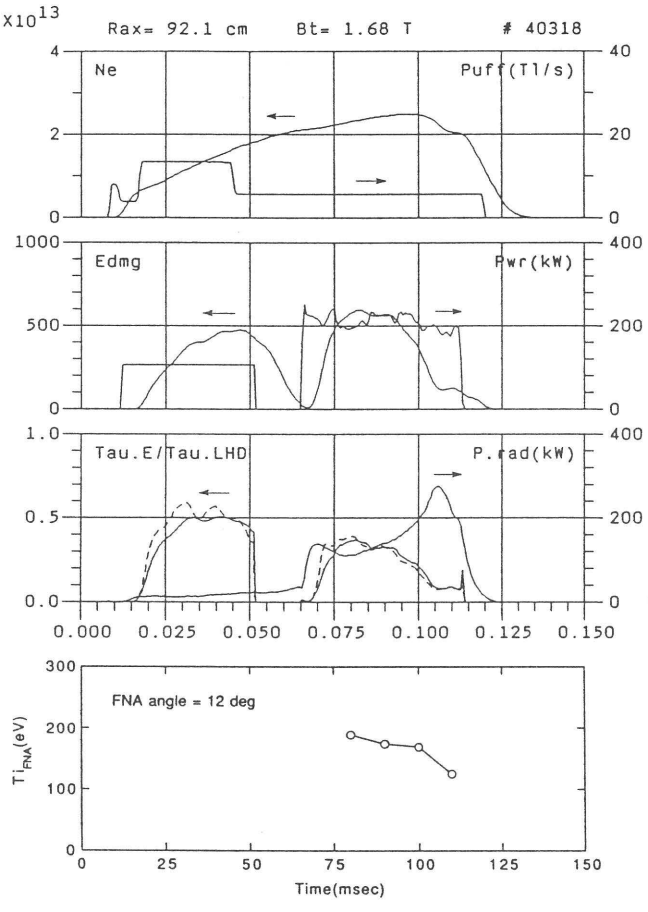

Fig. 1 Time traces of average density, gas puffing rate, diamagnetic energy, input power, confinement ratio (τ_E/τ_{LHD}), radiation power, ion temperature.

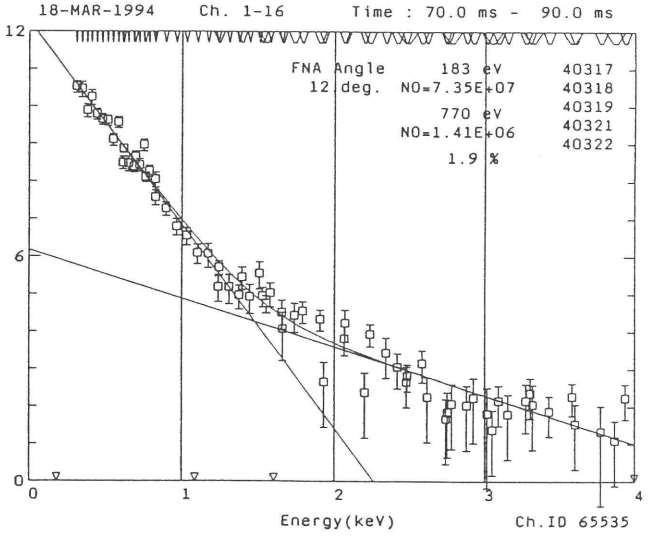

Fig. 2 Ion energy spectrum for neutral particle flux with perpendicular energy to the magnetic field.