§30. Bidirectional Observations of Charge Exchange Recombination Spectral Lines in CHS

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A new TVCXS (Television Charge Exchange Spectroscopy) system viewing the neutral beam line from up and down sides was installed on CHS to detect the absolute value of poloidal rotation velocity. Figure1 shows the configuration. The charge exchange recombination spectral lines produced by the heating neutral beam 'NBI#1' are measured via port'7U' and '7D' and the difference of their wave length gives the absolute value of plasma rotation velocity. The background radiation is measured via port '8D', to subtract it from the spectrum measured via chord viewing the beam[1].

The measured spectral lines are two CVI lines in the visible range, Δn=8-7 (λ=5292Å) and Δn = 7-6 (λ=3434Å). The wave length shifts measured via port'7U' and '7D'(before subtracting the background radiation) should have the same magnitude of reversed Doppler shifts (i.e. one is the blue shift and the other is the red shift) at each observation chord. The λ=5292Å line shows this behavior indicating the plasma poloidal rotation with the velocity of 4km/s in the direction of electron diamagnetic drift as shown in Figure2.The wave length shifts of the λ=3434Å line, however, don't have this up/down symmetry as shown in figure 3. There are relative blue shifts at peripheral region, compared with Figure 2. This blue shifts are probably the apparent shifts caused by interference lines in the background radiation. Although, the wave length and the intensity of interference lines are not clear in this measurement because the interference lines are close to the CVI line within the Doppler width, the total wave length shift of background radiation including this apparent shift sometimes reaches ($\Delta\lambda/\lambda$)c$\sim -$10km/s as shown in Figure 3, and this value is too large compared with the rotation velocity measured with the λ= 5292Å line. These results suggests that there are spectral lines of other impurity ions (for example, OVI) on the near blue side of CVI λ=3434Å line, in the back-ground radiation. Although the spectral fine structure of hydrogen-like ions based on l-mixing model[2] also causes an apparent wave length shift, this shift is ($\Delta\lambda/\lambda$)c < 0.5km/s at Ti > 100eV and thus negligible.

The background radiation measurement from down side only as shown in Figure 1 is available under the wave length up/down symmetry of the background radiation which can be made only by the Doppler shift. Therefore, after subtracting the background radiation, with the λ=5292Å line, same relative rotation velocity profiles are obtained from up and down side measurements and the difference of their wave length gives the absolute value of the velocity, while, with the λ=3434Å line, only down side measurement gives the right results because the background radiation is the mixture of the Doppler shifted CVI line and the interference lines. For this reason, i.e.the cross checking of up and down sides measurements with the background measurement from down side only under the intensive background radiation, the spectral line at λ=5292Å is better for the plasma rotation measurements.

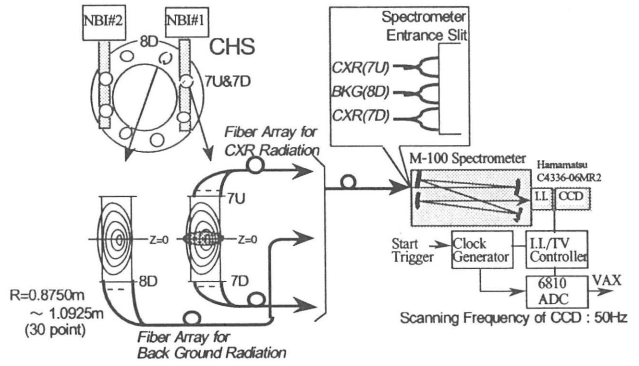

Fig.1. New TVCXS System Configuration

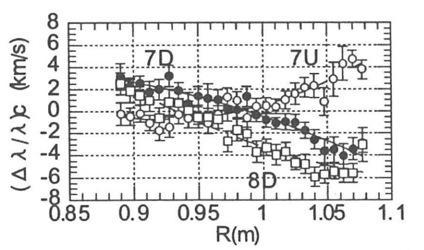

Fig.2. Wave Length Shift of λ=5292Å line

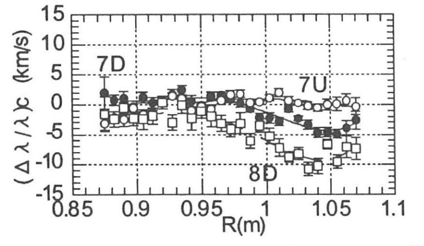

Fig.3. Wave Length Shift of λ=3434Å line

References

1) Ida,K.,et.al.;Rev.Sci.Instrum.60(1989)867
2) Fonck,R.J.,et.al.;Phys.Rev.A29(1984)3288