§21. Fast Charge Exchange Spectroscopy by Fabry-Perot Spectrometer in W7-AS

Yoshinuma, M., Ida, K.,
Baldzuhn, J. (Max-Planck-Institute for Plasma Physic)

In order to improve the time resolution of charge exchange spectroscopy, a Fabry-Perot spectrometer with CCD detector which has 80x80 pixels has been developed and applied to W7-AS. The time resolution of this system is 25 Hz - 200 Hz, which is good enough to subtract the background emission from the charge exchange emission by modulating the neutral beam.

Figure 1 shows the schematic diagram of Fabry-Perot spectrometer which has been installed in W7-AS. The wavelengh λ of the light that transmits through the Fabry-Perot spectrometer is given by

$$\lambda = \lambda_0 \cos\theta = \lambda_0 (f^2 / \sqrt{f^2 + d^2})$$

where d is the distance of the optical axis, and f is the focal length of the coupled lens. The Fabry-Perot spectrometer has 6 channels for measurement (No. 1-6 in Fig.1.) and a channel for calibration (No. 0 in Fig.1.) of center wavelength. The wavelength range of the measurement for fixed spacing of Fabry-Perot interferometer is about 0.8 nm. The spectral resolution (FWHM) and free spectrum range (FSR) of the spectrometer is 0.065 nm and 1.7 nm, respectively. The effective finesse (FSR/FWHM) is 26 which has been significantly improved compared with the preliminary Fabry-Perot system installed in JIPP TII-U in 1995 [1].

The charge exchange line of carbon impurity (λ=529.05 nm) is measured with a time resolution of 5 msec for high density quasi-steady discharges. The CVI intensity is modulated with 50 Hz associated with the modulation of the radial injector (RADI) of the neutral beam (10 msec on, 10 msec off) as shown in Fig.2. The component induced by the beam is comparable to the intensity induced by charge exchange reaction between carbon and thermal neutrals (background). The electron temperature and line averaged density are 200 eV and 3.7x10^{20} m^{-3} , while the total power of heating neutral beam is 3.5 MW.

Figure 3 shows the charge exchange spectrum of CVI at the timing of beam on and beam off. The difference between the spectra at beam on and beam off is considered to be CVI emission induced by beam as indicated with open square in Fig.3. The ion temperature is derived from the Doppler width of the beam induced component spectrum.

Reference
1) Ida, K., Fusion Eng. Design **34-35** (1997) 219.

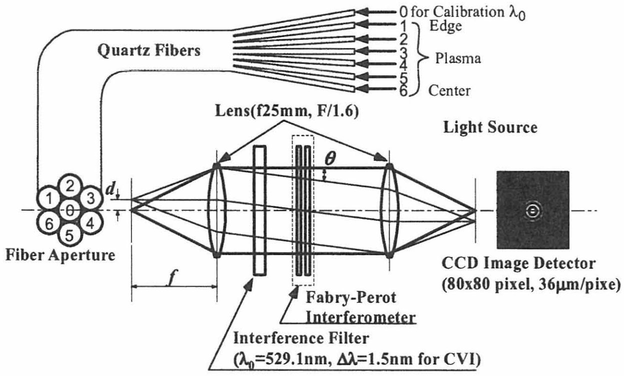

Fig.1. Schematic diagram of the Fabry-Perot spectrometer installed in W7-AS.

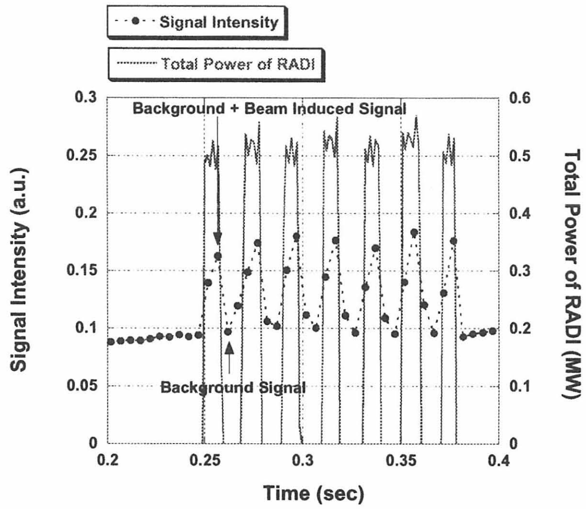

Fig.2. Signal intensity (solid circle) plotted with the total power of RADI (solid line).

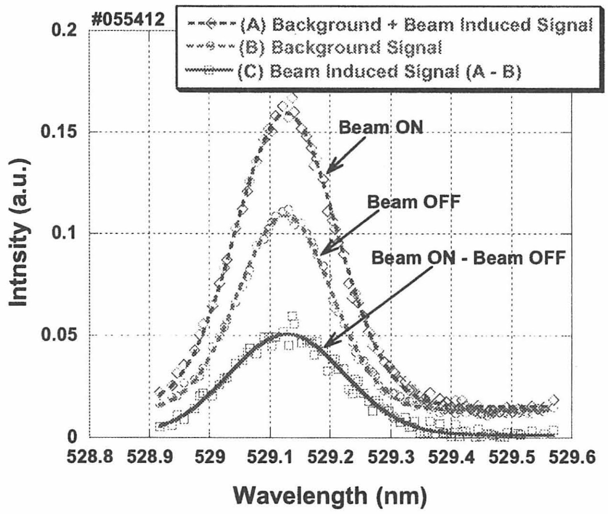

Fig.3. Spectra of the charge exchange line CVI with the RADI on (open diamond) and off (open circle). Spectra of the beam induced component (open square).