§18. Analysis of CV Spectral Lines and the Emitting Location in LHD Plasma

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Carbon is one of major impurities in laboratory plasmas. We are interested in carbon ions which are expected to exist mainly in peripheral region of LHD plasmas. We obtained VUV spectra of LHD plasma by using the SOXMOS in the 8th campaign and examined two CV emission lines, the resonance line, $1s^2\ ^1S$ – $1s2p\ ^1P$ (4.027nm), and the intercombination line, $1s^2\ ^1S$ – $1s2p\ ^3P$ (4.073nm) (Fig.1). The spectral line intensity ratio can be used for plasma diagnostics.

The relationship between line intensities and plasma temperature and density is usually obtained by a theoretical kinetic model. We used a collisional-radiative model (CRM) for CV ions developed by Fujimoto and Kato[1]. The calculated line ratio of the CV intercombination line and resonance line in ionizing plasma shows strong electron temperature dependence and weak electron density dependence for the density region of the LHD plasma. Thus we can use the line ratio as electron temperature diagnostics.

Comparing the measured line ratio with the calculated electron temperature dependence, we can estimate the electron temperature for the region where CV ions exist. Figure 2 shows the temporal evolution of the estimated electron temperature for 3 shots of the LHD plasma. During the steady state phase of the plasma after 1.6 sec, the obtained electron temperature is nearly constant at around 200eV. The plasma of the shots was continuously heated by NBI injection and showed nearly constant electron density and stored energy during the steady state phase.

Now we can compare the obtained temperature with the electron temperature radial profile measured by the Thompson scattering method in Figure 3. It indicates that CV ions exist at around r=2700~2800mm (ρ = 0.96~1.08) region. This result confirms that the CV ions really exist in peripheral low temperature region in the LHD plasma.

This work was performed as a subject to educate graduate students who attended the 2nd Soukendai summer school at NIFS in 2005.

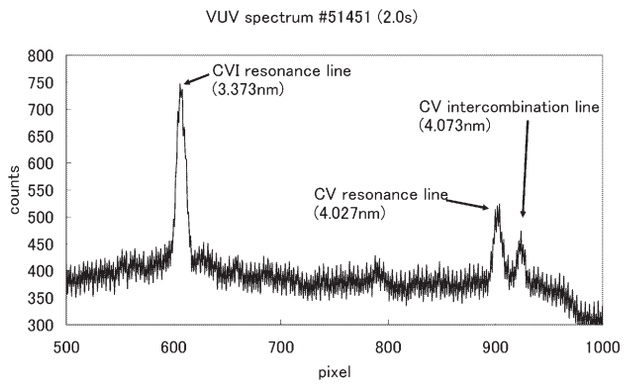

Fig.1 VUV spectrum for shot #51451 at 2.0sec.

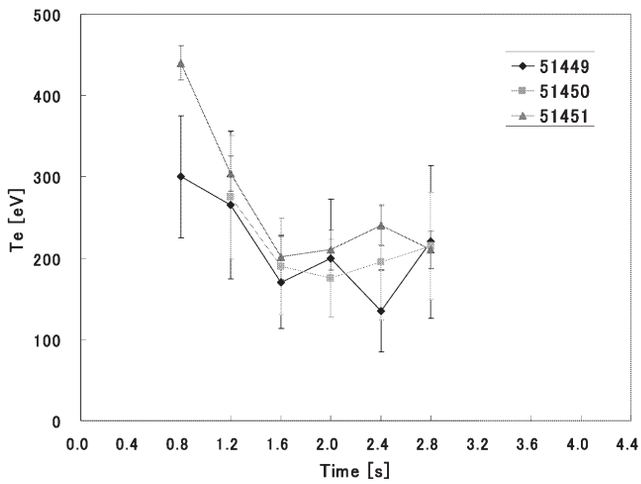

Fig.2 Temporary evolution of electron temperature estimated by using the CV line ratio with CRM calculation for the shots #51449~51451 of the LHD plasma.

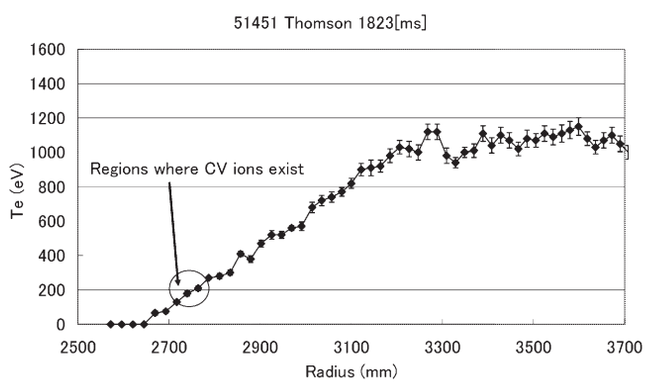

Fig.3 Electron temperature radial distribution measured by the Thompson scattering method for the shot #51451 at t=1823msec. Comparing with obtained electron temperature by using the CV line ratios, the region where CV ions exist is indicated.

References

1) Fujimoto, T. and Kato, T., Astrophys. J. **246** (1981) 994; Phys. Rev. A **30** (1984) 379.