§56. Spatial Profiles and Transport of Metal Impurities in LHD

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In the long pulse discharges of LHD, spatial profiles of VUV spectra could be obtained by changing the line of sight of the spectrometer. The VUV spectrometer looks at the plasma horizontally from an outer port. Figure 1 shows the schematic view of the line of sight of the spectrometer for spatial scanning. The line of sight was moved from the upper region to the lower region through the plasma center during one discharge.

The VUV spectra of a 120-second ICRF discharge are shown in Fig. 2. As the plasma parameters in this discharge were almost steady, the time axis of this figure corresponds to the spatial positions. The observed vertical position, Z, was changed from +45 cm to about 0 cm, where is the midplane. The data was acquired every 4 seconds. This time resolution corresponds to about 1.88 cm in scanning, but the actual spatial resolution is about 9 cm. The signals in the beginning phase represent the emission from the edge region and the signals near the end of the discharge are almost from the central chords. In this data, a peaked profile of the line emission of FeXXIII (132.87Å) can be seen, while some other lines show flat profiles.

In order to evaluate the impurity diffusion coefficient, D, and the velocity, v, the experimental data are compared with the calculation results of MIST, which is an impurity transport code. The experimental line intensity is evaluated by subtracting a certain offset value from the acquired data. The density of each charge state of the impurity is calculated and integrated along the lines of spectrometer sight. The normalized intensity of FeXXIII and FeXVI lines are compared with the results of MIST calculation in Fig. 3.(a) and (b) respectively. D, and v, are given as some functions of the minor radius, r. The same D and v values are used for different charge states of impurity ions. The dotted line indicates the case of $v = 0$ in the whole plasma region. In this case, the calculated profile of the FeXVI line is broader than the profile of observed data. The solid line shows the calculation results with a inward velocity, $v < 0$, profile in the peripheral region. These D and v are shown in Fig. 3.(c) and (d). In the $v < 0$ case, the calculated FeXXIII line has a narrower profile. One of the reasons of the broadening of the experimental data may be the overlap of FeXXIII and FeXX lines at this wave length. From these comparison, it is seemed that the inward velocity of impurity ions is necessary in the peripheral region.

These D and v values are also compared with simulation results of the time evolution of the emission of the Kα-line of titanium after the Ti pellet injection. The laser blow-off impurity injection experiment is also planned for the next experimental campaign.

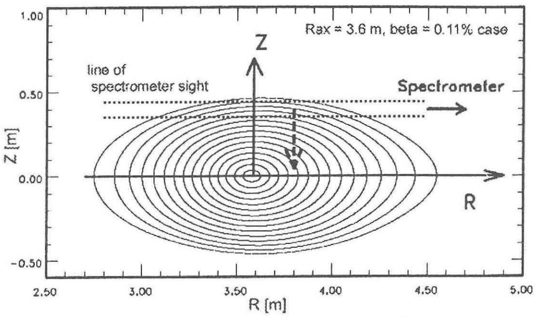

Fig. 1. The schematic view of the line of sight of the VUV spectrometer for spatial scanning.

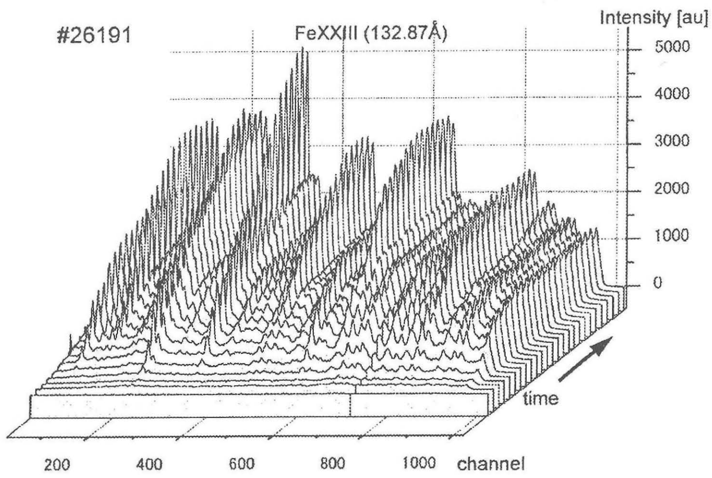

Fig. 2. The VUV spectra of an ICRF long dischrge.

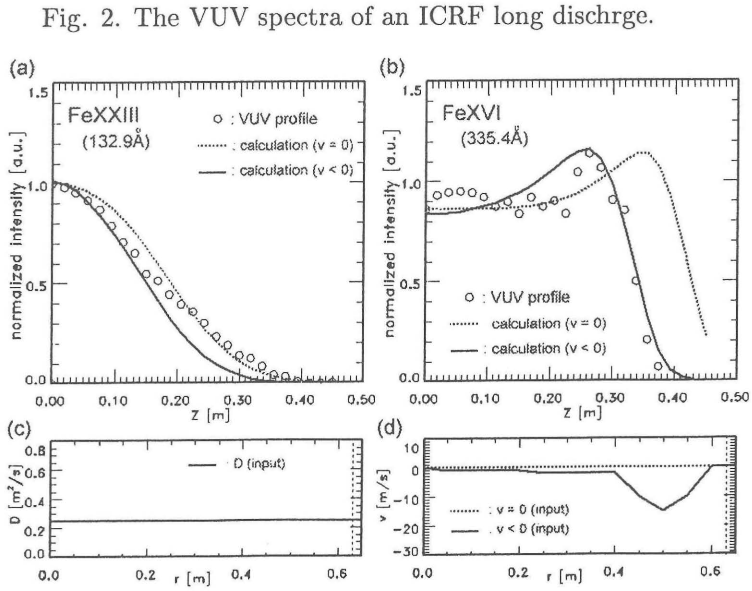

Fig. 3. Comparison of the line intensity with the normalized emissivity calculated by MIST. (a) FeXXIII, (b) FeXVI, (c) assumed D and (d) v.