§22. Measurement of C IV Line Emission Using a C IV-filtered AXUV Diode Array in the CH_4 SMBI Experiment on Heliotron J

Tamura, N., Suzuki, C., Peterson, B.J., Watanabe, S. (Kyoto Univ.), Nagasaki, K. (Kyoto Univ.), Yamamoto, S. (Kyoto Univ.), Kobayashi, S. (Kyoto Univ.), Okada, H. (Kyoto Univ.), Kondo, K. (Kyoto Univ.), Mizuuchi, T. (Kyoto Univ.), Sano, F. (Kyoto Univ.)

In the Heliotron J, which is capable of having a good particle confinement, an impurity accumulation will be a serious problem and it should absolutely be avoided. In order to gain a better understanding of the impurity behavior in Heliotron J plasmas, we have installed a carbon impurity ion profile measurement system, which consists of an Absolute eXtreme UltraViolet photoDiode (AXUVD, IRD inc., AXUV-16ELO/G) array and an optical filter (Acton Research Corp Inc., 155-N-.5D-MTD-SP) for measuring C IV line emission (155 nm: $1s^2 2s$-$1s^2 2p$)[1]. In JFY2008, a deliberate improvement for a stray light and so on has been implemented and in order to judge the health of the improved measurement system, the experiment with a carbon-rich plasma has been carried out on the Heliotron J. To introduce a carbon into the Heliotron J plasma artificially, a methane (CH_4) supersonic molecular beam injection (SMBI) technique[2] is utilized.

Figure 1 (b) shows a typical temporal evolution of the chord-integrated signal intensity from the channel number 8 of the C IV-filtered AXUVD array in an ECRH plasma of the Heliotron J with the CH_4 SMBI. The channel number 8 of the AXUVD array usually sees the center of the Heliotron J plasma. As can be seen in Fig. 1, just after the CH_4 SMBI, the signal intensity of ch. 8 of the C IV-filtered AXUVD array is abruptly increased and gradually decreased. The rise time of the AXUVD signal is slightly slower than that of C III line emission (464.7 nm) measured with a visible spectrometer, which can be considered to be reflected in the difference in the ionization time.

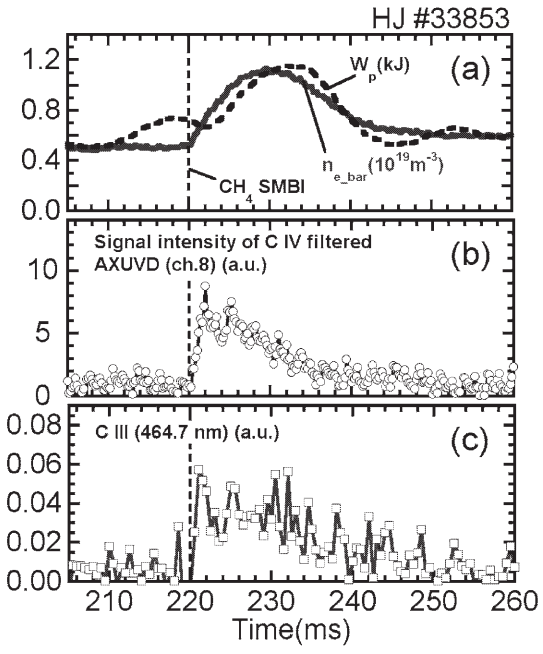

Fig. 1. Typical temporal evolution of (a) the line-averaged electron density, the plasma stored energy, (b) the chord-integrated signal intensity from the ch. 8 of the C IV-filtered AXUVD array and (c) C III line emission intensity (464.7 nm) on CH_4 SMBI experiment in Heliotron J. The vertical dashed line represents the time of the SMBI (t = 220 ms, beam pulse width = 1 ms).

As shown in Fig. 2(a), a channel profile of the chord-integrated signal intensity through the C IV filter shows slightly hollow just after the CH_4 SMBI. On the other hand, a channel profile of the chord-integrated signal intensity without any optical filter shows a slightly peaked one after the CH_4 SMBI as shown in Fig. 2(b). The experimental condition is almost the same in both cases. Thus the hollow profile in the case with the C IV filter can be attributed to the expected C^{3+} ion distribution in the Heliotron J plasma with getting around the stray light. Therefore the signal of the C IV-filtered AXUVD array could be considered to be truly due to the C IV line emission.

1) N. Tamura et al: Ann. Rep. NIFS (2006-2007) 509.
2) T. Mizuuchi et al.: Proc. 18th International Toki Conference (Toki, Japan, 2008)) P2-16, 343.

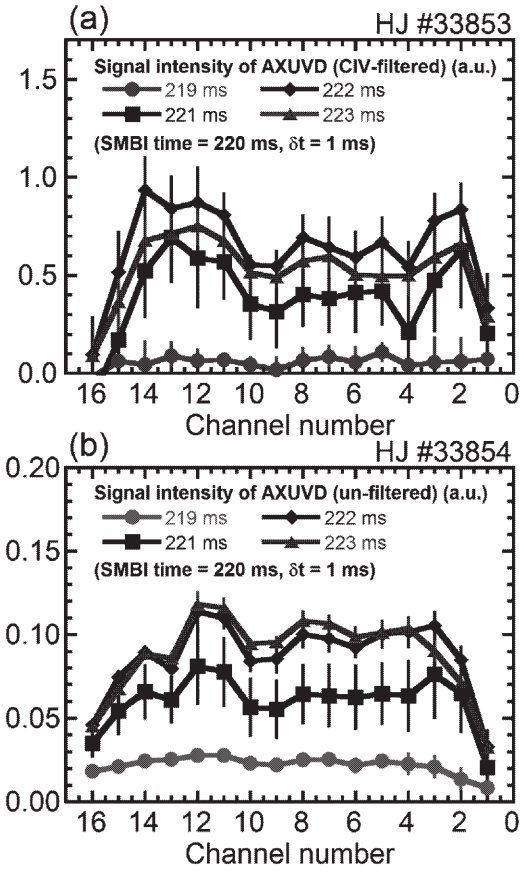

Fig. 2. Channel profiles of the chord-integrated signal intensity from the AXUVD array (a) through the C IV filter and (b) without any optical filters just before (t = 219 ms) and after (t = 221 ms, 222 ms and 223 ms) the CH_4 SMBI (t = 220 ms, beam pulse width = 1 ms).