§21. Temporal Evolution of C IV Line Emission Profile after the CH4 SMBI in Heliotron J ECH Plasmas

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

In Heliotron J, a good energy confinement capability has been observed. The global energy confinement time reaches over 1.5 times longer than that of the ISS95 scaling. One of the reasons for such good energy confinement is a good particle confinement of Heliotron J plasmas. Generally speaking, the good particle confinement can lead to an impurity accumulation, which should absolutely be avoided. Thus, in order to achieve the further improvement of plasma confinement in Heliotron J, it is important to clarify the relationship between the energy confinement and the impurity behavior in Heliotron J. In order to gain a better understanding of the impurity behavior in Heliotron J plasmas, we have developed a carbon impurity ion profile measurement system, which consists of an Absolute XUV 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 a methane (CH_4) supersonic molecular beam injection (SMBI)[2] experiment with Heliotron J ECH plasmas, temporal evolutions of C IV line emission profile measured with the developed system show the different behavior depending on the target plasma density. As can be seen in Fig.1, right after the CH_4 SMBI (t_{SMBI} = 220 ms, beam pulse width = 1 ms), the line-averaged electron density n_{e_bar} and the plasma stored energy W_p are increased dramatically and the C IV line emission intensity profiles show hollow in all cases. In the case of the target plasma density with n_{e_bar} = 0.5 x 10^{19} m^{-3}, the hollow C IV profile changes gradually to the flat one (i.e. C^{3+} ions seem to penetrate to the plasma core finally) and then decays. In the case of the target plasma density with n_{e_bar} = 0.7 x 10^{19} m^{-3}, the hollow C IV profile is maintained for a while and the more gradual decay of that is observed, compared to with n_{e_bar} of 0.5 x 10^{19} m^{-3}. In the case of the target plasma density with n_{e_bar} = 0.8 x 10^{19} m^{-3}, the hollow C IV profile almost remains the same (i.e. C^{3+} ions seem to accumulate in the plasma edge.). It should be noted here that the C IV line emission around the channel number 14 of the AXUVD array seems to increase with time locally. The peaking factors evaluated for both inboard and outboard sides indicate that the peaking factor for the inboard side is increased, unlike the outboard side. This behavior is quite similar to MARFE, which has been observed in many tokamaks and stellarators. Nevertheless, the experimental results shown here suggest that transport coefficients for the C^{3+} ions seems to decreases with the increase in the bulk density in the Heliotron J ECH plasma.

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

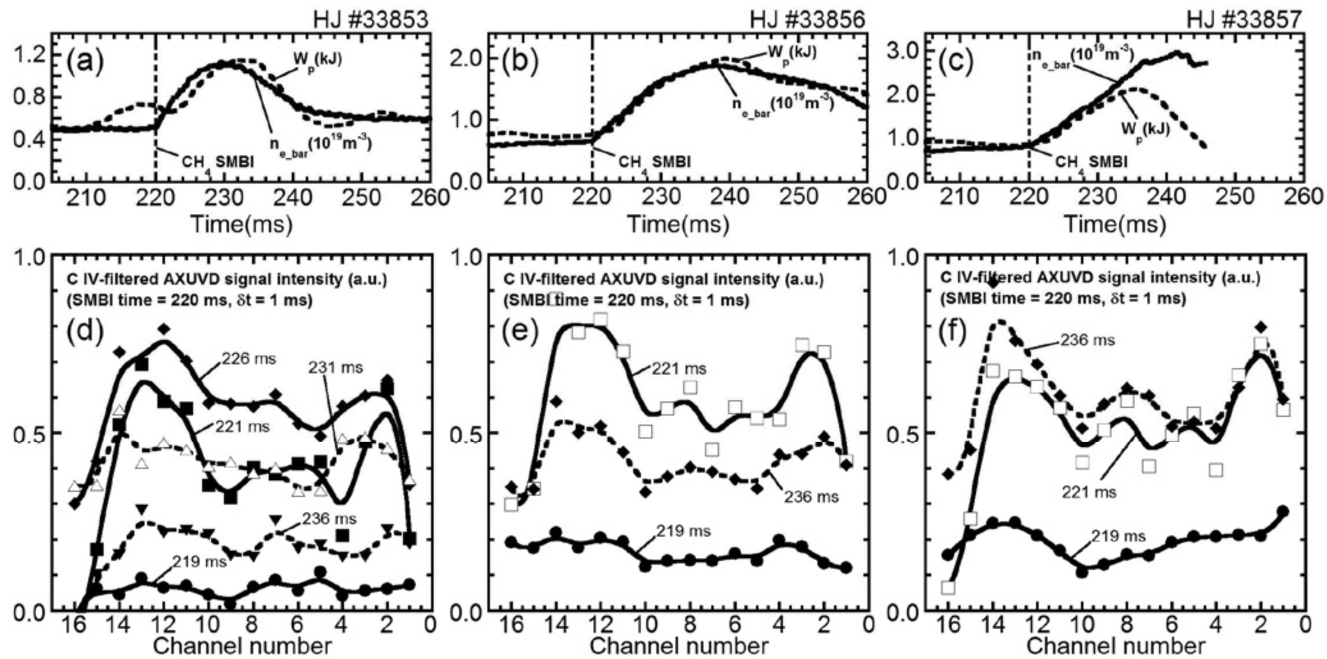

Fig. 1. Results from the CH_4 SMBI experiment with Heliotron J ECH plasmas. (a, b, c) Temporal evolutions of the line-averaged electron density, the plasma stored energy. (d, e, f) Channel profiles of the chord-integrated signal intensity from the C IV-filtered AXUVD array just before and after the CH_4 SMBI. The target plasma density is at 0.5 x 10^{19} m^{-3} in (a, d), at 0.7 x 10^{19} m^{-3} in (b, e) and at 0.8 x 10^{19} m^{-3} in (c, f). In the experiment, the plasmas were initiated and heated only by the ECH. The vertical dashed lines in (a, b, c) represent the time of the SMBI (t_{SMBI} = 220 ms, beam pulse width = 1 ms).