# §12. Impurity Diagnostics on Reheat Mode Discharges in CHS

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Behaviors of impurity ions in fusion plasmas are important in terms of power balance and achievable plasma performance. In order to measure radiations from impurities, three different types of diagnostics have been installed in CHS. In addition to a single-channel pyroelectric detector as a total radiation power monitor, an AXUV (absolute extreme ultraviolet) photodiode array has been installed to obtain profiles of radiation brightness.[1] Furthermore, vacuum ultraviolet (VUV) spectra have been measured by a grazing incidence spectrometer.[2] In this study we have examined characteristic behaviors of impurities found in high density reheat mode discharges[3] by using these diagnostics, and discussed the reason for the behaviors based on the comparisons among the three diagnostics.

The temporal evolutions of various parameters for a typical reheat mode discharge with the magnetic axis position $R_{ax}$ = 93.5 cm are plotted in Fig. 1. The stored energy recovers from 115 ms (10 ms after the termination of the gas puff) by entering the reheat mode, and finally reaches up to 8.6 kJ. The AXUV photodiode signals for the edge (ch 2) and the center (ch 7) viewing chords are shown in Fig. 1 (c). The total radiation power measured by the pyroelectric detector largely reduced during the reheat mode, while the AXUV photodiode signals increased especially for the center viewing chord.

The opposite behavior between the pyroelectric detector and the AXUV photodiode can be possibly explained by the reduction of the sensitivity of the AXUV photodiode in longer wavelength region of VUV spectrum. In order to assess this assumption, temporal evolutions of several representative impurity line intensities in the VUV spectra were measured in the same reheat mode discharge. The results are plotted in Fig. 2 with normalization at 55 ms. The emission from highly charged metallic ions largely increases in the reheat mode, while the emission from relatively low charged oxygen ions steeply decreases until 135 ms and increases again at 145 ms. By comparing Fig. 1 and Fig. 2, the metallic lines in shorter wavelength and the oxygen lines in longer wavelength agree well with the AXUV photodiode signal of the center chord and the total radiation power, respectively. Therefore these observations imply that the difference in the two bolometric signals would be due to the difference in spectral sensitivity in the VUV region . This study indicates that special care about the spectral sensitivity should be taken in the analyses of the AXUV photodiode signals, especially in plasmas where the radiations of low energy photons may become dominant. The comparison among the three types of diagnostics utilized in this study are useful for a comprehensive understanding of impurity behaviors.

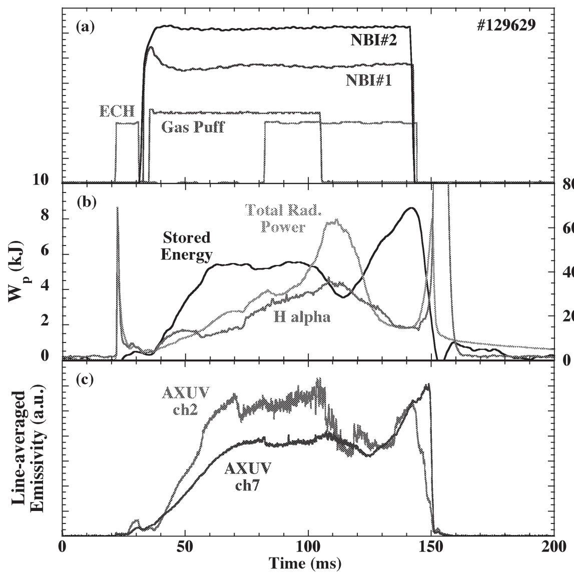


Fig. 1. Temporal evolutions of various parameters in a reheat mode discharge ($R_{ax}$ = 93.5 cm). The reheat mode is kept during 115–145 ms. The channels 2 and 7 of the AXUV photodiode signals correspond to edge and center viewing chords, respectively.

## References

1) Suzuki, C. et al.: Rev. Sci. Instrm. **75** (2004) 4124.

2) Suzuki, C. et al.: J. Plasma Fusion Res. SERIES **7** (2006) 73.

3) Isobe, M. et al.: Fusion Sci. Technol. **50** (2006) 229.

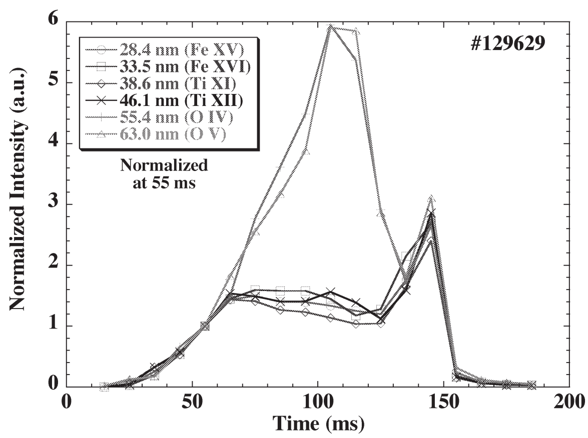


Fig. 2. Temporal evolutions of iron, titanium and oxygen line intensities in VUV region (normalized at 55 ms).