§18. Design of New AXUV Photodiode Arrays for Bolometric Measurements in CHS

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Measurements of radiated power from toroidal plasmas are of importance from the viewpoint of impurity particle transport in the plasmas. Metal foil bolometers have been widely used so far for such bolometric measurements. Recently a new wideband silicon detector called absolute extreme ultraviolet photodiode (AXUVD) has been developed by a new fabrication technique.[1] AXUVD realizes nearly flat spectral response from visible to soft X-ray region unlike normal silicon photodiodes, which makes it suitable for application to bolometric measurements of the plasmas. In addition, AXUVD keeps the general advantages of solid state devices such as fast response, compactness, and better cost performance. AXUVDs have already been adopted for radiation power measurements in several tokamaks and helical devices.[2),3)]

As a new diagnostic in CHS, we have developed a bolometric measurement system composed of two 20 channel AXUVD arrays. Figure 1 shows the observation chords of the diode arrays of this system together with the vacuum magnetic surface of the standard CHS configuration (R_{ax}=92.1 cm). The active areas of each AXUVD are located 15 mm behind small pinholes placed at R=143 cm and Z=±12 cm in the horizontally elongated cross section of the plasma. The fan arrays are arranged to cover all of the plasma volume from inward (R_{ax}=88.8 cm) to outward (R_{ax}=101.6 cm) shifted configurations. The combination of two arrays enables us to reconstruct spatial distributions of radiation intensity by using a tomographic technique.

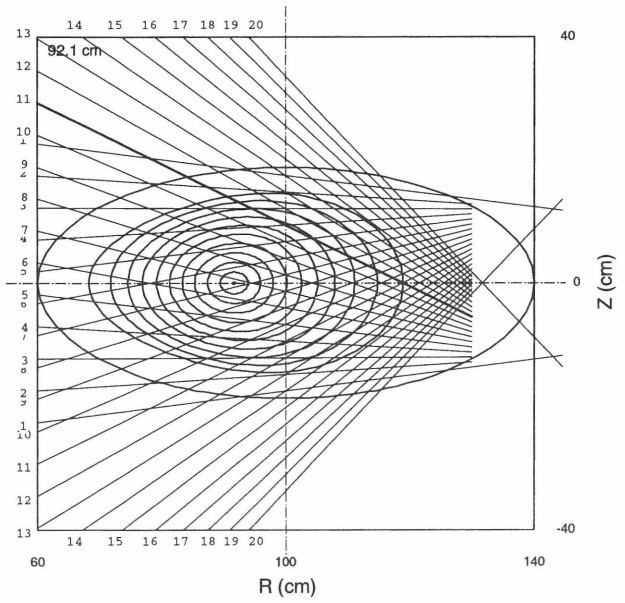

Fig. 1. Lines of sights of the AXUV photodiode arrays installed in horizontally elongated cross section of CHS. The flux surfaces of the standard CHS configuration (R_{ax}=92.1 cm) is also displayed. The channel drawn by a thick line (#11) is used for the data in Fig. 2

Photogenerated currents of all segments (0.75×4 mm^2) of AXUVD arrays are transmitted via a pair of 5 m parallel cables, then fed into current-voltage converters composed of wideband operational amplifiers with a conversion factor of 10^5 V/A. Several VME-bus based 16 channel analog-digital converters for data acquisition are now under preparation for future tomographic measurements. A preliminary result of a single channel (a thick line in Fig. 1) measurement with a digital oscilloscope is displayed in Fig. 2. The data was obtained in a discharge sustained by a single NBI with a certain amount of gas-puff. Sawtooth-like oscillation, which is hard to observe with standard bolometers, is clearly seen over the entire NBI phase. It has been confirmed that this sawtooth-like oscillation is synchronized with burst modes of magnetic probes.

References

1) Gullikson, E. M. et al.: J. Electron Spectrosc. Relat. Phenom. **80** (1996) 313.

2) Boivin, R. L. et al.: Rev. Sci. Instrum. **70** (1999) 260.

3) Kostrioukov, A. Yu. et al.: submitted to Rev. Sci. Instrum.

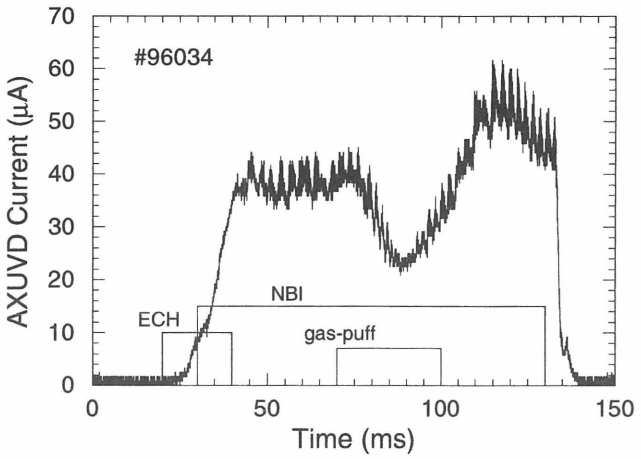

Fig. 2. Sawtooth-like oscillation of AXUVD signal (channel #11) observed in a CHS plasma (R_{ax}=92.1 cm) sustained by NBI.