§70. Absolute Intensity Calibration of Flat-field Space-resolved EUV Spectrometer Using Visible and EUV Bremsstrahlung Continuum Profiles

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A precise absolute intensity calibration of a flat-field space-resolved extreme ultraviolet (EUV) spectrometer working in wavelength range of 60-400Å [1] is carried out using a new calibration technique based on radial profile measurement of the bremsstrahlung continuum in Large Helical Device (LHD). A peaked vertical profile of the EUV bremsstrahlung continuum has been successfully observed in high-density plasmas ($n_e \geq 10^{14}$cm^{-3}) with hydrogen ice pellet injection. Typical EUV and visible spectra are shown in Fig.1 (a) and (b), respectively, with intense bremsstrahlung continuum. The absolute calibration can be done by comparing the EUV bremsstrahlung profile with the visible bremsstrahlung profile of which the absolute value has been already calibrated using a standard lamp [2].

The line-integrated profiles of the EUV and visible bremsstrahlung continuum are measured along vertical direction at horizontally elongated plasma cross section. results are shown in Fig.2. In the visible bremsstrahlung continuum the wavelength of 5300A is usually used because the absence of spectral lines. Upper half profile in the visible bremsstrahlung profile is used in the following analysis. At first, the line-integrated visible bremsstrahlung profile is converted into the local emissivity profile considering a magnetic surface distortion due to the plasma pressure. For a direct comparison with the measurement the line-integrated profile of the EUV bremsstrahlung continuum is calculated from the visible bremsstrahlung emissivity profile by taking account of the electron temperature profile using a equation of

$$\frac{p_{brem\_EUV}}{p_{brem\_Vis}} = \left(\frac{\lambda_{Vis}}{\lambda_{EUV}}\right)^2 \exp\left[-\frac{12400}{T_e}\left(\frac{1}{\lambda_{EUV}} - \frac{1}{\lambda_{Vis}}\right)\right]. \qquad (1)$$

The absolute intensity calibration factor is thus obtained as a function of wavelength. As a result, it is found that the grating reflectivity of EUV emissions is constant along the direction perpendicular to the wavelength dispersion, as shown in Fig.3. This fact newly observed in the present study clearly demonstrates the justification of the present space-resolved measurement based on the EUV spectrometer with flat-field varied-line-spacing (VLS) grating.

Finally, the absolute intensity calibration factor of the space-resolved EUV spectrometer is obtained in Fig.4 [3]. Several absolute calibration techniques of the EUV spectrometer such as branching ratio, synchrotron orbital radiation, hollow cathode lamp and collisional-radiative model calculation have been proposed and studied up to this day. On the other hand, the calibration technique presented here gives the best solution for the absolute intensity calibration of EUV spectrometer.

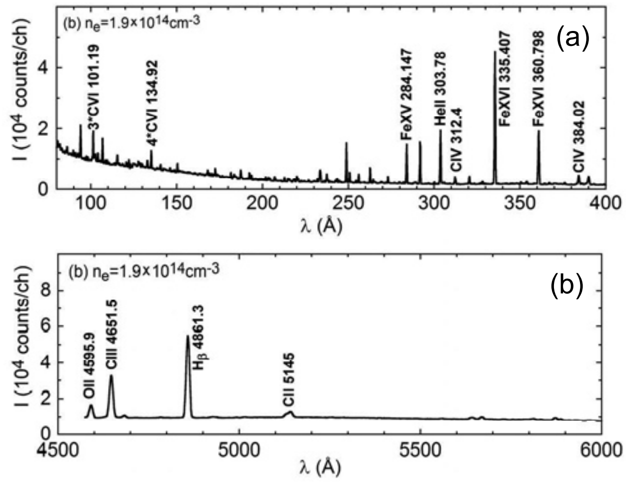

Fig.1 EUV and visible spectra in high-density discharges.

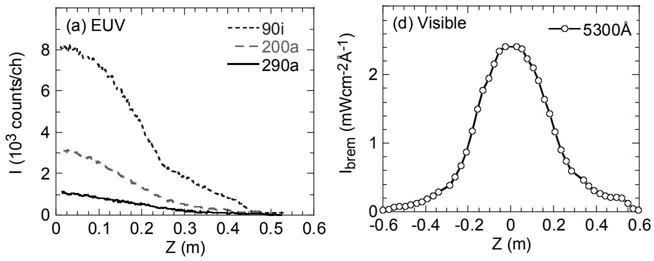

Fig.2 (a) EUV and visible bremsstrahlung profiles

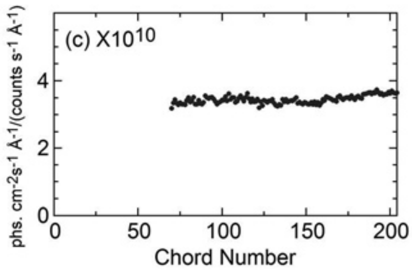

Fig.3 Grating reflectivity of EUV light along direction perpendicular to wavelength dispersion.

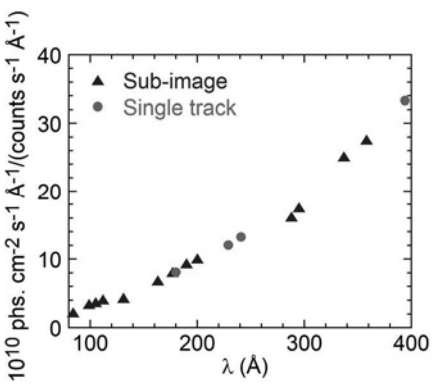

Fig.4 Absolute intensity calibration factor of space-resolved EUV spectrometer.

1) C.F.Dong, S.Morita et al., RSI **81** (2010) 033107.
2) H.Y.Zhou, S.morita et al., RSI **79** (2008) 10F536.
3) C.F.Dong, S.Morita et al. submitted to JAP.