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ヘリオトロンJにおける再構成されたEUVスペクトル空間分布の時間変化

Temporal behavior of the reconstructed spatial distribution of EUV spectra in Heliotron J

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Studying impurity ions has been regarded as an important topic because impurity ions enhance a radiation loss of energy in fusion plasmas. Spatial and temporal emission reconstruction from the extreme ultraviolet (EUV) spectra is a useful method to investigate the spatial behaviors of impurity ions in fusion-relevant magnetic confinement plasmas [1].

In this study, a sightline-scanning EUV spectroscopy system using Soft-X ray CCD camera has been applied to Heliotron J, a flexible helical-axis heliotron device that has an asymmetrical poloidal cross-section, to study spatial distribution of impurity spectra at 16 – 40 nm. Spatial position was scanned for each shot from the plasma center to the peripheral region, as shown in Fig. 1. Local emission distribution was reconstructed from line-integrated intensities of these impurity spectra based on the path-length matrix as the following equation:

$$\begin{pmatrix} \varepsilon(\rho_1) \\ \varepsilon(\rho_2) \\ \vdots \\ \varepsilon(\rho_j) \end{pmatrix} = \begin{pmatrix} L_{1,1} & L_{1,2} & \cdots & L_{1,j} \\ 0 & L_{2,2} & \cdots & L_{2,j} \\ \vdots & \ddots & \ddots & \vdots \\ 0 & \cdots & 0 & L_{i,j} \end{pmatrix}^{-1} \cdot \begin{pmatrix} I_1 \\ I_2 \\ \vdots \\ I_i \end{pmatrix}$$

where $L_{i,j}$ is the sight line lengths between each magnetic flux surface. I_i and $\varepsilon(\rho_j)$ correspond to the line-integral and local intensity for ith sight line and jth flux surface, respectively.

The spatial emission profile of two lines of O V (17.22 nm (2s^2 $^1S_0$-2s3p $^1P_1^0$) and 19.29 nm (2s2p $^3S_2$-2s43d $^3D_3$)) emission have been reconstructed. 17.20 nm line emission distribution during 220~250 msec as functions of time and the normalized minor radius is shown in Fig. 2.

On the other hand, the 17.22 nm line emission exhibited different behaviors. This difference is caused by the difference in the dependence on the electron temperature. This property can be used to determine the electron temperature in the peripheral region.

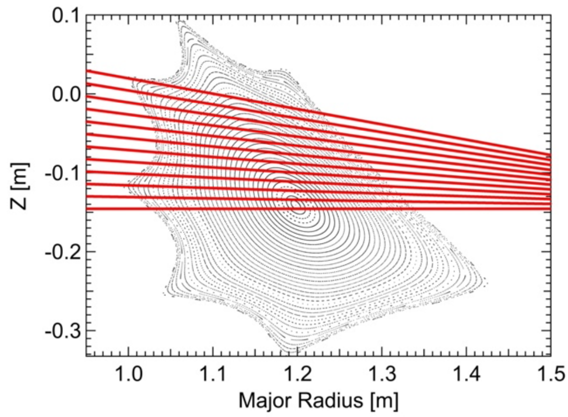

Figure 1 Magnetic flux surfaces and measurement sightlines

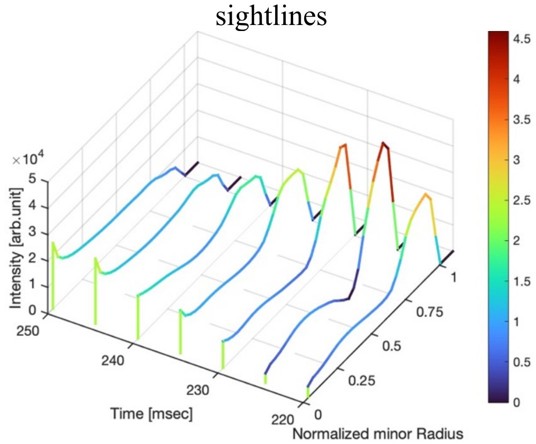

Figure 2 Temporal behaviors of emission spatial distribution of O V 17.22 nm

[1] J C. Dong *et al.*, Plasma and Fusion Research **6**, 2402078 (2011).