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空間分解3mVUV分光器を用いた LHDのエルゴディック層における不純物分布計測

Impurity profile diagnostics in the ergodic layer of LHD using space-resolved 3 m VUV spectrometer

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A space-resolved vacuum ultraviolet (VUV) spectroscopy using a 3 m normal incidence spectrometer has been developed to measure the radial distribution of VUV lines in the edge plasma of large helical device (LHD) of which the major/minor radii are 3.6/0.64 m in the standard configuration with maximum plasma volume of 30 m^3 and toroidal magnetic field of 3 T [1,2]. It measures the vertical spatial profile of VUV lines from impurities emitted in wavelength range of 300 - 3200 Å. The edge plasma of LHD consists of stochastic magnetic fields with three-dimensional structure intrinsically formed by helical coils called "ergodic layer", while well-defined magnetic surfaces exist inside the last closed flux surface (LCFS) [3]. It is therefore extremely important to study the impurity behaviors and transport in the ergodic layer and to compare with those in the scrape-off layer of tokamaks. The VUV spectroscopy is appropriate for the edge impurity study because the emissions are only located inside the ergodic layer with electron temperatures distributing in ranges of 10 to 500eV.

Figure 1 shows the observation range of the VUV spectroscopy measurement and plasma cross section with magnetic axis of R_{ax} = 3.60 m. The optical axis of the spectrometer is arranged perpendicular to the toroidal magnetic field in the bottom edge at a horizontally-elongated plasma cross section. The sightlines are vertically aligned in the observable range adjusted to measure the edge profile (denoted as "edge profile measurement in Fig. 1). In addition to the detailed edge profile measurement, the vertical range of the observable region can be extended by turning on a mirror optics unit mounted in front of the entrance slit of the spectrometer (denoted as "full profile measurement in Fig. 1). CIII (977.02×2 Å, $1s^2 2s^2$-$1s^2 2s2p$), CIV (1548.2×2 Å, $1s^2 2s$-$1s^2 2p$), and CV (2270.9 Å, 1s2s-1s2p) lines emitted from carbon ions as main radiator in LHD are successfully measured by using this VUV spectroscopy system. The measurement including other species of impurities and relationship between impurity emission profiles and discharge scenarios will be presented in the conference.

[1] T. Oishi *et al.*, Plasma and Fusion Research **8**, 2402093 (2013).

[2] T. Oishi *et al.*, *submitted to* Review of Scientific Instruments.

[3] T. Morisaki *et al.*, Journal of Nuclear Materials **313-316**, 548 (2003).

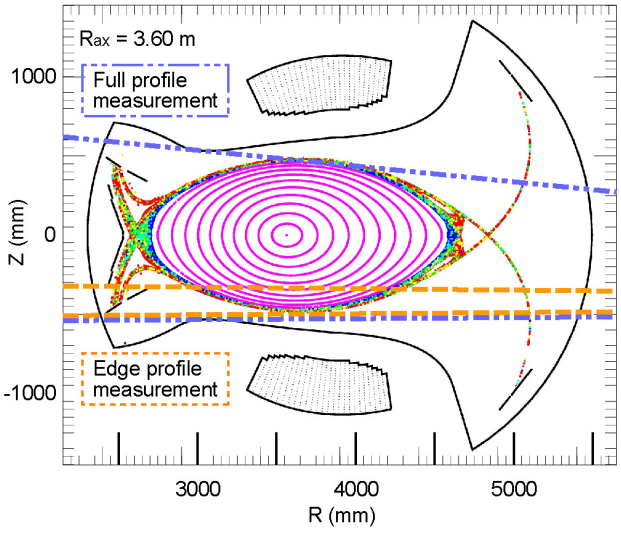

Fig. 1. Observation range of VUV spectroscopy measurement and plasma cross section with magnetic axis of R_{ax} = 3.60 m. The observation ranges are indicated for both the edge profile measurement and the full profile measurement.