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O3.102 Study of impurity transport in deuterium and hydrogen plasmas in the edge stochastic magnetic field layer of Large Helical Device

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The ergodic layer located at the plasma edge of Large Helical Device (LHD) consists of stochastic magnetic fields with three-dimensional structure intrinsically formed by helical coils. Reduction of impurity penetration into confinement region due to existence of the ergodic layer, so called “impurity screening”, has been studied in LHD. Intensities of carbon line emissions have been monitored for multiple charge states with the different ionization potential, Ei. CIII (Ei = 48 eV, lambda = 977.03 Å) and CIV (Ei = 65 eV, lambda = 1548.02 Å) are measured using a 20 cm normal incidence vacuum ultraviolet (VUV) spectrometer while CV (Ei = 392 eV, lambda = 40.27 Å) and CVI (Ei = 490 eV, lambda = 33.73 Å) are measured using a grazing incidence extreme ultraviolet (EUV) spectrometer. A line intensity ratio of (CV + CVI) / (CIII + CIV) can be regarded as an indicator of the impurity screening effect. It has been observed that the ratio decreases with the electron density due to an increase of carbon lines emitted from outer region of the ergodic layer (CIII, CIV) as well as a decrease of those from inner region (CV, CVI), indicating enhancement of the impurity screening in high density regime [1]. Recently, we found that the impurity screening is more obvious in the deuterium (D) plasmas compared to the hydrogen (H) plasmas. The carbon flow in the ergodic layer was also measured by Doppler profile measurement of CIV line with space-resolved VUV spectroscopy [2]. The direction of the observed flow in both D and H plasmas was same as the friction force in the parallel momentum balance calculated with the impurity transport simulation based on a three-dimensional simulation code, EMC3-EIRENE, indicating enhancement of the impurity screening by the friction force. The impurity flow velocity in the D plasma was, however, smaller than that in the H plasma, which is considered due to the mass dependence of the thermal velocity of the bulk ions. Impurity transport analysis in terms of the screening effects are presented.

[1] M. B. Chowdhuri, S. Morita, M. Kobayashi et al., Phys. Plasmas 16 (2009) 062502.
[2] T. Oishi, S. Morita, S. Y. Dai et al., Nucl. Fusion 58 (2018) 016040.

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