Estimation of total radiation of C^{2+} - C^{5+} ions in Large Helical Device based on VUV and EUV spectroscopy

Chunfeng DONG[a], Shigeru MORITA[a,b], Izumi MURAKAMI[a,b], Motoshi GOTO[a,b], Erhui WANG[b] and Tetsutarou OISHI[a]

[a]*National Institute for Fusion Science, Toki 509-5292, Gifu, Japan*
[b]*Department of Fusion Science, Graduate University for Advanced Studies, Toki 509-5292, Gifu, Japan*

Carbon is only an abundant impurity in recent fusion devices. In order to investigate the carbon radiation loss, the resonance transitions of CIII (977.03Å: $2s^2\ ^1S_0$-$2s2p\ ^1P_1$), CIV (1550Å: $2s\ ^2S$-$2p\ ^2P$), CV (40.27Å: $1s^2\ ^1S_0$-$1s2p\ ^1P_1$) and CVI (33.73Å: $1s\ ^2S$-$2p\ ^2P$) are measured from high-temperature plasmas in Large Helical Device (LHD) since such transitions occupy a large part of the radiation loss in each ionization stage. Absolute intensities of the CV and CVI resonance transitions are observed by an extreme ultraviolet (EUV) spectrometer and those of the CIII and CIV resonance transitions are observed by vacuum ultraviolet (VUV) spectrometers. All the spectrometers are absolutely calibrated based on bremsstrahlung continuum emitted from the LHD plasma. The total radiation power from C^{2+} to C^{5+} ions are calculated by the collisional-radiative (CR) model based on the measured resonance line intensities. The calculated result shows that the radiation loss from C^{2+} and C^{3+} ions increases with electron density, whereas the radiation loss from C^{4+} and C^{5+} ions almost keeps constant with the electron density. It indicates the impurity screening induced by stochastic magnetic field layer called 'ergodic layer' existing in the outside of main plasma with well-defined magnetic surfaces in LHD. The radiation loss from C^{3+} ion is two times bigger than that from C^{2+} ion, but it is negligible compared with that from C^{5+} ion. The total radiation losses from C^{4+} and C^{5+} ions are around 50kW in the present LHD plasma, which is much smaller than the total input power, e.g., 10-20MW. The total radiation is also compared among each ionization stage. The result is discussed with carbon transport and edge plasma parameters.