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Evaluation of extreme ultraviolet spectral models for mid-charged tungsten ions with LHD experiments

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The behavior of tungsten impurity in fusion plasmas is one of the important issues to be studied to achieve high-temperature plasmas for fusion reactions since tungsten used as plasma-facing material is sputtered by plasma particles and is expected to reduce electron temperature due to large radiation power. Many studies have been done to examine atomic properties and spectral models for tungsten ions, however, tungsten ions with 4f open subshells are not well studied yet due to the complexity of the atomic structure. Extreme ultraviolet (EUV) spectra of tungsten ions have been measured in various fusion devices and electron beam ion traps (e.g. [1,2]), and examined by comparison of theoretically calculated spectra by collisional-radiative (CR) models (e.g. [3,4]). The unresolved transition array (UTA) measured at 4.5-7nm wavelength region for plasma with electron temperature ~1keV is produced by numerous overlapped 4d-4f and 4p-4d transitions of tungsten ions. The wide two-peak feature of the UTA profile is not fully understood yet, even though recombination processes are included in the CR models [4,5] for Wq+ with q=25-39. On the other hand, the peaks measured at 2-4nm are well understood and are produced by many n=4-5 and n=4-6 transitions of Wq+ with q=22-30. They are useful to estimate charge state distributions [4,5]. For ions with q<22, no peaks are found in this region and we need some identifier for such lower charged ions. We extend our study to EUV spectra at 10-30nm where n=5-5 transitions are found for mid-charged tungsten ions by CR model calculations.
We have performed plasma experiments to measure tungsten spectra by pellet injection with Large Helical Device (LHD) for wide wavelength regions. Measured spectra at 10-30nm can be used to evaluate calculated spectra by CR models for mid-charged tungsten ions. Details of the comparison will be presented at the conference.

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