We have developed tungsten atomic modeling for understanding the tungsten behavior in fusion plasmas.

We observed tungsten spectra from plasmas of the Large Helical Device (LHD) with tungsten pellet injection and applied the modeling for the analysis.

Our tungsten atomic model can reproduce two-peak unresolved transition array (UTA) feature seen in extreme ultraviolet (EUV) spectra at 5-7nm for plasmas with electron temperature 1 – 1.5keV.

We identified EUV lines of W$^{24+}$ to W$^{33+}$ ions at 1.5 – 4nm by using compact electron beam ion trap device (CoBIT) and these lines are measured in LHD plasmas. They are very sensitive to electron temperature ($T_e$) and useful to examine the tungsten behavior in edge plasmas (Fig. 1). The charge state distributions are obtained by analyzing these lines with the atomic model (Fig. 2).

Based on the first quantitative analysis of measured spatial profile of W$^{44+}$ ion, the tungsten concentration is determined to be $n(\text{W}^{44+})/n_e = 1.4 \times 10^{-4}$ (Fig. 3) and the total radiation loss is estimated as $\sim 4$ MW, of which the value is roughly half the total NBI power.