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Theoretical Investigation on the spectrum of W LV ion

Jiaoxia Yang[1], Xiaobin Ding[1], Rui Sun[1], Fumihiro Koike[2], Izumi Murakami[3], Daiji Kato[3], Hiroyuki A Sakaue[3], Nobuyuki Nakamura[4], Chenzhong Dong[1]

[1] Key Laboratory of Atomic and Molecular Physics and Functional Materials of Gansu Province, College of Physics and Electron Engineering, Northwest Normal University, China,

[2] Department of Physics, Sophia University, Japan,

[3]National Institute for Fusion Science, Japan,

[4]Instititute for Laser Science, The University of Electro-Communications, Japan

The research on the energy level structure and radiative transition properties of Tungsten(W) ions in various ionization stage was largely spurred by the decision of chosen tungsten as the armor material of ITER divertor due to its favorable properties. In the high temperature fusion plasma, the tungsten ions will be generated by the edge plasma interaction with the wall and the divertor inevitably and will be transported into the high temperature core plasma as highly charged heavy impurity ions. Such impurities can not be fully ionized, thus the large radiation loss could be expected which will have important influence on the plasma performance. In order to monitor and control the tungsten ion impurities, the throughout knowledge of the tungsten ions especially the radiation properties are necessary.

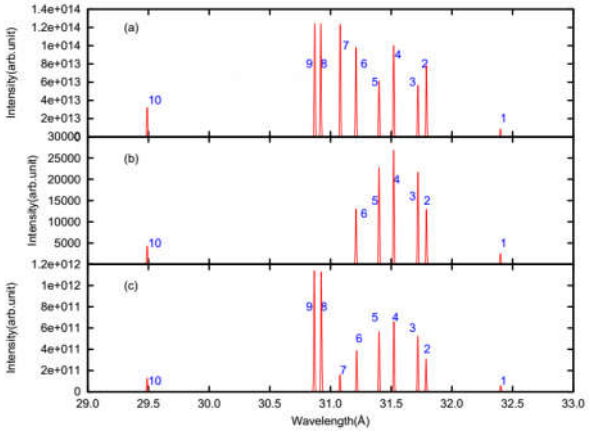

Figure 1. Theoretical spectra of W LV ion in wavelength 29.0-33.0 Å. (a). Convoluting the transition rate with the Gaussian profile with FWHM=0.05 Å; (b) the spectrum for the EBIT case with ne=1012mc-3 and Ee=18.2keV; (c). the spectrum for the LTE plasma with ne=1015cm-3 and Te=18.2 keV.

The energy level structure and radiation of W LV ion had been studied experimental and theoretically [1, 2]. Lennartsson et al. observed the spectrum of this ions in 18.4-19.8 Å [1]. The intensity I_{ij} of an observed transition line can be defined as:

$$I_{ij} \propto N(i)A_{ij}\phi(\lambda),$$

where A_{ij} is the transition probability which can be calculated by relativistic configuration interaction method, $N(i)$ is the population of the ions in the upper level i which can be acquired by constructing and solving the Collisional-Radiative model [3] in which all the necessary atomic data such as energy level, transition energy, probability and electron impact (de)excitation cross section has been calculated with the implementation of FAC code [4] , and $\phi(\lambda)$ is the normalized line profile which was taken as Gaussian profile.

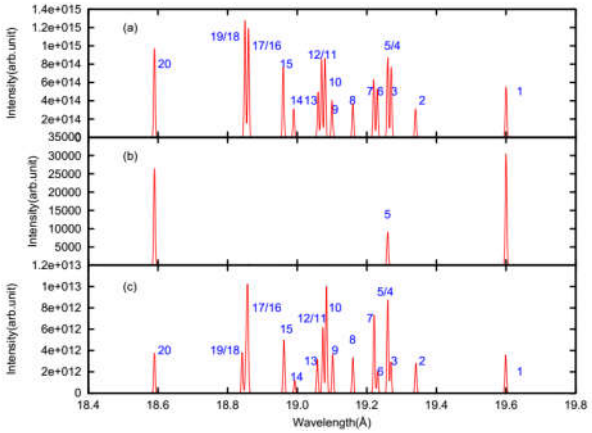

Figure 2. Theoretical spectra of W LV ion in wavelength 18.4-19.8 Å. (a). Convoluting the transition rate with the Gaussian profile with FWHM=0.05 Å; (b) the spectrum for the EBIT case with ne=1012mc-3 and Ee=18.2keV; (c). the spectrum for the LTE plasma with ne=1015cm-3 and Te=18.2 keV.

The present work explained the experiment by Lennartsson *et al.* in which only three strong E1 $3d \rightarrow 3p$ transition were observed although there were 20 transitions with large transition probability. This result means that the electron excitation process plays curial role in the excited states population. Other several observable transition were predicted in 29-32.5 Å in Fig.2.

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References

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