Theoretical study on the soft X-ray spectra of E1 transition of W LV ion

Jiaoxia Yang[*], Xiaobin Ding[*1], Rui Sun[*], Fumihiro Koike[†], Izumi Murakami[‡], Daiji Kato[‡], Hiroyuki A Sakaue[‡], Nobuyuki Nakamura [§], Chenzhong Dong[*]

[*] Key Laboratory of Atomic and Molecular Physics and Functional Materials of Gansu Province, College of Physics and Electronic Engineering, Northwest Normal University, Lanzhou 730070, China

[†] Department of physics, Sophia University, Tokyo 102-8554, Japan

[‡] National Institute for Fusion Science, Toki, Gifu 509-5292, Japan

[§] Institute for Laser Science, The University of Electro-Communications, Chofu, Tokyo 182-8585, Japan

Synopsis A collisional-radiative model was constructed to investigate the spectra of W LV ion from EBIT. A good agreement with previous experiment was obtained and some new transition lines were predicted.

The research on the energy level structure and radiation properties of various Tungsten(W) ions was largely spurred by the decision of chosen tungsten as the armor material of ITER divertor due to its favourable properties. In order to monitor and control the tungsten ion impurities produced when the plasma interact with the divertor, the throughout knowledge of the tungsten ions especially the radiation properties are necessary.

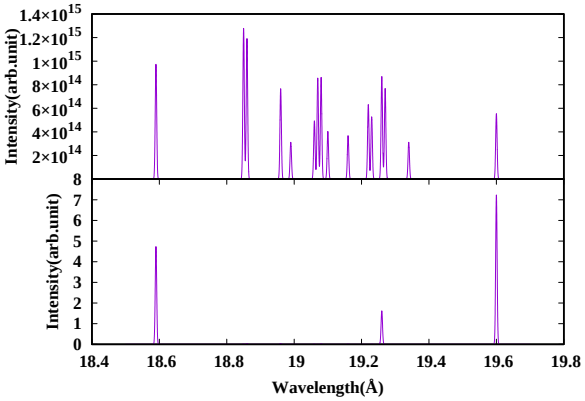

Figure 1. Theoretical spectra of W LV ion from EBIT with $n_e \approx 10^9 cm^{-3}$ and electron beam energy 18.2 keV in 18.4-19.8 Å. Upper: obtained by weighted transition probability. Lower: obtained by CRM.

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:

$$I_{ij} \propto N(i) A_{ij} \phi(\lambda) \qquad (1)$$

where A_{ij} is the transition probability which can be obtained 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.

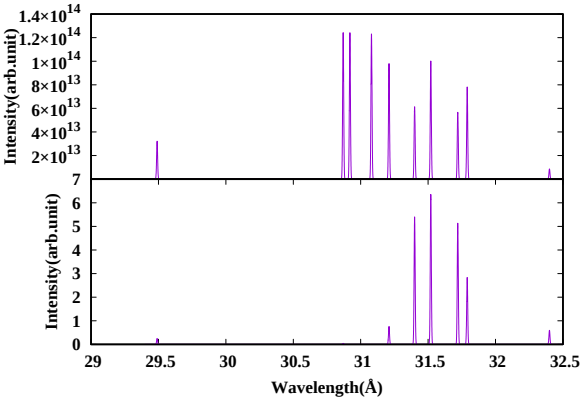

Figure 2. Theoretical spectra of W LV ion from 29-32.5 Å. The same as in Fig. 1.

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. Another several observable transition were predicted in 29-32.5 Å in Fig.2.

This work was supported by National Nature Science Foundation of China, Grant No:11264035 and Specialized Research Fund for the Doctoral Program of Higher Education(SRFDP), Grant No: 20126203120004, the Young Teachers Scientific Research Ability Promotion Plan of Northwest Normal University (Grant No:NWNU-LKQN-15-3).

References

[1] Lennartsson *et al.* 2013 *Phys. Rev. A* **87** 062505

[2] X.B. Ding *et al.* 2017 *J. Phys. B: At. Mol. Opt. Phys.* **50** 045004

[3] X.B. Ding *et al.* 2017 *Phys. Lett. A.* **380** 874

[4] M. F. Gu *et al.* 2008 *Cana. J. Phys.* **86** 675

[1] E-mail: dingxb@nwnu.edu.cn