

Analysis of Visible Transitions in WIX and WX observed with an Electron Beam Ion Trap

Priti¹, Daiji Kato^{2,3}, Izumi Murakami^{2,4}, Hiroyuki A. Sakaue², Nobuyuki Nakamura¹

¹Institute of Laser Science, University of Electro-communications, Tokyo, 182-8585 Japan 182-8585

<http://yebisu.ils.uec.ac.jp/nakamura/>

²National Institute for Fusion Science, Toki, Gifu 509-5292, Japan

³Department of Advanced Energy Engineering Science, Kyushu University, Fukuoka 816-8580, Japan

⁴Department of Fusion Science, SOKENDAI, Toki, Gifu 509-5292, Japan

Visible spectroscopy of few times ionized tungsten is very useful tool to diagnose the ITER edge plasma [1]. In addition, the visible transitions of WIX and WX can be helpful to understand the time variation of fundamental constants as these transitions are proposed as a potential candidate for more precise optical atomic clocks [2]. However, to date there are no experimental or theoretical atomic data for line or structure is available for WIX and WX ions. Therefore, to fill this void low charged tungsten ions (WVII- WXIV) were produced and trapped in compact electron beam ion trap (CoBIT) [3]. Emission was observed with a Czerny–Turner visible spectrometer.

In the present talk, we will present various new transitions in visible range identified from observed spectra [3] for WIX and WX. The analysis of the observed spectra is based on the collisional-radiative (CR) modeling with fine structure sublevels atomic kinetics. Model includes basic kinetic processes such as electron impact excitation (de-excitation) and radiative decay. Recombination processes such as radiative recombination, three-body recombination, and dielectronic recombination, are ignored in the model as they have negligible contribution under the present experimental conditions. To ensure the identification of lines done by the CR model we have also performed the accurate calculation of transition energies and transition probabilities within multi configurational Dirac-Fock using the GRASP2018 [4]. In the spectrum, most of the observed lines are identified as magnetic dipole (M1) transitions between lower-lying states of these ions. Details of the model and analysis will be presented in the meeting.

References

1. J. Clementson *et. al.*, *Atoms* 2015, 3, 407–421
2. J C Berengut *et. al.*, *Phys. Rev. Lett.* 2010, 105, 120801
3. M. Mita *et. al.*, *Atoms* 2017, 5, 13
4. C. Froese Fischer, *et. al.*, *Computer Physics Communications* 2019, 237, 184.