Study of intensity ratio of L X-rays in Tungsten

Arvind Kumar Jain

Department of Physics, M. L. N. College, Yamuna Nagar, 135 001, Haryana, India

Synopsis L X-ray intensity ratios for Tungsten (W) as a function of proton energy have been calculated in the energy range 260-400 keV. An important effect i.e. multiple ionization (MI) which is essential for the accurate calculations has been employed with ECPSSR model. The calculations involving MI effect agree well with the experimentally measured values compared to the calculations without MI effect.

It is known that any change in the binding energy of shells / sub shells of an atom considerably shifts the X-ray peak from its position. This transference affecting the X-ray spectra of an element via altering the atomic parameters like intensity ratios. All this is attributed to the multiple ionization (MI) or the simultaneous ionization. This effect (MI) serves as a basis for a systematic understanding of X-ray emission process and their precise calculations. Up till now plenteous of research work has been performed exclusively on the inner shell ionization [1,2]. The outer shell ionization has been accomplished much interest since few years [3, 4]. Due to the outer shell ionization, additional vacancies are created. These vacancies change the atomic parameters by increasing Fluorescence yields and decreasing Coster-Kronig probability. Consequently, X-rays emitted from the multiple ionized atoms are considerably shifted in both position and width [5]. This shift is major source of the discrepancy in the results which requires an amendment [6] to correct these parameters. This adjustment considers a basic assumption that the intensity ratios are modified due to the incoming projectiles, with an equal probability, which is calculated through the binary encounter approximation. Miranda *et al.* [7] showed that, at least in case of protons with the energies below 1 MeV, the correct database of atomic parameters improves agreement with theoretical prediction. In view of this, we have examine this effect (MI) by computing L X-ray intensity ratios for Tungsten by proton impact within the energy range 260 – 400 keV as shown in Figure 1. Calculations are based on two models i.e. ECPSSR and ECPSSRUA models. We proposed the concept of MI effect in ECPSSR model and observe the outcomes. Assessment shows that the large discrepancy between the theoretical predictions and experimental values is due to ignorance of the MI effect. Calculations with MI effect give more reliable results. It means that MI is an auspicious aspect for evaluation of the X-ray spectra and in other words promising method to understand the atomic properties of matter. The detailed results will be presented during the conference.

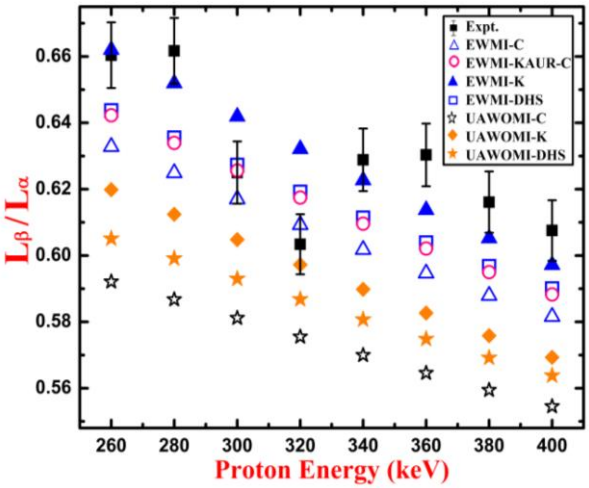

Figure 1. L_β/L_α for **Tungsten** as a function of proton energy.

References

[1] D. Bhattacharya *et al.* 1994 *Phys. Rev.* A **49** 4616.
[2] J. Miranda and G. Lapicki 2014 *At. Data Nucl. Data Tables* **100** 651.
[3] C. Ciortea *et al.* 2003 *Nucl. Instr. Meth.* B **205** 789.
[4] S. Kumar *et al.* 2017 *Nucl. Instr. Meth.* B **395** 39.
[5] M. Czarnota *et al.* 2009 *Phys. Rev.* A **79** 032710.
[6] G. Lapicki *et al.* 1986 *Phys. Rev.* A **34** 3813
[7] J. Miranda *et al.* 2002 *Nucl. Instr. Meth.* B **189** 21.

E-mail: arvindjain61@gmail.com