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Transition probability and oscillator strength determination in Os4+ by means of semi-empirical HFR+CPOL and ab initio MCDHF-RCI

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Saturnin Enzonga Yoca1,2, Exaucé Bokamba Motoumba1, Pascal Quinet2, Patrick Palmeri2

1 Faculty of Sciences and Techniques, Marien Ngouabi University, BP 69, Brazzaville, Congo
2 African and Malagasy Council for Higher Education - CAMES, O1 BP 134 Ouagadougou 01, Burkina Faso
3 Atomic Physics and Astrophysics, University of Mons - UMONS, B-7000 Mons, Belgium
4 IPNAS, Liège University, B-4000 Liège, Belgium

Corresponding author e-mail address: saturnin.enzongayoca@umng.cg

1. Introduction

Fusion is the process that powers stars like our sun, and promises an inherently safe, near-limitless clean electricity source for the long term, using small amounts of fuel that can be sourced worldwide from inexpensive materials. The fusion process brings together atoms of light elements like hydrogen (the optimal reaction implies deuterium and tritium) at high temperatures to form helium and release tremendous energy as heat, which can then be converted into electricity. But realizing this process in earth is a very challenging task.

Osnium (Z=76) is an element which could be a candidate in plasma-facing materials in thermonuclear fusion devices (Tokamaks, ITER) [1]. As a result, its sputtering may generate ionic impurities of all possible charge states in the duterium-tritium plasma that could contribute to radiation losses in these devices. In this context, the radiative properties (transition probabilities, oscillator strengths, ...) of these ion have therefore potential important applications in this domain.

Up to now, the spectrum of four times ionized osmium (OS V) has been much less investigated. Azarov et al. [1] have classified the Os V (5d4 + 5d36s) - 5d36p transitions in spectra recorded of Os in the wavelength range 22.5-210 nm on a 3 m normal incidence spectrograph using a triggered spark light source, and then they have established 57 even levels and 86 odd ones. These authors have also given transition probability values (gA) calculated using orthogonal operators.

As an extension of our previous work on Lu IV, Hf V and Ta VI that belong to the isoelectronic sequence of Er I [3], in view of no radiative rate measurements available in the literature, we have adopted two independent theoretical methods, i.e. the semi-empirical Hartree-Fock with relativistic corrections method (HFR), including core-polarization effects (HFR+CPOL) [4,5], and the ab initio multiconfiguration Dirac-Hartree-Fock with subsequent relativistic configuration interaction method (MCDHF-RCI) [6] in order to determine the transitions probabilities of allowed transitions (E1) in Os4+ and estimate their accuracy.

1. Results

The radiative properties (transition probabilities and oscillator strengths) have been computed employing HFR/HFR+CPOL for the 2677 E1 transitions falling in the UV range 46.37-77.85 nm between all the experimental energy levels published by Azarov et al. [3]. MCDHF-RCI calculations are in progress, and our preliminary results will be presented in details during this conference.

1. References

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Primary author: Dr ENZONGA YOCA, Saturnin (Faculty of Sciences and Techniques Marien Ngouabi University)

Presenter: Dr ENZONGA YOCA, Saturnin (Faculty of Sciences and Techniques Marien Ngouabi University)

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