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Energy levels, transition rates, lifetimes of transmutation of tungsten atoms He-like-(Hf, Ta, Re and Os) deduced from relativistic multiconfiguration Dirac–Hartree–Fock and many body perturbation theory calculations

The present study has determined excitation energy of the 127 states of the transmutation of tungsten atoms He-like-(Hf, Ta, Re and Os). In this work, we use the ab initio MCDHF and MBPT methods implemented in GRASP2018 and FAC codes, respectively. We extend the calculation for n = 8 to improve the precision of the atomic data used in line identification, plasma modeling and diagnostics of astrophysical plasmas. The BI + QED effect has been included in the calculations to improve the generated wave functions. Wavelengths, weighted oscillator strengths and transition probabilities for E1, E2, M1, and M2 transitions among these levels are also given. A comparison is made between our two sets of results obtained from GRASP2018 and FAC codes, as well as with the available theoretical ones, although there are only a few levels. A satisfactory agreement is found between them. In fact, while comparing the lifetimes calculated with both MCDHF and MBPT methods we find a good agreement around 3 % for helium like isoelectronic sequence Z = 72–76. The present set of complete results for radiative and excitation rates for all transitions of He-like-ions will be highly useful for the modeling of a variety of plasmas such as those investigated in controlled thermonuclear fusion, laser and plasma physics as well as astrophysics.

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