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2015 J. Phys.: Conf. Ser. 635 052058

(http://iopscience.iop.org/1742-6596/635/5/052058)

XXIX International Conference on Photonic, Electronic, and Atomic Collisions (ICPEAC2015) IOP Publishing
Journal of Physics: Conference Series **635** (2015) 052058 doi:10.1088/1742-6596/635/5/052058

Electron-impact ionization of W^{26+} ion

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Synopsis Electron-impact ionization for W^{26+} ion is investigated using Dirac-Fock-Slater approximation. The large scale calculations are performed for the excitations to over 800 configurations. Influence of radiative damping on the excitation-autoionization cross-sections is estimated.

Energy losses determined by radiation of impurities in various ionization stages have to be controlled for the successful ignition of a deuterium-tritium plasma in thermonuclear reactors. Ionization balance in the plasma is mainly established by electron-impact ionization and recombination processes.

The aim of the current work is to study influence of the excitations to the high-nl shells for electron-impact ionization of the W^{26+} ion which has two $4f$ electrons in the valence shell. The electron-impact excitations from the levels of the ground configuration to the levels of over 800 configurations of the W^{26+} ion are analyzed in order to find out contribution to the ionization cross-sections of the excitations to the high-nl shells ($n \leq 40$, $l \leq 6$). In addition, all electric dipole and Auger transition probabilities from the excited configurations are investigated to determine influence of radiative damping on the excitation-autoionization (EA) cross-sections. Besides to the electron-impact ionization cross-sections, the current study provides Maxwellian rate coefficients of the ionization process.

Our current results for contribution to the EA cross-sections of excitations to high-nl shells from the ground configuration are presented in Figure 1. The contribution of the EA channels from the high-nl shells ($n \geq 9$) is approximately equal to the contribution of the shells with $n \leq 8$.

Contribution of the excitations to shells with the orbital quantum number $l = 4$ is the largest for the excitations to the $n \leq 8$ and the higher ($9 \leq n \leq 40$) shells. The same tendency was observed for the W^{27+} ion the ground configuration of which has only one electron in the $4f$ valence shell [1].

The largest contribution to the EA process corresponds to the excitations from the $4p$ shell when investigation includes only the shells with $n \leq 8$. However, the contribution from the $4d$ shell dominates for the higher shells with $9 \leq n \leq 40$.

Current study shows that contribution to the total ionization cross-sections of excitations to high-nl shells amounts to about 15 % at the peak of the data. The total EA process contributes about 40 % to the ionization cross-sections. These results contradict conclusions about relatively small EA contribution to the cross-sections obtained from the semirelativistic calculations [2]. It can be explained by the fact that the configuration-average approach was used and important excitations to the shells with orbital quantum number $l = 4$ were omitted in the previous investigation.

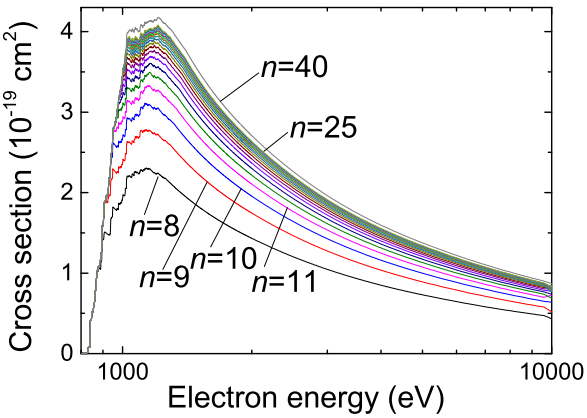

Figure 1. EA channels to the high-nl shells for the ground subconfiguration of the W^{26+} ion.

Acknowledgment: This research was funded by European Social Fund under the Global Grant Measure (No.: VP1-3.1-SMM-07-K-02-015)

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