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Theoretical investigation of spectroscopic properties of W^{27+} ion

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Synopsis Analysis of energy levels and radiative transition probabilities for the W^{27+} ion is performed using multiconfiguration Dirac-Fock method. Configuration interaction strength has been used to determine the influence of correlation effects.

Concentration of tungsten as an intrisic impurity in fusion devices has to be monitored in order to create and maintain the fusion reaction. Thus, reliable atomic data for various tungsten ions are needed for predicting possible plasma scenarios.

The aim of the current work is to investigate energy levels, radiative transition probabilities, and relativistic and correlation effects for W^{27+}. We focus our attention on the emission in spectral range $2-30$ nm where intensive radiation of tungsten ions has been theoretically and experimentally studied.

The investigation of energy levels and electric dipole, quadrupole, and octupole as well as magnetic dipole and quadrupole transitions is performed using multiconfiguration Dirac-Hartree-Fock method implemented in GRASP2K code [1]. The extended average level (EAL) approximation is employed in our study. Relativistic effects with quantum electrodynamic corrections are taken into account to provide accurate wavelengths and radiative transition probabilities.

The lowest configurations of the W^{27+} ion are shown in Figure 1. The levels having the largest lifetimes and levels to which radiative transition takes place from these levels are analyzed.

The ground configuration for the W^{27+} ion has one electron in the valence $4f$ shell. The first excited $[\mathrm{Kr}]4d^{10}5s$ configuration can decay only through weak electric octupole transitions to the ground configuration. Previous study for the W^{25+} ion demonstrated that configuration mixing opens electric dipole transitions from the first excited $[\mathrm{Kr}]4d^{10}4f^2 5s$ configuration to the ground one [2]. The same results were obtained for the $[\mathrm{Kr}]4d^{10}4f5s$ configuration in the W^{26+} ion. However, the electric dipole transition from the $[\mathrm{Kr}]4d^{10}5s$ configuration is forbidden for the W^{27+} ion by $\Delta J = 0, \pm 1$ selection rule.

Configuration interaction strengths T are calculated for the $4f$, $5l$ $(l = 0, 1, 2, 3, 4)$, $4d^9 4f^2$, $4d^9 4f5s$ and $4d^9 4f5p$ configurations of the ion. The T value, divided by the statistical weight g_1 of the analyzed configuration has the meaning of the average weight of the admixed configuration in the expansion of the wave function for the initial configuration. The obtained data show that the core and core-core correlations play the major role compared to the valence and valence-valence correlations for all configurations among which transitions form the strongest lines in the spectrum of the W^{27+} ion. It has to be noted that the $4d^{-2}4f^2$ correlation is the strongest for these configurations.

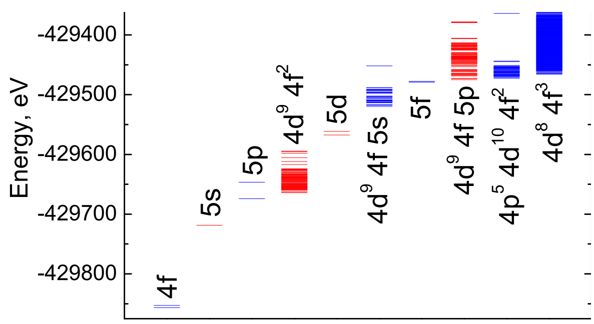

Figure 1. The lowest configurations of the W^{27+} ion.

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References

[1] P. Jönsson *et al* 2013 *Comput Phys Commun* **184** 9

[2] A. Alkauskas *et al* 2014 *J Quant Spect Radiat Transfer* **136** 108

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