Spectral analysis of moderately ionized silver ions (Ag III-Ag V)

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Silver (Ag) is one of the elements that are produced through the rapid neutron capture (r-process) in supernovae explosion. Thus, the atomic data of silver is highly desirable for testing the nucleosynthesis models. Both theoretical and experimental data on neutral and singly ionized silver ions is sufficiently available in the literature but the data for the higher ionized species of silver is inadequate. This work is a step to obtain the atomic data of moderately ionized silver [1].

Doubly Ionized silver (Ag III) has ground state $4p^6 4d^9$. Excitation of $4p^6 4d^9$ leads to the $4p^6 4d^8 n\ell$ ($n \geq 4$, $\ell \geq 0$) and $4p^5 4d^{10}$ configurations. Recently, several inconsistencies present in the previous work have been resolved and we have published the extended analysis of Ag III very recently [2] by incorporating the new transition array $4d^8 5p$ - $4d^8(5d+6s)$. Trebly ionized silver (Ag IV) has the ground electronic configuration $4p^6 4d^8$, that is comprised of nine energy levels. The outer and core electron excitations from $4d^8$ lead to the configurations of the type $4p^6 4d^7 n\ell$ ($n \geq 4$, $\ell \geq 0$) and $4p^5 4d^9$ respectively. The excitation of the two electrons from $4d^8$ leads to the configurations $4d^6 5p^2$, $4d^6 5s^2$, $4d^6 5s5p$ etc. The recent available data on Ag IV includes the ground ($4d^8$) and the two excited configurations namely $4d^7 5s$ and $4d^7 5p$. A few of the reported of Ag IV have been revised with an extension of the reported work to establish the new energy levels of the configurations $4d^7(5d+6s)$. The structure of four times ionized silver (Ag V) is much more complicated and having ground configuration $4p^6 4d^7$ and the excited ones are of the type $4p^6 4d^6 n\ell$ ($n \geq 4$, $\ell \geq 0$). The work on the transition array $4d^6 5p$-$4d^6(5d+6s)$ is currently in progress. For all above investigation the theoretical predictions for the spectrum have been made using the Cowan's Code [3, 4] which is based on the quasi-relativistic Hartree-Fock method including the superposition of interacting configurations.

The work on Ag V with Ag IV is in progress and the latest findings will be presented.

References

[1] L. Mashonkina, 2009, Physica Scripta, T134, 014004.

[2] S. Ankita and A. Tauheed, 2018, Journal of Quantitative Spectroscopy and Radiative Transfer, 217, 130.

[3] R. D. Cowan, “The Theory of Atomic Structure and Spectra", University California: Berkeley, CA, USA, (1981).

[4] A. Kramida, 2017, Computer Physics Communication, 232, 266 and Cowan Code developed for windows-based personal computers. NIST Public DATA Repository, (2018). (doi:10.18434/T4/1502500).