A distorted wave method applied to study the 2^3S and 2^3P excitation of helium atom by electron impact

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Abstract: Differential and total cross sections for 1^1S-2^3S and 1^1S-2^3P excitation of helium atom has been calculated using distorted wave method. The distortion potential is taken as the static potential of the helium atom in the initial state (1^1S) for initial channel andthe average of the initial- and final-state static potentials for the final channel. The results obtained are compared with available experimental and theoretical results. The present results for 1^1S-2^3P transition are in a good agreement with experimental and theoretical results than in case of 1^1S-2^3S transition.

The distorted wave method has been applied to calculate the differential and integral cross sections for 1^1S-2^3S and 1^1S-2^3P excitations of helium atom by electron impact in the energy range of 40-200 eV. The initial distortion potential is taken as the static potential of the helium (target) atom in the initial state (1^1S) while the final distortion potential is taken as the average of the initial- and final-state static potentials of helium atom. The distorted wave method used here has been applied to study the magnetic-sublevel differential cross section of helium atom by electron impact excitation of 2^1P state of helium [1] and to study the electron impact excitation of 2^1S state of helium atom [2], but it has never been applied to study the excitation to triplet states which occurs through exchange process. So it would be interesting to see how it works for 1^1S-2^3S and1^1S- 2^3P excitation of helium atom by electron impact and see how the results obtained compares with other theoretical and experimental results available.

We have calculated the differential and total cross section for 2^3S and 2^3P excitation of helium by electron impact using the distorted wave model mentioned above and compared the results with available experimental and theoretical results. The comparison of the results shows that the present results are in good agreement at lower scattering angles for 1^1S-2^3S transition at all incident energies except for 200 eV which show a good qualitative agreement with the experimental results throughout the scattering angles. In case of 1^1S-2^3P transition the present differential cross section results are in good agreement with most theoretical calculations and experimental results at all electron incident energies =50 eV. But, for incident energy 40 eV the agreement is no so good. This may be attributed to the fact that the first order distorted wave method does not produce good results at low incident energies.

If we ignore the 40 eV results for 2^3P excitation, the present differential cross section results for 1^1S-2^3P transition are in better agreement with the corresponding theoretical and experimental results than the present results for 1^1S-2^3S transition when compared with other theoretical and experimental results. So, we can say that the present distorted wave method works better in case of 1^1S-2^3P transition than in case of 1^1S-2^3S transition.

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References

[1] Singh, C.S. (2004). Magnetic-sublevel differential cross section for electron impact Excitation of 2^1P state of helium. *East African Journal of Physical sciences* **5**:85 – 98

[2] Singh, C.S. (2005). Electron impact excitation of 2^1S state helium atom. *East African Journal of physical sciences* **6(2):** 67-77