PHOTOABSORPTION FOR HELIUM ATOM IN THE MODIFIED RPAE

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Although the random phase approximation with exchange (RPAE) has been applied with success in explaining the photoabsorption (photoexcitation and photoionization) processes in light atoms /1/, there are some discrepancies between the theoretical results and experimental data /2/, claimed sometimes to have an experimental error not greater than 1%. These discrepancies are ascribed to the fact that the RPAE does not include contribution of some Feynman diagrams which cannot be neglected.

The calculations presented here include the electron shell rearrangement due to removal of the photoelectron, by calculating the single-electron excited states in the frozen core field of core states, obtained from the self-consistent field calculation of ion instead of neutral atom, and then by applying the usual RPAE method. (The self-consistent field calculation in the case of He^+ ion reduces to the solution of the hydrogen-like problem, but it has still been solved numerically by our computer programs /3/). Such procedure includes the processes which are beyond the RPAE /4/.

The results of our calculations of the oscillator strengths for helium atom in the modified RPAE are presented in the table and are compared with the RPAE values and experimental data. Somewhat better agreement with the experiment is obtained in the modified RPAE for two lowest transitions (1s→2p and 1s→3p) for which the discrepancy between the RPAE and experiment is greatest, whereas for higher excitations both the RPAE and its modification practically coincide. The photoionization cross section is calculated in the modified RPAE up to photoelectron energy of about 14 Rydbergs, and is practically equal to the RPAE values within the calculation error, at most few percents.

Transition	RPAE	Mod. RPAE	Experiment
1s→2p	0.252	0.26	0.272±1%
1s→3p	0.0702	0.071	0.0734±1%
1s→4p	0.0290	0.029	0.0302±3%
1s→5p	0.0147	0.015	0.0153±(<10%)
1s→6p	0.0084	0.008	0.0085±(<10%)

References

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2. The experimental data are refered to in Ref. 1.

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