Effect of confinement and interchannel coupling on high-Z atoms

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Synopsis Photoionization studies of outer shells of high-Z atoms like Radon (Z=86) and Radium (Z=88) have been studied using relativistic random phase approximation (RRPA) [1,2]. Multiple minima found in the photoionization cross section were attributed to many electron correlations resulting from interchannel coupling with photoionization channels from neighboring subshells. In the present work, we report the combined effect of confinement, correlation and relativistic interactions on the structure of these multiple minima in high-Z atoms by using the RRPA.

Photoionization studies of high-Z atoms is of great interest as simultaneous effects of relativistic interactions and many electron correlations can be investigated in these atoms. Studies for outer shell high-Z atoms like Radon (Z=86) and Radium (Z=88) have already been reported [2]. These studies predicted multiple minima in the subshell cross sections. The multiple minima were attributed to the correlations resulting from interchannel coupling, shown in Fig.1 (from Ref. [2]) for the case of Radon 7s photoionization. The effect of interchannel coupling also appears in other photoionization parameters like photoelectron angular distribution and branching ratios, etc.

Atoms trapped in fullerene cages (A@C_{60}) have attracted considerable attention in the recent past owing to their importance in areas such as material science, nano-science, biological science etc. The external potential causes significant changes in atomic ionization probabilities by inducing confinement oscillations in the photoionization parameters. The existence of such oscillations in Xe@C_{60} has been verified in a recent experiment [3]. These developments have motivated us to study the combined effect of confinement, relativistic interactions and correlation on photoionization process at high Z.

In the present work, we report on photoionization studies of high-Z atoms that are trapped inside a fullerene molecule (A@C_{60}) to understand the effects of confinement on the multiple minima in the photoionization. The fullerene potential is simulated by using an annular spherical shell model and Dirac-Hartree-Fock (DHF) method is employed to determine ground state energies and wavefunctions. The relativistic random phase approximation (RRPA) is used to obtain the photoionization parameters like cross-sections, angular distribution and branching ratios.

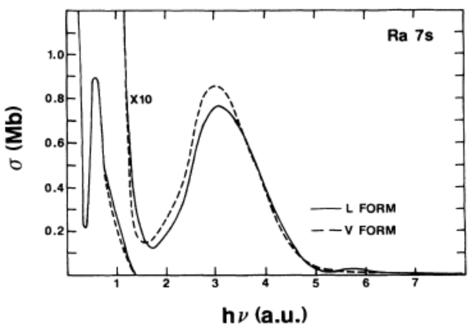

Figure1. Cross-section of 7s shell of radium in length and velocity form [2]

We find that confinement alters the structure of the oscillations in the cross-section manifest as multiple minima in photoionization.

References

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