Confinement effects and angular dependence of Wigner-Eisenbud-Smith time delay

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Synopsis The effect of confinement on the angle dependent Wigner-Eisenbud-Smith time delay in photoionization of atomic xenon is studied. A finite spherical annular well potential is used to model the nearly spherical confinement due to fullerene C_{60} molecular cage. The confinement is seen to have a significant effect on the time delay.

Estimation of Wigner-Eisenbud-Smith (WES) time delay in atomic photo-transitions has received much attention in recent years [1]. Some recent studies reveal the effect of confinement on the time delay [2]. The interference of different photoionization channels play an important role in determining the time delay and also determines the angle dependence of WES time delay (except for *ns* photoionization) [3].

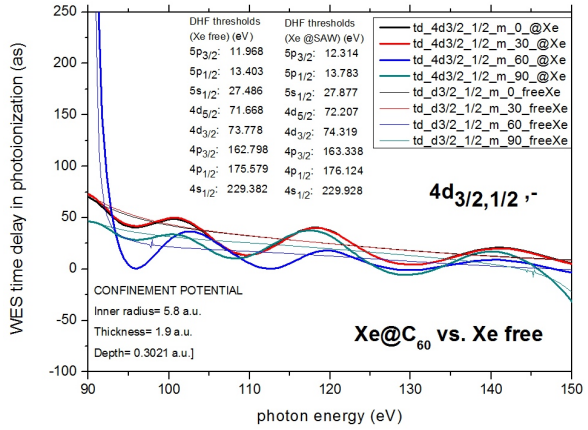

Figure 1. WES time delay for dipole transitions from $4d_{3/2,1/2}$ to the spin *down* final state for confined Xe (bold lines); thin lines are for free Xe.

Based on the formalism of [4] and [3] we study the WES time delay for free and confined Xe atom for the photoionization from $4d_{3/2}$ and $4d_{5/2}$ subshells at various angles. Illustrative results are shown in Fig. 1 where we have plotted the WES time delay in the dipole photoionization channel from the $4d_{3/2,1/2}$ level to the final state with $\nu = -1/2$ (spin down). Since measuring the initial m-states and the polarization of the emerging photoelectron is difficult, the weighted average over all the initial states with different m quantum numbers and sum over photoelectron spin states has been calculated and is shown in Fig. 2. The results of both the individual channels and the weighted average show significant effects of the confinement on the oscillation of the time delay about the results for the free atom. More details concerning the individual photoionization amplitudes could be obtained if the photoelectron spin states were detected.

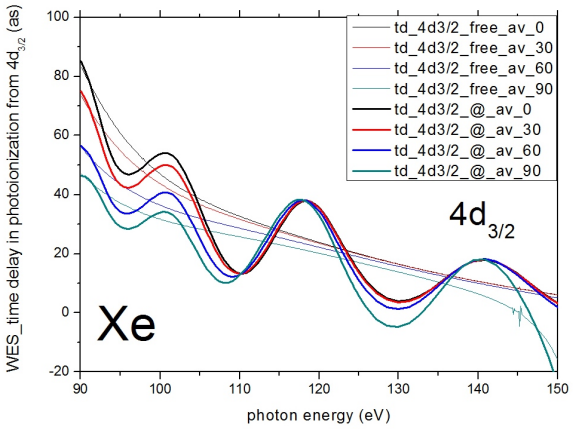

Figure 2. $4d_{3/2}$ time delay, averaged over initial and summed over final states. Bold lines are the WES time delay for confined Xe and thin lines are for free Xe.

References

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