Study of angular dependence of photoionization time delay in $(n-1)d \rightarrow \varepsilon f$ channels for Zn, Cd and Hg

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Synopsis The angular dependence of Wigner-Eisenbud-Smith photoionization time delay has been investigated for the $nd \rightarrow \varepsilon f$ dipole channels in atomic Zn, Cd and Hg using the relativistic random phase approximation (RRPA). The studies have been carried out also in the nonrelativistic limit. This technique enables identification of the relativistic effects on the angular dependence of photoionization time delay.

Photoionization of $(n-1)d$ subshell of atomic Zn, Cd and Hg (which all have outer electron configuration $(n-1)d^{10}ns^2$) has been studied previously using the relativistic random phase approximation (RRPA) formalism [1, 2]. The Wigner-Eisenbud-Smith (WES) photoionization time delay [3, 4, 5, 6] results for photoionization of atomic Zn and Cd are also reported [7]. These calculations are extended in the present study to (a) include Hg, for which relativistic effects are expected to be significant, being a high-Z atom with similar electronic configuration as Zn and Cd (b) carry out the studies in the RRPA and also in the nonrelativistic limit of the RRPA (NRL-RRPA) in order to pinpoint the effects of relativistic interactions, and (c) study angular dependence of the WES time-delay. The angle-resolved studies of the WES time delay have been carried out using the formulation described in Reference [8].

The results show the evolving importance of relativistic interactions, with increasing Z, on both the total WES time delay as well as the angular distribution of the time delay. Also, the interplay between relativistic and many-body interactions is highlighted. Results in non-relativistic limit are not shown in the figures.

There is of course no Cooper minimum in the $3d$ photoionization of Zn, but significant effects are seen at the Cooper minimum in the case of Cd and Hg, with the relativistic effects most dominant for Hg.

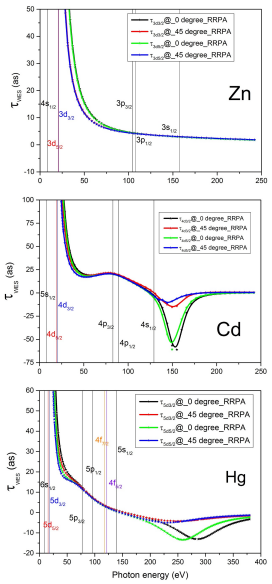

Figure 1. WES $(n-1)d \rightarrow \varepsilon f$ photoionization time-delay in Zn, Cd, Hg

References

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