On the effects of Orbital Angular Momentum (OAM) and impact parameters on (e, 2e) process on atoms by twisted electron

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Synopsis We present our theoretical study of (e, 2e) process on atoms by the twisted electron, with special emphasis given on the effects of OAM and impact parameters on TDCS.

Electron impact scattering/coincidence ionization processes in the atomic physics are important to study the basic few-body Coulomb problem, correlation effects, target structure and the spin dependent effects at microscopic level. Hitherto, most of the reported studies have been confined for the incident electron beam which does not carry any angular momentum and transverse linear momentum (untwisted electron beam). Recently, there is a growing interests to revisit theses processes with the twisted electrons beam [1-2]. Serbo *et al* [2] found that the scattering of the relativistic twisted electron from atoms/solid targets is sensitive to the longitudinal and transverse components of the linear momentum as well as on the projection of angular momentum (OAM) number *m* of the twisted electron state.

Here, we report our study on the K-shell ionization of the atoms by the twisted electron. To the best of our knowledge, the K-shell (e, 2e) process with the impinging twisted electron is not reported earlier. We compute the triple differential cross sections (TDCS) in different geometrical arrangements of the scattered and ejected electrons and study the TDCS as a function of different projections of the angular momentum and transverse linear momentum of the twisted electron. The calculation has been performed in the first Born approximation in the frozen core approximation wherein the effects of the other bound electrons in the (e, 2e) process are ignored. We use twisted plane wave for the incident electron, plane wave for the scattered electron and hydrogen like wave function with Darwin spinors and Coulomb wave function with Dirac spinors for the bound and the ejected electron respectively. Our preliminary results show that the binary and recoil peak are shifted from the momentum transfer direction for the twisted electron (e, 2e) process. This is highly in contrast with the normal (e, 2e) process by untwisted electron wherein we get symmetric angular profile of TDCS in the first Born approximation with binary and recoil peak in the momentum transfer and opposite to momentum transfer direction respectively. We also observe that the amount of shifting in the peak depends on the projection of angular momentum of the twisted electron state (see figure 1). Our preliminary results in the relativistic electron energy observe more interesting results. The transverse spin asymmetry in the TDCS is found to be dependent on the various parameters which describe the twisted state of the electron beam. We are in process to study the effects of the impact parameters on the TDCS and the transverse spin asymmetry.

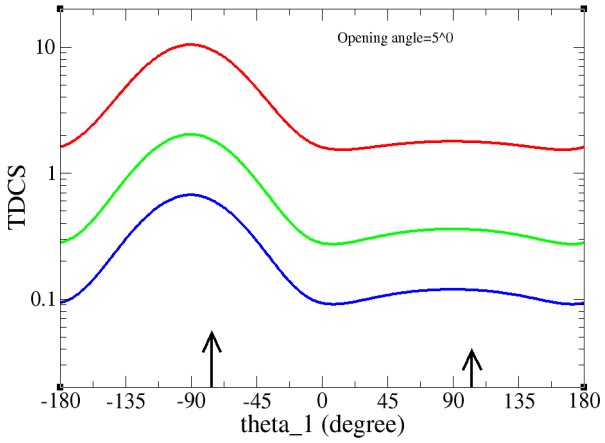

Figure 1. TDCS vs the angle of the ejected electron for the apex angle 5^0 and for *m*= 0.5 (red curve), 1.5 (green curve) and 2.5 (blue curve) of the incident twisted electron beam carrying energy 5530 eV on He atom. The other kinematics parameters are same as in [3]

References

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