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Revisit of (e,2e) & (e,3e) processes on atoms with twisted electron impact

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Synopsis We compute Triple Differential Cross Section (TDCS) and Five-fold Differential Cross Section (FDCS) for (e,2e) & (e,3e) processes on atoms respectively to investigate the effects of non zero angular momentum and the apex angle of the twisted electron. We observed that the differential coincidence cross sections largely depend on these parameters.

Since the first measurement of (e,2e) process on atoms [1, 2], there have been extensive theoretical and experimental studies on (e,2e) process on atoms, molecules, and solid targets. Till now, most of the activities have been confined to an electron beam which moves in the straight line and hit the target. Recently, it has been possible to generate twisted electron beam that carries orbital angular, angular momentum apart from its linear momentum [3]. When we study scattering/ionization processes with a twisted electron beam, we can get more information as we have more control parameters to play, like Orbital Angular Momentum (OAM), the apex angle of the beam and the impact parameter. There have been few theoretical studies on the scattering of twisted electrons by microscopic targets (see e.g. [4]). This field is largely unexplored to electron impact ionization process on atoms and other microscopic targets. In this communication, we present the results of our calculations of (e,2e) & (e,3e) processes on atomic targets to elucidate the effects of OAM and apex angle of the twisted electron beam on the coincidence differential cross sections in various geometrical modes. We describe incident electron as twisted electron plane wave [4], scattered electron as plane wave, the ejected electron as Coulomb wave (or 2 Coulomb waves with Gamow factor (2CG) for the ejected electrons in the (e,3e) process) and a Hydrogen-like wave function for bound electron (or He like wave function for (e,3e) process). Through our study on (e,2e) process, we found that the TDCS depends largely on OAM

and apex angle of the twisted electron beam. We also found that the spin asymmetry in TDCS also depends on these parameters. We are in process to compute the FDCS for the (e,3e) process on the atoms with twisted electrons. We will present our detailed finding on (e,2e) and (e,3e) processes in the conference.

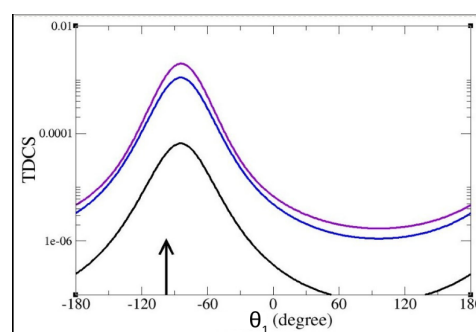


Figure 1. TDCS as a function of the angle of the ejected electron (θ_1) for He atom in coplanar asymmetric geometry. E_i (incident energy) = 100keV, E_1 (ejected electron energy) = 125eV, scattering angle(θ_s) = 7° , apex angle of twisted electron(θ_p) = 5° . Black curve(OAM = 1/2), Blue curve(OAM = 3/2), Violet curve(OAM = 5/2). Arrow represents the direction of momentum transfer.

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