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What do electrons dance before the break-up in transfer-ionization?

ALEXANDER GODUNOV, Department of Physics, Old Dominion University, Norfolk, VA 23529-0116, USA

The transfer-ionization process offers a unique opportunity to reveal tiny details of radial and angular electron correlation in the ground states of atomic systems. We report a theoretical analysis and calculations for fully differential cross sections for the transfer ionization process.

$$Z^{q+} + \mathrm{He} \rightarrow Z^{(q-1)+} + \mathrm{He}^{2+} + e^{-}.$$

The theoretical model includes both the first and second order terms on projectile-target interaction. The wavefunction for the ground state of helium was calculated in the multiconfigurational Hartree-Fock approximation (MCHF). Results of our calculations for different collision geometries demonstrate a clear target dependency and we thus conclude that the two-electron processes in fast transfer ionization reactions occur mainly due initial state correlations and post collision electron correlations have only a minor influence on the final- state momentum pattern. It terms of a Hartree-Fock description of the helium ground state we have shown that terms other than the (ns^2) give the dominant contributions to the transfer ionization fully differential cross section. We have, we believe, demonstrated conclusively that the mechanism proposed by Schmidt-Bocking does indeed give the dominant contribution to the transfer-ionization process. Both theory and experiment are now in good accord and indicate that transfer ionization in fast collisions at small scattering angles is very sensitive to high-level target correlation effects.

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2. A.L. Godunov, Colm T. Whelan and H.R.J. Walters et al, *Phys. Rev.* A (2005) (submitted)
3. M. Schöffler, A.L. Godunov, Colm T. Whelan, et al *J. Phys. B:* (2005) (submitted)