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Post-collision interaction effects on the triple-differential cross-section for the ionization of helium by fast positrons

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Abstract. Triple differential cross-sections for the ionization of helium by fast positrons are calculated in a 'correlated' first Born approximation supplemented by the inclusion of post-collision interaction effects. The results are analysed with respect to electron-helium experimental data of Jung and coworkers in coplanar asymmetric geometry.

Keywords. Triple differential cross-section; coplanar asymmetric geometry; correlated first Born approximation; post-collision interaction effects.

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1. Introduction

The triple differential cross-sections (TDCS) for the electron impact ionization of atoms are known to be quite sensitive to the choice of the scattering model used. This is particularly so in the case of asymmetric Ehrhardt type kinematical arrangement. The theory is generally not in satisfying agreement with experiment even at high energies. For the fast incident electrons (energy E_0) and a fixed asymmetric partitioning of energy the angular distribution of the slow electron (energy E_b), at a fixed small scattering angle θ_a for the fast electron (energy E_a) shows a two-peaked structure: a peak (binary peak) near the momentum transfer direction and another subsidiary one (recoil peak) near the opposite direction.

The developments in the theory beyond the first Born approximation have proceeded along the following lines: (i) distorted wave Born approximation (McDowell *et al* 1973; Baluja and Taylor 1976; Madison *et al* 1977; Bransden *et al* 1978, 1979; Smith *et al* 1979; Tweed 1980). (ii) Coulomb-projected Born approximation (Geltman 1971, 1974; Geltman and Hidalgo 1971, 1974; Hidalgo and Geltman 1972; Schulz 1973; Schubert *et al* 1979; Lal *et al* 1979; Pathak and Srivastava 1980, 1981; Ghosh *et al* 1984a, b). (iii) Second Born (B2) approximation which has been shown to essentially reproduce the main characteristic features (angular positions of the binary and recoil peak maxima and the ratio of binary to recoil peak intensities) of the TDCS angular distribution (Byron *et al* 1980, 1982; Ehrhardt *et al* 1982). (iv) Eikonal-Born series approach (Byron *et al* 1983, 1984, 1985) to consistently include all contributions up to order k^{-2} in the direct scattering amplitude. (v) Modified Glauber (MG) approximation (Byron and Joachain 1975; Gien 1976) which has recently been used to include still higher order ($n > 3$) terms of the direct scattering amplitude. The MG approximation is found to further improve the B2 results in the cases where the scattering angle θ_a