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Theoretical study of electron momentum distribution in He tunneling ionization LI GUO, SHENGSHENG HAN[1], JINGYUN FAN, Joint Quantum Institute, NIST and UMCP, JING CHEN, Institute of applied physics and computational mathematics — The electron scattering amplitude given by the S-matrix theory, up to the third order, can be written as $S_{fi} = -i\int_{-\infty}^{\infty} dt \left\langle \psi_{A_f}(p,t) \right| V_A(t) \left|\varphi_0\right\rangle - i\int_{-\infty}^{\infty} dt \int_{-\infty}^{\infty} dt' \left\langle \psi_{A_f}(p,t) \right| V G_A(t,t') V_A(t') \left|\varphi_0\right\rangle - i\int_{-\infty}^{\infty} dt \int_{-\infty}^{\infty} dt' \int_{-\infty}^{\infty} dt'' \left\langle \psi_{A_f}(p,t) \right| V G_A(t,t') V G_A(t',t'') V_A(t) \left|\varphi_0\right\rangle$, with the first term describing the direct ATI process (that the initial state directly scatters to the final state), the second term describing that the electron initially scatters to the intermediate states via the laser-electron interaction (V_A) and then scatters to the final state via the electron-ion interaction (V) (a rescattering ATI process), and the third term describing that the electron scatters to the final state via two cascaded ATI processes. All scattering processes are physically indistinguishable, so we assume that all divergence parts in scattering processes (corresponding to the forward scattering) can be absorbed into the first term and exclude them in the calculation, where the divergence is due to the long range Coulomb interaction ($V = -1/r$). We apply this method to study the He ionization and our theoretical results are qualitatively consistent with recent experimental observations.

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