

Electron emission in collisions between atoms and dressed projectiles

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Keywords Ionization, collision, cross sections

Synopsis Double-differential cross sections (DDCS) for electron emission in ionization under the impact of dressed projectiles has been calculated within the framework of three-Coulomb wave (3CW) model. The interaction between the dressed projectile ion and the active electron is approximated by a model potential. In order to take into account of the effect of the passive electrons, we have also constructed a model potential which satisfies initial condition and the corresponding wave function has been calculated from the model hamiltonian of the active electron in the target.

The study of electronic interactions in collisions between partially stripped projectiles and atomic targets has received increasing interest in the past two decades. These systems provide a suitable framework in which to investigate the relative importance of the electron-electron interactions versus the electron-nucleus interactions. Therefore, detailed knowledge of the mechanisms of electron emission in collisions between fast partially striped ions with atoms is relevant in many scientific areas, such as astrophysics, plasma physics, radiation damage and in hadron therapy. The shape of electron emission spectrum observed in heavy ion-atom collisions is sensitive to the various ionization mechanisms. Such spectrum clearly identifies different processes, such as soft collision (SC), two-center electron emission (TCEE), electron capture to the continuum (ECC) and the binary encounter (BE). A large amount of experimental data for double differential cross sections (DDCS) are available in the literature involving bare [1-2] and partially striped projectile ions [3,4] impinging on atomic targets at intermediate and high collision energies. In the present investigation, we have focused our attention on the determination of DDCS for single ionization of partially striped lithium and carbon projectiles with helium atoms at intermediate and high energies. The transmission amplitude for the process may be written

$$T_{if} = \langle \psi_f^{3CW} | V_i | \psi_i \rangle, \quad \text{where}$$

$$V_i = V_{TP} + V_{Pe} \quad V_{TP} = \frac{qz_T^{eff}}{R},$$

$$V_{pe} = -\frac{q}{r_p} - \frac{e^{-\lambda r_p}}{r_p} \{ (Z_P - q) + br_p \},$$

where z_P and q are respectively the number and asymptotic charge of the projectile ions. The final state wavefunction χ_f^{3CW} is approximated as

$$\chi_f^{3CW} = (2\pi)^{-3} e^{i\vec{k}_P \cdot \vec{R} + i\vec{k}_e \cdot \vec{r}_T} C_1(\alpha_{TP}, \vec{k}_R, R) \\ C_2(\alpha_{Te}, \vec{k}_e, \vec{r}_T) C_3(\alpha_{pe}, \vec{k}_{pe}, \vec{r}_p).$$

The initial state wavefunction is given by

$$\psi_i = \frac{1}{(2\pi)^{\frac{3}{2}}} e^{i\vec{k}_i \cdot \vec{R}} \phi(\vec{r}_T),$$

Here we used for $\phi(\vec{r}_T)$ an RHF initial wavefunction corresponding to the model potential taking into account the interaction of the electron with the remaining dressed target. We found that our calculated results are in good agreement with the available experimental and theoretical works.

References

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