# Close-Coupling Approach to Differential Ionisation in Ion-Atom Collisions

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Accurate modelling ion-atom collisions is important for astrophysical and laboratory plasma research. However, theoretical description of electron emission in ion collisions with multielectron targets remains a challenging problem. Even for the simplest case of bare ion scattering on helium, there are no nonperturbative approaches that can provide reliable information about all interconnected reaction channels, in particular, the kinematically complete differential picture of ionisation when electron capture to the continuum is important. A wave-packet convergent close-coupling approach is capable of providing benchmark data on the integrated and differential cross sections for all processes taking place in such collisions. The approach is based on expansion of the scattering wave function using a two-centre pseudostate basis [1]. This allows one to take into account all underlying processes, namely, direct scattering and ionisation, and electron capture into bound and continuum states of the projectile. The wave packets are used to discretise the continuum. The generated pseudostates are used in the expansion of the total scattering wave function. The approach allows to calculate integrated, fully differential, as well as various doubly and singly differential cross sections for ionisation of atomic targets. The approach has been applied to p-He collisions [2]. Calculations of ionisation cross sections differential in the electron emission energy, in the emission angle, as well as in the scattered-projectile angle have been performed [3] in the intermediate energy region where coupling between various channels and electron-electron correlation effects are important. The results agree well with experimental data, where available. Moreover, our calculations reveal an interesting interplay between direct ionisation and electron capture into the continuum. We demonstrate that the ionisation cross section differential in the angle of the ejected electron is dominated by electron capture into the continuum for ejection into small angles, while ejection into large angles is purely due to direct ionisation. The method has recently been extended to p-$H_2$ collisions [4,5]. This constitutes the first application of the coupled-channel formalism to ion-molecule collisions.

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