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Differential analysis of the ionization of hydrogen in Debye plasmas by light particle impact

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In the present work, we calculate and analyze ionization total, singly differential and fully differential cross sections for hydrogen embedded in a weak plasma environment due to light particle impact. Calculations at the total and singly differential level, either in terms of the electron emission energy or the emission angle, are performed within the framework of the classical trajectory Monte Carlo method [1]. Fully differential cross sections (FDCS), on the other hand, are calculated by means of a Born-3DW model, in which distorted waves are used to represent the interactions among the three fragments resulting from the collision (projectile, target ion and emitted electron) [2,3]. This model can be considered the natural extension of the extensively used Born-3C model [4,5] for the case of screened interactions. In all cases, the interactions among particles were described by means of the Debye-Hückel potential.

The main focus of our study is placed on describing the sensitivity of the structures of the different cross sections with the degree of screening and tracing the physical origin of the changes they exhibit. While total cross sections are directly analyzed in terms of the projectile charge sign and the Debye screening length (r_D) at a given impact energy, differential cross sections require the specification of the geometrical configuration resulting from the collision process. In addition, we show that a scaling law for the fully differential cross section in terms of the nuclear charge Z, proposed by Kornberg and Miraglia in the photo-double ionization context [6], also holds for the light particle impact ionization of hydrogenic ions in the present screened context.

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