

Theoretical and experimental investigations of electron emission during water ionization by light ion impact

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Ionization of atoms and molecules by fast charged particles is of prime importance in a large number of areas including plasma physics, radiation physics and the study of penetration of charged particles through matter. It has also been shown that experimental and theoretical data about the ionization of biological systems are needed in fundamental studies of charged particle interaction in biological matter (and more precisely in heavy-ion cancer therapy [1]). Moreover with the more and more regular use of ionizing radiations in medicine, it is today necessary to appraise the biological consequences of radiological examinations particularly to know, with the highest degree of accuracy, the energy deposits induced by all the radiations commonly used in radiotherapy and even in medical imaging (light and heavy ions, electrons and positrons, X-rays and γ -rays).

To describe the track-structure of a charged particle in the biological matter and then to quantify the full spectra of molecular damage radio-induced, Monte Carlo simulation is the preferential method. This latter consists in simulating, interaction after interaction, the history of each ionizing particle created during the irradiation of the biological matter. In this kind of study, all the projectile-target interactions are modelled by means of a large set of multi-differential and total cross sections to describe the complete kinematics of the collisions.

We present in this work both doubly, singly differential and total cross sections for the direct ionization of water vapour by light ions (protons, alpha particles and Carbon ions). An ab-initio calculation has been made by using the first Born approximation and an accurate molecular wave function proposed by Moccia [2]. The results of this model are compared to experimental data and to results obtained via semi-empirical models and a good agreement is generally observed [3, 4].

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