## Dosimetry of ionizing radiations in biological tissues:

## Importance of calculations at a microscopic scale

## **Christophe Champion**

Centre Lasers Intenses et Applications, Université Bordeaux, France

When biological matter is irradiated by charged particles, a wide variety of interactions occurs, which leads to a deep modification of the cellular environment. To understand the fine structure of the microscopic distribution of energy deposits, the Monte Carlo event-by-event simulations are particularly suitable. However, the development of these track structure codes requires a large set of accurate multiple differential and total cross sections for describing all the collision processes including the ionization, the electronic excitation, the elastic scattering and the Positronium (Ps) formation event when incident positrons are considered.

In this context, we have recently developed a Monte Carlo code for electron and positron tracking in water. All the processes are studied in detail via theoretical differential and total cross section calculations performed within the quantum mechanical framework. Comparisons with existing theoretical and experimental data in terms of stopping powers, mean energy transfers and ranges have shown a very good agreement. Moreover, thanks to the theoretical description of Ps formation, we access to the complete kinematics of the electron capture process [1-2]. Then, the current Monte Carlo code is able to describe the detailed Ps history, what provides useful information for medical imaging (like Positron Emission Tomography) where improvements are needed to define with the best accuracy the tumor volumes [3-4].

Besides, recent quantum mechanical models for treating the electron-induced ionization process in a realistic biological medium have been implemented into the code in order to extend its applications. Thus, an accurate description of biological volumes of interest - including the nucleobases as well as the sugar phosphate backbone - may be considered in the current version [5,6].

A detailed overview of the code will be exposed along this talk with in particular its related version - called CELLDOSE - devoted to absorbed dose calculation in nanometer-size volumes for radio-isotopes of medical interest [7-8] providing accurate quantities such as dose point kernel (DPK) functions and S-values that are commonly used in radiopharmaceutical dosimetry.

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Contact: christophe.champion@u-bordeaux.fr

Centre Lasers Intenses et Applications

Domaine du Haut-Carré, 43, rue Pierre Noailles,

33/05 TALENCE Codey ERANCE