Modelling the production of electrons and X-rays for Monte Carlo dosimetry calculations

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Monte Carlo codes play a fundamental role in dosimetry calculations. Simulating particle transport through matter, Monte Carlo codes and toolkits, such as MCNP and Geant4, have significantly evolved in the last decade, currently allowing for the accurate determination of the deposited energy in tissues. The accurate determination of the deposited energy in matter relies on the implemented physical models as well as on the available databases of fundamental parameters, cross sections, stopping powers, and so on.

Among the physical processes that need to be modelled, one needs to consider ionization, atomic excitation and deexcitation, which result in the production of primary and secondary particles (X-rays and Auger electrons) that need to be accounted for. In the scope of microdosimetry and, in particular, of Auger electron microdosimetry, the accurate determination of the total number of electrons produced, either in primary or secondary processes, is of crucial importance.

Here, I will present and discuss a model for cross-sections for the ionization of K-, L- and M-shells induced by proton and alpha particles, which has been recently implemented in Geant4, as well as a model for Auger electron fluorescence and production of secondary Auger electrons.