Total cross sections of ionization and electron capture for DNA nucleobases impacted by light ions

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Synopsis We report total cross sections for single ionization and electron capture from biological targets, namely, water and DNA nucleobases, impacted by bare projectiles. The calculations are performed within the Continuum Distorted Wave–Eikonal Initial State approximation and compared with existing experimental data.

Ionization and electron capture from atoms and molecules impacted by charged particle impact are of relevance in many areas of physics including astrophysics, plasma physics and radiobiology with a particular emphasis in medical physics. Indeed, at medium and high impact energies, the latter are the main mechanisms leading to energy loss in the living matter. In this context, modeling the radiobiological damages induced by charged particles crossing the living matter requires a precise knowledge of the full radiation history. Thus, various electronic reactions must properly be characterized in order to access to the finest description of the cell-damaging processes and the dose deposition. In this respect, Monte-Carlo (MC) track structure codes are among the best-suited tools by providing an acute description of the radio-induced energetic pattern at the nanometer scale. However, to achieve this goal, the MC codes must be supplied with a full set of cross sections data for all the involved electronic reactions. Besides, as demonstrated in our previous work, the biological tissue has to be properly modeled by taking in particular a realistic DNA composition instead of using water as surrogate of living matter [1].

We aim here at describing the ionization and the electron capture processes within the Continuum Distorted Wave-Eikonal Initial State (CDW-EIS) approach for water and DNA nucleobases impacted by light ions at intermediate and high energies.

In the current work we will present preliminary results in terms of total cross sections as well as energy transfers for both ionization and electron capture induced by α-particles and carbon ions [2].

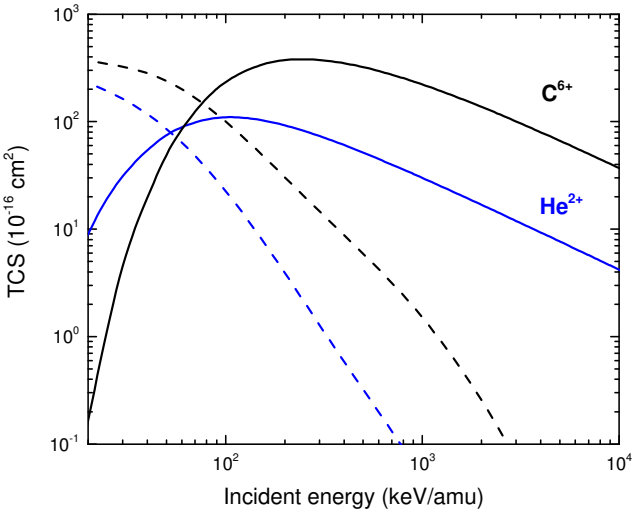

Figure 1. Total cross sections of ionization (solid line) and electron capture (dashed line) for adenine impacted by He^{2+} (blue) and C^{6+} (black) ions.

References

[1] C. Champion *et al.* 2015 *Phys. Med. Biol.* **60**, 7805
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