Abstract (Max 2000 characters not including title, spaces and authors)

Ianik Plante and Francis A Cucinotta

Calculation of the frequency distribution of the energy deposition in DNA volumes by heavy ions

Radiation quality effects are largely determined by energy deposition in small volumes of characteristic sizes less than 10 nm representative of short-segments of DNA, the DNA nucleosome, or molecules initiating oxidative stress in the nucleus, mitochondria, or extra-cellular matrix [1]. On this scale, qualitatively distinct types of molecular damage are possible for high linear energy transfer (LET) radiation such as heavy ions compared to low LET radiation. Unique types of DNA lesions or oxidative damages are the likely outcome of the energy deposition. The frequency distribution for energy imparted to 1-20 nm targets per unit dose or particle fluence is a useful descriptor and can be evaluated as a function of impact parameter from an ions track [2]. In this work, the simulation of 1-Gy irradiation of a cubic volume of 5 μm by: 1) 450 $^{1}H^{+}$ ions, 300 MeV; 2) 10 $^{12}C^{6+}$ ions, 290 MeV/amu and 3) $^{56}Fe^{26+}$ ions, 1000 MeV/amu was done with the Monte-Carlo simulation code RITRACKS [3]. Cylindrical targets are generated in the irradiated volume, with random orientation. The frequency distribution curves of the energy deposited in the targets is obtained. For small targets (i.e. <25 nm size), the probability of an ion to hit a target is very small; therefore a large number of tracks and targets as well as a large number of histories are necessary to obtain statistically significant results. This simulation is very time-consuming and is difficult to perform by using the original version of RITRACKS. Consequently, the code RITRACKS was adapted to use multiple CPU on a workstation or on a computer cluster [4]. To validate the simulation results, similar calculations were performed using targets with fixed position and orientation, for which experimental data are available [5]. Since the probability of single- and double-strand breaks in DNA as function of energy deposited is well know, the results that were obtained can be used to estimate the yield of DSB, and can be extended to include other targeted or non-target effects. References: [1] Goodhead, D.T. (2007) Radiat. Prot. Dosim. *122, 3-15;* [2] Cucinotta, F.A. et al. (2000) Radiat. Res. 153, 459-468; [3] Plante I. and Cucinotta, F.A. (2008) New J. Phys. 10, 125020; [4] Plante, I. and Cucinotta, F.A. (2012) CIBB 2012, submitted; [5] Plante, I. and Cucinotta, F.A. (2010) Radiat. Env. Biophys. 49, 5-13.