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Simulation of ultrasoft x-rays induced DNA damage using geant4

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Human awareness of ionizing radiations and their harmful effects on biological materials has a 100-year history starting with the discovery of X-rays. Radiation induced DNA damage such as single strand break (SSB), double strand break (DSB), base damage (BD), DNA–DNA and DNA–protein cross link can disrupt normal biological processes and cause chromosome aberrations, mutations or cell death. In this study, the total yields of simple SSB and DSB induced by electrons with different energies associated with the energies of the ultrasoft X-rays, between 0.28 and 4.55 keV, have been calculated in Charlton and Humm volume model using the Geant4-DNA extension of the Geant4 toolkit. A comparison between the obtained results and other experimental and theoretical data shows the suitability of this simple model of DNA for calculating the total damage with the advantages of reducing the complexity of the simulations and decreasing the computational time. Also, it has been found that in the low energy region (under 5 keV), the yield of the total SSB remains nearly independent of the initial electron energy while the DSB yield increases with decreasing energy. Moreover, a direct dependency between DSB induction, RBE value and the mean lineal energy, as a microdosimetry quantity, has been observed. Meanwhile, it has revealed that the threshold energy of 10.79 eV to calculate the total strand breaks yields results in a good agreement with the theoretical and experimental data while the other threshold energies such as 12.61 eV or 17.5 eV result in significant difference.

Biography

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