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Simulations of DNA damage types and frequencies induced by carbon ions

H Moeini[1] and M Mokari[2]

[1] Department of Physics, School of Science, Shiraz University, Shiraz, Iran
[2] Department of Physics, Behbahan Khatam Alanbia University of Technology, Behbahan, Iran

E-mail: h.moeini@shirazu.ac.ir

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Abstract
Carbon ions' dose distribution, in comparison with lighter hadrons, has certain therapeutic advantages due to their relatively higher biological effectiveness in tumors. Simulating the physical and chemical interactions of carbon ions in a sphere of liquid water of cellular scales, we derived the mean number of deposited energies per unit dose per a DNA segment of 216 bp as a function of deposited energy. As such, the frequency of complex damage was obtained from the point of view of a multiplicity of damage points on the DNA strands. Furthermore, the damage yields for different types of single- and double-strand breaks were obtained and, specifically, the mean number of simple single- and double-strand breaks per DNA segment were calculated as a function of deposited energy.

Keywords: damage yield, DNA damage, Geant4-DNA code, carbon ion, μ-randomness method

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