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Investigating the damage to the genetic material of the cell induced by protons and carbon ions with the MCDS code compared to the results of the Geant4-DNA Monte Carlo code

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Abstract
Due to physical and chemical interactions with the cell DNA, ionizing radiations induce early and late damage to the genetic material. This type of damage, which is mainly caused by single-stranded and double-stranded breaks in DNA, and if not repaired by the cell, can lead to genetic mutations or cell death. In this research, the DNA damage of living cells, induced by protons and carbon ions, which are of great importance in radiation therapy studies, has been investigated with the MCDS code. In order to check the accuracy of the MCDS code results in this research, the probability of each type of damage and the yields have been calculated and compared with the results of previous works with Geant4-DNA. The results of this research, especially double-strand breaks, are very close to the results calculated with the Geant4-DNA code. There are also differences in the results due to the difference in the cross-sections of the two codes, especially in ionization and excitation interactions, as well as the reaction rates of chemical radicals. The results of this research regarding the efficiency of double-strand breaks can be very useful in the planning of treatment with protons and carbon ions.

Keywords: Monte Carlo simulation, DNA damage, proton, carbon ion, MCDS code, double-strand break.

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