Recent developments of the Geant4-DNA extension of the Geant4 Monte Carlo simulation toolkit

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Modeling accurately biological damage induced by ionizing radiation at the scale of the DNA molecule remains a major challenge of today's radiobiology research. In order to provide the community with an easily accessible mechanistic simulation platform, the general purpose and open source "Geant4" Monte Carlo simulation toolkit is being extended in the framework of the "Geant4-DNA" project[1-3] with a set of functionalities allowing the detailed simulation of particle-matter interactions in biological medium. These functionalities include physical, physico-chemical and chemical processes that can be combined with nanometer size geometries of biological targets in order to predict early DNA damage. We will present an overview of the Geant4-DNA project and discuss on-going developments. In particular, these include the recent addition of new physics models for liquid water, bio- and gold materials. Newly developed physics verification or validation examples will be presented. Finally, the first combination of physics, physico-chemistry, chemistry and geometries for the prediction of early damage in biological targets will be shown.

[1] http://geant4-dna.org
[2] Track structure modeling in liquid water: A review of the Geant4-DNA very low energy extension of the Geant4 Monte Carlo simulation toolkit, Phys. Medica, 31, pp. 861-874 (2015).
[3] Comparison of Geant4 very low energy cross section models with experimental data in water, Med. Phys., 37, pp. 4692-4708 (2010).