

Title: Geant4-DNA for FLASH radiotherapy: status and challenges

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Background: Various studies over the past decade have shown that ultra-high dose rate (UHDR) irradiation significantly reduces toxicity in normal tissues compared to conventional low dose rate irradiation, while maintaining the same level of tumour control. [1-2]. Although this biological effect, known as the FLASH effect, is the subject of intensive research, the mechanism responsible for it is not yet fully explained. Track structure codes such as Geant4-DNA[3], with their chemical extension and ability to calculate biological damage, are powerful tools to study the impact of UHDR on the physical, physicochemical and chemical stages of water radiolysis as potential part of the chain mechanism involved in the FLASH effect.

Methods and results:

We will review the developments available in Geant4-DNA to study the FLASH effect. In particular, the ability to model the presence of oxygen and scavengers and to study inter-track radical recombination will be presented. The challenges and potential extensions of Geant4-DNA to study the FLASH effect will also be discussed.

[1] V. Favaudon et al., *Science. trans. medicine*, (2014) vol. 6, no. 245

[2] M.-C. Vozenin et al., *Clinical Cancer Research* (2019), vol. 25, no. 1, pp. 35

[3] S. Incerti et al., *Int J Model Simul Sci Comput* 1 (2010) 157-178