

## Evaluation of the effect of oxygen in Flash irradiation through Geant4

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**Background:** The recent studies on the animal models [1], [2], [3] indicate that thanks to the advent of the state-of-the-art modality in external radiation therapy (RT) called Flash-RT, the protection of normal tissue is remarkably increased, while the tumor control remains like conventional treatment and consequently it can improve the transferring the higher dose to the tumor.

One of the main reasons that Flash-RT can have an advantage versus conventional RT can be related to the oxygenation process [4]; As far as the indirect damage of radiation is concerned, the level of oxygenation plays a significant role in biological systems damage which is strongly associated with the chemical stage [5], [6] of radiation; But the mechanism of the oxygenation effect in FLASH irradiation is not completely clarified.

**Material and Methods:** To evaluate the effect of oxygen concentration, Monte Carlo simulations of electron and proton irradiations in an oxygenated water with different oxygen concentrations were carried out by different groups [7],[8] In the simulations of this effect through GEANT4-DNA toolkit, the temporal yields (G-values) of some chemical species in water [9],[10] with different oxygen concentrations is calculated, firstly, and then by considering the oxygenation enhancement ratio(OER), weighted dose under dynamic oxygen pressure [8], and by comparing to conventional irradiation at constant

OER, the impact of the high dose rate radiation on the chemical species is assessed.

**Preliminary results:** we analyzed and compared the results under this condition (the simulation of oxygen effect by taking into account the OER-weighted dose) for the GEANT4-DNA and the TRAX codes. The results indicate that the oxygen depletion can just have an insignificant effect on radiosensitivity through oxygen enhancement that shows a close agreement with TRAX code.

It was concluded that an improved Geant4-DNA toolkit is a capable option to achieve this goal.

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