A Monte Carlo based investigation of the FLASH effect by examining inter-track interactions in radiobiological simulations performed with TOPAS-nBio

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Background: Even though FLASH-RT shows promising results, the FLASH effect is still not fully explained. One possible explanation might be that interactions between the chemical molecules produced by water radiolysis of different primary ionizing particles trigger this effect. In this work we investigated the yield of chemical molecules (G-value), and the resulting DNA damages produced by ionizing particles in dependence of the dose rate.

Material and Methods: The Monte Carlo Code TOPAS-nBio was used to calculate the G-value of electrons with an energy of 60 eV in dependence of the dose rate. The realization of different dose rates, which cannot be set by default in TOPAS-nBio, was achieved by a different number of tracks of primary particles that can interact with each other. Further, we examined G-values and resulting DNA damages in dependence of the dose rate using a proton beam of 10 MeV and 100 MeV.

Preliminary results: Increasing the dose rate, i.e., the number of interacting tracks, decreases the G-value of hydroxyl ($OH^{\bullet}$) at the end of the chemical stage for the electron (see Figure 1) and proton sources. As a result, less reactions of $OH^{\bullet}$ at the DNA occur reducing the amount of indirect DNA damages when using a higher number of interacting tracks for both proton sources.

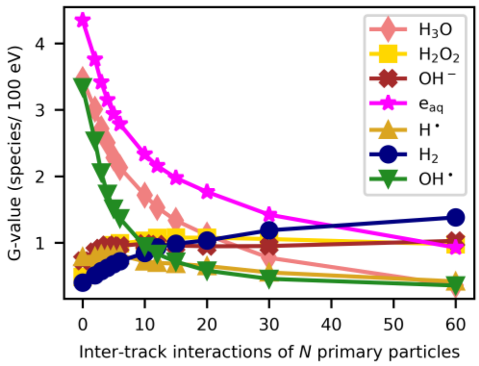

Figure 1: G-values at the chemical time end in dependence of the number of interacting tracks for 60 eV electrons.