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Derivation of the beta coefficient of cell survival curves for low-energy ion irradiation within the NanOx biophysical model

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Biophysical models are of interest to estimate the biological dose in radiation therapy. The main output of these models are the alpha and beta coefficients describing cell survival as a function of dose. Such information may be used for instance to optimize beam parameters in hadrontherapy when integrated into treatment planning systems. However, novel radiation therapy modalities such as targeted radionuclide therapy or boron neutron capture therapy bring into play low-energy ions for which the radiobiological parameters are known with less accuracy. In this work we investigate the alpha and beta coefficients obtained from the NanOx biophysical model for low-energy helium ion irradiation of three different cell lines: HSG, V79 and CHO-K1. The results show that for all the studied cell lines the value of the beta coefficient decreases at least by a factor of 3 when the ion's energy changes from 10 MeV/n to 50 keV/n. Furthermore, we propose within the NanOx formalism an analytic expression relating the alpha and beta coefficients, which shows good results with reduced computational burden.

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