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NanOx-based multiscale modeling of the biological dose in BNCT to estimate the impact of boron microdistributions

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not supported the dose calculation in-air in the focus window of External-Beam-Planning. To directly assess the accuracy of modeling for in-air spot profiles on Eclipse, a method is proposed.

Materials and Method: This method is conducted the dose profile measurement in a virtual water phantom generated using Eclipse. The dose profile at 0.3 g/cm² is considered to provide similar distribution measured in air (Figure1(c)). An evaluated source parameter set and Monte Carlo simulator were applied to evaluate the feasibility of proposed method. The impacts of scattered events, including backscatter (Figure1(b)) and combination of shallow region- and back-scatter (Figure1(c)), on the spot profile for mono-energetic proton beams were assessed using sigma (σ) and point-to-point dose difference.

Results: In general, the discrepancy of spot size between reference and the proposed method was less than 0.5% for the selected energies. In comparison to the reference configuration, the point-to-point percentage dose differences resulting from backscatter and the combination-scatter were overestimated with 1% and 5% (Figure2), respectively.

Conclusions: Preliminary results indicate that the method is feasible for proton beams with selected energies. To assess the response of energies for clinical applications and obtain an optimal reference depth, further investigations are necessary.

P 265 - NanOx-based multiscale modeling of the biological dose in BNCT to estimate the impact of boron microdistributions

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BNCT is a promising therapy for bad prognosis tumors like glioblastoma or recurrent head and neck cancer. The benefit of BNCT relies on both the boron targeting into the tumor and the biological effectiveness of the low-energy ions following the neutron capture. Biological dose modeling is therefore required in order to optimize the treatment plans. Several formalisms have been presented over the years but they do not consider the microdistribution of boron that should strongly impact tumor control probability (TCP). The present study aims at quantifying this impact using multiscale modeling and consideration of biological effect due to each secondary particle instead of weighting factors. The scales range from nanometers, through the biophysical model NanOx, up to the patient for which the resolution is defined by the voxel size. NanOx has proven its accuracy to describe the cell response under several ion-type irradiations of interest for hadrontherapy. Our multiscale methodology can be decomposed in 4 stages: Modeling of multicellular geometry and various scenarios of intracellular boron distributions; for these scenarios, pre-calculations of biological coefficients with NanOx for several cell lines; in each voxel of the patient CT scan, calculations by Monte Carlo simulations of the dose deposited by gammas, the energy spectra of recoil protons and the concentration of neutron captures by boron; and calculation of 3D biological dose distributions and TCP by combining the outcomes from the two previous stages. Comparisons will be done with existing BNCT formalisms and various neutron spectra. Preliminary results will be presented for simplified BNCT irradiation conditions.

P 266 - A hybrid deterministic/probabilistic approach for beam angle optimization in IMPT

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Appropriate selection of proton beam directions in intensity-modulated proton therapy (IMPT) may have a profound impact on the quality of dose distributions, particularly due to the small number and depth-dose characteristics of beams used in IMPT. However, most of the time, the beams are fixed a priori, and no beam angle optimization (BAO) is performed. BAO is a highly non-convex optimization problem that can be interpreted as the optimization of an expensive multi-modal black-box function. Deterministic direct-search methods have been successfully used to address the BAO problem, but with the shortcoming of being computationally time-consuming procedures. For proton therapy, the number of degrees of freedom for