HIGH SPATIAL RESOLUTION MICRODOSIMETRY WITH ΔE-E DETECTOR ON C-12 BEAM: MONTE CARLO SIMULATIONS AND EXPERIMENT

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For ^{12}C radiotherapy it is important to calculate relative biological effectiveness (RBE) distribution additionally to absorbed dose distribution. Different methods and approaches are used for calculation of the RBE-weighted absorbed dose in treatment planning system (TPS) for ^{12}C therapy. The microdosimetric RBE based on the tissue equivalent proportional counter (TEPC) measurements in ^{12}C therapy has been reported. However large size of commercial TEPC is averaging RBE which dramatically changes close to and in a distal part of the Bragg peak (BP) that can have clinical impact.

Silicon microdosimetry devices are offering sub-millimeter high spatial resolution of RBE measurements along the BP. A silicon ΔE-E telescope was evaluated in PMMA phantom on 290MeV/u ^{12}C therapeutic ion beam at HIMAC, Japan. The detector consists of ΔE stage and E stage with thickness1.8 μm and 500 μm, respectively and provides possibility of microdosimetry using ΔE stage and secondary and primary charged particles and fragments identification using the scatter plot ΔE-E+ΔE.

The response of ΔE-E telescope in ^{12}C ion beam at defined positions within the BP at different depths with 0.5mm step was studied using Geant4 Monte Carlo toolkit. The microdosimetric spectra derived from ΔE stage response along with simulated scatter plots for the same points. It was demonstrated that microdosimetric spectra is changing dramatically within 0.5 mm depth increments close to and at distal part of the BP that is impossible to observe with TEPC.

Partial contributions to microdosimetric spectra and to Y_D from primary ^{12}C ions, fragments (He^4, He^3, Li^7, Be^9, B^{11}) and neutrons has been analyzed for each position. Monte Carlo derived microdosimetric spectra were compared with experimentally measured under the same conditions.