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Validation of TEPCActor for slab detectors in microdosimetry

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Monte Carlo (MC) simulations of microdosimetric spectra are available for different codes, detectors and particle types/energies. While good results can be achieved if the detector geometry is modelled in detail [1, 2], a simpler approach can also result in very good agreement.

At five positions along a 238.6 MeV/u carbon ion pencil beam, spectra were collected using the Silicon MicroPlus probe. The measurements were collected along CAX as well as 10 mm off-center. The MC was performed with GATE/Geant4, using our validated beam model and a simplified detector geometry. Only the 400 sensitive volumes (diameter = 20 μm , thickness = 10 μm , spaced 50 μm apart) were simulated, none of the housing/surrounding materials.

The off-center measurements show a higher contribution of secondary particles, which we were able to reproduce in the MC (Figure 1). The agreement of the shape of the spectra is excellent for all positions along the Bragg peak. Especially in the fragmentation tail, where we were able to measure and simulate the boron edge with high accuracy.

This simplified detector geometry could be implemented in future GATE installation checks, to perform a validation down to the microdosimetric scale. MC also offers a spectrum down to very low keV/ μm values, which can be used to complete any experimentally obtained spectrum.

[1] David Bolst et al 2020 Phys. Med. Biol. 65 045014

[2] Anna Bianchi et al 2023 Phys. Med. Biol. 68 034001

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