

# Lineal Energy Calibration of Mini-Tissue Equivalent Proportional Counter: Geant4 Monte Carlo Study

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Tissue Equivalent Proportional Counter (TEPC) is a detector which can measure the absorbed dose delivered by the mixed field radiation to a microscopic tissue volume. The commercial TEPCs have a spherical gas cavity and wall of which the diameters are about a few centimeters. For the microdosimetry of therapeutic radiation beams, the miniaturized TEPC (mini-TEPC) will be better. Mini-TEPC has the right cylindrical shape ( $D = H$ ) of which the length is about a few millimeters. To investigate the dose distribution detected with mini-TEPC, we performed Monte carlo simulation with Geant4. In this mini-TEPC, propane-based tissue equivalent gas is injected and the wall material is A-150 tissue equivalent plastic. Photons from  $^{137}\text{Cs}$  and  $^{60}\text{Co}$ , and neutron spectrum from  $^{252}\text{Cf}$  were used as beam sources. We simulated 4 tissue sizes, 0.3, 0.5, 1.0 and 2.3  $\mu\text{m}$ , and got comparable results with experimental data from the reference paper. For the calibration, the concept 'edge' defined as the maximum energy delivered by charged particles should be calculated. Dose distribution data from the simulation results were fitted to the Fermi-like function, then the three markers,  $y_{\text{flex}}$ ,  $y_{\delta\delta}$ , and  $y_{\text{IC}}$ , were obtained.  $y_{\text{flex}}$  is the position of the inflection point,  $y_{\delta\delta}$  is a maximum of the second derivative, and  $y_{\text{IC}}$  is the intercept of the tangent through the inflection point with the x-axis. These values were compared to the analytical electron edge value and the proper one was decided as a calibration point. We suggested the  $y_{\delta\delta}$  was closest to the analytical value and discussed the reasonability of this decision.

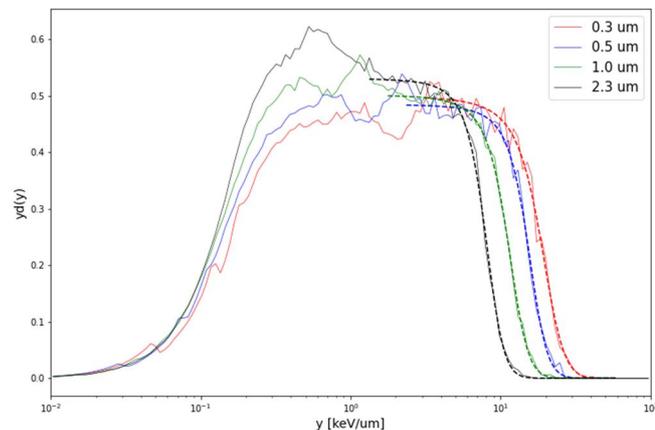


Fig. 1. Dose distribution from  $^{137}\text{Cs}$  photon source (solid) and fitted Fermi-like function (dot).

