AbstractID: 11726 Title: Energy spectra reconstruction from beta emitters: a study of the Sr-90/Y-90 case

Purpose: Reconstruction of the energy spectrum of a $^{90}Sr/^{90}Y$ radioactive source for low dose (~1Gy) radiation biology experiments.

Method and Materials: Electrons originated from a 25 μCi $^{90}Sr/^{90}Y$ radioactive source were recently used in radio-biology experiments to study the response of cancer cells to low dose irradiation (~1Gy). The beam was separated into individual energies using a dipole magnet, the number of exited electrons measured by a scintillating fiber based detector and the dose obtained using double-layered EBT films. The dipole was constructed from two 5.08 x 5.08 x 2.54 cm^3 permanent magnets separated by a distance of 2 cm and having a maximum field of about 5 kG at the center. The beam entered the magnet through a 1 cm diameter, 0.5 cm thick leaded glass collimator. The detector was an array of 16 blue shifted 1 mm thick scintillating fibers. A realistic Geant4 simulation was used to account for the energy loss while electrons propagate throughout the system. The incident energy spectrum was generated from the NIST-logft calculation.

Results: The data was first compared with measurements using a pancake frisker detector for an overall general assessment of the data quality, giving an agreement to within 15%. The average deviation of the data/simulation ratio is ±2.5% and there is a $^{+15}_{-5}$%. A comparison between the measured and simulated mean energies gives an agreement to within 1σ (less than 0.3%).

Conclusion: The simple system developed for this work can serve as a mean for an efficient way to accurately reconstruct the energy distribution of charged particle emitters as well as to assess expected dose delivery to biological systems. Such data can also be used to benchmark low energy physics processes implemented in simulation tools for medical physics purpose.