AbstractID: 7107 Title: Fluence Determination in a Polarized Synchrotron-Generated Monochromatic X-ray Beam

Purpose: K-edge capture radiotherapy using monochromatic x-ray beams necessitates development of corresponding dosimetry techniques, one being utilization of Monte Carlo methods. Since Monte Carlo simulations yield dose per particle, a methodology to measure the beam fluence of a monochromatic synchrotron-generated x-ray beam was developed using Compton scattering techniques.

Method and Materials: X-rays were produced at the LSU CAMD synchrotron by passing a 1.3-GeV electron beam (≈200 mA) through a 7-T superconducting wiggler. The resulting polychromatic beam passed through a double multilayer monochromator to generate a ~0.1×2.8-cm^2 beam. Since high fluence rates make direct measurement of beam fluence impossible, photons Compton scattered by thin polyethylene targets into a 1-mm thick × 2.54-cm diameter NaI(Tl) scintillation detector were counted. Incident beam fluence was calculated from net peak counts via application of the Klein-Nishina collisional cross section for polarized radiation at multiple scattering angles. Simultaneously, percent polarization of the beam was determined by separating the Klein-Nishina cross section into its two orthogonally-polarized components. Measurements were taken at 4 scattering angles (15°-60°) with the fraction of photons (*f*), polarized such that the angle between the direction of incident polarization and the scattering plane is 0°, determined by minimizing the standard deviation of the calculated fluences.

Results: Incident beam fluence rates for 100 mA of synchrotron ring current were determined with ~1% precision and ranged from $(9.58\pm0.08)\times10^{10}$ to $(1.55\pm0.02)\times10^{11}$ photons·cm^{-2}·s^{-1}. Measurement showed that the 35-keV beam was highly polarized in the plane of the synchrotron, e.g. f =97%.

Conclusion: We have demonstrated a feasible method based on Compton scattering to determine incident synchrotron-generated x-ray beam fluence and polarization. Fluences determined via this method can provide input data that will allow currently underway Monte Carlo simulations to predict dose distributions in homogeneous phantoms for comparison with more traditional dosimetry methods (ion chamber and radiochromic film).