AbstractID: 14044 Title: Development of the first MGH proton range telescope (PRaT) prototype using scintillating fibers

Purpose: To describe the development of the first MGH proton range telescope (PRaT) prototype using scintillating fibers. Monte Carlo simulations were used to assess the image quality of this PRT.

Materials & Methods: Standard commercially available scintillating fibers from Saint Gobain have been used to build the X/Y mesh of the PRaT. Fiber optic detectors are extremely cheap to build therefore the opto-scintillator design may be easily replaced or improved over time with minimal cost. GEANT4 (G4) version 9.0.p01 (2007) was used to simulate a proton radiograph of an actual patient lung tumor. For each primary proton entering the patient, the energy, position and direction cosines were recorded. Primary or secondary particles exiting the patient were then correlated to the ones entering the patient using a Track ID number.

Results: The energy resolution of the PRaT was within 3MeV for protons ranging from 70MeV to 200MeV, while the spatial resolution was 2 to 3mm, depending on the coincidence parameters of the electronics. Initial studies used 1-3 MHz through-put electronics. While, using 10-30MHz electronic, 1-2mm spatial resolution could be achieved. G4 simulations show that spatial resolution of photon X-ray images is superior, allowing better viewing of the edges of the various organs such the lung chest wall, the supra-clavicle collar bones, etc. The poor spatial resolution is an intrinsic limitation of the proton range telescope due to multiple Coulomb scattering. On the other hand, the PRT allows better visualization of tissue density changes within soft and bone tissue regions such as the lung and supra-clavicle region.

Conclusions: The first PRaT prototype using scintillating fiber was developed at MGH. Our preliminary results of evaluating the PRaT with G4 Monte Carlo toolkit showed that it can produce images with fair spatial resolution, while offering very good edge detection within soft tissue.