AbstractID: 8947 Title: A Scanning Photon Pencil Beam for Temporally Precise IMRT

Purpose: We present an early feasibility analysis of a scanning photon pencil beam (SPPB) system capable of producing temporally optimized IMRT fields for real-time motion tracking. A high energy electron beam will be electromagnetically scanned with dwell times corresponding to beam weights, and impinge upon a target. A dual focused collimator (DFC) will transmit only pencil beams whose divergence matches the incoming electron beam angle. **Methods and Materials:** The EGSnrc, BEAMnrc and DOSxyz Monte Carlo simulation codes were used to model relevant system characteristics including forward bremsstrahlung efficiency, focal spot size, and DFC transmission efficiency. Monte Carlo modeling of a potential DFC was used to assess whether the proposed system is capable of producing a sharply focused pencil beam, and both uniform and modulated treatment fields. We simulated an 18 MeV electron beam, 5 mm thick tungsten target and an 8 cm thick tungsten DFC containing 200 hexagonal channels, each with a 0.5 mm radius and wall thickness. The dose to water at 2 cm following a 20 cm air gap was simulated for a single pencil beam. A pencil beam summation script was used to assess the system's ability to produce uniform and modulated fields. **Results:** The efficiency of dose delivery to a very small forward-directed cross section increases by an order of magnitude between energies of 6 MeV and 50 MeV. The focal spot size produced using a tungsten target is approximately 4 times smaller than that produced using a Be target. Our simulated system produced a pencil beam with FWHM of 6mm. The uniformly irradiated field possessed local uniformity to within +/-1%, verifying that septa-induced dead spots are compensated by phantom scatter. **Conclusions:** These early results support the feasibility of producing a DFC-based SPPB system.

This work was supported by Varian Medical Systems