AbstractID: 7328 Title: A Monte-Carlo study of the effects of miniphantom-material on in-air output ratio

**Purpose**: To investigate the effects of miniphantom materials on in-air output ratio measurement.

**Method and Materials**: Monte-Carlo (MC) simulations were performed to examine the effects of miniphantom materials on in-air output ratio for photon energies 6 MV and 15 MV and for collimator settings ranging from 3×3 to 40×40 $cm^2$. The miniphantom materials included water, PMMA, graphite, copper, and lead. EGSnrc and BEAMnrc (2007) software packages were used for the simulations. The miniphantoms in the simulations were of cylindrical shape and the lateral dimensions were 4 $g/cm^2$, which were large enough to provide electron equilibrium. Attenuation coefficients and energy absorption coefficients for each collimator setting were calculated using energy spectra. Phantom scatter factors were obtained by dose simulations in miniphantoms. Correction factors were developed for attenuation coefficient, mass energy absorption coefficient, and phantom scatter factor. The product of these three correction factors gave a total correction factor for in-air out ratio.

**Results:** In-air energy spectra for primary and headscatter beams were obtained for each energy setting and collimator setting using beam code. There is an energy spectrum shift between the headscattered and primary beams. In addition, the magnitude of headscatter energy fluence increases significantly as the collimator setting is changed from 3×3 to 20×20 $cm^2$. Correction factors for in-air output ratio, which were determined by MC simulations and measurements, respectively, were compared.

**Conclusions**: MC simulations confirmed our experimental correction factors for miniphantoms made of different materials. The maximum total correction factors for miniphantom thicknesses up to 30 $g/cm^2$ are less than 1.01. For the miniphantom thickness of 10 $g/cm^2$, the maximum MC (measured) total correction factors for in-air output ratio on the central-axis are 1.002 (1.002), 1.004 (1.003), 1.005 (1.005), and 1.007 (1.007) for PMMA, graphite, copper, and lead, respectively. The correction factors are much larger at off-axis locations.