AbstractID: 4547 Title: Radiation Quality in High Contrast Imaging with Orthogonal Bremsstrahlung Beams

Purpose: To study the characteristics of orthogonal bremsstrahlung photons produced by megavoltage electron pencil beams and to evaluate the suitability of their use for improved radiation therapy imaging.

Method and Materials: A 10 MeV electron beam emerging through the research port of a Varian Clinac-18 linac was made to strike targets of carbon, aluminum and copper. The quality of resulting forward and orthogonal bremsstrahlung beams was evaluated using PDD and attenuation measurements, and the experimental findings were compared with Monte Carlo-calculated results using the EGSnrcMP code. Images of contrast objects were acquired with Agfa 400 diagnostic films and their contrast levels were analyzed.

Results: Photon yield and mean energy of the forward bremsstrahlung spectra were determined to be essentially independent of the target's atomic number Z. In comparison with forward bremsstrahlung, the yield and effective energy were lower in the orthogonal direction, and this decrease was more pronounced for targets of lower atomic number. The effective energy of a spectrum produced by carbon dropped by a factor of 10 from 1535 keV in the forward direction to 151 keV in the orthogonal direction, while for aluminum it dropped by 77% to 425 keV, and for copper by 37% to 1107 keV. The image contrast of films exposed with orthogonal beams was qualitatively determined to be superior to that obtained using the forward megavoltage beams.

Conclusions: Orthogonal bremsstrahlung beams produced by megavoltage electrons have a significantly lower mean energy compared to forward beams. In the orthogonal direction, higher Z targets create higher intensity, while lower Z targets provide a more desirable low energy spectrum. Using their relatively low effective energy, orthogonal bremsstrahlung beams produced by megavoltage electrons striking low atomic number targets yield images with a higher contrast than do forward bremsstrahlung beams.