AbstractID: 8253 Title: Measurements of X-Ray Spectra Emergent from Low-Energy Photon-Emitting Brachytherapy Sources

Purpose: To investigate changes in the emergent spectra of low-energy photon-emitting brachytherapy sources as a function of angle in the plane of the source long axis. **Method and Materials:** X-ray spectrometry was performed utilizing a high-purity germanium detector, having a 1 cm diameter aperture, located at a distance of 177 cm from the center of the source. The source, with the long axis parallel to the floor of the laboratory, was mounted on a rotating vertical post. Emergent spectra were measured at rotation intervals that varied from 5 degrees to 15 degrees for a total of forty spectra per source. The intensity ratio of K_β to K_α x rays from the decay of the radionuclide, the intensity ratio of Ag K_α fluorescence x rays to the 35 keV emission line from I-125 sources that contained silver, and the air-kerma strength were all calculated from the measured spectra as a function of source rotation angle. **Results:** The degree of anisotropy about the axis perpendicular to the mid-point of the long axis of the source was characterized by calculating the ratio of the air-kerma strength of the source positioned perpendicular to and parallel to the detector face. Values of this "air-anisotropy ratio", α_S, varied from 0.05 for a Pd-103 source with thick end caps to about 1 for an I-125 source with a uniform encapsulation thickness. Sources with low values of α_S showed a significant increase in the K_β-to-K_α intensity ratio for emissions from the seed ends. **Conclusion:** Variations in the designs of brachytherapy sources significantly influence their emergent spectra. Measuring the spectra around these sources has lead to an understanding of the response of well-ionization chambers, used in therapy clinics to verify source air-kerma strength prior to treatment, relative to the NIST Wide-Angle Free-Air Chamber (WAFAC) primary standard.