

AbstractID: 5327 Title: More accurate determinations of air-kerma strength for brachytherapy sources

Purpose: To determine more accurately the air-kerma strength of low-energy photon-emitting brachytherapy sources.

Method and Materials: Air-kerma strength is the agreed upon metric for most brachytherapy sources and is defined as the product of the kerma rate *in vacuo* at distance d on the transverse axis of a seed (polar angle of 90 degrees), multiplied by the square of this distance d^2 . This work introduces new methods to evaluate how anisotropy affects air-kerma strength. First, NaI detector measurements yield in-air anisotropy data that were previously reported only with Monte Carlo transport methods. In addition, multiple aperture sizes are used to evaluate large-angle free-air ionization chamber measurements. Lastly, a new method of Monte Carlo transport, which incorporates the distance-dependent geometry effects of certain brachytherapy seeds, is used to determine more accurately the air-kerma rate on the transverse axis of the source. These methods may be used to evaluate air-kerma strength to a higher degree of accuracy.

Results: Well-collimated NaI detector measurements yield precise in-air anisotropy measurements that may be compared directly with Monte-Carlo transport simulations. Measurements of two seed types show deviations near the transverse axis of the source of at least 5%. Monte-Carlo determined point-detector simulations yield more accurate estimations of air-kerma strength and show that air-kerma strength is not constant for all distances *in vacuo*, as would be predicted by its definition.

Conclusion: This work shows that with the combination of these new measurement techniques, air-kerma strength may be evaluated to a higher degree of accuracy for low-energy photon-emitting brachytherapy sources. New experimental data on two seeds' in-air anisotropy is also presented.