AbstractID: 11783 Title: Accurate Water Calorimetry Without Corrections for Heat Transport?

Purpose: To use the phase transform of the output-time waveform from a water calorimeter subject to periodic radiation exposure for purposes of identifying shutter periods at which corrections for heat transport are unnecessary.

Method and Materials: The response of a Domen-type calorimeter of cylindrical geometry to radiation exposure in a 60Co beam is studied analytically, numerically and experimentally under conditions in which the beam is chopped by a shutter. Previous studies in our laboratory have shown an oscillatory dependence of the apparent dose rate upon shutter period which is the signature in the frequency domain of the effects of heat conduction and convection. However, because the apparent dose rate oscillates about the actual dose rate, it should be possible to identify one or more shutter periods at which the effects cancel and the resultant Fourier amplitude provides an accurate measure of the dose rate despite the presence of distortions in the time waveform. Identifying these nodes in the magnitude frequency response of the calorimeter is possible with accurate analytical and numerical models, but we are also exploring the relationship between real and imaginary components of the calorimeter frequency response to identify such points from the phase transform. Using COMSOL Multiphysics, models of our calorimeter have been run with heat sources that mimic a 10 cm x 10 cm 60Co beam. Output of these models is compared to series solutions of the heat transport equations and experimental data.

Results: Computational and experimental data exhibit correlated oscillations in the phase and magnitude transforms that suggest a simple analytical relationship between them that would allow the identification of shutter periods at which the effects of heat transport are negligible.

Conclusion: The existence of distinct shutter periods where heat transport distortions cancel is demonstrated, suggesting that water calorimetry might be done without such corrections.