AbstractID: 10496 Title: Re-evaluation of the product of W/e and the graphite to air stopping power ratio for Co-60 air kerma standards

Purpose: To reanalyze experiments which determine $(W/e)_{air}\left(\bar{L}_{\Delta}/\rho\right)_a^C$, the product of $(W/e)_{air}$, the average energy deposited per coulomb of charge released in dry air, and $\left(\bar{L}_{\Delta}/\rho\right)_a^C$, the Spencer-Attix mass collision stopping-power ratio for graphite to air, and to calculate an average value for this product for the BIPM ^{60}Co air kerma standard: $(W/e)_{air}\left(\bar{L}_{BIPM}/\rho\right)_a^C$. This value could be adopted for use with ^{60}Co air kerma primary standards, along with corrections to account for variations due to cavity size. **Methods and Materials:** The experiments measured $(W/e)_{air}\left(\bar{L}_{\Delta}/\rho\right)_a^C$ by various methods, often involving calorimeters and ionization chambers. Correction factors, *e.g.*, to account for gaps about a calorimeter core or perturbations due to a cavity's presence, are calculated as needed for each experiment using the EGSnrc user-codes CAVRZnrc, DOSRZnrc, and CAVITY. Stopping power ratios are evaluated using SPRRZnrc for different choices of graphite density (bulk 1.70 g/cm^3 or grain 2.265 g/cm^3) for the density effect correction and average excitation energy for graphite (I=78 or 87 eV). For each experiment, the corrected value of $(W/e)_{air}\left(\bar{L}_{\Delta}/\rho\right)_a^C$ is multiplied by $\left(\bar{L}_{BIPM}/\rho\right)_a^C \Big/ \left(\bar{L}_{\Delta}/\rho\right)_a^C$, the quotient of the stopping power ratios for the BIPM chamber and the experiment in question. A least squares technique is used to compute an average value of $(W/e)_{air}\left(\bar{L}_{BIPM}/\rho\right)_a^C$. **Results**: The correction factors generally decrease the value of $(W/e)_{air}\left(\bar{L}_{\Delta}/\rho\right)_a^C$ for each experiment, often outside the range of one standard deviation quoted with each experimental result. The ratio $\left(\bar{L}_{BIPM}/\rho\right)_a^C \Big/ \left(\bar{L}_{\Delta}/\rho\right)_a^C$ varies by less than 0.1% for different choices of density correction and I-value and hence the product $(W/e)_{air}\left(\bar{L}_{BIPM}/\rho\right)_a^C$ is also relatively insensitive to these choices.

Conclusion: The preliminary analysis suggests that the accepted value of $(W/e)_{air}\left(\bar{L}_{BIPM}/\rho\right)_a^C$, 33.97 J/C ±0.15% , is 0.6% too high. This would have implications for primary ^{60}Co air kerma standards worldwide and for the value of $(W/e)_{air}$ which is used in low energy x-ray standards.