AbstractID: 7636 Title: Development of an ultra-wide dynamic range electrometer

Purpose: To develop a wide range electrometer for measuring the charge from large volume ion chambers, while maintaining reading accuracy and resolution for small charge measurements.

Method and Materials: Standard commercially available electrometers typically unable to integrate the charge from a large volume ion chamber period without saturating. While it is possible to design an electrometer that can integrate a large charge, readout accuracy and resolution for low charge readings is often compromised. We have developed a unique wide dynamic range electrometer (WDE) design that overcomes these problems by using dual electrometers operating in a switching configuration. Each electrometer is of the familiar integrating capacitor type. The integrating amplifier used is a commercially available integrated circuit designed specifically for use as an integrating electrometer, with on-chip reset, hold and multiplexing switches. A microcontroller controls the switching, readout and reset of the electrometers such that one electrometer is integrating the ion chamber signal while the other is being read and reset, as well as the communication with PC-based software. Using this method large charge measurements are possible while maintaining the accuracy and resolution of low charge measurements. The maximum measurable charge is limited only by the firmware. The reproducibility and linearity of the electrometer design is comparable to commercially available electrometers.

Results: For large ion chamber current measurements of ≈5 uA, the electrometer is able to measure the charge to within an accuracy of 0.2%, compared to a 45% error when using a commercial electrometer. At lower currents, the WDE can accurately measure charge with a reproducibility standard deviation of 0.06% and a linearity standard deviation of 0.007%, which is comparable to commercial electrometers.

Conclusion: A large dynamic range electrometer has been developed that allows measurement of large ion chamber currents while maintaining the accuracy and resolution of small charge measurements.