Purpose:

Small Diodes are widely used for beam data measurements, specially for stereotactic dosimetry, small field dosimetry and electron dosimetry. Hence it is important that data measured with such diodes be as accurate as possible so that data can be accurately modeled in the treatment planning systems. This study attempts to compare the signal-to-noise ratio of SNC edge detector with Scanditronix CC01, CC04 and CC13 compact ionization chambers.

Methods:

The signal-to-noise ratio for each of the detectors were measured on a Varian 2100C machine with 5x5 field size and 80 dose rate. This was then compared to the mathematical models of the CC01, CC04, CC13 ion chambers and the Edge diode detector. Monte Carlo code PENELOPE (v 2008) was used for simulating the microdosimetric spectra in each detector for several energies. These spectra were used for estimating the detector inaccuracy of measurement at 0.05 cGy dose delivered to the detector.

Results:

Monte Carlo simulation and analysis confirmed that a significant portion of the measurement noise is coming from the interaction between ionizing radiation and the detector’s sensitive volume as opposed to the electrometer or cable connections. This microdosimetric noise is inherent to the detector design and cannot be minimized by other than statistical methods. The magnitude of the silicon diode microdosimetric noise is estimated to be 1.08% +/- 0.05% at 0.05 cGy and for the 0.125 cm3 ion chamber is 0.28% +/- 0.05% at 0.05 cGy.

Conclusions:

Monte Carlo simulation and analysis show that the microdosimetric noise model is consistent with the difference in noise signal magnitude between silicon diodes and ion chambers under a radiation beam. Ion chambers also have a slightly better signal-to-noise-ratio as compared with the edge detector.

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