AbstractID: 4730 Title: Radiation characteristics of a gated fiber-optic-coupled detector

Purpose: To study the dosimetric characteristics of a gated fiber-optic-coupled detector for measuring absorbed dose from a linear accelerator. The favorable properties of these dosimeters are their superior spatial resolution, real-time readout and potential as in-vivo dosimeters. In an application that takes advantage of its spatial resolution, small field tissue-phantom-ratio (TPRs) measurements from 0.6x0.6 to 2.0x2.0 cm^2 are obtained and compared to those measured with a diamond and diode detector.

Method and Materials: The detector is a short length of Cu^{1+} fused doped quartz fiber coupled to a fiber-optic cable. It has an atomic number of about 10.8 with a density of 2.2 g/cm^3 and is 1 mm long with a diameter of 0.4 mm. The background signal generated by Cerenkov radiation and native fluorescence within the optical fiber during irradiation is separated from the detector luminescence via gating the signal with the radiation pulses from the accelerator. A linear accelerator provides mega-voltage photon and electron beams to investigate its energy response, dose rate dependence, dose linearity and reproducibility.

Results: There is no measurable difference in the detector response between 6 and 18 MV photons. However, for electrons the dose response increases gradually by 7% from 6 to 20 MeV. Its dose rate response relative to a Farmer chamber exhibits a behavior similar to a diamond detector decreasing by about 4.5% from 0.8 to 10.7 Gy/min for both 6 and 18 MV photons. The measured response is linear from 0.2 to 10 Gy and its reproducibility is better than 2%. The small field TPR measurements are in good agreement with the diamond and diode detector.

Conclusion: The dosimetric properties of this detector compare favorably with other radiation detectors, and its small size and optical interface make it potentially very useful for small field and in-vivo radiation dosimetry.