AbstractID: 9587 Title: Modeling of a commercial CdTe photodiode detector using the MCNP code

Purpose: To model a commercial CdTe photodiode detector using the MCNP code for the optimization of various x-ray measurement tasks related with an animal study to demonstrate the tumor dose enhancement by gold nanoparticles and kilovoltage x-rays. **Method and Materials:** The MCNP code was used to model a commercial CdTe photodiode detector (XR-100T, Amptek Inc.). MCNP calculations were performed with a phantom made of the mixture of gold nanoparticles and water at various gold concentrations to investigate photon attenuation, scattering, and gold fluorescence x-ray generation. A circular 100 kVp x-ray beam with a diameter of 1 cm was assumed to be incident on a phantom at a source-to-surface distance at 12.5 cm. The detector model was tested for the detection of gold fluorescence x-rays from the phantom by scoring photons coming out of the phantom at two different off-axis angles (i.e., 135^{o} and 90^{o}) with respect to the x-ray beam direction to minimize unwanted scatters to the detector. Three different concentrations (i.e., 3%, 1% and 0.1%) of gold nanoparticles were used for these simulations. **Results:** MCNP results indicated that the current CdTe detector model was capable of producing expected results, for example, showing the fluorescence x-ray peaks from gold. As expected, the height of these peaks was proportional to the concentration of gold nanoparticles within the phantom. The detector located at 135^{o} off-axis angle resulted in more prominent gold fluorescence peaks than that located at 90^{o} off-axis angle. **Conclusion:** The current study indicates that an MCNP model of a CdTe detector would be helpful to optimize x-ray measurement tasks required for *in vivo* demonstration of tumor dose enhancement by gold nanoparticles and kilovoltage x-rays.