AbstractID: 9468 Title: Detection of gold fluorescence x-rays for the in-vivo quantification of gold concentration during gold nanoparticle-aided radiation therapy (GNRT)

Purpose: To determine the concentration of gold (Au) nanoparticles presented within the tumor during *in vivo* demonstration of tumor dose enhancement by detecting gold fluorescence x-rays. **Method and Materials:** Gold nanoparticle solution of 1% by weight in saline was prepared using commercially available gold nanoparticles with 1.9 nm core diameter. A cylindrical sample container (2.5 cm in diameter and 5.0 cm in height) was irradiated with 110 kVp and 200 mA x-rays from conventional radiotherapy simulator for 40 seconds with 1 cm x 1 cm x-ray beam at 85 cm source-to-surface distance (SSD) and spectrum was obtained using either Si-PIN or CdTe photodiode detector using a container-to-detector geometry to minimize unwanted photons entering the detector. **Results:** The spectrum collected using the Si detector successfully captured the Au *Lα* and *Lβ* fluorescence lines at 9.7 and 11.4 keV, respectively, well above the background. Au *K* lines could not be measured with Si-PIN photodiode due to Si-PIN detection inefficiency above 60 keV. To capture the Au *K* lines, CdTe photodiode detector was employed which has high detection efficiency for energy range of Au *K* lines. The spectrum collected using CdTe detector clearly showed the Au *Kα2*, *Kα1*, and *Kβ* lines corresponding to energies of 67.0, 68.8, and 77.9 keV, respectively. **Conclusion:** The magnitude of obtained *Kα* fluorescence signal (i.e. greater than 50% above all background scattering) is very encouraging considering the tested gold concentration. With more sophisticated geometry to minimize scattered photons reaching the detector, Au fluorescence output from *K* lines can be used to measure even lower concentrations of gold nanoparticles. Fluorescence output as a function of Au concentration can be developed to accurately measure gold nanoparticle concentration.