AbstractID: 6811 Title: Detector technologies for photon counting/energy resolving x-ray and CT imaging

Purpose: To evaluate existing and a new detector technologies for photon counting/energy resolving x-ray and CT imaging. **Materials and Methods:** Digital mammography with photon counting Si and gaseous Xe detectors is now available. Although CZT and CdTe detectors are more attractive for photon counting x-ray and CT imaging, they suffer from hole trapping and charge sharing between pixels, which decrease energy resolution, count rate, and spatial resolution. We have proposed using CZT/CdTe crystals in a tilted angle configuration when the x-ray hits the crystal surface at a small angle. This allows decreasing crystal thickness significantly while maintaining high photon absorption. The tilted angle CZT/CdTe was simulated for 0.3-1 mm crystal thickness, 10°-90° tilting angles, and 50-150 keV photon energies. The results were compared to a crystal with 3 mm thickness used in normal irradiation. Experiments were performed with a tilted angle CZT with 2 mm crystal thickness using 59 keV and 122 keV photons and 110 kVp x-ray. **Results:** The count rate of the tilted angle CZT detector was higher by 10-20 times for 0.3-1 mm crystal thickness and 50-150 keV photon energies compared to CZT with normal irradiation. The electron collection time was shorter by 3-6 times. The charge diffusion and charge sharing between pixels was decreased correspondingly. The experiments have shown significant decrease in tailing of the energy spectrum with tilted angle detector. The peak/tail ratio of the measured energy spectrum was increased by 2.4 and 2 times for 59 keV and 122 keV photons, respectively, when 20° tilting angle was used.
Conclusion: The proposed tilted angle CZT/CdTe detector allows significant increase in count rate, energy resolution, and spatial resolution, as compared to currently used CZT/CdTe detectors. This potentially enables using tilted angle CZT/CdTe detectors for photon counting/energy resolving x-ray and CT imaging.