AbstractID: 3817 Title: Development and Analysis of a High Quantum Efficiency Thick Scintillator based Video EPID for Sub-MU Verification Imaging

Purpose:
The major limitation of current electronic portal imaging devices (EPIDs) is poor quantum efficiency (QE) with less than 5% of incident radiation being typically detected. We present a high QE prototype EPID based on a CsI(Tl) thick scintillation crystal (TSC) for high quality sub-MU verification imaging.

Method and Materials:
The prototype TSC utilizes a 12 mm thick clear 17X17cm2 CsI(Tl) screen (QE=24%) coupled to a 12-bit, 1024X1240 Plumbicon-tube camera (250 μm pixel-size at isocenter) installed on a clinical Siemens BEAMVIEWPLUS gantry. The initial performance of the TSC was studied with experimental measurements of spatial resolution and noise, along with a quantum accounting diagram (QAD) based on linear cascaded systems theory to predict system detective quantum efficiency (DQE). The theoretical model was used to study the effect of various components of the detector geometry on image quality, and to optimize the TSC for improved image quality.

Results:
The current TSC prototype with DQE(0)~0.01 provides an order-of-magnitude improvement in image quality over traditional VEPIDs, while matching the performance of flat-panel imagers at low frequencies. Since the optical geometry of the BEAMVIEW gantry was not optimized for the TSC, there was some loss in spatial resolution resulting in diminished performance at high frequency. Overall good image quality was observed even at low exposures.

Conclusion:
The enhanced luminescent output of the TSC results in high quality portal images even at sub-MU dose, and significant potential for daily verification imaging without risk of additional patient dose and intra-treatment imaging to monitor patient motion. Proposed improvements in the TSC include the optimization of the detector geometry for greater light collection efficiency and spatial resolution. Based on the QAD model, the performance of the TSC with proposed improvements is expected to improve significantly (DQE(0)~0.1) and exceed that of current flat-panels.