Contribution ID: **31**   Type: **Oral**

Fast Detectors Viewed from a Different Angle: Scintillators and SiPMs for Photon-Counting CT

Tuesday, 21 May 2024 10:10 (20 minutes)

Photon-counting computed tomography (PCCT) is a rapidly emerging medical imaging technology. Several PCCT scanners were recently developed based on finely pixelated room-temperature semiconductor detectors. Although scintillation detectors were traditionally considered too slow to handle the X-ray fluence rates > 108 photons s-1 mm-2 encountered in PCCT, the fast signals provided by modern scintillators and silicon photomultipliers (SiPMs) allow us to rethink this paradigm. SiPM-based scintillation detectors are commonly used in time-of-flight PET systems and have enabled the integration of PET and SPECT with MRI. Recent research indicates that SiPMs combined with ultrafast scintillators can also provide a robust, scalable, and affordable X-ray photon-counting technology. This offers new perspectives for the development of cost-effective X-ray photon-counting imaging equipment for different applications, including multimodal imaging and image-guided interventions. This presentation offers an overview of recent theoretical and experimental work, demonstrating the potential of SiPM-based scintillation detectors as an alternative for direct-conversion detectors. It will be shown how the choice of scintillator and other factors affect detector performance parameters such as count-rate capability and spectroscopic performance. Moreover, research opportunities in the areas of scintillator development, SiPM design, and X-ray photon counting medical imaging devices will be outlined.

Field

Detectors and electronics

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Session Classification: Fast timing sensors and electronics

Track Classification: Fast timing