Contribution ID: **32** Type: **not specified**

Strategies to Obtain Time of Flight Resolution in the 100 Picosecond Range.

Thursday 30 August 2012 11:35 (25 minutes)

Abstract. The use of time-of-flight (TOF) information in positron emission tomography (PET) significantly improves the image quality, in particular the signal-to-noise ratio. Commercially available TOF-PET systems have a CRT in the order of ˜500 ps FWHM, which has been shown to significantly improve whole-body PET images. The TOF benefit is inversely proportional to the coincidence resolving time (CRT). Achieving a timing resolution in the order of ˜100 ps FWHM would not only benefit whole-body PET, but would also enable dedicated TOF-PET(/MRI) systems for brain imaging. However, such an improvement of the timing resolution only makes sense if it can be achieved without sacrificing other important performance parameters, such as spatial resolution, energy resolution, and system sensitivity. This talk addresses some topics of importance for successful strategies towards these combined objectives. For example, the properties of the scintillator impose inherent limitations on the timing resolution. Research into new and improved materials therefore is ongoing. Furthermore, new photosensors such as silicon photomultipliers (SiPMs) have been shown to enable excellent coincidence resolving times (CRTs), in some cases better than conventional photomultiplier tubes (PMTs). SiPMs furthermore provide MRI-compatibility as well as greatly increased flexibility in the optimization of the detector geometry. We have recently shown how Cramèr-Rao theory can be used to quantitatively predict the best timing resolution achievable as a function of the scintillator and photosensor properties. Both this model and recent experimental results indicate that a 100 ps scanner should in principle be feasible, provided that one minimizes the time spread due to the variation of the position of interaction of the annihilation photons within the scintillation crystals. This requires innovative detector designs as well as new approaches in readout electronics, involving e.g. rapid digitization of a large number of detector channels and real-time signal (pre)processing. These topics will be discussed from a theoretical as well as from a practical point of view, including some examples of recent experimental approaches towards 100 ps PET.

Presenter: Dr SCHAART, D.

Session Classification: Photodetectors: - Developments in SiPMs - overview SiPM different designs and properties