
Contribution ID: **481** Type: **Oral Presentation**

# Optimization of the SiPM Pixel Size for a Monolithic PET Detector

*Friday 10 June 2011 17:10 (20 minutes)*

Molecular imaging of small animals with PET demands high detection efficiency (DE). PET detectors consisting of monolithic scintillators coupled to position sensitive photo-detectors can yield high DE by eliminating detection-inactive space. Silicon photo-multipliers (SiPMs) are compact photo-detectors with high gain, high photon detection efficiency (PDE) and fast response, and there is substantial interest in employing SiPMs for developing monolithic scintillator-based PET detectors. In this work, we investigate the optimization of the pixels size of an SiPM array to read out a monolithic scintillator. This pixel size affects the spatial resolution of the resulting detector. Generally, smaller pixels can measure more accurately the distribution of the scintillation lights at the exit surface of the scintillator to attain higher spatial resolution. However, smaller pixels also detect fewer light photons and result in higher pixel noise, thereby degrading the spatial resolution and energy resolution. The tradeoff between accuracy and precision therefore determines the optimal pixel size for the SiPM array. Using DETECT2000, we conducted Monte-Carlo (MC) simulations to investigate the relationship between the pixel size of the SiPM array in conjunction with a monolithic-scintillator PET detector and the resulting spatial resolution. In our study, the scintillator was 10 mm thick LYSO. Gamma rays were assumed to interact at the center of the scintillator and the light output of the scintillator was 30,000 photons per 1 MeV. The PDE of the SiPM was set as 20%. The position of a detected event was estimated from the light distribution pattern measured by the SiPM array employing a least-square fitting method that we developed. The full-width-at-half-maximum (FWHM) of the point spread function was obtained for assessing the spatial resolution of the detector. Our initial results showed a spatial resolution of 0.84 mm with a pixel size of 6×6 mm2, 0.58 mm with 9×9 mm2, and 0.69 mm with 12×12 mm2, indicating an optimal pixel size between 6×6 mm2 and 12×12 mm2.

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**Session Classification:** Instr. for Medical, Biological and Materials Res.

**Track Classification:** Instrumentation for Medical, Biological and Materials Research