LSU LOUISIANA STATE UNIVERSITY

PHYSICS & ASTRONOMY
WEEKLY CALENDAR

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WEEKLY CALENDAR

January 14 – 18, 2013

DEPARTMENTAL COLLOQUIUM

"Position Estimation in Monolithic Scintillation Detector"

3:30 PM, January 17, 2013
109 Nicholson Hall

Krishnendu Saha
University of Massachusetts Medical School

Host: Wayne Newhauser

• Refreshments served at 3:10 PM in 232 (Library) Nicholson Hall •

One promising detector design approach that can improve spatial resolution and detection sensitivity of dedicated breast PET at reduced cost is the use of monolithic scintillators. The estimate of the gamma photon interaction position in a monolithic scintillator requires an accurate mean light response function. The purpose of this work is to investigate the use of a modeling approach to estimate light response in monolithic LYSO scintillators. To accomplish this, irradiation of a detector geometry comprising of a 20 mm x 20 mm x 10 mm (depth) LYSO monolithic scintillator by a 511 KeV beam source of gamma ray photons of diameter 0.9mm (FWHM) was modeled by Geant4 [1] Monte Carlo simulation technique. The deposited energy for photoelectric and Compton interactions was assumed to generate optical photons at the interaction position having wavelength of 420 nm. cartesianDETECT2 [2] simulation software was utilized for tracking and sensing of light in 20 x 20 mm array of pixels of 200 um dimension placed at the entry face of the gamma photons on the detector. The resolution of the measured light at the photosensors at various beam locations (0 to 8 mm from the detector center) within the scintillator was compared to values in the literature using other simulators.

The measured resolution at the center of the detector of 1.63 mm (0.1 mm SD) was comparable to both simulated (1.66 mm) and experimental (1.67 mm) measurements for the same geometry reported by van der Laan et al [3]. Detector spatial response degraded at the edges of the scintillator compared to the center because of increased reflection and absorption. These results suggest that optical simulation of a monolithic LYSO scintillator using cartesianDETECT2 provides similar light sensing to both simulated and experimental measurements previously reported with a different simulation code. This simulation model can be applied for accurate estimation of detector response function for LYSO monolithic scintillators.

[1] J. Allison et al., "Geant4 development and aplications," IEEE Tans. Nucl. Sci., vol. 53, no. 1, pp. 270-278, 2006.

[2] D. Sharma et al. "Depth of interaction Monte Carlo estimates in crystallized CsI:Tl sensors," submitted to IEEE Trans. Nucl. Science.

[3] D.J. van der Lann et al. "Optical simulation of monolithic scintillator detectors using GATE/Geant4," Phys. Med. Biol., vol. 55, pp. 1559-1674, 2010.