



Contribution ID: 53

Type: **not specified**

Spatial Resolution Optimization of Sensor Arrangement Around a Monolithic Scintillator

Friday 20 June 2025 12:10 (20 minutes)

Preclinical positron emission tomography (PET) requires high spatial resolution of the detector. A monolithic scintillator detector block is one of the promising approaches due to its ability to estimate the depth of interaction (DOI) and improve resolution through processing multiple channels and analyzing light distribution. The typical construction of such a block is a matrix of silicon photomultipliers (SiPMs) attached to a larger surface of the scintillator. This design has several difficulties, such as edge effects, a high number of readout channels, and resolution degradation with increasing distance from the sensors matrix.

One way to achieve better resolution is to apply an alternative sensor arrangement. Modeling is useful for such optimization tasks. Geant4 provides precise modeling of optical processes and particles interactions. However, sufficient statistical data must be collected for accurate resolution estimation. Additionally, the resolution is influenced by the estimation algorithm, calibration procedures, and other factors.

In this work, an optical model is provided. The optical model formulates the dependence of registered pixel values based on pixel placement and distance. Model factors for calculations are solid angle and Fresnel's reflection coefficient. A resolution criterion, analogous to SNR, was introduced for position estimation. The mean value of this criterion over the entire volume can be calculated within an acceptable time using multi-threaded fast numerical integration algorithms.

The model was developed for a LYSO scintillator with dimensions $30 \times 30 \times 15$ mm. Subsequently, a Geant4-based model was used for precise optical simulation and resolution evaluation.

Author: ALEKSEEV, Nikita (National Research Tomsk Polytechnic University)

Co-authors: GOGOLEV, Aleksey (Tomsk Polytechnic University); FILATOV, Nikolay (National Research Tomsk Polytechnic University); CHISTYAKOV, Sergey (National Research Tomsk Polytechnic University); ERUNTSOV, Vyacheslav (National Research Tomsk Polytechnic University)

Presenter: ALEKSEEV, Nikita (National Research Tomsk Polytechnic University)

Session Classification: Oral Session S20-2