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A simple identification of multiple-hit events to improve the image quality of fine-pixel scintillation detector

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Scintillation detectors are widely used in various imaging techniques in the fields of medicine, astronomy, and environment. In general, large-area and fine-pixel scintillation arrays are needed to improve the sensitivity and image quality of detectors. However, a large scintillation array requires a huge number of read-out channels, which makes the detector system complex and expensive. The use of a resistive charge-division network can effectively reduce the number of readout channels. However, the disadvantage is that such detectors are insensitive to "multiple-hit"events, in which gamma rays interact multiple times within the same scintillator array. In this paper, we propose a simple method to identify multiple-hit events to improve the image quality of fine-pixel scintillation detectors. As a first demonstration, we obtained the flood map of a 42 times 42 Ce:GAGG scintillator array coupled with 8 times 8 MPPC of 3 times 3mm2 pixels. Using a 2D charge division network, 64 ch signals from MPPCs are compiled into four analog signals from the corners, S0, S1, S2, and S3. Then, the centroid of X and Y can be calculated in two ways by different groupings of Si. We assume that mismatched position (either X or Y) may be due to multiple-hit events that occurred within the scintillator. By rejecting such multiple-hit events, which accounts for ˜10% of the total, we confirmed that the peak-to-valley rate of the flood map improved from 6.00 to 8.79 at 350-550 keV with irradiated 137Cs. In general, multiple-hit events tend to occur during high-energy events. We also confirmed that the rejection rate was higher in the high-energy range compared with the low-energy range as expected by drawing spectral of rejected events. Our method is easy to use and can be applied to existing data for improving the image quality of fine-pixel scintillation detector.

Submission declaration

Original and unpublished

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