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#11-127 Spectral Resolution Enhancement of a SiPM Array-Based Radiation Detector

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Silicon Photomultipliers (SiPM) are becoming more attractive in radiation detection applications then the traditional photo multiplier tubes due to their low working voltage, compactness and immunity to electromagnetic interference (EMI). However, due to their small size, an array of SiPM components is required in order to cover the whole plane area of a scintillator. On the other hand, since SiPM is a semiconductor, that is biased in a reversed voltage, gain variation and strong temperature dependence are introduced. As a result, SiPM based detectors, particularly an array of SiPMs, undergo spectral resolution reduction.
In our work, we propose an electronic approach to overcome this technological drawback by individually adjusting the bias voltage for each SiPM in the array. This developed technology, provides an adequate temperature dependent, commonly distributed high bias voltage and an individual offset-voltage fine tuning. That enables to adjust all the SiPM components to their optimum operating points. Power-wise it is beneficial to operate SiPM at lower voltages, where undesirably gain variation are more dominant. This presented solution enables lower bias voltages, which provides both lower power consumption and enhanced spectrum resolution.
A group of ten SiPM devices was tested for break-down voltage analysis, by Inverse Logarithmic Derivative (ILD) criteria. The most suitable devices with respect to resolution were selected, to assemble a 2X2 SiPM array that is biased with our individual-offset topology. By means of pulse- height analysis, we investigated the ability to enhance the spectral resolution of an SiPM array coupled to various scintillators. The presented topology provides improved power consumption with enhanced spectral resolution over the traditional biasing methods.

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