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Position-sensitive Solid-state Photomultiplier Devices

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Nuclear imaging applications, such as PET, often use position-sensitive photodetectors coupled to scintillation detectors, to determine the location and energy of the event in a scintillation detector. Coupling nuclear imaging techniques to magnetic-resonance imaging, for morphological images, introduces a strong magnetic field that constrains the choice of photodetector. Solid-state photomultipliers (SSPMs) are high-gain photodetectors that are suitable for scintillation-based applications and are insensitive to magnetic fields. In general, SSPM detectors provide the energy of the scintillation event, but not its location.
Charge dividing networks require a small number of readout channels and are used to provide position information in photomultiplier tubes and avalanche photodiode detectors. In this work, we describe the design, modeling, and performance of position-sensitive SSPM detectors using charge dividing networks. The performance of devices that divide the charge between segments of SSPM detectors is compared to that of devices that divide the charge between each Geiger photodiode element of the SSPM detector. The performance of prototypes is compared, including position resolution and timing as a function of detector area and size of the resistors in the resistor network. The signals produced by GPD elements in a simple resistor network were modeled in SPICE to determine the best value for the network resistor. Simple simulation results will be presented.

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