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A simulation study to compare performance of analog and digital silicon photomultiplier tube by LTspice package

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Detectors play a fundamental role in understanding physical phenomena and improved our understanding. The rapid development in this area of science has been increased interest to enhance the performance of detectors to achieve precise results. Photomultiplier tube (PMT) known as one of the main parts of the detectors which are constructed in the shape of a vacuum tube and can detect light photons emitted by scintillators and amplify the intensity of light up to 100 times. Alongside the advantages of PMT, it has weaknesses such as being sensitive to a magnetic field which prevents their use in magnetic resonance imaging (MRI), low gain, and less coverage of scintillators. These weaknesses caused to development of an alternative type of element called silicon photomultipliers (SiPM). SiPMs are the latest generation of photomultipliers, which due to their low operating voltage, are currently used by many groups in a variety of fields, including high-energy physics calorimetry, solid-state physics, and nuclear medicine. SiPMs consist of independent pixels that are connected parallel to each other. It has a rectangular sensitive cross-section where each pixel consists of a series connection of an avalanche photodiode (APD) in Geiger mode and a quenching resistor. Thanks to this geometrical design, SiPM are able to provide larger sensitive areas in comparison to PMTs. In this study, we made a comparison of analog and digital SiPM as the most popular and recent type of photomultipliers via LTspice simulation package. The obtained results can provide a general perspective for each type for further utilization.

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