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Optical simulation study and Testing of ASIC chip

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The functionality and radiopurity of SiPM-based photodetectors with integrated electronics, which will meet the demanding requirements for radio pure detectors looking for dark matter. ASIC (application-specific integrated circuit) readout electronics have the potential to replace discrete electronic components and to reduce the radioactivity of photo sensor frontend electronics. For future dark matter experiments, we will need to scale-up the photo sensor coverage area, which will call for the development of integrated electronics with digital readout, capable of operation at cryogenic temperatures. ASIC uses Time-over-Threshold (ToT) method, which is a time-width signal processing method. This method has an advantage in its simplicity because it does not need a complicated ADC (Analogue to Digital Converter) circuit. Its disadvantage is the nonlinearity, which causes distortions in energy spectra. We used Geant4 simulations for uniformly generating recoiling electrons inside the TPC, with different energies i.e. 0.3, 0.7, and 1.1 keV. For the analysis, we used different segmentation sizes for each PDM (Photo detector module) i.e. $5 \times 5 \text{ cm}^2$, $2 \times 2 \text{ cm}^2$, $1 \times 1 \text{ cm}^2$ and $0.5 \times 0.5 \text{ cm}^2$. The $1 \times 1 \text{ cm}^2$ shows promising results as most of the channels see 1 photon while fewer channels see 2,3, or more photons. We are working on a small scale setup at AstroCeNT. We will perform tests using ASIC digital readout for SiPM (Silicon photo-multiplier) at cryogenic temperature.

Primary author: AHMAD, Iftikhar (Astrocent, Poland)

Presenter: AHMAD, Iftikhar (Astrocent, Poland)

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