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SiPM Based Cherenkov Camera Simulation

Future space detectors for Ultra High Energy neutrinos and cosmic rays will utilize Cherenkov telescopes to detect forward-beamed Cherenkov light produced by charged particles in Extensive Air Showers. A Cherenkov detector can be equipped with an array of Silicon Photo-Multiplier (SiPM) pixels, which offer several advantages over traditional photomultiplier tubes (PMTs). SiPMs are compact, lightweight, operate at lower voltages, and exhibit lower sensitivity to temperature variations, making them well-suited for space-based experiments.

To leverage these benefits, we designed, built, and tested a compact, modular UV detector that integrates a 64-pixel Multi-Pixel Photon Counter (MPPC) from Hamamatsu. This detector is coupled with low-power readout electronics based on the Radioroc ASIC by Weeroc and a Xilinx Artix FPGA.

To characterize the detector's performance, a simulation of its response to incident light is required. This simulation will account for the Photo Detection Efficiency (PDE) of individual MPPC pixels as a function of wavelength, the temporal response to individual photons, and the overall gain in terms of ADC counts recorded by the readout electronics per photoelectron, all under varying conditions.

A dedicated SiPM simulation module is currently under development within the OffLine detector simulation framework. The first step in validating this module will be to accurately reproduce the test setup in which SiPMs are exposed to different light sources.

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