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Development of a SiPM-based Water-Cherenkov Detector for Astrophysics

The Cherenkov effect is widely employed in experiments involving cosmic rays and neutrinos that utilize large sensitive volumes. The water is widely employed as the sensitive medium, with the primary particle to be detected being the muon. In this work, we present the development of a new water-Cherenkov detector that utilizes a photon trapping system and silicon photomultipliers (SiPMs) to record the detector signals, which has been named C-Arapuca. The utilization of SiPMs presents advantages over the traditional photomultiplier tube, PMT, including the utilization of much lower operating voltages and enabling the construction of more compact devices with greater geometric freedom. To study the performance of the C-Arapuca, a tank containing 550 liters of ultra-pure water was utilized. The confinement of Cherenkov photons is achieved through the utilization of a dichroic filter in the optical window and a bar that serves to shift the wavelength and guide the photons to the eight SiPMs coupled to the sides of the bar. The results of the efficiency of muon detection from local cosmic radiation are presented, indicating the feasibility of employing the C-Arapuca in future astroparticle experiments.

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