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Development of a Hodoscope for Testing and Characterization of WCD Detectors for SWGO

The Southern Wide-Field Gamma-ray Observatory (SWGO) is an international collaboration for the design and construction of the first wide-field gamma-ray observatory in the southern hemisphere. The observatory will be primarily based on surface water-Cherenkov detectors (WCD) sensitive to gamma rays from a few hundred GeV to the PeV. As part of the SWGO R&D activities, we developed a large-scale hodoscope installed at the Brazilian Center for Physics Research (CBPF) in Rio de Janeiro to test, characterize, and calibrate different WCD designs for SWGO. The modular set-up structure can accommodate WCD configurations up to 3 m in height and 30 m³ total water volume. The hodoscope employs four MARTA-type RPC detectors at its base, originally developed for the upgrade of the Pierre Auger Observatory, operating in avalanche mode and covering 7.3 m² with 256 pads. The upper detector plane uses 64 scintillator bars arranged in a 32x32 matrix, providing 5x5 cm resolution over 2.6 m². The front-end electronics utilize Altera Cyclone V FPGAs and MAROC ASICs with 64 channels, implemented both in the RPC and scintillator detectors. Five front-end units synchronize via a central control unit (CeU), for data recording and triggers. In this contribution, we will describe the CBPF hodoscope set-up and discuss some detector characterization already performed, including a complete set of Geant4 simulations developed to model the detector response to secondary cosmic rays and help validate the detector characterization. The hodoscope at CBPF is a key experimental facility to advancing WCD unit testing and characterization for SWGO.

Collaboration(s)

SWGO Collaboration

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