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A high performance and low-cost multipurpose Cosmic Ray Detector

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Proof of concept of a 2-channel Data Acquisition system for Astroparticles detectors.
The astroparticle detector is a 1000Lts Water Cherenkov Detector plus 2 scintillating pads.
This detector allow to perform measurements of the Vertical Equivalent Muon that are used to improve the calibration factors.

Summary (500 words)

Cosmic Ray (CR) detection systems are nowadays the only way to detect High Energy particles (> 14 GeV) to study Gamma Ray Bursts (GRB) and Solar Physics to name some applications. The Latin American Giant Observatory (LAGO) operates a network of Water Cherenkov Detectors (WCD) at different sites in Latin America. Spanning over different altitudes and geomagnetic rigidity cutoffs, the geographic distribution of the LAGO sites, combined with a high-performance, low-cost (< 1K USD) data acquisition (DAQ) board allows the realization of diverse astrophysics studies at a regional scale. The LAGO WCDs, located at high altitudes, possess good sensitivity to electromagnetic secondary radiation.
The DAQ board is composed of two channels for data acquisition working at a 125 MSPS rate, it has precise timing using a GPS receiver and atmospheric pressure and temperature sensing.
This work describes the development of a multipurpose CR detector based on a 1000 lts WCD plus 2 scintillator pads connected to two LAGO DAQ systems with the characteristics described above. As a proof of concept, a procedure to calibrate the WCD is performed. We characterize the dark pulses of the photomultiplier tube (model R5912) and discriminate the Vertical Equivalent Muon (VEM) from the charge histogram in order to improve the accuracy of the energy histogram; this procedure is going to improve the accuracy in the determination of the calibration factors of the WCD.

Primary authors: CAZAR RAMIREZ, Dennis (Universidad San Francisco de Quito (EC)); Dr ARNALDI, Horacio (Comisión Nacional de Energía Atómica, CNEA); SIDELNIK, Ivan (CONICET (Consejo Nacional de Investigaciones Científicas y Técnicas) - Centro Atómico Bariloche - Argentina); Dr AUDELO, Mario (Escuela Superior Politécnica del Chimborazo,)

Presenter: CAZAR RAMIREZ, Dennis (Universidad San Francisco de Quito (EC))

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