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Characterization of the signal produced by muons into one Water Cherenkov Detectors of the LAGO Observatory

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The Latin American Giant Observatory (LAGO) is an observatory array of Water Cherenkov

Detectors (WCDs) expanded throughout Latin America, from Mexico to Antarctica, with scientific objectives to study the cosmic rays, space weather phenomena, and ground-level atmospheric radiation. The quality of the data recorded by LAGO is guaranteed based on a protocol that includes the installation process and periodic monitoring of the instrument's calibration. This calibration is based on the signal produced by muon-like particles that completely and vertically pass through the WCD, it is called VEM (Vertical Equivalent Muon); so, VEM identification is important to the trustworthiness and correct interpretation of the LAGO data. Currently, the LAGO's algorithm to process and analysis the data allows us to identify the VEM signal, but this algorithm fails occasionally for some data, mainly because the water into the WCD becomes more absorbing to Cherenkov photons, so this data is rejected. Here we show a statistical analysis of the signals produced by muons into one of the WCD of LAGO with the aim of recovery the rejected data. In this study, we have used a full month of accepted data to characterize the properties of the muon signal, i.e. peak and integral of the signal, the decay time of the pulse, among others, later we built a pulse model for muon signal and we have tested it throughout Monte Carlo simulations, using the simulation framework of LAGO based on Geant4. Finally, we have validated this model with another set of accepted data.

Keywords: Background Cosmic radiation, Muon signal, Water Cherenkov Detector

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