An Advanced Triggerless Data Acquisition System for GRAPES-3 Muon Detector

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Executive Summary

What is this contribution about ?

- A new FPGA based compact, powerful triggerless muon data acquisition (TM-DAQ) system for large number of channels with the negligible dead time ~0.001%
- Design features including hardware and firmware for a rugged DAQ which allows to record each PRC hits with a time resolution of 10 ns

Why is it relevant / interesting ?

TM-DAQ opens a new window on several physics fronts such as,

- Precise measurement of the muon flux for thunderstorm studies
- Study of large angle EAS using the muon component
- Search for exotic particles characterized by its early or delayed arrivals

What have we done ?

- Designed TM-DAQ
- TM-DAQ installed for 4 muon modules - 928 PRCs in parallel to existing system

What is the result ?

- It allows to record ~20% more muon flux using same detectors with finer resolution
- Triggerless feature allows offline software trigger algorithm to be deployed and has demonstrated to reconstruct the muons as large as 85^{o} . It records a good fraction of large angle muons (~5% at $\theta > 60^{o}$) with a good angular resolution [PoS(ICRC2021)379]