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Expected Performance of cosmic muon veto detector at IICHEP, Madurai, India

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The purpose of the cosmic muon veto (CMV) detector is to investigate the feasibility of constructing a large-scale neutrino experiment at shallow depths. An extruded plastic scintillator (EPS)-based active veto system for cosmic ray muons is being built around the existing miniICAL detector, which is a scaled-down version of the proposed ICAL detector, at the transit campus of India-based Neutrino Observatory in Madurai.

Individual detector consists of extruded plastic scintillator (EPS) ($\sim\ 500cm \times 5cm \times 1cm$) consisting of two WLS fibres to collect scintillation photons and four silicon-photomultipliers (SiPMs) as photo-transducers. Eight such detectors are grouped to form a module, called a tile, which is placed adjacent to other tiles to cover the entire mini-ICAL detector. To achieve high efficiency and cover the dead space, up to four of these layers are stacked, to form veto-wall. The CMV detector comprises four walls, one on top, three on the sides, making it an active veto system that covers the miniICAL detector. The performance of scintillators, WLS fibres, SiPM readout systems, and muon reconstruction in the miniICAL have been well established. Using these developments, this work examines the feasibility of building such a large veto system around the miniICAL detector using the GEANT4 toolkit. The efficiency of the CMV is estimated using reconstructed muon tracks in the RPC stack with sufficient hits and good fit quality. The performance of the CMV detector is tested with and without a magnetic field using the muon reconstruction algorithm and extrapolating the same to the veto detector.

The goal is to achieve a veto efficiency $> 99.99\%$ and a false-positive rate of less than 10^{-5}. By achieving this high level of veto efficiency, the neutrino experiment can be conducted at a much shallower depth (just 100m) than what would normally be required (1.3km). The detailed performance of the hardware components and expected performance of the CMVD around the miniICAL will be discussed in this presentation.

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