

Muon flux measurement with INO-ICAL prototype detector

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As part of INO-ICAL R&D program, a prototype detector stack comprising of 12 layers of RPCs of (1 m \times 1 m) in area has been running for last three years and collecting data using cosmic muon trigger. Passage of a muon through this muon telescope is obtained from position informations in each layer and those are later on analysed to get zenith angle distribution of muons. Efficiency of muon trajectory in these RPC is estimated using signals in other layers. A straight line track is fitted through selected muon hits (rejecting noise events) where the calibrating layer is excluded from fitting. Difference between hits and fit points (residue) is used to defines the relative position bias in a layer with respect to others and position resolution of that chamber. These process is repeated to correct the relative position bias of all layers. If residue appears within one strip pitch, efficiency for that particular layer is being counted. These efficiency profiles and multiplicity distributions are used in Monte Carlo (MC) simulation to simulate muon tracks. Detector differential aperture are correctly estimated in MC considering all these fluctuations. Statistical minimisation method is applied to the observed zenith angle distribution of muons using Equ. 1,

$$\chi^2 = \sum_{\theta=0}^{\theta_{\max}} \frac{(N^{Obs.}(\theta) - I_0 \cos^n \theta \times \omega(\theta))^2}{N^{Obs.}(\theta)} \quad (1)$$

to estimate muon flux at the Earth's surface. $N^{Obs.}(\theta)$ is experimentally observed count in a θ bin and $\omega(\theta)$ is the solid angular acceptance in that angle bin. Muon flux distribution is assumed to be $I_0 \cos^n \theta$, where I_0 is the vertical muon flux ($\text{cm}^{-2} \text{s}^{-1} \text{sr}^{-1}$). Experimental results shows at 18°54'N (latitude), 72°48'E (longitude) $n = 2.150 \pm 0.011$ and $I_0 = (6.217 \pm 0.005) \times 10^{-3} \text{ cm}^{-2} \text{s}^{-1} \text{sr}^{-1}$.

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