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Simulation Studies for Reconstructed Muon Energy and Direction Resolutions in the ICAL Detector

The main goals of the proposed magnetized Iron Calorimeter (ICAL) detector at the India-based Neutrino Observatory(INO) are to make precision measurements of the atmospheric neutrino oscillation parameters and to determine neutrino mass hierarchy. Neutrinos interact with the the detector material via the charged current or the neutral current processes and produce leptons and hadrons. The ICAL detector is optimized primarily to measure the muon momentum and direction with good resolutions and efficiency. The charge,momentum and the direction of the muons can be determined by measuring its curvature as it passes through the magnetized volume of the detector. Here we present the simulation results for the muon energy resolution(σ_E), direction resolution($\sigma_{cos\ \theta}$), reconstruction efficiency(ϵ_R) and the charge identification efficiency(ϵ_C) for the current ICAL configuration with a magnetic field of about 1.5 T in the central region.

We have used a GEANT4 based simulation code developed by the INO collaboration for the detailed simulation of ICAL geometry and propagation of particles. This gives us the hit positions in the active detector as a particle propagates through the detector. A Kalman filter based algorithm is used to reconstruct the muon energy and the direction at the vertex. We propagate an ensemble of muons with fixed energy(E) and zenith angle(cos θ) through the detector in order to determine the resolutions and efficiencies. We have obtained the resolutions and efficiencies in the energy range 0.5-25 GeV and in the cos θ range [-1,1].

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