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# Hadron Energy Resolution and Three Flavor Neutrino Physics Analysis at INO-ICAL Detector

The proposed detector for India-based Neutrino Observatory (INO) is a magnetized Iron Calorimeter (ICAL) consisting of Resistive Plate Chambers (RPC) as the active detector. The main purpose of ICAL detector is to study the neutrino physics. Determination of neutrino mass and mixing parameters is one of the important open challenge in
today' s physics. The ICAL detector is designed to to perform these measurements. The detector will have a modular structure of total size 48m x 16m x 14.5m and consists of stack of 151 horizontal layers of 5.6 cm thick iron slab interleaved within 4 cm gap for the active detector element. The RPC' s of dimension 2m x 2m will be used as an activedetector. The readout of the RPC' s is through the external orthogonal copper pick up strips. This type of detector has good time resolution (1ns) and spatial resolution.
When cosmic rays interact with atmosphere it produces pions which then further decays into muons and corresponding neutrinos. These atmospheric neutrinos act as a source for the ICAL detector. Atmospheric neutrinos interaction with detector produces associated
leptons and hadronic shower. In order to get back the neutrino parameters we need to reconstruct the muons and hadrons with reasonable precision. Simulation studies has been carried out for finding the hadron energy resolution for INO-ICAL detector with the help of GEANT4 based simulation. Analysis has been done for Monte Carlo and NUANCE (neutrino generator) generated events at various direction and energy. Hadrons produces shower hits inside the active detector. The energy of hadrons can be reconstructed by taking these hits into account. Hit distribution for each energy and angle bin has been obtained and fitted with different distribution function and
it was observed that the hadron energy is proportional to the number of hits in an event.
Resolution of the detector based on this proportionality behavior has been obtained and different fitting function has been applied to calibrate the resolution as a function of energy.
Further, using the INO-ICAL detector resolutions, we have also performed two and three flavor neutrino oscillations studies for the precision measurement of neutrino oscillation parameters. From our analysis we have obtained the sensitivity of the ICAL detector for
the oscillation parameters. In the talk, we will present the results for the hadron energy resolution and the latest status on the oscillation parameter studies for the INO-ICAL detector.

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