Machine learning based event classification for INO ICAL prototype stack

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Abstract

The India based Neutrino Observatory is a project, which aims to build an underground laboratory to study atmospheric neutrinos using a 50 kiloton Iron Calorimeter detector(ICAL) in a 1300 meter deep cave at Theni, Tamil Nadu, India. The primary goal of this observatory is to make a precise measurement of atmospheric neutrino oscillation parameters like mixing angle and the mass square difference and more importantly addressing the mass hierarchy problem. The Resistive Plate Chambers are being used as the active detector element in the INO-ICAL. As a part of its R & D program, a prototype detector stack consisting of 12 layers of glass Resistive Plate Chambers (RPCs) of size 1 m $\times$ 1 m has been set up at Tata Institute of Fundamental Research (TIFR), Mumbai. This detector stack is being used as a test-bench of the INO-ICAL. Cosmic muons are monitored continuously in this detector stack. Many cosmic muon studies like measurement of zenith angle distribution and cosmic muon intensity were performed using this stack. In this report, the result of analysis with simulated datasets is presented for muon multiplicity estimation using this stack and the result of analysis with real datasets is presented for event classification using this stack. Here we propose to use a machine learning-based algorithm to classify events as single muon, multi muon and noisy events. For this purpose, simulated datasets have been generated which have been used to train the machine and to test the efficiency as well. We have shown that the trained model can be used satisfactorily to classify the multi muon events, which were earlier regarded as noise.