



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

NOvA (NuMI Off-Axis ν_e Appearance) experiment is a neutrino $\nu_\mu \rightarrow \nu_e$ oscillation experiment with a baseline of 810 km. The signature for a $\nu_\mu \rightarrow \nu_e$ oscillation in the far detector is the production of an electromagnetic (EM) shower due to the charge current (CC) interaction of ν_e with the detector material. Cosmic muon induced electromagnetic showers can serve as a source of EM shower sample that can be used as a data-driven method for validating the EM shower modelling and EM shower identification algorithms at NOvA. The work reported in the thesis is the first ever implementation of cosmic muon induced EM shower for such a purpose in the NOvA experiment. We extracted EM shower sample from two sources - muon undergoing bremsstrahlung (Brem) and muon decay in flight to electron (DiF). Brem sample, extracted from cosmic muon, turns out to be a very useful data-driven method for testing EM shower modelling and the particle identification (PID) algorithms for the detection of ν_e -CC interactions. A new muon removal (MR) technique is developed and applied to remove the muon hits inside the bremsstrahlung shower. However, a complete removal of the muon energy in the event is not possible with high efficiency. DiF induced EM shower, on the other hand, is exactly similar to ν_e -CC EM shower because DiF is a pure electron initiated EM shower. Therefore, DiF EM shower, once extracted, mimicks the shower of a ν_e -CC interaction event. We present the extraction methods for both brem and DiF events in MC and cosmic data in far and near detector of NOvA and its use in data driven validation of ν_e EM shower modelling and ν_e signal selection efficiency across the detector. A systematic uncertainty is also assigned on ν_e appearance signal selection based on this study to take into account the difference in EM shower modelling in data and MC.