Selection and kinematic properties of ν_μ charged-current inclusive events in 5×10^{19} POT of MicroBooNE data - Public Note - (MICROBOONE-NOTE-1010-PUB)

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Abstract

This note describes a first selection of ν_μ charged-current inclusive events in the MicroBooNE detector. MicroBooNE is a 170 ton liquid-argon time projection chamber, located at surface level in the Booster Neutrino Beam at Fermilab. The detector is therefore continuously exposed to cosmic rays, which outnumber the observed neutrino interactions by almost three orders of magnitude. Hence, the selection of neutrino interactions within the cosmic background is the first step towards any neutrino physics analysis in MicroBooNE. This note describes two approaches, which successfully select ν_μ charged-current events in a fully automated way. It also outlines further necessary steps to improve the detector understanding and reconstruction, increase the selection efficiency and address systematic uncertainties, before the first neutrino-argon cross sections can be derived.

1 Introduction

MicroBooNE is a liquid argon time projection chamber (LArTPC) with an active volume of 87 tons [1]. The drift distance between the cathode, which is operated under a voltage of -70 kV, and the wire plane anode is 2.56 m. The wire plane anode consists of three planes of wires with a plane and wire spacing of 3 mm, and wires oriented at a 60° angle. The wires are gold coated stainless steel and a total of 8256 are deployed in the anode frame. Ionization electrons created by charged particles from neutrino interactions in the liquid argon drift towards the anode under the influence of the applied electric field. The electron signals collected by the wires are read out and amplified by electronics submerged in the liquid argon, before being transported to a readout system outside the detector. The arrival times and deposited charge on the wires allows a three-dimensional reconstruction of the final state particles from a neutrino interaction. A light system consisting of 32 8-inch photomultipliers (PMTs) records associated scintillation light and delivers precise timing information for triggering and reconstruction.

MicroBooNE is the first LArTPC operating in a neutrino beam while located at surface level. Since the electrons in liquid argon move rather slowly, the maximum drift time for ionization electrons to cover the entire distance between cathode and anode in a drift field of 273 V/cm is 2.3 ms [2]. During this time window, a large number of cosmic induced particles traverse the detector, which can either overlay a triggered neutrino interaction or even deposit a sufficient amount of light to trigger the readout of an event by itself. This results in about a dozen cosmic induced particle trajectories within a 2.3 ms time window [3], which need to be tagged as background during the reconstruction and selection process.