



Contribution ID: 19

Type: not specified

Demonstration of \sim ns timing resolution in MicroBooNE Photon Detection System

Thursday, 16 September 2021 13:15 (15 minutes)

The MicroBooNE detector, located in the Booster Neutrino Beamline (BNB) at Fermilab, has been operating since 2015 as part of the Short Baseline Neutrino (SBN) program. MicroBooNE's Liquid Argon Time Projection Chamber is accompanied by a Photon Detection System (consisting of 32 PMTs) used to measure the argon scintillation light and determine the timing of the neutrino interactions. This work will demonstrate the analysis techniques developed to improve the timing resolution of the light signals to $\mathcal{O}(\text{ns})$. The result obtained allows MicroBooNE to access the 2ns neutrino pulse structure of the BNB for the first time, which enables significant enhancement of cosmic background rejection for all neutrino analyses. Furthermore, the ns timing resolution opens the door for searching new long-lived-particles (i.e. Heavy Neutral Lepton, Higgs Portal Scalars) as we develop light-based trigger systems for future large LArTPC experiments, namely SBN and DUNE.

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Session Classification: Signal Reconstruction (3C)

Track Classification: Signal reconstruction and identification (analysis methods, simulations)