Contribution ID: **34** Type: **not specified**

Analysis of Scintillation Signals from PMTs in ICARUS: Data and Simulation Comparison

Wednesday, 18 June 2025 12:30 (20 minutes)

ICARUS (Imaging Cosmic and Rare Underground Signals) is the Far Detector of the Short Baseline Neutrino (SBN) program at Fermilab, designed to search for evidence of sterile neutrinos in the eV mass range.
The detector consists of two large liquid argon time projection chambers (LArTPCs), each containing 760 tons of liquid argon. A key subsystem is the array of 360 photomultiplier tubes (PMTs), which detect the prompt scintillation light produced by charged particles traversing the argon.
The scintillation signal provides fast and accurate timing information, essential for event triggering, reconstruction, and for distinguishing neutrino interactions from cosmic-ray backgrounds.
The ICARUS PMTs are Hamamatsu R5912-MOD models, 8 inches in diameter and optimized for cryogenic operation. These devices offer high quantum efficiency, excellent timing resolution, and low dark current (~10 nA at 1500 V), with a spectral sensitivity from 300 to 650 nm—well matched to argon scintillation light.
The presentation focuses on analyzing the waveforms recorded by the PMTs and comparing them with Monte Carlo simulations to assess the consistency between data and simulation. This validation process is essential for improving event reconstruction, evaluating detector performance, and ensuring reliable calibration for current and future neutrino physics operations.

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Session Classification: Oral contribution