Time calibration and synchronization of the scintillation light detection system in ICARUS-T600

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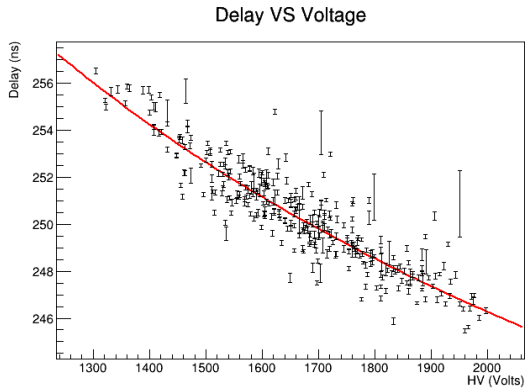
Abstract:

The ICARUS-T600 liquid argon (LAr) time projection chamber (TPC) is presently used as a far detector of the Short Baseline Neutrino (SBN) program at Fermilab (USA) to search for a possible LSND-like sterile neutrino signal at $\Delta m^2 \sim o(eV^2)$ with the Booster Neutrino Beamline (BNB).

A light detection system, based on 360 large area Photo-Multiplier Tubes (PMTs), has been realized for ICARUS-T600 to detect VUV photons produced after the passage of ionizing particles in LAr. This system is fundamental for the TPC operation, providing an efficient trigger and contributing to the 3D reconstruction of events. Moreover, since the detector is exposed to a huge flux of cosmic rays due to its shallow depths operations, the light detection system allows for the time reconstruction of events, contributing to the identification and to the selection of neutrino interactions within the BNB spill gate.

The correct time reconstruction of events requires the precise knowledge of the delay of each PMT channel and a good synchronization of recording electronics, this last based on fast sampling digitizers. To this purpose light pulses produced by a laser calibration system are sent simultaneously to the PMT windows and the corresponding signals are recorded. Collected data allows the evaluation of the time differences among the PMTs and the delays with respect the trigger pulse with a precision better than 1 ns.

The procedure adopted for the time calibration and synchronization of the light detection system is introduced together with a presentation of the main results.



Example of delay distribution of different PMT channels as a function of applied HV power supply as resulting from the laser calibration