Implementation of the trigger system of the ICARUS-T600 detector at Fermilab

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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 with the Booster Neutrino Beam (BNB).

The trigger system exploits the coincidence of the BNB and NuMI beam spills, 1.6 and 9.5 μs respectively, with the prompt scintillation light produced by charged particles in liquid argon as detected by the PMT (Photo Multiplier Tube) system installed behind the wire planes of each of the 4 TPCs. PMT signals are digitized and the corresponding LVDS signals are processed by FPGA modules according to a Majority logic (> N signals above a threshold) to produce a Global Trigger that activates the full detector readout.

The Trigger system layout is based on NI (National Instruments) PXIe instrumentation fully contained in a single PXIe crate (NI-1082) and consists of: a Real Time (RT) controller (NI PXIe-8840), one SPEXI board by INCAA Computers, and three FPGA programmable boards (NI PXIe-7820R).

NI-LabVIEW 2020 code, with Real Time and FPGA modules, handles all inter-boards communications and, in the event of a Global Trigger, sends trigger data to the DAQ to build and record events.