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Performance and opportunities of the trigger system for the ICARUS-T600 detector, exposed to the Booster and NuMI neutrino beams

The ICARUS-T600 liquid argon time projection chamber (LArTPC) detector is currently taking data at shallow depth as the far detector of the Short Baseline Neutrino program at Fermilab, to search for a possible sterile neutrino signal at $\Delta m^2 \approx 1$
$textnormaleV^2$ with the Booster (BNB) and Main Injector (NuMI) neutrino beams.
The ICARUS trigger system exploits the coincidence of the 1.6 and 9.6 μs BNB and NuMI beam spills with the prompt scintillation light signals produced by ionizing particles in LAr and detected by 360 8" photo-multiplier tubes (PMTs).
Due to the 0–2 GeV (0–5 GeV) neutrino energy range of BNB (NuMI), neutrino interactions are on average contained in a 4-m length along the beam direction, motivating a trigger based on a PMT-multiplicity inside limited TPC regions.
The first trigger efficiency measurement leverages cosmic ray data collected with a minimum-bias trigger, without imposing any scintillation light requirement, and the timing from an external cosmic ray tagger system.
The efficiency with a highly-pure stopping muon sample saturates at $E_\mu \approx 300$ MeV, covering most of the BNB and NuMI charged-current neutrino interactions.
For the latest ICARUS run, the PMT-multiplicty threshold is being lowered to further improve the low-energy trigger detection efficiency.
Special *adder* boards, performing the analog sum of scintillation light signals in limited TPC portions, are being introduced as an additional trigger system to possibly recover low-energy neutrino interactions close to the PMTs.
Finally, the ns-scale timing resolution is being leveraged to reconstruct the bunched structures of the BNB and NuMI beams, with the aim of eventually introducing an off-line time-based trigger to cut in-between bunches, rejecting cosmic rays with high efficiency while retaining neutrino interactions with high purity.

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