



# Status of ICARUS commissioning

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PMG/AEM 01/07/2021

# December updates

- Icarus **Operations Readiness Review** (ORR), commissioned by Fermilab's Chief Research Officer, held virtually on December 8-11, 2020.
  - Goal: determine readiness to take high quality data, plans to publish results and communication/availability of required resources from various Divisions and Sections in the Fermilab Organization.
  - Very positive feedback from the committee: evaluated Experiment Operations Plan (EOP) document and presentations high quality, acknowledged progress in construction and commissioning despite difficult Covid19 circumstances.
- Transition of **Deputy Commissioning Coordinator** role from B. Howard (FNAL) to A. Scarpelli (BNL).

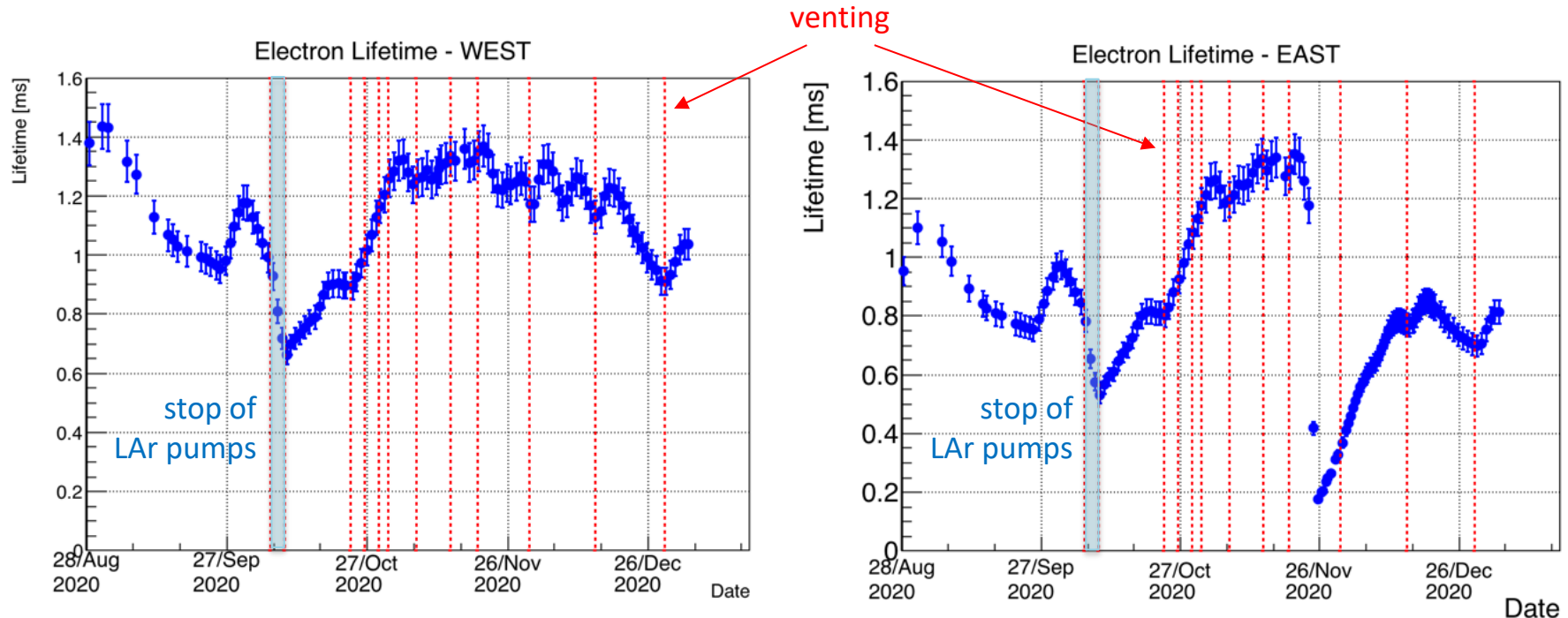
Many thanks to Bruce for his valuable contributions on several aspects of commissioning, in particular for setting up the control room and remote shift tools!
- A **Google Voice** account (+1 631 894 4173) was set up in order to have one single phone number used by the shifters.
  - Successfully used in the last 2 weeks for communicating with Main Control Room.
  - If a call is not answered by the shifter, forwarded to Commissioning Coordinator -> deputy Commissioning Coordinator -> Operation Support Coordinator.

# December updates (cont'd)

- **PMT** commissioning.
  - Equalization: counting rates of each PMT recorded at different discrimination thresholds, and operating threshold values chosen to equalize the counts.
  - Recording of counting rates for all possible logic configurations within each PMT pair, to confirm that  $\text{PMT}_{\text{or}} = \text{PMT}_{\text{even}} + \text{PMT}_{\text{odd}} - \text{PMT}_{\text{and}}$ .
  - Hardware interventions (new cabling of the distribution of the trigger signal) to enable commissioning of the trigger system.
  - Upgrades of the PMT slow control system.
- **DAQ** commissioning.
  - General debugging/stability testing.
  - Work on configuration database utilities.
  - Incorporation of the trigger fragment (containing White Rabbit timestamp) for event synchronization.
  - PMT DAQ updates/tests for trigger compatibility and readout configurations to support beam timing studies.

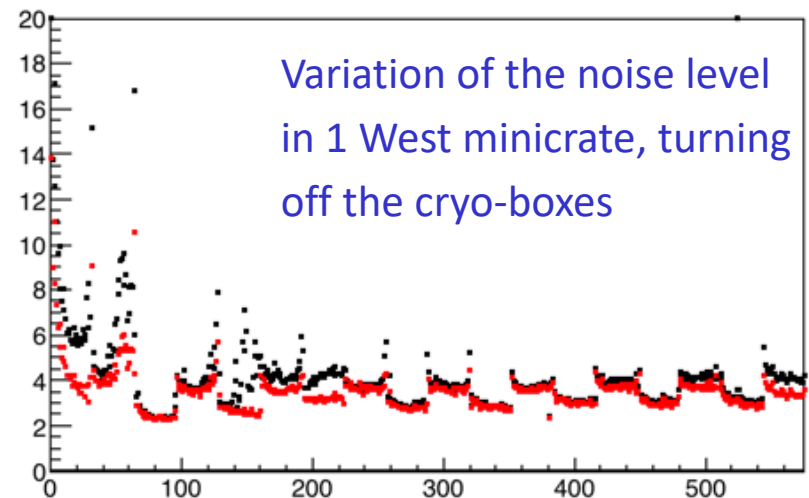
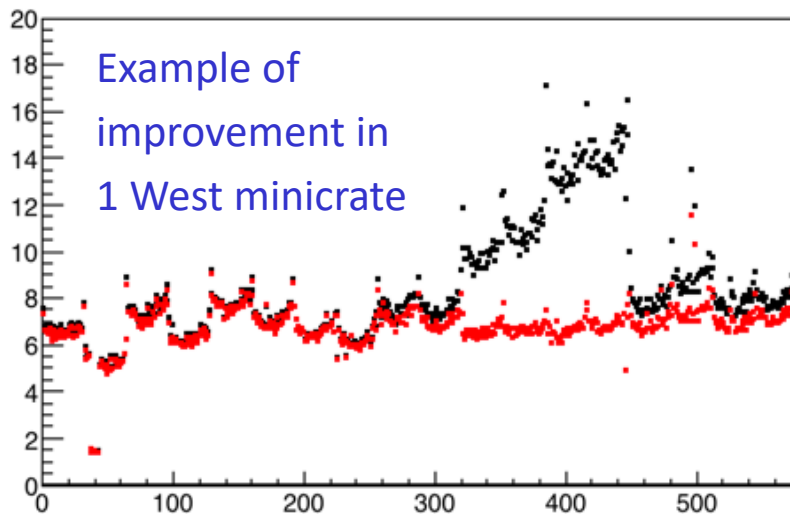
# Cryogenics and electron lifetime updates

- Cryogenic system overall stable and operational, except SouthEast condenser.
- Filters of both condensers for the West cryostat regenerated.
- No improvements observed in the electron lifetime, maintained stable at  $\sim 1$  ms with periodic venting. Plan being developed to incorporate an additional external gas filtration system.



# Mitigations of excessive TPC noise

- Systematic survey of the TPC readout in WEST cryostat, started on Nov 30<sup>th</sup>, thanks to presence onsite of experts from Padova.
- Higher-than-average noise reduced in 10 (out of 28) mini-crates by installing two 100 Ohm resistors on the digitizer boards.
- Possible external sources of noise (cryo-boxes and strain gauges) switched off to verify the impact on the RMS on 12 mini-crates. Relatively small changes observed, in particular when turning off the cryo-boxes.





# Commissioning of the trigger system

- Setup of a “provisional” trigger system based on simplified PMT majority request in coincidence with the BNB gate opening for a single cryostat.
- Allow to verify the correctness of the trigger chain and its functioning, as well as exercise the synchronization of the DAQ components, on a shorter timescale (a few working weeks), in parallel with development/commissioning of full trigger.
- Two steps:
  - 1) Spill-only trigger, based on the BNB extraction signal (gated-BES) distributed via White Rabbit network, to read-out both TPC and PMTs signals in the EAST cryostat;
  - 2) Addition of scintillation light info by requesting  $\sim 10$  PMT pairs in either PMT wall in the EAST cryostat inside a  $1.6 \mu\text{s}$  BNB gate.
- Timing of the gate opening will be optimized by searching for the maximum of the event rate induced by  $\nu$  in-spill interactions in addition to the cosmic rays.
- This procedure would allow the recording of first neutrino interactions. At the present 3 Hz Booster extraction rate,  $\sim 2.5 \cdot 10^5$  spill-only triggers should be reduced to  $< 10^4$  by asking  $\sim 10$  fired PMT pairs. Additional offline filtering would select  $< 5000$  events to be scanned.

# Schedule of commissioning activities

BNB on ORR

