SBN Joint Working Groups Update

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SBN Oversight Board Meeting, June 9th, 2023

SBN Working Groups

- SBN DAQ and Data Pre-Processing *[conveners: Bill Badgett, Angela Fava, Wes Ketchum]*
  - *Goal*: Develop common tools for **trigger, data acquisition and data pre-processing**, and coordinate activities in those areas.
- SBN Slow Controls *[convener: Geoff Savage, Sungbin Oh]*
  - *Goal*: Develop **control systems** based on **hardware and software interfaces** as much as possible identical for the two detectors.
- SBN Cosmic Ray Tagger *[conveners: Laura Patrizii, Minerba Betacourt]*
  - *Goal*: Review the **CRT production status and the installation plans** for the two detectors, develop common CRT **DAQ and monitoring.**
- SBN Analysis Infrastructure *[conveners: Giuseppe Cerati, Steven Gardiner]*
  - *Goal: C*oordinate and address **data and software infrastructure** and **computing resource needs** across the SBN
- SBN Analysis Trigger *[conveners: Angela Fava, Michelle Stancari]:*
  - *Goal: Share and discuss strategies for cross-checking trigger efficiencies independently measured by the two detectors*
- SBN Analysis *[conveners: Daniele Gibin, Georgia Karagiorgi]*
  - *Goal:* Take care of all the aspects of the multi-detector physics analysis for **SBN sterile neutrino oscillation searches**

SBN Slow control WG – SBND overview

Goal: establish controlling/monitoring system for important devices

- Build input/output controller (IOC) apps
  - Use the EPICS Channel Access protocols to access process variables (PVs)
  - PV : a quantity being monitored or controlled
- Make Graphical User Interface (GUI) for convenient access to PVs
- Connect to the database servers : archiving history of PVs
- Build monitoring webpage : easy access to history of PVs

Example PVs - TPC Drift HV

Read & Write	Read PV	Write PV
Current limit	sbnd_drift_hv/curr	sbnd_drift_hv/set_curr
Voltage setting	sbnd_drift_hv/meas_volt	sbnd_drift_hv/set_volt
Average number of recording	sbnd_drift_hv/aver	sbnd_drift_hv/set_aver

Major updates

- Improvements for TPC wire bias powers and cold electronics side
- Adding frontend pages for shifters - works for building skeletons are done

ICARUS Slow Control

- Group members: Jamie Dyer - CSU grad student (new), Antonio Gioiosa - INFN PISA (new), Niccolo Moggi – INFN Bologna, Geoff Savage – Fermilab
- Updates for Icarus drift HV (in production on 14-Feb-2023):
  - ramp down of drift hv when AC input is missing from the drift HV ups (Building power cut, fire, local power issue)
  - updated program for control and monitoring of Icarus drift HV
- ArchiveEngine monitoring
  - Values from electronics are stored in a database
  - The status is available through a web page and the information is sent to the control system;
  - first version of the gui panel
- White rabbit switch (WRS) monitoring
  - scripts to create the control system configuration for monitoring a WRS
  - WRS information displayed in gui panels
  - Using scripts will simplify the transition from WRS firmware v5 to v6

SBN Analysis infrastructure

Resources for near-term production.

- Resources allocated for 2023 as requested to Fermilab computing
  - Additional 1 PB of disk added to allow efficient reprocessing of ICARUS Run 2 data (followed by later SBN campaigns)

- Ongoing ICARUS production campaigns based on recent release, targeting preliminary results for summer conferences
  - Run 2 data keep-up processing
  - Run 1 re-processing (at CNAF)
  - MC Campaign for ~5M events, both BNB and NuMI

- Preparation underway to start SBND production

- AI group represented on new SBND Operations Planning Task Force
  - Initial discussions related to data handling, monitoring, etc.

SBN Analysis infrastructure - cont

Infrastructure plans for first SBN analyses

- Co-organizing July 2023 workshop at Fermilab with SBN Analysis Group
  - Focus is readiness for first SBN analysis results in calendar year 2024

- Analysis Infrastructure effort will particularly focus on unifying simulation, reconstruction, and systematics treatments between the two experiments
  - Refactoring detector simulation
  - GENIE-based neutrino interaction model
  - Integration and updates to framework for reweighting-based systematic uncertainties

- SBN AI group recently reorganized but needs new members
  - Itemized list of tasks developed, multiple vacancies for important priorities
  - Under-staffed technical and scientific tasks are all critical for first physics results

SBN DAQ and Data Pre-processing WG : ICARUS

- Upgrades to new operating system
  - Preparing tests over summer to begin transition to Alma Linux 9 (SLF7 end of life next year)
  - Full transition requires support from SciSoft team for upgrades to build system (common with offline software)
- Continued discussions with White Rabbit timing system experts at CERN on sustainable support for SBN needs
  - Plans for a "White Rabbit Consortium" to be launched by CERN in late 2023
  - When more details available on membership requirements/costs, will need to evaluate
- Common developments/maintenance continuing. Some highlights:
  - Upgrades and fixes on CAEN V1730 (PMT digitizers) and CRT board readout (including bottom panels for ICARUS)
  - Smoother integration of offline software with online data quality monitoring

SBN DAQ and Data Pre-processing WG: SBND

- DAQ is being run using one subsystem at a time and integrating a few subsystems and data are being validated.
- DAQ group is exploring possibilities for TPC channel mapping:
  - first proposal under discussion;
- Monitoring tools and infrastructure for various subsystems (TPC, PMT, CRT) exist and are currently being used during DAQ runs:
  - Data Quality Monitoring group will be communicating with experts to setup monitoring metrics for operation;
  - Monitoring tools for Trigger Boards and DAPHNE are pending DAQ testing;
- EPICS I/O control programs for detector control and GUI pages for monitoring are complete for all devices at SBN-ND:
  - DAQ users have started using these programs at ND;
  - Next, the plan is building alarm servers for the DCS summary page.

SBN Analysis trigger WG

Group activities were relaunched since last oversight board meeting:

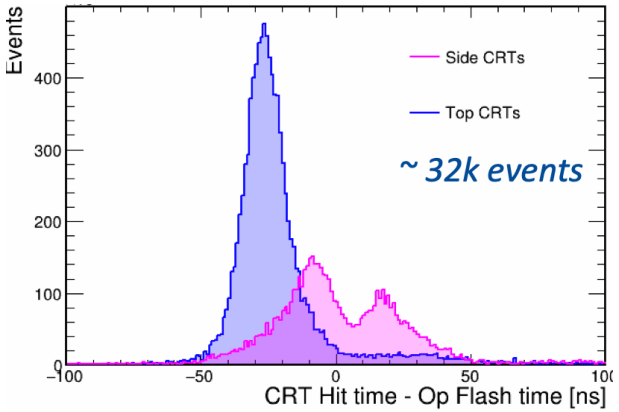
- a mini-workshop (~15 people per meeting) dedicated to the White Rabbit system: three 1-hour meetings: Mar 10, Mar 17 and Mar 24. Agenda and slides are available on docdb: conferenceid=14685, conferenceid=14740 , conferenceid=14800,
  - quite successful in capturing and sharing the details of the current network implementation and usage in SBND and ICARUS.
  - lively discussion on long term support and upgrades, which led to getting back in touch with the CERN team and considering joining the White Rabbit Collaboration.
  - goal to draft a technical internal note collecting all information and documentation on the system, hopefully becoming a publication in the near future.
- The group is looking forward at another mini-workshop in a similar format, whose topic is still being discussed.

ICARUS CRT – status and updates

- Two-layer Top CRT external telescope included in regular data taking. To be exploited for timing and reconstruction studies;
- Bottom CRT to be soon included in regular data taking. Its calibration and timing synchronization with Top and Side CRTs is starting;
- CRT-PMT based event filter implemented in the event reconstruction chain. Validation ongoing;
- CRT-TPC matching in progress.

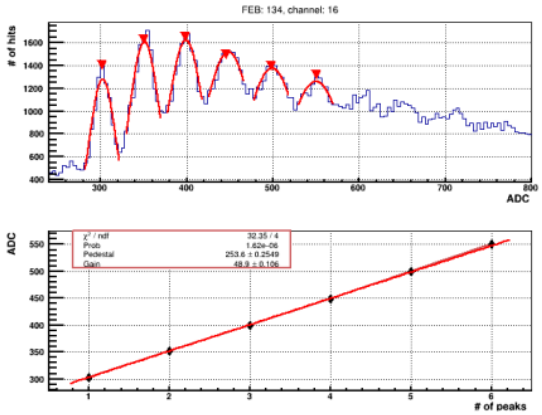
External CRT telescope

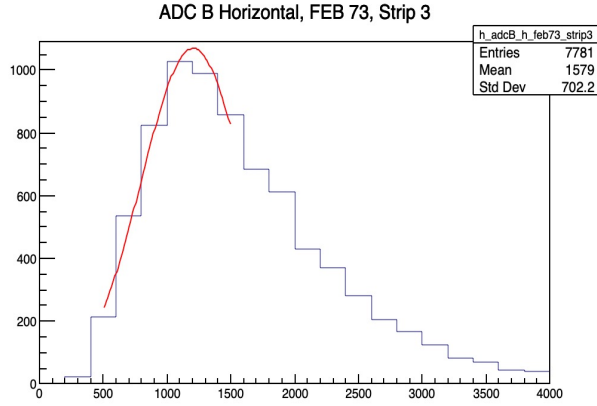
CRT-PMT Matching (Data)



SBND CRT A-frame Test Stand

- Check for light leaks;
- Verify electronics functionality:
  - Dead channels;
  - Bias voltage/pre-amp gain control;
  - Timing;
- Measure SiPM gain-voltage curves;
- Characterize MIP muon: response:
  - Light yield;
  - Attenuation;
  - Tagging efficiency;
- Used for all 16 North Wall modules.





SBN Analysis Working Group

- The activities of the SBN Oscillation WG convened by E. Worcester and J. Zennamo have been revitalized, ongoing discussions on SBN analysis strategy:
  - Considering first SBN joint result on muon neutrino disappearance, with early SBND physics data;
  - Primary concern is production timelines
- SBN Analysis Workshop during July 25-28, at Fermilab, with the possibility of remote participation: https://indico.fnal.gov/event/59757. Four main topics:
  - Developing methods to assess full systematics envelope, with a primary focus on detector and Geant4 systematics;
  - Understanding where SBND+ICARUS simulation and reconstruction diverge, re-benchmarking reconstruction performance, and working on fixes/convergence;
  - Getting 2D drift simulation and deconvolution integrated in both SBND and ICARUS and calibrated
  - Informing early SBN results strategy, e.g. POT needed, exclusive or multi-channel search, etc.