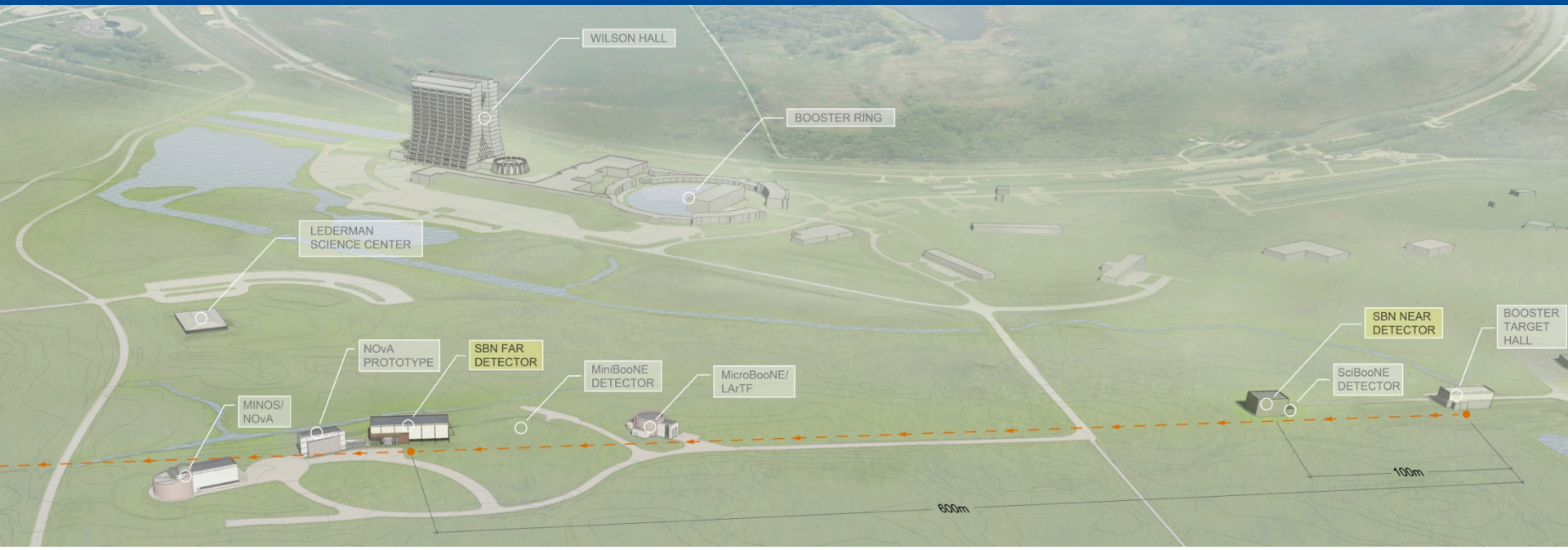


SBN Working Groups

SBN Oversight Board Meeting

June 12th 2020

Ornella Palamara

SBN Working Groups

- SBN DAQ and Data Pre-Processing *[conveners: Bill Badgett, Angela Fava, Wes Ketchum, Sandro Ventura]*
  - *Scope*: Common efforts on **trigger, data acquisition and data pre-processing**, and coordinate activities in those areas.

- SBN Slow Controls *[conveners: Sowjanya Gollapinni, Geoff Savage]*
  - *Scope*: Develop a **control system** based on **hardware and software interfaces** as much as possible identical for the two detectors.

- SBN Cosmic Ray Tagger *[conveners: Umut Kose, Igor Kreslo, Minerba Betacourt]*
  - *Scope*: Review the **CRT production status and the installation plans** for **the two detectors**, develop common CRT **DAQ and data output format** (together with the SBN DAQ WG), develop **common CRT monitoring.**

- SBN Analysis *[conveners: Daniele Gibin, Ornella Palamara]*
  - *Scope:* Implement a **multi-detector** simulation, the reconstruction algorithms/tools and the **analysis tools for the SBN oscillation analysis**.

SBN Working Groups

- SBN Analysis Infrastructure *[conveners: Wes Ketchum, Joseph Zennamo]*
- *Scope:* Manage SBN production and data resources, define analysis data format, develop data-driven, beam and detector-external interaction simulations.

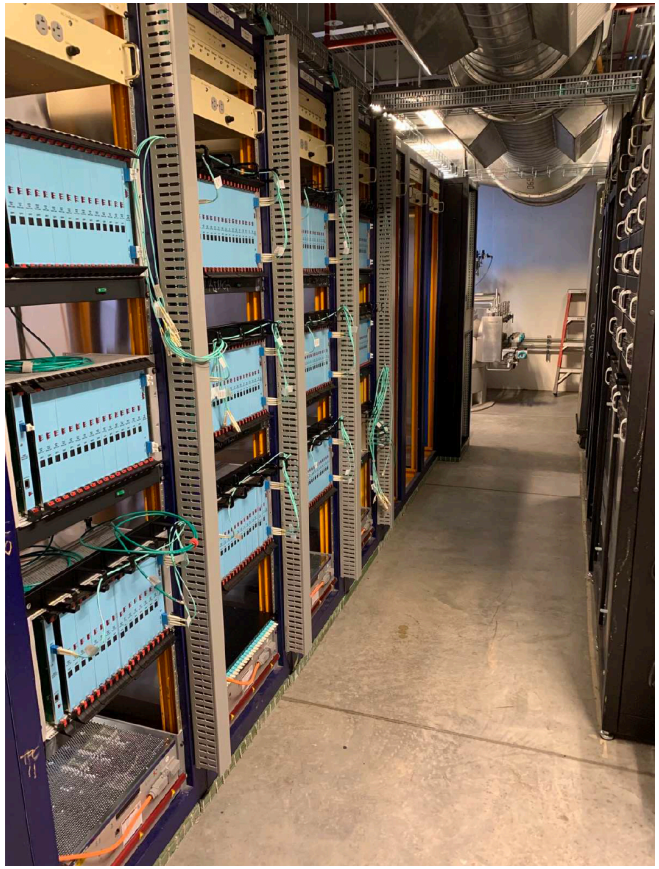
Note: Several activities of the WGs were slowed down or could not be executed because of the pause of the activities at Fermilab in the last three months due to COVID-19

SBN DAQ and Data Pre-processing WG

- Continued work and support for ICARUS commissioning
  - Continuous running and monitoring of noise from detector
  - Integration of ICARUS trigger → model of integration for SBND trigger in future
- Significant SBND TPC readout/DAQ progress
  - Integration of WIBs with Nevis readout cards at SBN-ND building
  - First SBN-ND DAQ run!
- CRT readout electronics and DAQ debugging
  - With CRT working group identified and characterized a problem of 'stuck data' in CRT readout
  - With help from CAEN and SCD experts, understand issue to be related to access of memory banks in on-board CPU software
  - Preliminary fixes already developed and being tested

SBN DAQ and Data Pre-processing WG

- PMT readout electronics configuration/calibration and tests of baseline shifts with respect to temperature
  - Taking place at both SBN-FD and DAB Teststand



SBN Slow Controls WG

ICARUS specific:

- Inside cryostat
  - Liquid argon temperatures
  - Liquid argon levels
- TPC
  - Wire bias power supply
  - Readout crate power supply
- PMT
  - HV power supply
  - HV distribution
  - VME crate power supply
  - Calibration system
- Drift (cathode) HV
- CRT
  - Readout power supplies
  - HV power supplies

Comments:

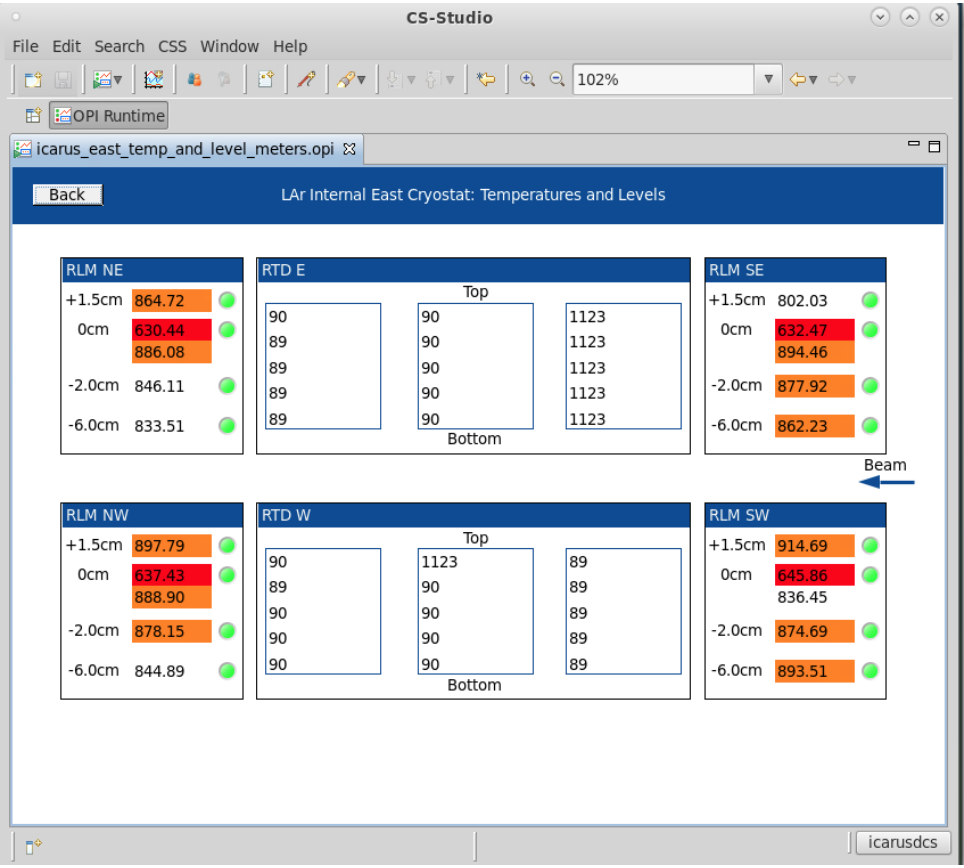
- No significant change from last update
- Underscore indicates tested with a user interface
- All other items are in progress

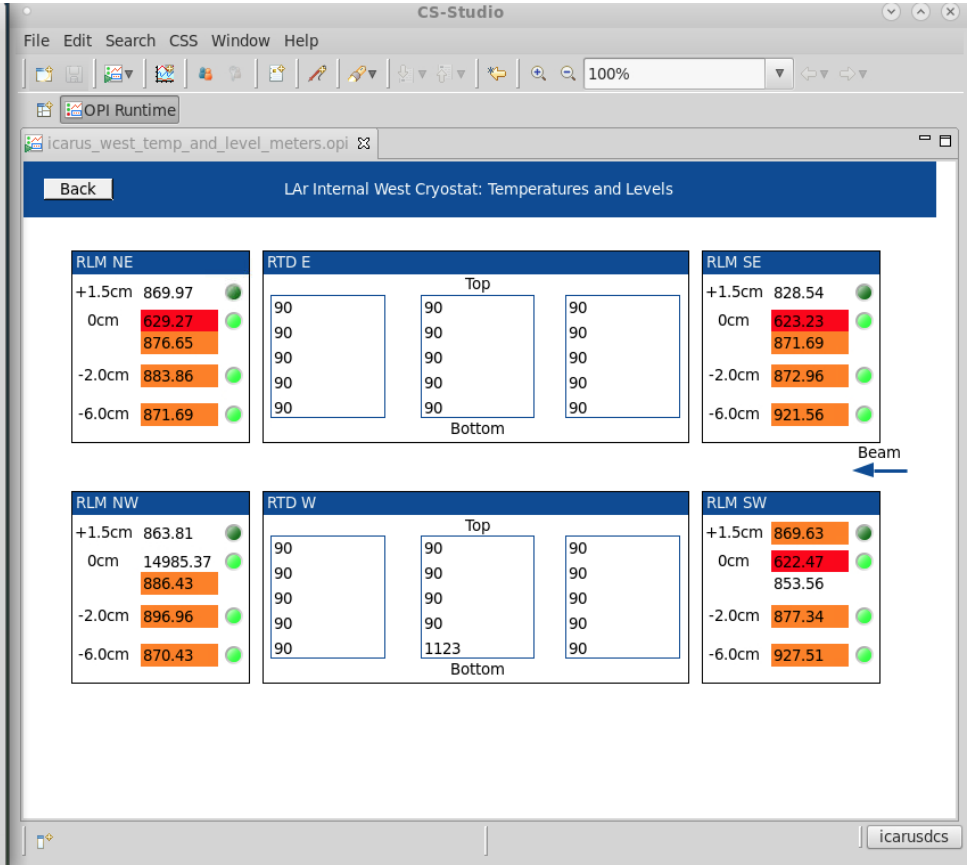
SBN Common:

- GPS
- Impedance monitor
- Cryogenics
- Beam
- Computer status
- DAQ status
- Environment

- ICARUS status
  - Successful readout of 16 PMTs with HV controlled via slow controls
  - Preparing for cathode HV turn on and expanding TPC readout
  - LAr level meter monitoring used during detector top off

ICARUS - LAr temperature and level control





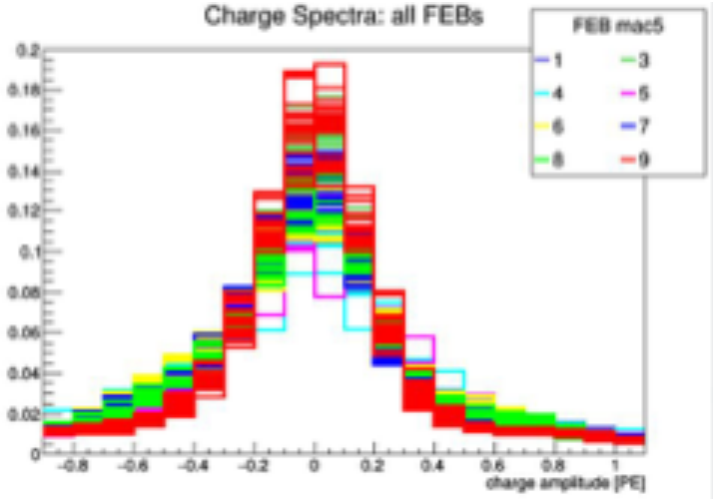
- Temperature probes show 89/90K
  - Probes showing 1123 don't exist or are non-functional
  - There are mapping issues in the physical connections to the resistive level meters

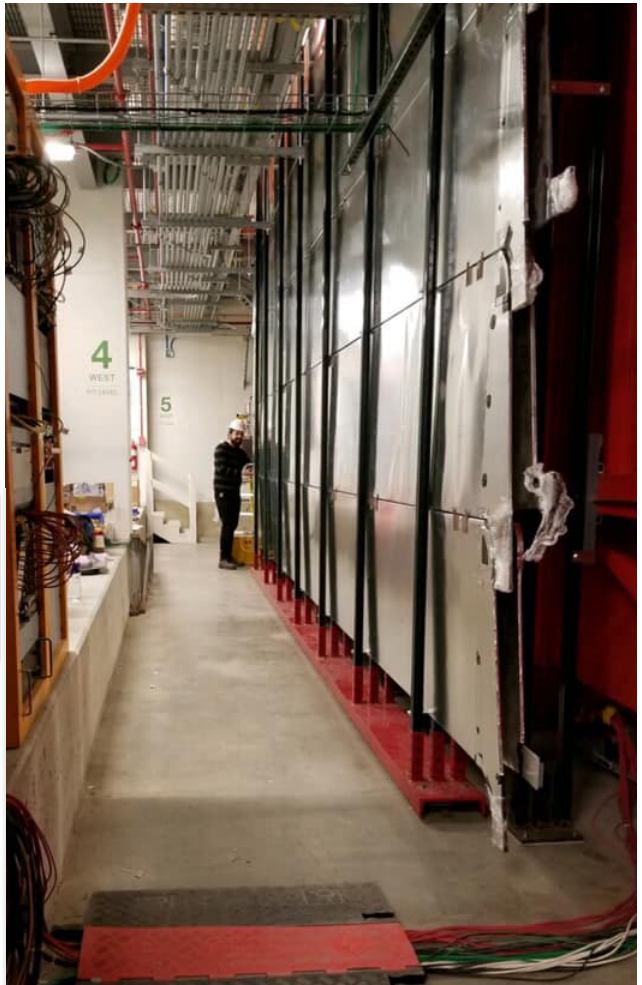
Cryostat filled on 20-May-2020

Starting the commissioning of side ICARUS CRT

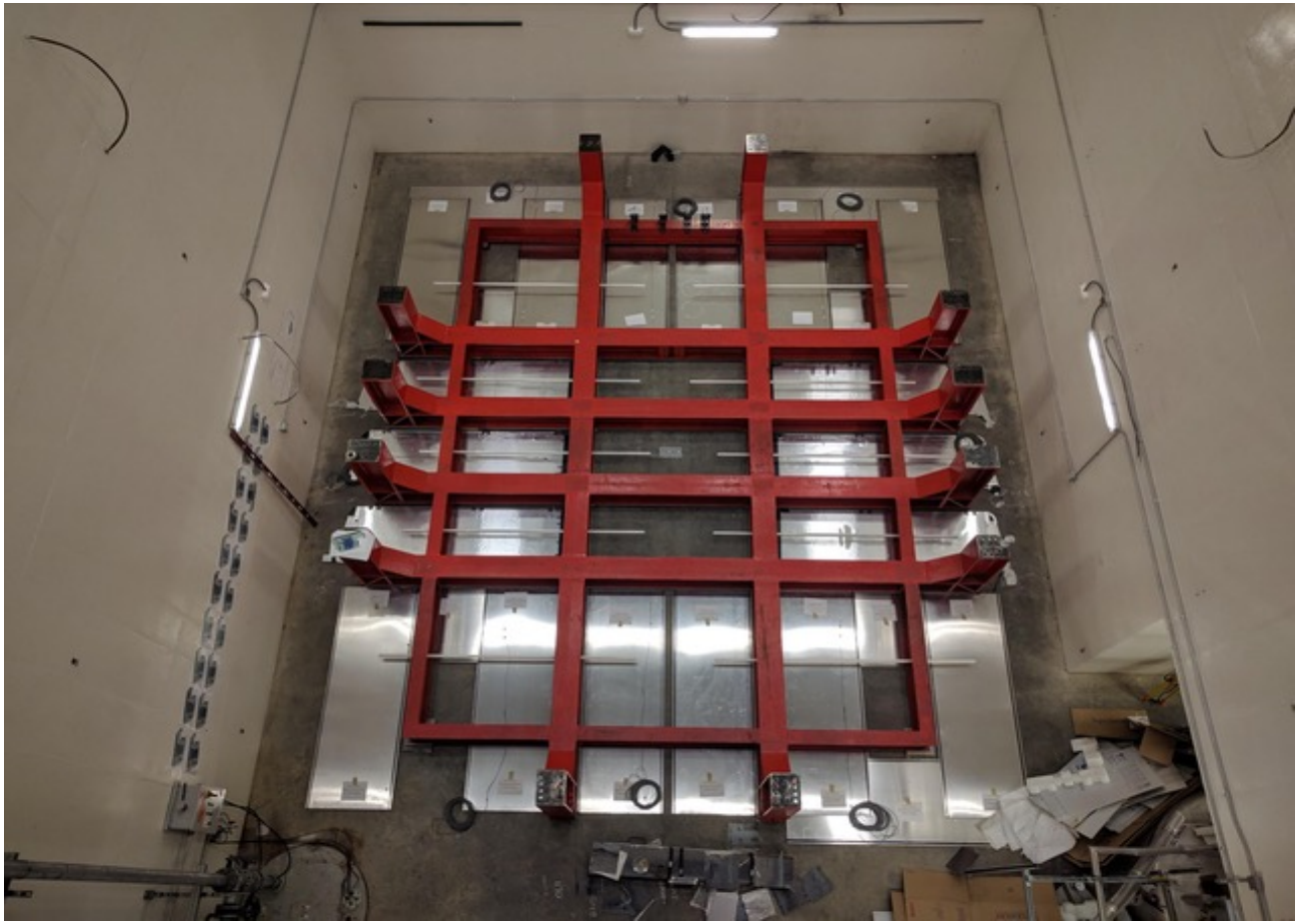
- Two walls from side ICARUS CRT have been installed
- Readout electronics have been installed for both walls
  - Reading 600 channels (20 FEBs)
- Taking cosmic data!
- Exercising the DAQ and analyzing the data collected
- Optimizing configurations (thresholds as well as equalizing the gains, etc)
- Modules for the top CRT to be Fermilab soon
- Full side CRT and top CRT to be installed after filling

Pedestal for each FEB after calibration





SBND: CRT Bottom layer installed (Sept. 2019)



SBN Analysis WG

- Work toward **updating the projections of expected physics capabilities of the SBN program** using full simulation and reconstruction
  - Include updated reconstruction efficiencies, performances, systematic effect and background rejection from a full MC simulation of the detectors.

- SBN Analysis Group wiki page https://cdcvs.fnal.gov/redmine/projects/sbn-analysis-group/wiki

- "Report on the SBN Analysis Working Group" presented by Daniele Gibin at the Physics Advisory Committee (PAC) meeting on January 15th, 2020
- V SBN Analysis Workshop (Monday, March 23rd – Friday, March 27th, 2020)
- "SBN Calorimetry" mini-workshop on July 6th-7th, 2020

Excerpt from the January 2020 PAC report -1

The PAC committee acknowledges the progress of the SBN Analysis WG in all the different areas

Daniele Gibin presented the status of the SBN analysis working group. The PAC commends the SBN analysis working group for maintaining a steady pace in developing joint reconstruction, simulation and analysis tools for the SBN oscillation studies. The oscillation fit procedure has

In particular, the oscillation sensitivity studies

The working group presented the first comparison between the sensitivity estimates obtained with the three fitters, using truth-level information and the proposal-era assumptions on the signal efficiencies, background rejection, and the neutrino interaction model and systematics. Overall, the results are found to be in good agreement with the estimated sensitivity in the proposal, and with each other. This applies both to the muon neutrino disappearance and electron neutrino appearance, thus meeting the first January 2019 PAC recommendation.

Minor residual differences are observed for the 90% exclusion regions between the outputs of the fitters. The origin of these differences is being investigated by the working group. The effect of using a recent version of GENIE with a large normalization for the meson exchange current channel has been investigated. A reassessment of the sensitivities using more realistic estimates of backgrounds and systematics, as noted in the January 2019 PAC report, is in progress.

Also recognizes the progress in the simulation and reconstruction using common tools and the progress in addressing some systematic differences between the near and far detector

In the meantime, improvement on the full simulation has been carried out with a detailed modeling of the response for TPC wires, photosensors and CRT detectors. Detector-specific and data-driven description of noise and space charge effects account for differences between the near and far detectors. Common reconstruction and event selection tools for TPC, PMTs and CRTs and the first demonstration of cosmic background rejection matching TPC and light information were shown. Electron neutrino event selection and tagging need further development.

January 2020 PAC report - comments and recommendations

The Far detector operation is a turning point!

Exploit synergies with existing expertise in LAr TPC!

The PAC concurs that the upcoming commissioning of the far detector operation will be a turning point for the SBN analysis group. The availability of actual data will be a major boost to the efforts to improve the understanding of the detector performance and the experimental systematics.

The presentation indicates an active exchange of results and expertise between the SBN analysis working group and the MicroBooNE collaboration. The PAC encourages the SBN analysis working group to continue, and expand where possible, its engagement with MicroBooNE, as well as protoDUNE for the development of realistic reconstruction.

Recommendations:

The PAC recommends that the SBN analysis group explicitly identify the known sources of systematic errors and the best available estimates for each of them. Plans on how these estimates will be improved with the availability of new data should also be discussed.

PAC looks forward to oscillation physics sensitivity results based on the full event simulations and reconstructions.

V SBN Analysis Workshop

Monday, March 23rd - Friday March 27th 2020

(Originally planned to be in person at Cern on March 25-29)

- One-week-long, Zoom-only workshop.
- https://sbn-docdb.fnal.gov/cgi-bin/private/DisplayMeeting?conferenceid=7328
- The working groups are:
  - **Oscillation WG**
  - **Event Selection WG**
  - **Systematics WG**
- Every day we had plenary sessions with updates on the progress of all the working groups, discussions and tutorials!

Discussions:

- Software Infrastructure
- Event Displays
- Space Charge
- Commissioning

WG Updates:

- Production
- Shower Reconstruction
- PDS
- Generator

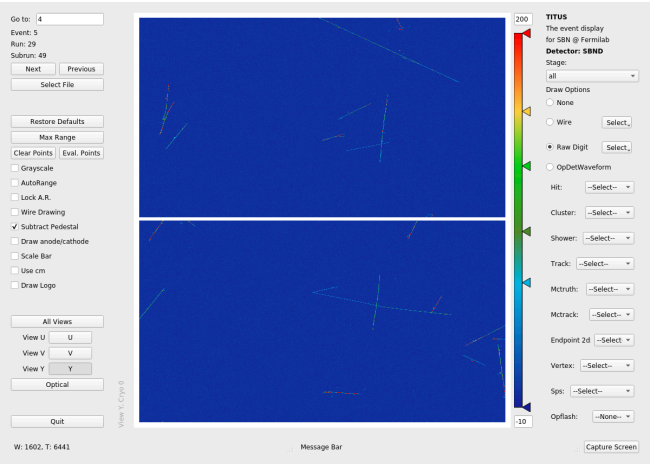
Tutorials:

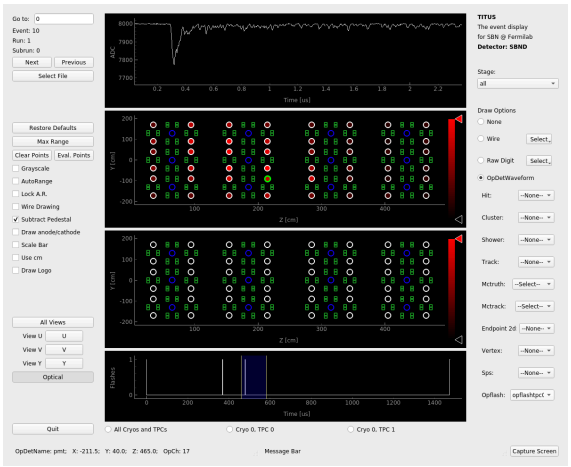
- LArSoft
- CAF
- Python

Marco Del Tutto
Christian Farnese
2
31st March 2020

V SBN Analysis Workshop

- Very productive workshop, with very good attendance, reaching 70 participants during some sessions.





Event Generators
Oscillation sensitivities
Space charge studies
PID in presence of SCE
Hit finding efficiency
Shower reconstruction
Light Detection systems
SBN Event Displays
Software framework
Commissioning
…

SBN Analysis Infrastructure

- Presented a (unified) picture of the SBN Program's computing needs to Fermilab Scientific Computing Division in May 2020
- Developing and implementing a computing model that will enable the timely production and analysis of the SBN Program's data and simulation
- Currently working to re-orient the analysis, production, and simulation code to enable seamless sharing of developments between SBND and ICARUS
- Planning a large-scale summer production to provide groups with Monte Carlo samples to study the latest improvements in reconstruction and simulation

SBN Computing Model and Assessment

- Evaluated and presented baseline computing needs for the SBN program over next 3 years to the annual Fermilab computing review (Fermilab Computing Resource Scrutiny Group)
- Assessments based on dynamic computing model, accounting for expected data size and computing time per event
  - Based on current simulation and detector data campaigns
- Expect by 2022:
  - Need 30M CPU hrs
  - 36 PB of data on tape
  - Production dominated data I/O resources (read from tape)
- Using this to inform improvements in Software Infrastructure