SBN Joint Working Groups

SBN Oversight Board Meeting

FNAL

June 14th 2019

Ornella Palamara

# SBN Joint Working Groups

❏ **Existing Working Groups**
- ❏ **SBN DAQ and Data Pre-Processing** *(conveners: B. Badgett, A. Fava, W. Ketchum, S. Ventura)*
  - ❏ *Scope*: Identify areas of common effort on **trigger, data acquisition and data pre-processing**, and coordinate activities in those areas.
- ❏ **SBN Slow Controls** *(conveners: A. Fava, S. Gollapinni)*
  - ❏ *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: U. Kose, I. Kreslo, B. Wilson)*
  - ❏ *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 Data Management** *(convener: W. Ketchum)*
  - ❏ *Scope:* Review computing resources and needs for SBND and ICARUS, and define a **model for SBN computing**. Collaborate with the Fermilab Scientific Computing Division to develop an **implementation of the SBN computing** strategy.
- ❏ **SBN Analysis** *(conveners: D. Gibin, O. Palamara)*

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SBN DAQ and Data Pre-processing WG Status

❑ See presentation from Wes Ketchum at this meeting

SBN Slow Controls WG Status

❑ Meeting Frequency: once every 4 weeks.
Meeting page: https://sbn-docdb.fnal.gov/cgi-bin/private/ListEventsBy?authorid=723

❑ Common activities in Detector Control System, both hardware & software.

❑ Updates presented at corresponding experiment DAQ/SBN online meetings.

❑ Prioritization of common tasks driven by the ICARUS commissioning timeline.

❑ Initial setup for the ICARUS online monitoring ready

    ❑ Need to add detailed information for data quality from the different subsystems, PMT, TPC and CRT

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ICARUS Online Monitoring
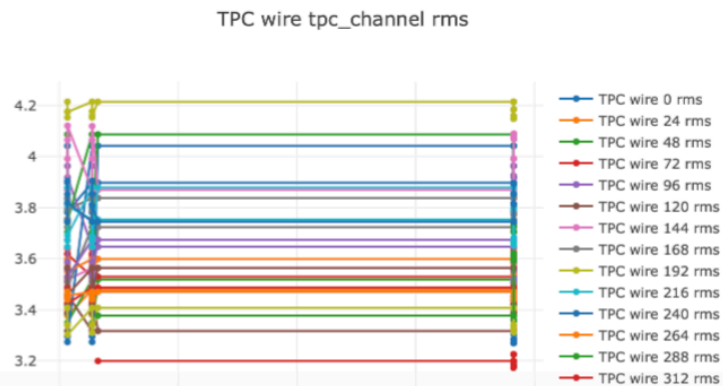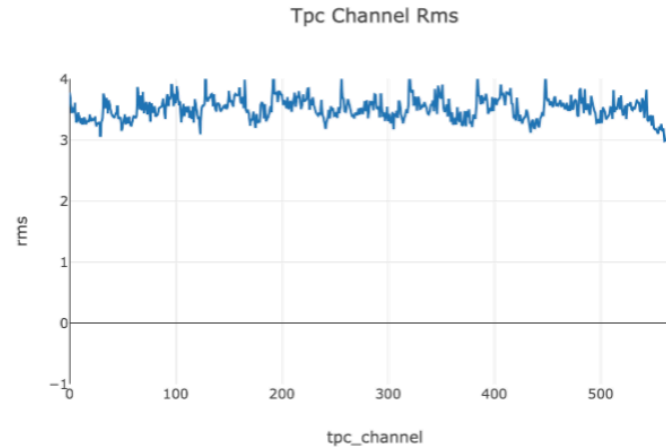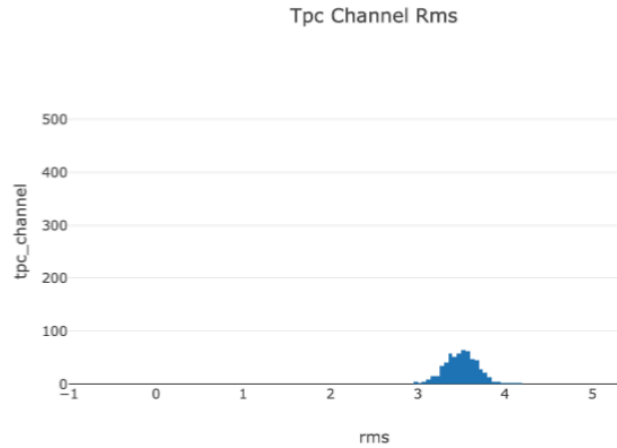
Data from the ICARUS VST

SBN CRT WG Status

- Cosmic Ray Tagger System for SBN detectors reviewed. Similarities and differences of the systems are identified and documented in SBN Document 11589-v1
- Production and installation plan for ICARUS and SBND CRT reviewed.
- GPS and beam spill timing references to be supplied to the CRT FEBs have been defined. Implementation of the White Rabbit system for the synchronization of the other subdetectors with the CRT systems has been agreed.
- Common meetings with Calibration Working Groups to review the need of CRT data for calibration purposes.
- Defining common data output format (in meetings with the DAQ Working Group).

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SBN Data Management WG Status

❑ Goal and near-term tasks defined

❑ Meeting with computing experts on <u>needs and technical models for common data management</u>.

❑ Meeting with collaborators to discuss about <u>computing and storage offsite</u>.

❑ Performing <u>data volume diagnostics</u> from Monte Carlo simulations output files as basis to plan for data reduction schemes.

SBN Analysis WG Status

❑ Work toward **updating the projections of expected physics capabilities of the SBN program** using full simulation and reconstruction

    ❑ Generating <u>common MC samples</u> with the current software packages.

    ❑ Including <u>updated reconstruction efficiencies, performances, systematic effect and background rejection</u> from a full MC simulation of the detectors.

    ❑ Combining <u>appearance and disappearance</u> channels.

    ❑ Exploiting different <u>models with multiple sterile states</u> and <u>exclusive topology</u> measurements.

SBN Analysis Group

❑ Implement a **multi-detector** <u>simulation</u>, implement <u>reconstruction</u> algorithms/tools and <u>analysis tools</u>.

❑ <u>Oscillation Analysis:</u> proceed in three (parallel) intermediate steps

I. Consistency check - **reproduce the SBN proposal-era oscillation sensitivities** with 3 new oscillation fitting frameworks, using truth-level information and the same inputs for beam, reconstruction efficiencies, backgrounds and systematic uncertainties.

II. Update the oscillation sensitivities - still using truth-level information, and exploiting **updated inputs** for efficiencies/backgrounds and systematic effects (accounting for the available/developed SBN event reconstruction and recent results from other LAr experiments).

III. Oscillation physics sensitivity results based on full event simulation and full event reconstruction.

SBN Analysis Group - Sub-groups

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

❑ The **internal organizational structure** with sub-groups working on specific reconstruction and analysis topics is working well.

❑ Activities progress in parallel within the sub-groups.

❑ Individual sub-groups have regular meetings and there is continuous **sharing of information** through presentations of the status of the activities/discussions within the different subgroups at the joint bi-weekly SBN Analysis Group meetings.

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SBN Analysis Workshop

Overview of the workshop
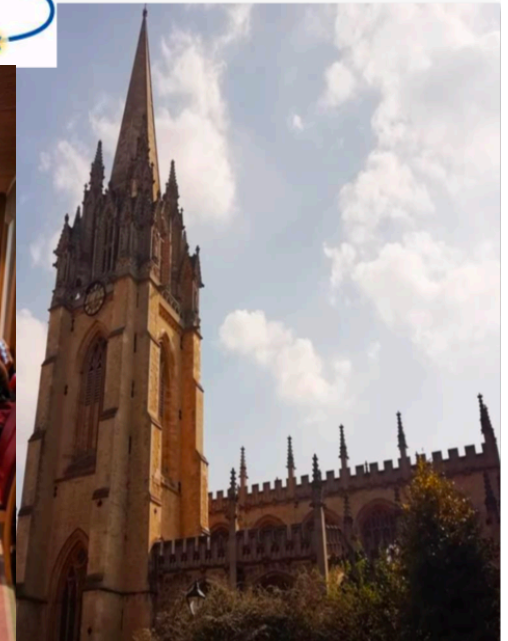
- ⚛ 30 physicists
- 📅 5 days
- 📋 3 working groups

March 30-April 3 2019

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Workshop Organization

Three working groups:

- Event Reconstruction & Selection
  - Scope: Selection and reconstruction tools
  - Deliverables: Extracting reco-based efficiencies and resolutions to add realism to (truth-based) fits
- Detector Simulation & Uncertainties
  - Scope: Detector simulation development and modeling of uncertainties, including PMTs, CRT simulation
  - Deliverables: Estimate of detector-related uncertainties impacting the multi- detector fits
- Oscillations Fits & Systematics
  - Scope: Oscillation fitters, systematics model, SBNCode framework
  - Deliverables: Sensitivity for truth-level selections with current reconstruction performance and uncertainty estimates

Tutorials and daily focus discussions:

- SBNCode tutorial - docdb #11925
- Ghost points removal using deep learning - docdb #11955
- TPC/PMT/CRT reconstruction - docdb #11961
- Discussion of backgrounds - docdb #11973
- Pandora & CRT cosmic removal - docdb #11964

DocDB Agenda: https://sbn-docdb.fnal.gov/cgi-bin/private/DisplayMeeting?conferenceid=4986

Workshop Org[anization]

Three working groups:

- Event Reconstruction
  - Scope: Selection a[nd...]
  - Deliverables: Extr[...]dd realism to (truth-based) fits
- Detector Simulation
  - Scope: Detector si[...]nties, including PMTs, CRT simulation
  - Deliverables: Esti[...]the multi- detector fits
- Oscillations Fits & Sy[stematics]
  - Scope: Oscillation[...]
  - Deliverables: Sens[...]nstruction performance and uncertainty estim[...]

Tutorials and daily focu[s]

- SBNCode tutorial - doc[...]
- Ghost points removal u[...]
- TPC/PMT/CRT reconst[...]
- Discussion of backgrou[...]
- Pandora & CRT cosmic[...]

Workshop summary

- A great week of really productive work

- A lot of progress was made

- Each subgroup has a clear path forward

- Every team is continually growing!

DocDB Agenda: https://sbn-docdb.fnal.gov/cgi-bin/private/DisplayMeeting?conferenceid=4986

SBN Analysis Group - Deliverables

❑ Implement a **multi-detector** <u>simulation</u>, implement <u>reconstruction</u> algorithms/tools and <u>analysis tools</u>.

❑ <u>Oscillation Analysis</u>: proceed in three (parallel) intermediate steps

    I.   Consistency check - **reproduce the SBN proposal-era oscillation sensitivities** with 3 new oscillation fitting frameworks, using truth-level information and the same inputs for beam, reconstruction efficiencies, backgrounds and systematic uncertainties.

Status: working on understanding differences in the oscillation sensitivities produced by the 3 fitters when we include systematics.

SBN Analysis Group - Deliverables

❑ Implement a **multi-detector** <u>simulation</u>, implement <u>reconstruction</u> algorithms/tools and <u>analysis tools</u>.

❑ <u>Oscillation Analysis:</u> proceed in three (parallel) intermediate steps

II.   Update the oscillation sensitivities - still using truth-level information, and exploiting **updated inputs** for efficiencies/backgrounds and systematic effects (accounting for the available/developed SBN event reconstruction and recent results from other LAr experiments).

Status: working on ν_μ and ν_e event selection and reconstruction and background rejection.

Overflow

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SBN Oscillation Analysis Group Organizational Chart

SBN Analysis Working Group

Convener: Daniele Gibin
Convener: Ornella Palamara

Neutrino Event Generators
(Simulation and tuning on SBN data)
Convener: Jarek Nowak
Convener: Marco Roda

Track Reconstruction in TPC
(Consistent clustering, vertexing, track reconstruction)
Convener: Tracy Usher
Convener: Jonathan Asaadi

TPC Simulation and Calibration
(Consistent hit/charge reconstruction, dQ/dx->dE/dx, lifetime and space charge measurements and cross-validation)
Convener: Filippo Varanini
Convener: Mike Mooney

Commissioning liaisons: Angela Fava , Michelle Stancari

Light Detection Systems Simulation & Reconstruction
(LDS signals, timing, LDS-TPC matching)
Convener: Alessandro Menegolli
Convener: Diego Garcia Gamez

MC Production
(Consistent generation of different type of events)
Convener: Maya Wospakrik
Convener: Dom Brailsford

Shower Reconstruction in TPC
(Consistent shower ID, vertexing, and reconstruction)
Convener: Yun-Tse Tsai
Convener: Dom Brailsford

CRT Simulation & Reconstruction
(CRT signals, timing, CRT-TPC matching)
Convener: Umut Kose
Convener: David Lorca

Analysis Software
(sbncode - General tools for event selection and analysis)
Convener:
Convener: Andy Mastbaum

Event Selection, Cosmic ID and Rejection
(Triggers, PID, consistent combination of TPC, CRT and LDS, cross-validation on exclusive channels)
Convener: Christian Farnese
Convener: Andrzej Szelc

Systematics and Oscillation Sensitivities
(Consistent evaluation of flux, cross-sections and detector systematics, tools to evaluate oscillation sensitivities)
Convener: Daniele Gibin
Convener: Costas Andreopoulos

Oscillation Sensitivities - Milestones and Timeline

M.1: Reproduce the SBN proposal oscillation sensitivity for both ν_e appearance and ν_μ disappearance (**Mid March 2019**).

M.2: Revise the proposal assumptions using more realistic estimate of efficiency and backgrounds, implementing a truth-level based sensitivity study for both appearance and disappearance channels (**Summer 2019**).

M.3: Produce an end-to-end analysis of ν_μ disappearance with as complete as possible event selection and reconstruction (**End of 2019**).

M.4: Produce an end-to-end analysis of ν_e appearance with as complete as possible event selection and reconstruction (**Spring 2020**).

M.5: Final, complete, reconstruction & systematics included appearance and disappearance sensitivities (**by end of 2020**)