

# SBN Program Status

Peter Wilson – SBN Program Coordinator

SBN Oversight Board

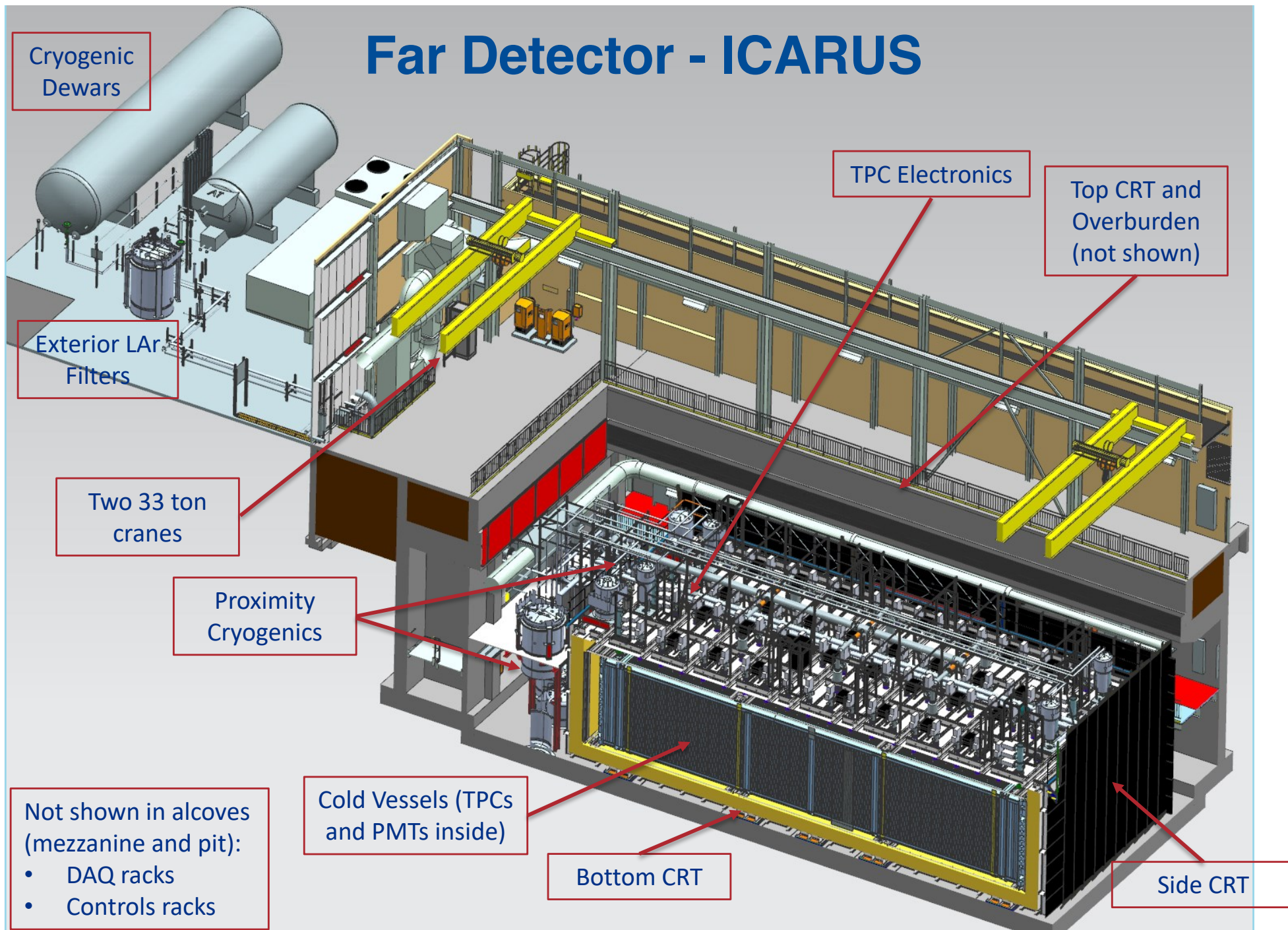
8 March 2019

# Outline

- ICARUS technical progress
- SBND technical progress
- December Director's review
- DOE Funding
- Transition to Operations Planning

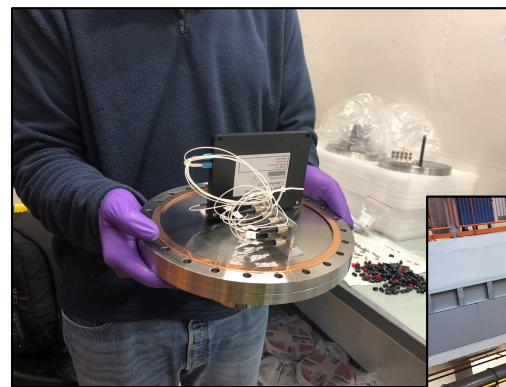


# Far Detector - ICARUS



# ICARUS Installation Progress

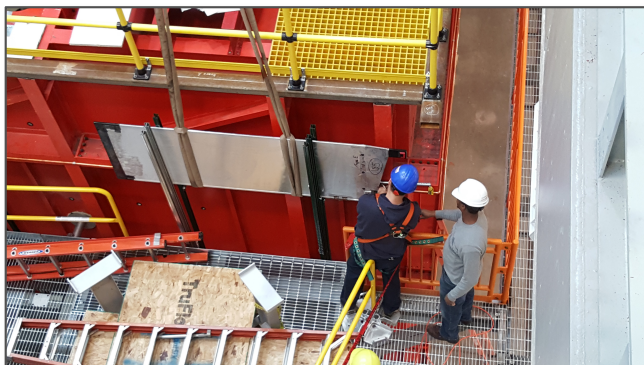
- Detector installation work continues on schedule:
  - ✓ Installation of feedthrough crosses completed
  - ✓ Feedthrough flanges installed
  - ✓ First checkout of feedthroughs completed finishing corrections on specific flanges
  - ✓ North wall CRT modules (repurposed MINOS modules) installed
    - Start installation of electronics and power supplies in April
    - On track to be ready for LAr fill in summer



Preparing a  
PMT fiber  
flange



Flange  
installation and  
vertical slice  
test



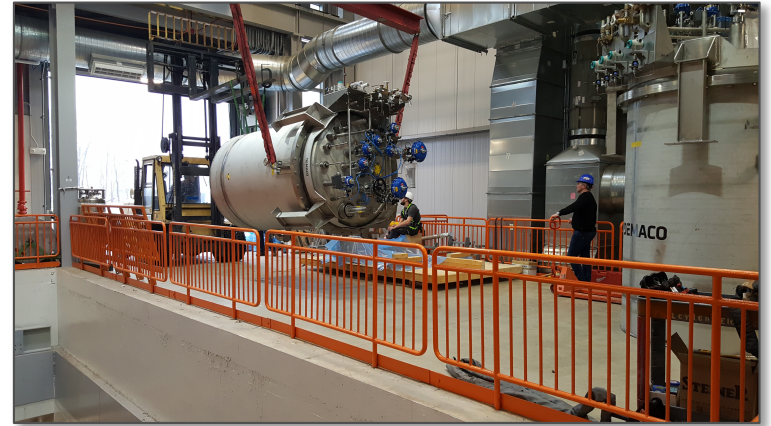
North Wall CRT



Testing TPC  
flange  
connectivity

# ICARUS Installation Progress

- Cryogenics installation work on schedule:
  - ✓ Proximity cryogenics components delivered from CERN in early December (ten shipping containers)
  - ✓ Installation started by Demaco on Jan 28
  - ✓ All 14 valve boxes installed within two weeks
  - ✓ Transfer line installation progressing well
  - ✓ Fermilab continues installation of items such as vent lines in parallel
- Controls programming progressing well
- Controls wiring to start shortly
- 3 transfer lines damaged in transport from CERN
  - Very fast response by CERN and Demaco
  - New lines being constructed at Demaco – delivered to FNAL by end of May
  - Installation order adjusted to accommodate
- Mitigating delays to maintain LAr fill date in July
- always safety first!



Rigging valve boxes



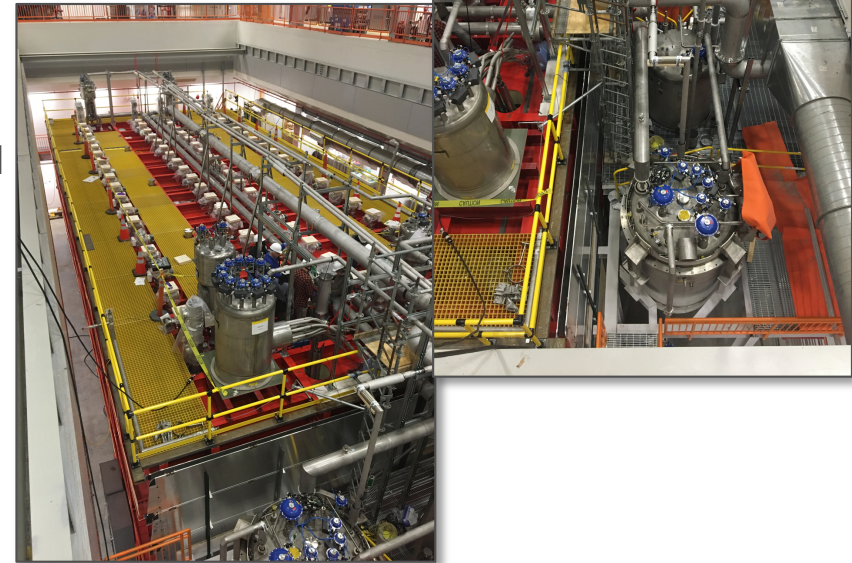
# ICARUS Installation Progress

- Cryogenics installation work on schedule:
  - ✓ Proximity cryogenics components delivered from CERN in early December (ten shipping containers)
  - ✓ Installation started by Demaco on Jan 28
  - ✓ All 14 valve boxes installed within two weeks
  - ✓ Transfer line installation progressing well
  - ✓ Fermilab continues installation of items such as vent lines in parallel
- Controls programming progressing well
- Controls wiring to start shortly
- 3 transfer lines damaged in transport from CERN
  - Very fast response by CERN and Demaco
  - New lines being constructed at Demaco – delivered to FNAL by end of May
  - Installation order adjusted to accommodate
- Mitigating delays to maintain LAr fill date in July
- always safety first!



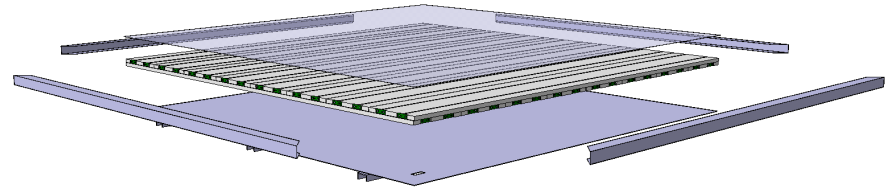
**Installing Vent Line  
(FNAL Scope)**

**Current Status**

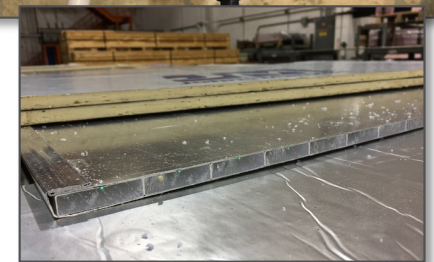
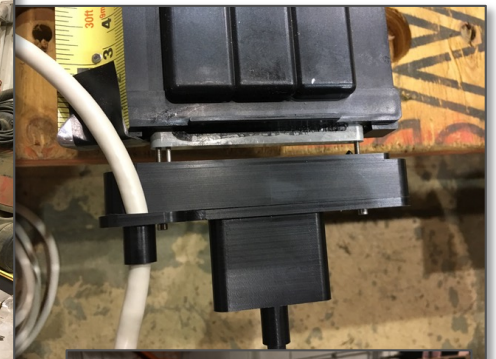
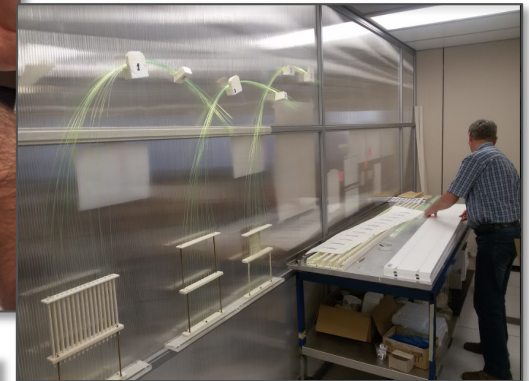


# ICARUS Progress

- TPC electronics production in final phase (INFN)
  - On track to complete delivery to FNAL by May
- Cosmic Ray Tagger (CRT)
  - Top CRT panel production starting in Frascati
  - Side CRT readout: final design review for SiPM board and cabling on Jan 7
    - Responding to recommendations now
  - North side install between cryo plant and vessel
    - Mounts installed
    - Modules cut and wrapped
    - Modules installed at end of January



**Top CRT  
Production in  
Frascati**



**Side CRT SiPM Board  
and module cutting  
@ Wideband lab**

# Installation work stop Mar 5-6

- Installation work on top the warm vessel was stopped for one day this week in response to three recent injuries:
  - Student tripped on top of the vessel (December) – bruises
  - Technician (Demaco) had pipe sleeve strike hand (February) – stitches
  - Technician (INFN) tripped on top of the vessel (March) – stitches
- Paused work: address trip hazards and work rules
  - Removed materials and tools
  - Advanced the installation of additional decking by several weeks
  - Final decking to be installed in stages following completion of work on crosses
  - Added safety cones and caution tape to warn of trip hazards
  - Updated requirements on usage of hard hats
- Held two safety briefings – at stop and restart of work
  - Included all collaborators and technical staff currently engaged in the work
- Reinforcing daily work planning/safety meetings and communication on plans between the collaboration and Fermilab technical team





# Far Detector Commissioning – cryogenics prep.

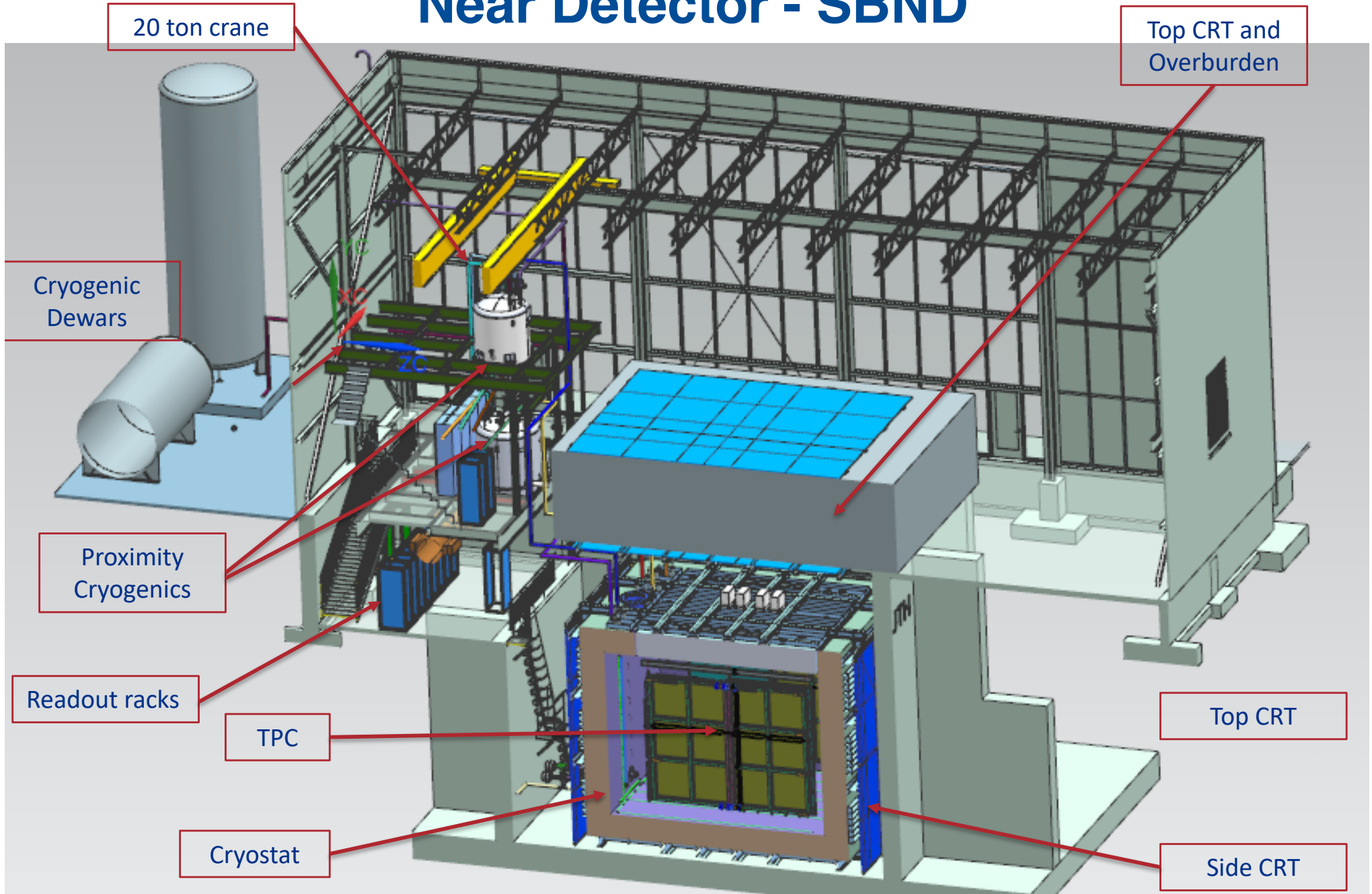
- Cold vessel engineering note and validation
  - Completed verification of CERN FEA by Fermilab analysis engineer
  - Engineering note completed by provided to safety committee
  - SBN Cryo Working Group initiated: preparing validation and fill plan
- Cryogenics system engineering notes completed and reviewed
  - Need review of installed system to complete operations clearance
- LAr contract:
  - Bid package completed and sent to vendors on Feb 11
  - Received two bids on Feb 28; first look
    - Both meet schedule requirement of 6 deliveries/week
    - Both meet meet or beat technical specifications on contaminants
  - Technical evaluation in progress
  - On track for LAr fill milestone.
  - Thanks to procurement for excellent response time

# ICARUS Milestones to I-1 Ready to Fill

Intermediate Milestone	Owner	Baseline Date	Forecast Date		Actual Date
Vessels rigged into building	P. Wilson	16-Aug-2018		✓	16-Aug-2018
Manholes welded and vacuum test successful	C. Montanari	10-Oct-2018		✓	11-Oct-2018
Warm Vessel roof complete	C. James	15-Nov-2018		✓	31-Oct-2018
Cryo Platform complete	C. James	15-Dec-2018		✓	04-Oct-2018
Proximity cryogenics installation begins	B. Norris	15-Jan-2019		✓	28-Jan-2019
DBB & flanges installation complete and tested	A. Fava	15-Feb-2019	1-Mar-2019	b	
Cold proximity cryogenics installation complete	B. Norris	15-Apr-2019	25-Apr-2019	c	
1 <sup>st</sup> T300 readout installation complete	A. Fava	15-Mar-2019	8-Apr-2019	d	
All detector readout installed	A. Fava	1-May-2019	31-May-2019	e	
Begin vacuum pumping	C. Montanari	15-Jul-2019	15-May-2019		
Cryogenic operation approved	B. Norris	15-Jul-2019	28-Jun-2019		
<b>I1: ICARUS detectors ready to fill with LAr</b>	<b>P. Wilson</b>	<b>30-May-2019</b>	<b>11-Jul-2019</b>	<b>f</b>	

Forecast update awaiting details on replacement transfer lines

# Near Detector - SBND

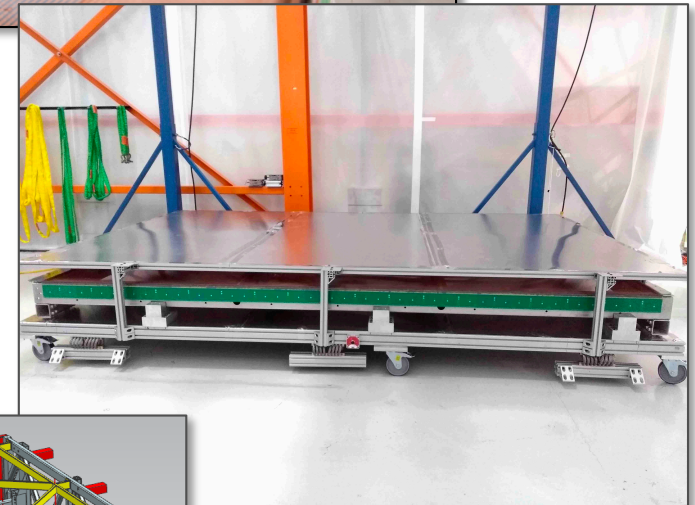


# SBND TPC Progress

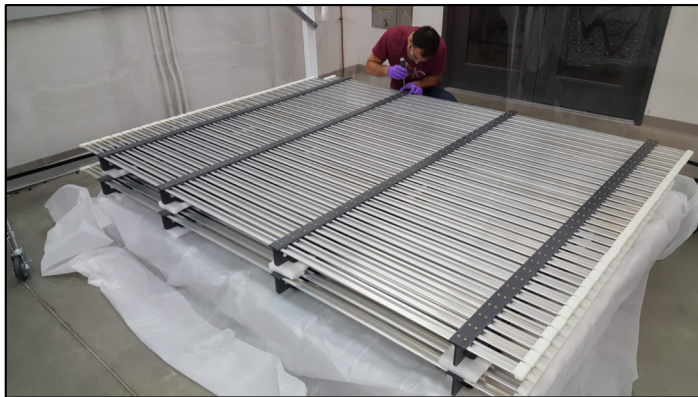
- UK: Manchester completed wiring the 2<sup>nd</sup> APA at Daresbury lab. Shipped on Feb 25  
Arrival at Fermilab in March
- US: field cage and 2<sup>nd</sup> anode plane received at Fermilab on Mar 1
- Three (of 4) APAs now in the Dzero assembly facility
  - Two in clean tent, one on the alignment fixture
  - One stored outside tent
- TPC assembly and transport frame (atf) in fabrication – delivery to FANL in April



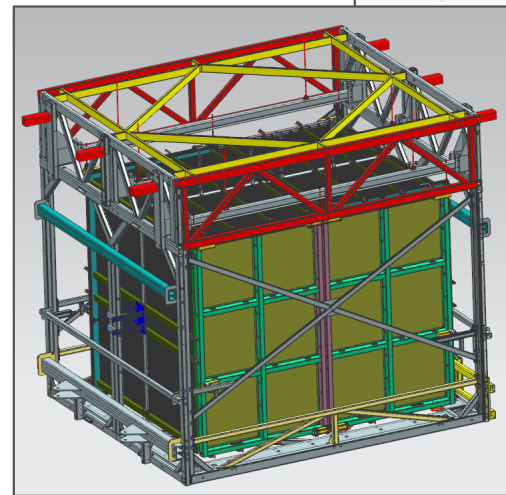
1<sup>st</sup> UK APA on the alignment fixture



1<sup>st</sup> Yale APA in clean tent



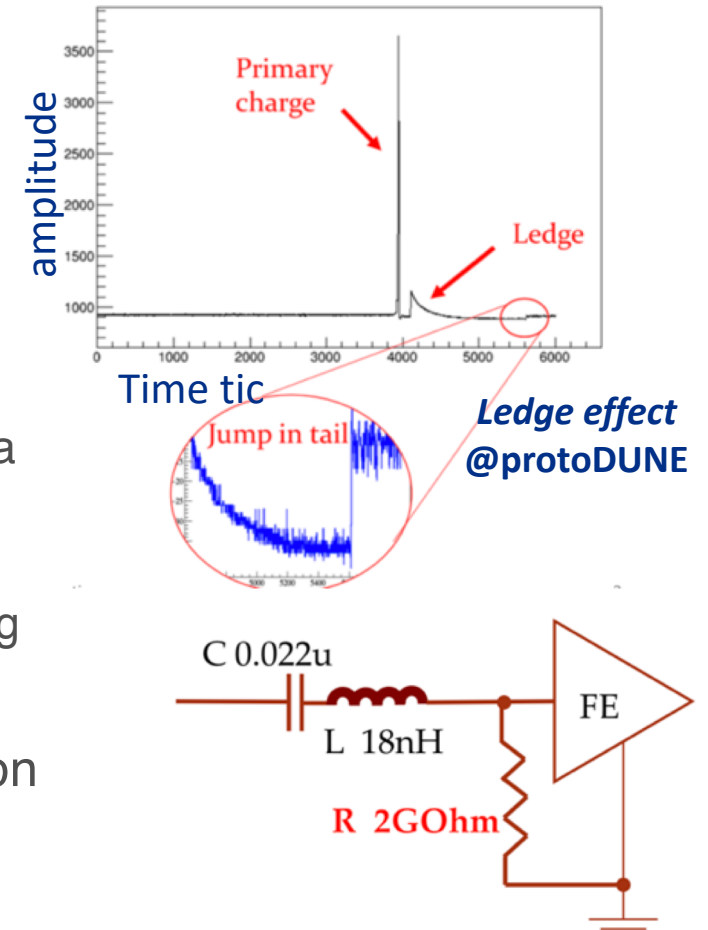
Field cage panels at Yale



Assembly and Transport Frame

# SBND TPC Electronics Progress

- Cold electronics (BNL):
  - Design very similar to ProtoDUNE (eg same FE ASIC)
  - Use cold qualified commercial off the shelf ADC
- Warm backend (Columbia – Nevis)
  - Update of MicroBooNE design
- Addressed lessons from ProtoDUNE
  - FE ASIC “ledge effect” – large charge depositions cause a dead period of several hundred microseconds
  - Mitigated by modifying layout of FE board to include 1-2GOhm resistor and operation with higher baseline setting
- Successful Production Readiness Review Nov 29
- Both cold and warm electronics on track for completion milestones this spring/summer

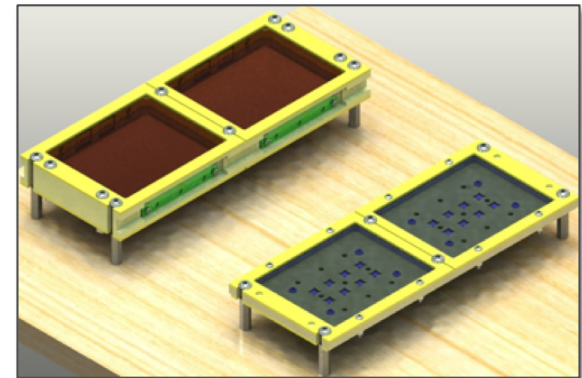


# SBND Photo Detection Progress

- Full PMT system under test in the Coherent CAPTAIN-Mills Detector (CCM) at Los Alamos
  - Ready to install in fall 2019
- ARAPUCA system
  - tested in argon
  - feedthroughs ordered
  - Production review completed
  - Ready to install in summer 2019
- Light guide bars
  - Production review completed
  - Ready to install in fall 2019



CCM  
preparing  
to test  
PMTs at  
LANL



ARAPUCA  
prototypes

# SBND CRT/Laser

## Production

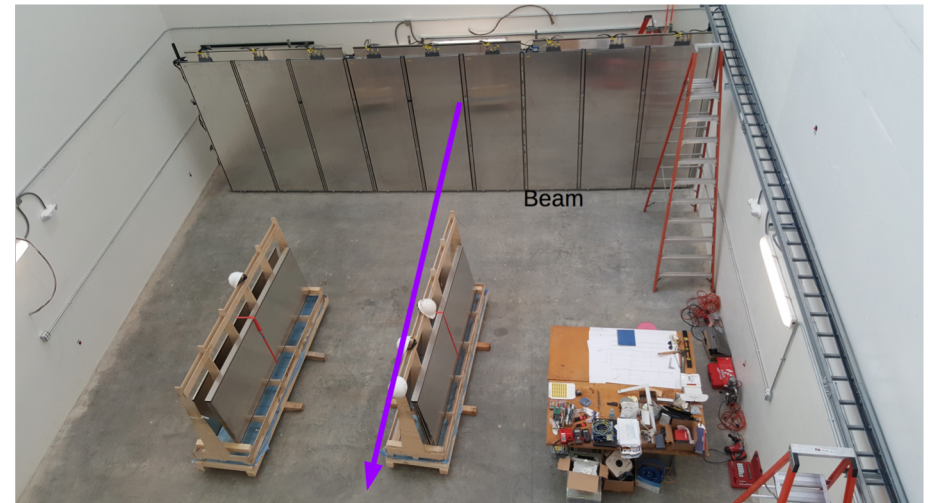
- Bottom and side CRT modules complete
- Top CRT modules and laser system production @Bern on track.

## CRT Test Setup

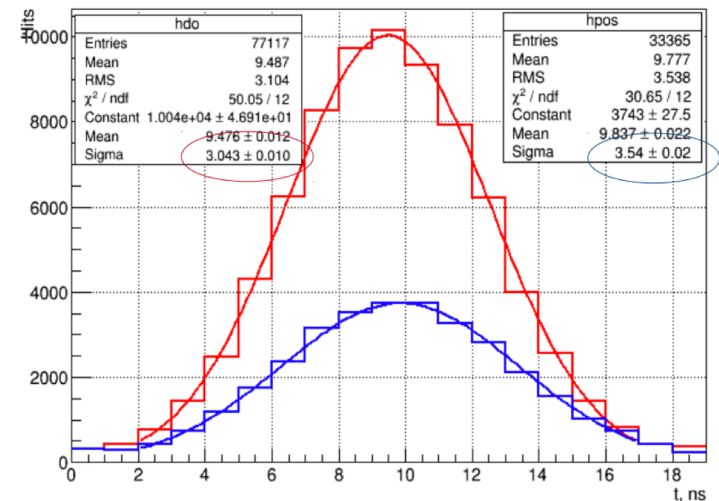
- Running successfully with 24 modules
- Preliminary measurement of BNB bunch shape after BNB bunch rotation turned on on Jan 14 (DocDB #11107).

## Upcoming Installation

- CRT test setup to conclude data taking in March, to make space for Demaco proximity cryogenics installation
- Discovered interference between six bottom CRT modules and final cryostat design.
  - Discussion with Bern on how to solve.



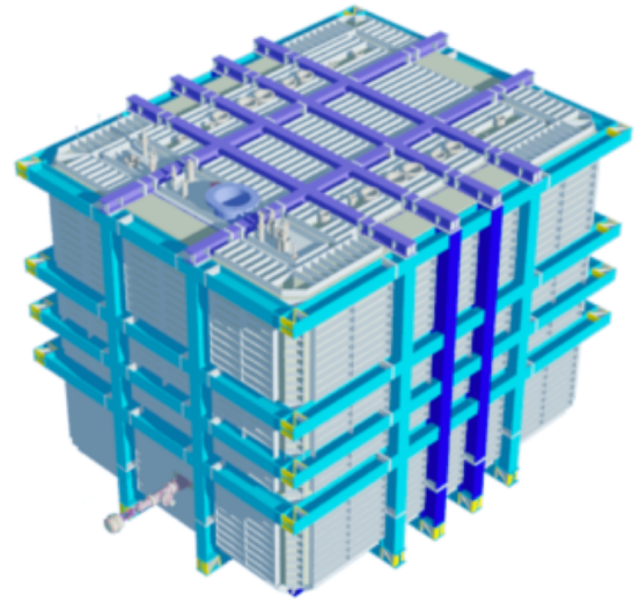
BNB bunch seen by SBND CRT



Bunch rotation:  
Sigma: 3.04 ns --> 3.54 ns (  $\oplus$  1.8ns )  
Mean: + 0.36 ns

# SBND Cryostat

- Outer steel structure
  - Material delivered to CERN in February
  - Preassembly about to start at CERN
  - On track for installation at FNAL in May/June
- Membrane cryostat
  - Design contract being placed by CERN
  - Design to start in March
  - Material delivery to FNAL in fall for installation late 2019

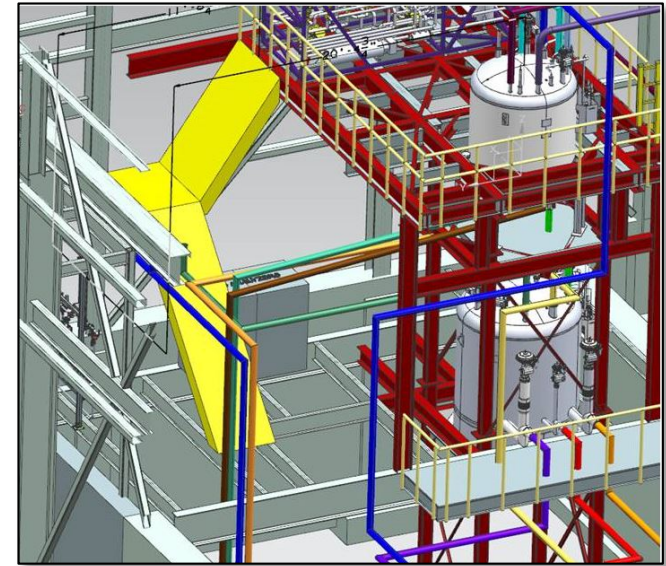


SBND Cryostat Model



# SBND Cryogenics

- Cryogenics Platform
  - Installation started this week – complete by early April
- Proximity cryogenics
  - Equipment delivered in December from CERN
  - Installation starting in April when Demaco is done with installation in FD building
  - Complete by end of May



**Cryo platform  
design**



**Crated Valve  
boxes in ND  
Building**

**Preparing for  
platform  
install**



# Near Detector Personnel Changes

- Anne Schukraft has taken over as Technical Coordinator
  - Brian Rebel has moved to a joint faculty position at U. Wisconsin / staff position at Fermilab with primary focus on DUNE
  - Anne has extensive experience from MicroBooNE and SBN FD CRT
- Roberto Acciarri fills the new position of Installation Coordinator
  - Roberto has most recently been working on ProtoDUNE-SP based at CERN

## SBND Milestones to S-1 SBND ready to move

Intermediate Milestone	Owner	Baseline Date	Forecast Date (Schedule)		Actual Date
First set of APAs shipped to Fermilab	K. Mavrokoridis	24-Sept 2018		<b>a</b>	25-Feb-2019
PO for COTS ADCs placed	H. Chen	10-Oct-2018		✓	30-Oct-2018
All TPC Components at Fermilab	K. Mavrokoridis	1-Mar-2019	19-Mar-2019		
Complete atf assembly at DAB	J. Zennamo	1-May-2019	18-Apr-2019	<b>b</b>	
50% of motherboards delivered to Fermilab	H. Chen	15-May-2019	19-Apr-2019		
APAs and CPAs installed in atf	J. Zennamo	15-Jun-2019	5-Jun-2019		
Field cage assembly complete	J. Zennamo	15-Jul-2019	15-Jul-2019		
Cold electronics installed and tested	H. Chen	23-Aug-2019	20-Aug-2019		
<b>S1: TPC ready to move to SBN ND</b>	<b>A. Schukraft</b>	<b>30-Aug-2019</b>	<b>23-Aug-2019</b>		

Forecast update awaiting placement of atf contract

- a) US APA group decided to ship both their APAs and field cage in one shipment, delaying shipment of the first APA from September to early February. This should have little to no impact on completion the final assembly
- b) The atf bidding process has been delayed due to holidays by about 8 days. This delay propagates through to forecast dates of subsequent milestones. We are working on absorbing this delay in the assembly process.

# SBN Director's Review – Dec 2018

- Director's Review for SBN was held Dec 17-19 2018
- The final review report available on the review website:
  - [Review Final Report](#)

*The review committee was pleased with the progress made since the June 2018 review which focused primarily on schedule. The committee congratulates the team for the great progress in getting the far detector modules installed. Progress on the near detector components is also quite impressive.*

- Total of 16 recommendations (had 34 from June review)
  - Expect all but one to be addressed by end of March
  - Common theme in comments about need for better documentation: Steve B and Peter W decided to create our own 17<sup>th</sup> recommendation to address this
- Expect next review in December 2019
  - Focus on SBND Installation



# DOE Funding

- In Spring 2018 we requested an additional \$3,900k of funding from DOE to keep the program on track
  - Funds needed in the 2019 fiscal year to prevent significant delays for both far and near detectors
  - Repeated request at the time of the December 2018 Director's Review
- On January 29, Steve Brice, Tim Meyer and Peter Wilson visited DOE to brief them on financial status of SBN
- After the briefing DOE has provided the requested additional funds
- This allows critical procurements to proceed unimpeded, for example:
  - LAr contract for the far detector
  - contribution to near detector cryostat design contract
  - near detector cold electronics

# Transition to Operation Planning

- At January DOE briefing we also presented a plan for transition to operations
- Address commissioning and operations plans for both detectors and associated support (e.g. cryogenics, online computing, data storage)
- Transition to Operations Team created
  - Angela Aparicio – Neutrino Division (ND) Safety Officer
  - Steve Brice – ND Representative
  - Angela Fava – Far Detector Deputy Technical Coordinator and Deputy Commissioning Coordinator
  - Cat James – Deputy Program Coordinator
  - Claudio Montanari – Far Detector Technical Coordinator and Commissioning Coordinator
  - Barry Norris – SBN Program Engineer and Head of ND Technical Support Dept
  - Dave Schmitz – SBND collaboration representative
  - Michelle Stancari – Near Detector Commissioning Coordinator
  - Peter Wilson – Program Coordinator, chair of TOT
  - Bob Wilson – ICARUS collaboration representative
  - Wes Ketchum - Scientific Computing Division representative
- Kick-off meeting in February
  - Presentations on the organization of experiment operations at Fermilab including support model and example of the MicroBooNE operations organization
- Regular meetings to start in March to define organizations and prepare Experiment Operations Plan
- Operations Readiness Review organized by Fermilab in fall 2019 to coincide with start of neutrino beam to far detector. Expect 2<sup>nd</sup> review in 2020 when near detector starts

# Backup



## Notes on milestones to I-1

- a) Arrival of subcontractor delayed by CERN to ensure transport of equipment was completed in advance with schedule contingency
- b) Delivery of last cross and PMT flanges from INFN/CERN completed by end of January
- c) Start delayed by 2 weeks, see a) above. Parts to replace those damaged in shipping are expected to arrive in May, however these parts are not anticipated to impose any delay on installation of other components
- d) Added contingency in materials transport
- e) Added contingency in materials transport
- f) Baseline for I-1 set in March 2018 when delays in delivery of cold shields has not been completely realized. Detailed intermediate milestones were defined and baselined in July 2018



# ICARUS Milestones to I-2 Detector Filled

Intermediate Milestone	Owner	Baseline Date	Forecast Date		Actual Date
Cold shield cooldown complete	C. Montanari	7-Aug-2019	15-Jul-2019		
Vessels filled with LAr, ready for HV	M. Geynisman	30-Sept-2019	10-Sept-2019		
Drift HV operational	F. Garcia	15-Oct-2019	10-Sept-2019		
PMTs operational	G. Raselli	30-Oct-2019	15-Oct-2019		
Cryogenics commissioning complete	M. Geynisman	30-Nov-2019	22-Oct-2019		
Cosmic tracks are observed in the TPC	A. Fava	30-Nov-2019	22-Oct-2019		
<b>I2: detector is filled with liquid argon and ready for physics commissioning (LAr purity adequate for physics has been achieved)</b>	<b>P. Wilson</b>	<b>30-Nov-2019</b>	<b>01-Nov-2019</b>		

# ICARUS Milestones to I-3a ready for physics data – CRT operational

Intermediate Milestone	Owner	Baseline Date	Forecast Date		Actual Date
Complete installation of Side CRT modules (a)	A. Schukraft	31-July-2019	28-Jun-2019		
Top CRT panels delivered to Fermilab	U. Kose	30-Sept-2019	31-Jul-2019		
Slow controls operational for all detector systems	K. Biery	31-Oct-2019	30-Sept-2019		
DAQ operational with >5Hz output	K. Biery	31-Oct-2019	30-Sept-2019		
Detector system timing synchronized with beam	K. Biery	30-Nov-2019	31-Oct-2019		
Trigger system operational	A. Guglielmi	31-Dec-2019	30-Nov-2019		
Top CRT panels are installed and ORC'ed	U. Kose/A. Fava	31-Jan-2020	5-Dec-2019		
<b>I3a: ICARUS detectors are ready for physics data – CRT is operational</b>	<b>P. Wilson</b>	<b>31-Jan-2020</b>	<b>17-Dec-2019</b>		

## Notes:

- a) This milestone is currently at T4 in the schedule file. Will promote to T3 at the next schedule statusing

# ICARUS Milestones to I-3b ready for physics data – shielding in place

Intermediate Milestone	Owner	Baseline Date	Forecast Date		Actual Date
Shielding blocks in place	C. James	28-Feb-2020	6-Feb-2020		
<b>I3b: ICARUS detectors are ready for physics data – Shielding in place</b>	<b>P. Wilson</b>	<b>28-Feb-2020</b>	<b>18-Feb-2020</b>		

# SBND Milestones to S-2 Ready to Fill

As presented at  
Jan 2019 PMG.

Intermediate Milestone	Owner	Baseline Date	Forecast Date		Actual Date
GTT Design Study Begins	M. Nessi	1-Feb-2019	2-Jan-2019		
Delivery of warm box steel	M. Nessi	15-Jun-2019	25-Apr-2019		
Warm vessel installation complete	M. Nessi	15-Jul-2019	29-Jul-2019		
TPC Transport to ND building complete	J. Zennamo	15-Sept-2019	3-Sept-2019		
Cryostat material arrives at Fermilab	M. Nessi	1-Oct-2019	17-Sept-2019		
Cryostat top plug is ready to attach to atf	M. Nessi	1-Nov-2019	15-Oct-2019		
Membrane Cryostat Completed	M. Kim	1-Mar-2020	22-Jan-2020		
Plug welded to cryostat	M. Kim, J. Zennamo	15-Apr-2020	18-Mar-2020		
Cryogenic operation approved	M. Geynisman	1-Jul-2020	11-Jun-2020		
<b>S2: SBND detector is ready to fill with liquid Argon</b>	<b>A. Schukraft</b>	<b>15-Jul-2020</b>	<b>11-Jun-2020</b>		

Comment: We expect intermediate milestone forecast dates to change in the near future as the installation sequence is undergoing some changes. Note, that this will not affect the forecast date of key milestone S2.

# SBND Milestones to S-3 Detector Filled

As presented at  
Jan 2019 PMG.

Intermediate Milestone	Owner	Baseline Date	Forecast Date		Actual Date
Laser system installation complete	I. Kreslo	1-Oct-2020	10-Apr-2020		
Detector checkout at 130-150 K complete	M. Stancari	15-Nov-2020	26-Oct-2020		
Vessels filled with LAr, ready for HV	M. Geynisman	21-Dec-2020	23-Nov-2020		
Drift HV operational	A. Schukraft	31-Jan-2021	9-Dec-2020		
PMTs operational	R. Van de Water	31-Jan-2021	2-Dec-2020		
Cryogenics commissioning complete	M. Geynisman	28-Feb-2021	23-Dec-2020		
Cosmic tracks are observed in the TPC	M. Stancari	28-Feb-2021	23-Dec-2020		
<b>S3: SBND detector is filled with liquid argon and ready for physics commissioning (LAr purity adequate for physics has been achieved)</b>	<b>A. Schukraft/M. Stancari</b>	<b>28-Feb-2021</b>	<b>23-Dec-2020</b>		

## SBND Milestones to S-4a ready for physics data – CRT operational

Intermediate Milestone	Owner	Baseline Date	Forecast Date		Actual Date
Top CRT panels delivered to Fermilab	I. Kreslo	1-Jul-2019	3-Oct-2019	<b>a</b>	
Slow controls operational for all detector systems	S. Gollapinni	15-Sept-2020	17-Aug-2020		
DAQ operational with >5Hz output	W. Badgett	1-Nov-2020	12-Oct-2020		
Detector system timing synchronized with beam	W. Badgett	15-Nov-2020	21-Sept-2020		
Trigger system operational	W. Badgett	15-Jan-2021	2-Dec-2020		
Top CRT panels are installed and ORC'ed	I. Kreslo	31-Mar-2021	20-Jan-2021		
<b>S4a: SBND detectors are ready for physics data – CRT is operational</b>	<b>M. Stancari</b>	<b>31-Mar-2021</b>	<b>25-Jan-2021</b>		

- a) Production of the top CRT modules has been delayed to reflect current SBN schedule and optimize load on the Bern workshop. There is no impact on the overall SBN schedule (Installation is planned to start in Dec 2020).

As presented at  
Jan 2019 PMG.

## SBND Milestones to S-4b ready for physics data – shielding in place

Intermediate Milestone	Owner	Baseline Date	Forecast Date		Actual Date
Shielding blocks in place	C. James	21-Apr-2021	16-Feb-2021		
CRT system complete and fully commissioned	I. Kreslo	30-Apr-2021	25-Feb-2021		
<b>S4b: SBND detectors are ready for physics data – Shielding</b>	<b>M. Stancari</b>	<b>30-Apr-2021</b>	<b>25-Feb-2021</b>		

As presented at  
Jan 2019 PMG.