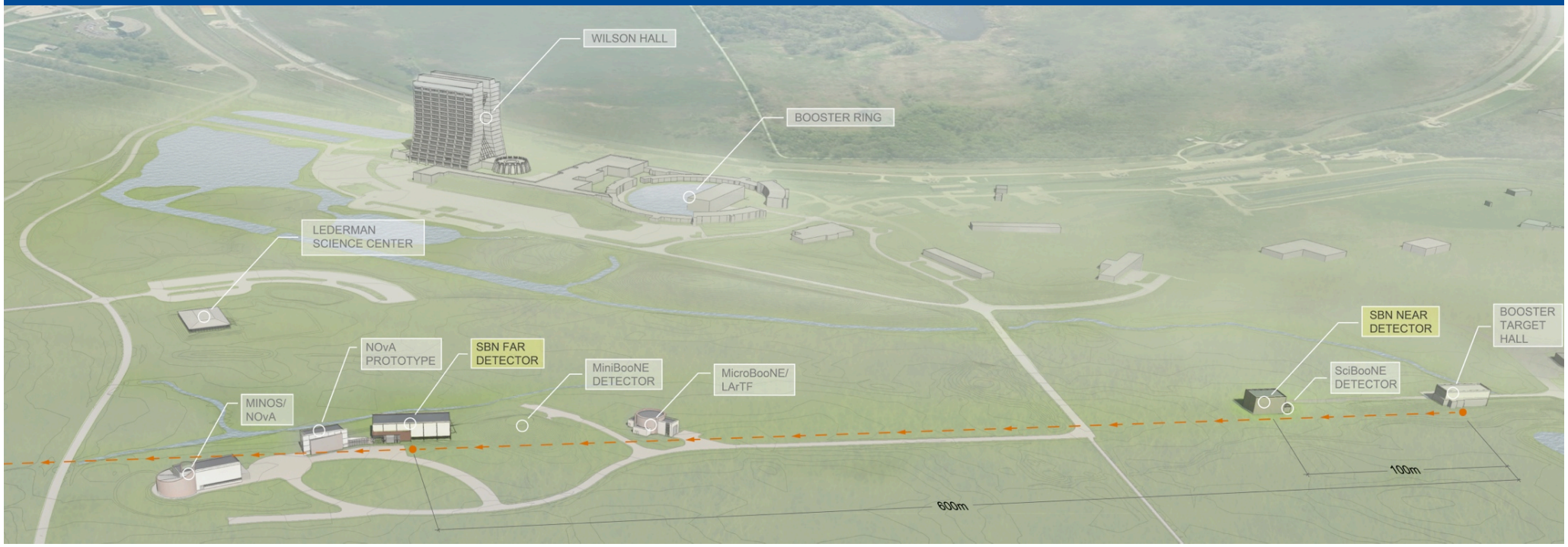


SBN Program Status

Peter Wilson – SBN Program Coordinator

SBN Oversight Board

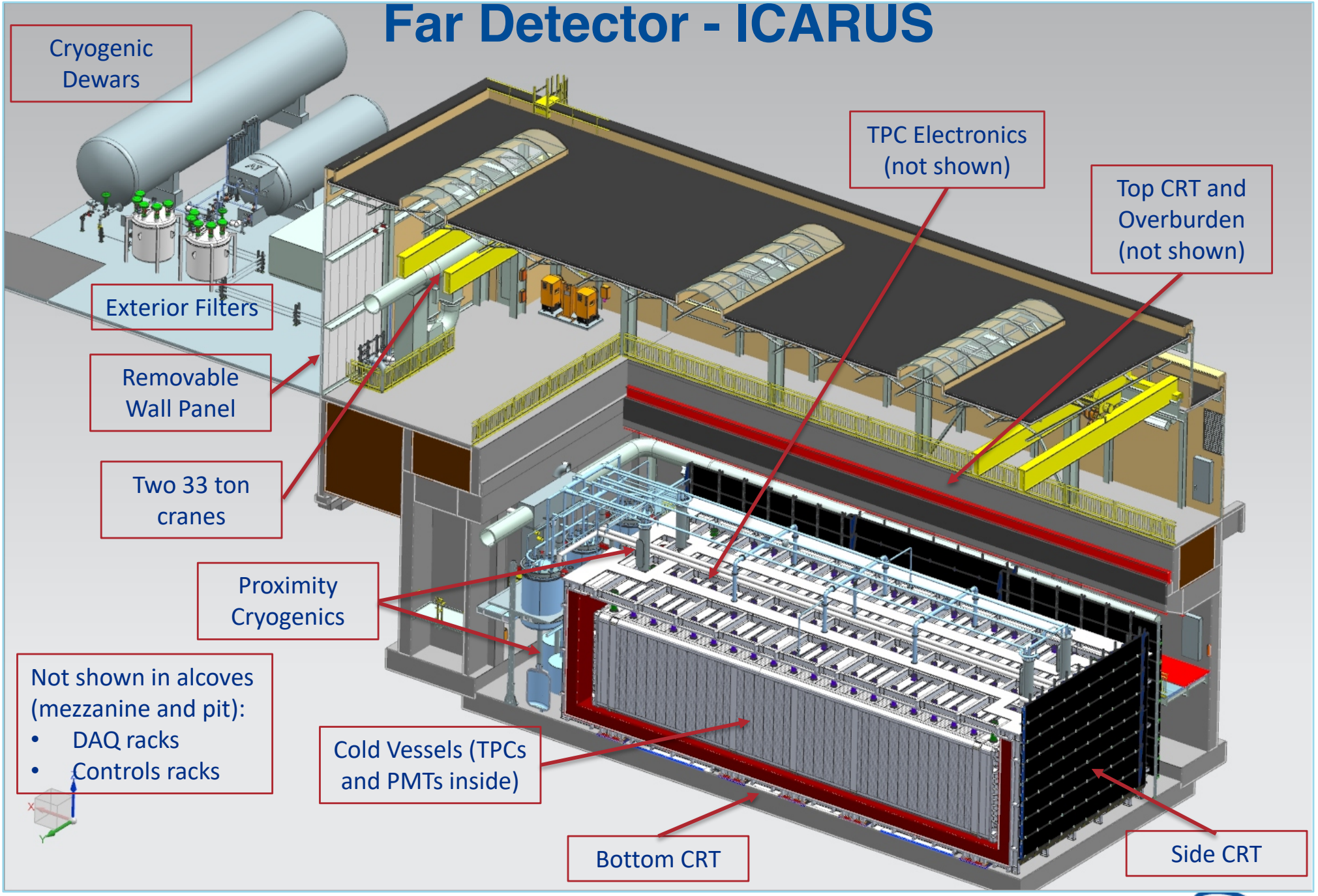
30 November 2018

Short Baseline Neutrino

Outline

- ICARUS technical progress
- SBND technical progress
- December Director's review

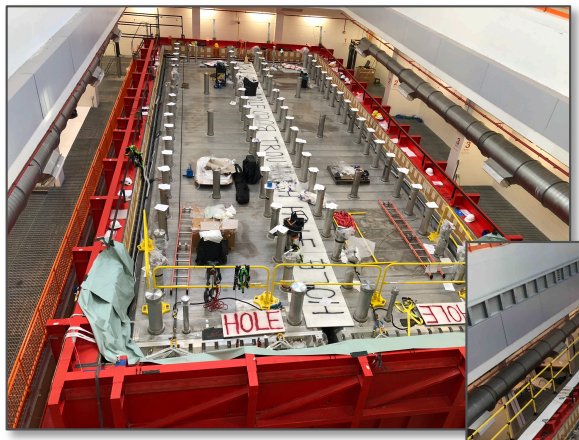
Far Detector - ICARUS



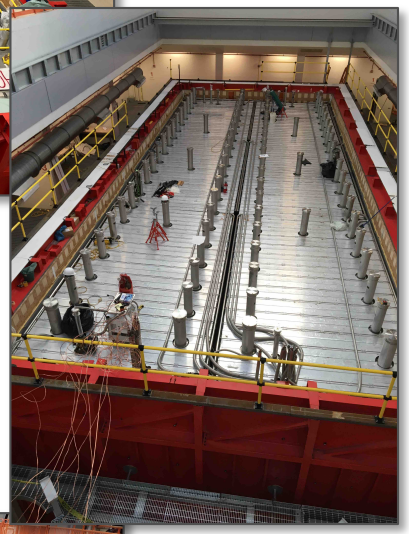
Short Baseline Neutrino

ICARUS Installation Progress

- Post rigging installation on schedule:
  - ✓ Vacuum test completed
  - ✓ Top cold shield installed and complete system pressure tested
  - ✓ Warm vessel roof installed, welded and leak checked
  - ✓ Installation of steel structures completed:
    - CRT top steel, cryogenic platform and stairs
    - Guardrails
  - – Installation of feedthrough crosses is in progress
  - – Installation of feedthrough flanges to start next week
  - – Proximity cryogenics components in transit from CERN
    - Arrived in New York this week, delivery to FNAL early December
  - – Demaco (CERN contractor) scheduled to start proximity cryogenics installation on Jan 28



Chimney Installation (collaboration)



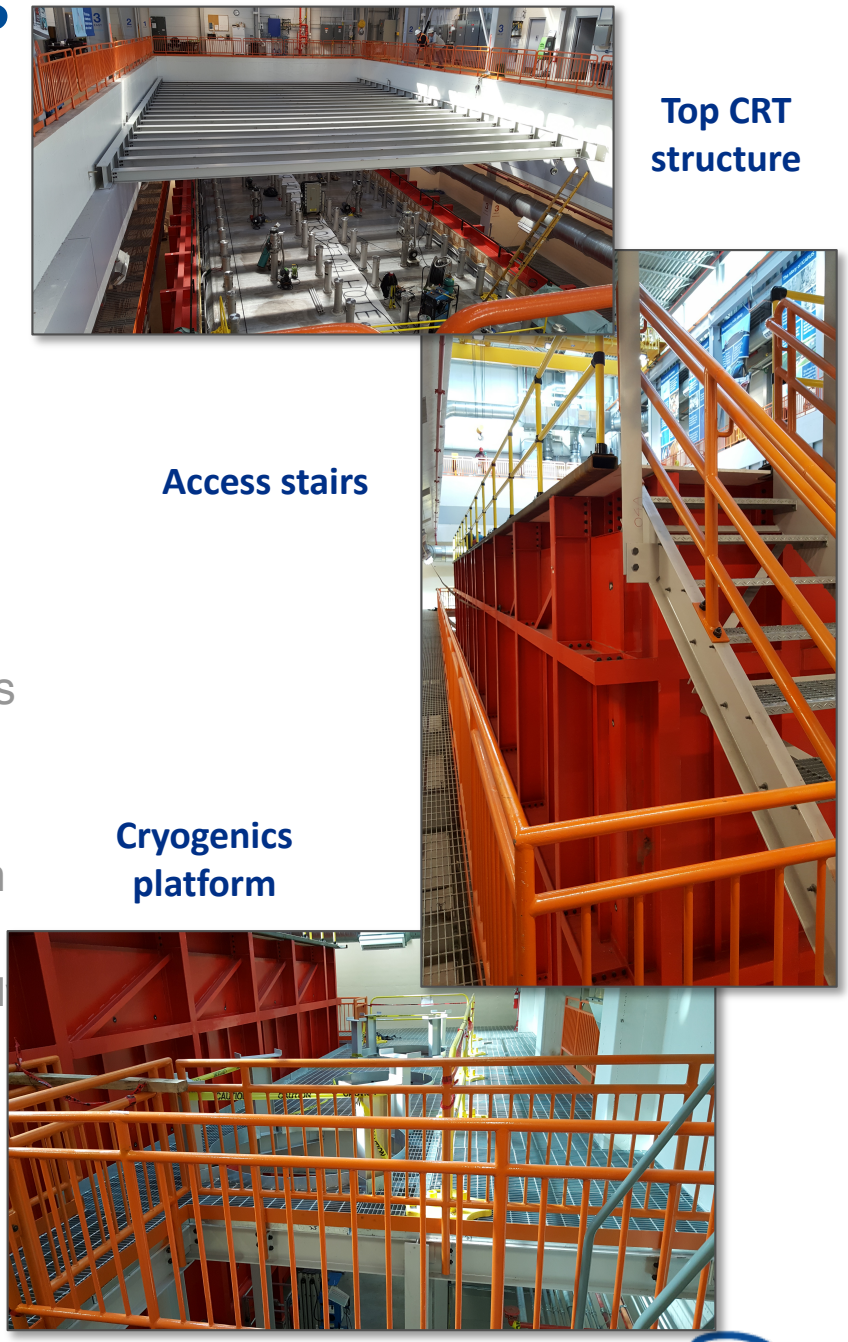
Cold shield pressure test

Warm vessel roof installation

Short Baseline Neutrino

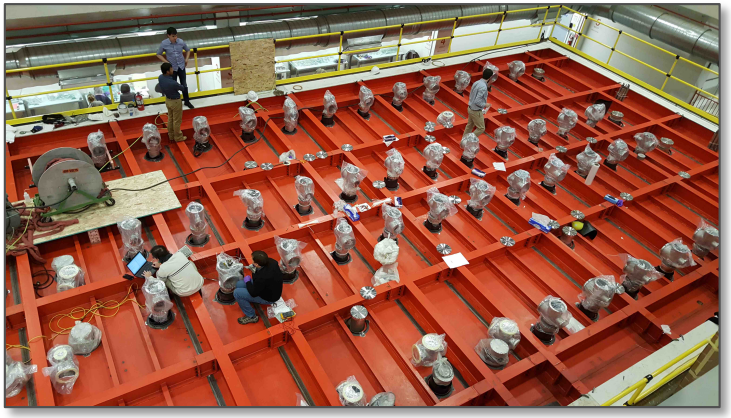
ICARUS Installation Progress

- Post rigging installation on schedule:
  - ✓ Vacuum test completed
  - ✓ Top cold shield installed and complete system pressure tested
  - ✓ Warm vessel roof installed, welded and leak checked
  - ✓ Installation of steel structures completed:
    - CRT top steel, cryogenic platform and stairs
    - Guardrails
  - – Installation of feedthrough crosses is in progress
  - – Installation of feedthrough flanges to start next week
  - – Proximity cryogenics components in transit from CERN
    - Arrived in New York this week, delivery to FNAL earl December
  - – Demaco (CERN contractor) scheduled to start proximity cryogenics installation on Jan 28



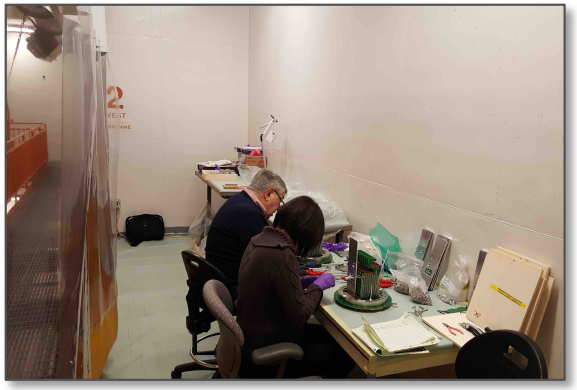
ICARUS Installation Progress

- Post rigging installation on schedule:
  - ✓ Vacuum test completed
  - ✓ Top cold shield installed and complete system pressure tested
  - ✓ Warm vessel roof installed, welded and leak checked
  - ✓ Installation of steel structures completed:
    - CRT top steel, cryogenic platform and stairs
    - Guardrails
  - – Installation of feedthrough crosses is in progress
  - – Installation of feedthrough flanges to start next week
  - – Proximity cryogenics components (far and near detector) in transit from CERN
    - Six of ten containers at port in New York, delivery to FNAL in early December
  - – Demaco (CERN contractor) scheduled to start proximity cryogenics installation on Jan 28

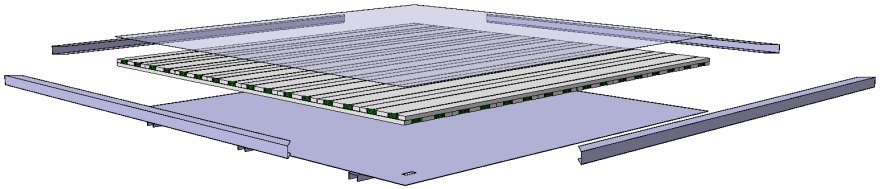


Installing feedthrough crosses

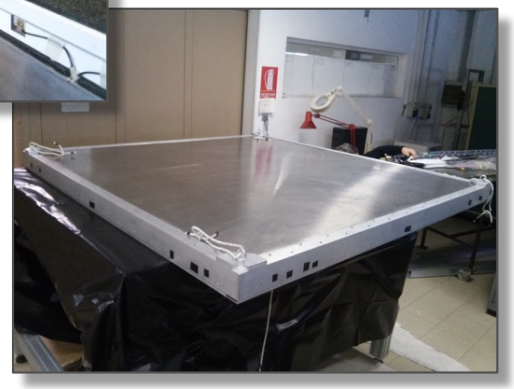
Attaching decoupling cards to flanges



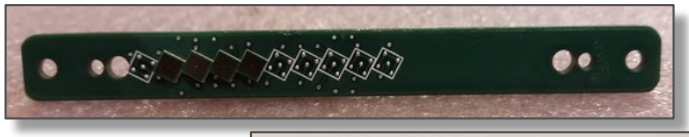
ICARUS Progress



- TPC electronics production in final phase (INFN)
  - On track to complete delivery to FNAL by May
- Cosmic Ray Tagger (CRT)
  - Bottom modules installed in 2017 (Double Chooz spares courtesy of U. Chicago)
  - Top module production has at Frascati (CERN/INFN)
    - First modules complete in January 2019
    - Complete assembly in summer 2019
  - Sides re-use MINOS far detector modules (FNAL/US), completing design of SiPM board
    - Review of final prototype in January 2019
    - SiPMs ordered
  - Common electronics for top, sides and SBND – designed by U. Bern, commercialized by CAEN
  - DAQ/event builder code
- DAQ servers ordered (FNAL/INFN)



PreProduction Top CRT Module @ Bologna



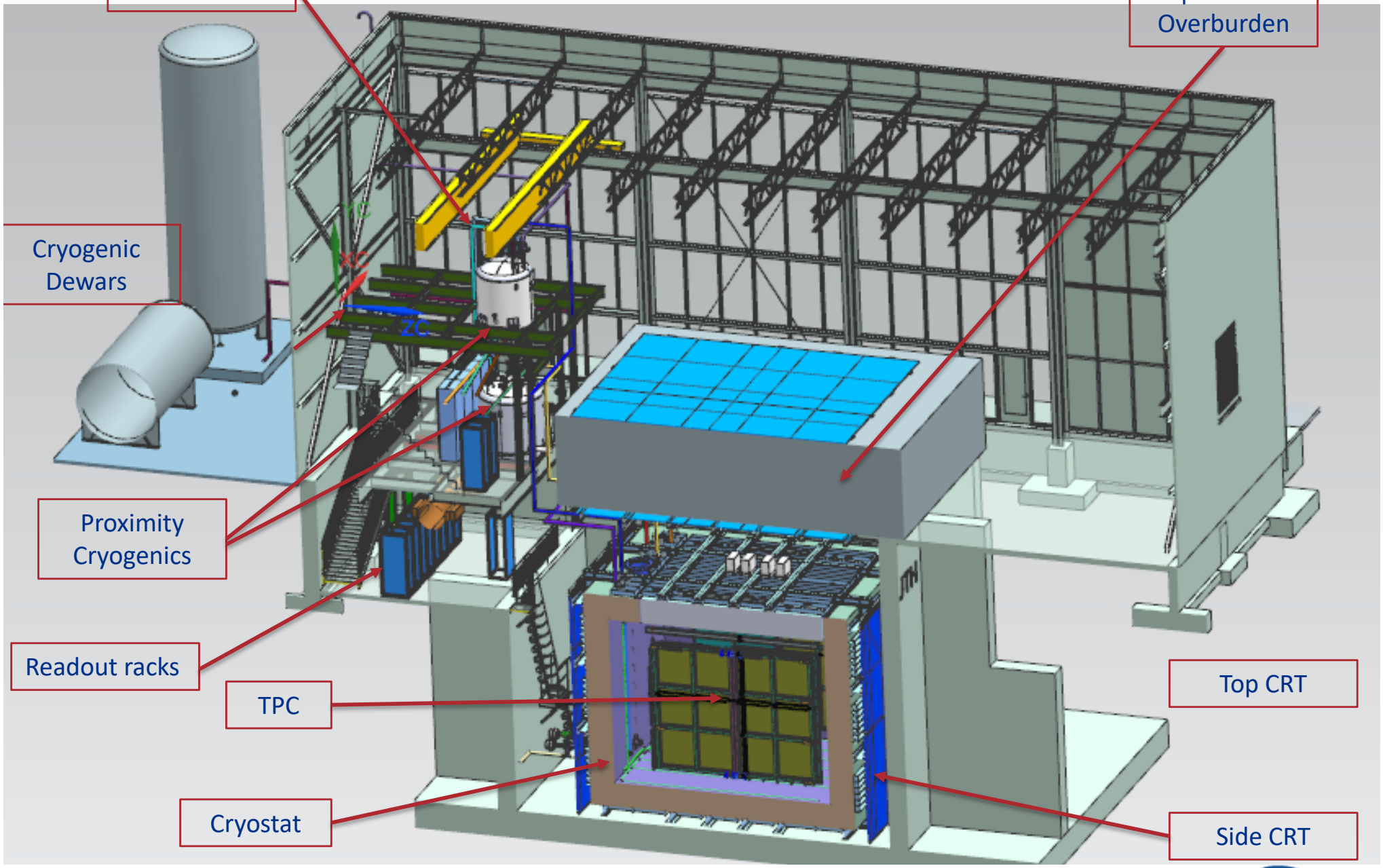
Prototype SiPM board and cable shroud for MINOS Modules

Short Baseline Neutrino

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	✓	16-Aug-2018
Manholes welded and vacuum test successful	C. Montanari	10-Oct-2018	03-Oct-2018	✓	11-Oct-2018
Warm Vessel roof complete	C. James	15-Nov-2018	9-Nov-2018	✓	31-Oct-2018
Cryo Platform complete	C. James	15-Dec-2018	12-Oct-2018	✓	04-Oct-2018
Proximity cryogenics installation begins	B. Norris	15-Jan-2019	30-Jan-2019		
DBB & flanges installation complete and tested	A. Fava	15-Feb-2019	21-Feb-2019		
Cold proximity cryogenics installation complete	B. Norris	15-Apr-2019	23-Apr-2019		
1st T300 readout installation complete	A. Fava	15-Mar-2019	11-Mar-2019		
All detector readout installed	A. Fava	1-May-2019	19-Apr-2019		
Begin vacuum pumping	C. Montanari	15-Jul-2019	15-May-2019		
Cryogenic operation approved	B. Norris	15-Jul-2019	28-Jun-2019		
I1: ICARUS detectors ready to fill with LAr	P. Wilson	30-May-2019	28-Jun-2019		

Near Detector - SBND



Short Baseline Neutrino

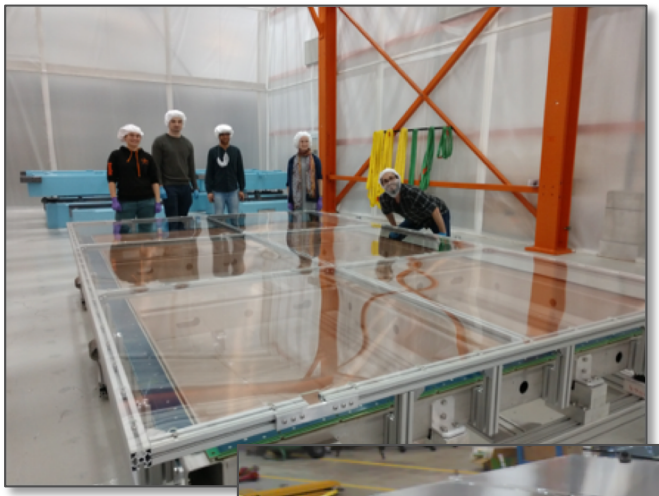
SBND TPC Progress

Joint responsibility of UK, US-NSF, FNAL

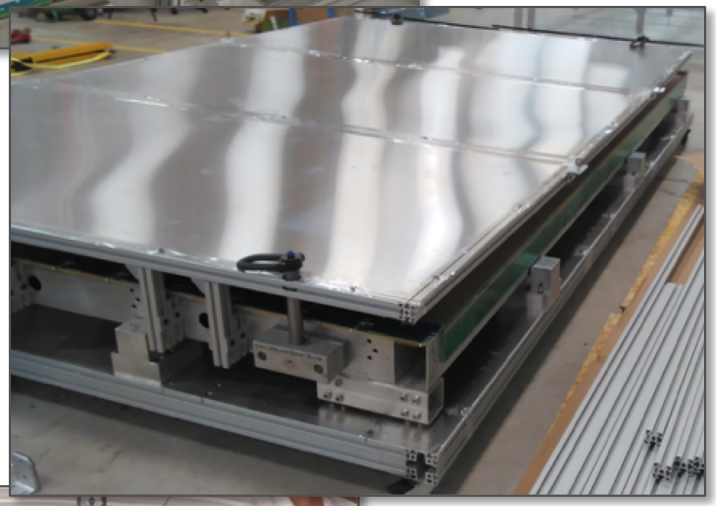
- UK: Cathode plane, two anode planes, HV feedthrough
- US-NSF: field cage, two anode planes, HV feedthrough
- FNAL: support integration and assembly

Recent Milestones:

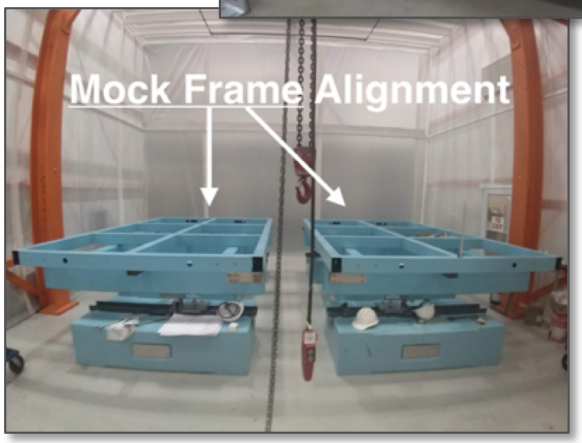
- ✓ Aug 2018 1st UK and US anode planes completed
- ✓ Sept 2018 Field cage completed
- ✓ Oct 2018 1st UK anode delivered to FNAL
- ✓ Sept 2018 Test of assembly fixture at FNAL
- ✓ Nov 2018 2nd US anode plane completed
- Dec 2018 US anodes delivered to FNAL
- Feb 2019 2nd UK anode delivered to FNAL



1st Manchester APA at FNAL in DZero clean tent



Yale – 2nd APA ready to ship



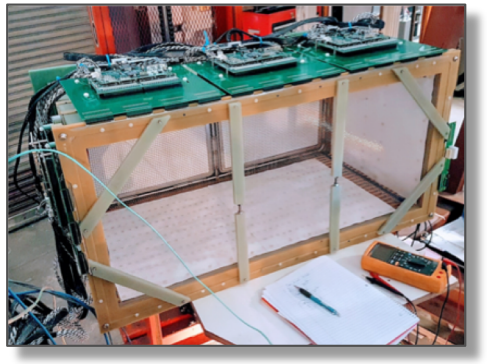
Assembly facility at Dzero Assembly building

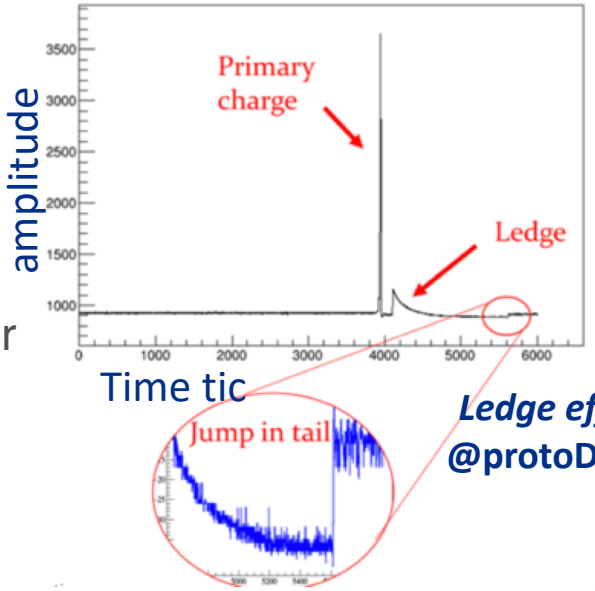
Short Baseline Neutrino

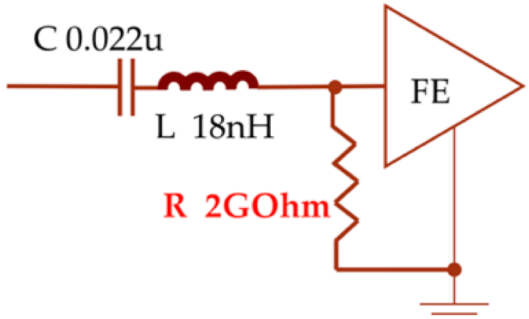
SBND TPC Electronics Progress

- 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
- Vertical slice test in summer 2018 with LArIAT TPC
  - good noise performance
  - No major issues with Nevis electronics
  - Proximity of HV to cables and electronics caused FE channel failures and data corruption, very different detector configuration than SBND
- Addressing lessons from ProtoDUNE
  - FE ASIC “ledge effect” – large charge depositions cause a dead period of several hundred microsecs
  - Ongoing investigations by ProtoDUNE and at BNL
  - Mitigated by modifying layout of FE board to include 1-2GOhm resistor and operation with higher baseline setting
  - Continuing study of physics effects
- Production Readiness Review – Nov 29
  - Recommends proceeding with production

LArIAT TPC w/ SBND electronics







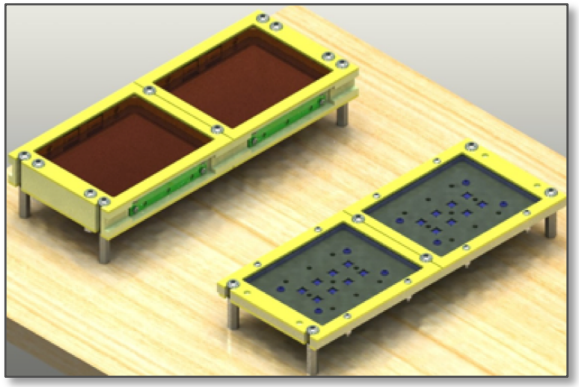
Short Baseline Neutrino

SBND Photo Detection Progress

- 120 SBND PMTs are now in the Coherent CAPTAIN-Mills Detector (CCM)
  - Fill with LAr ~now
- Electronics and DAQ are ready, the HV breakout boxes will be finished soon

- ARAPUCA group has made prototypes to be tested in argon at the end of November
- ARAPUCA group ready to purchase feedthroughs as soon as bar group makes a final decision about connectors and costs

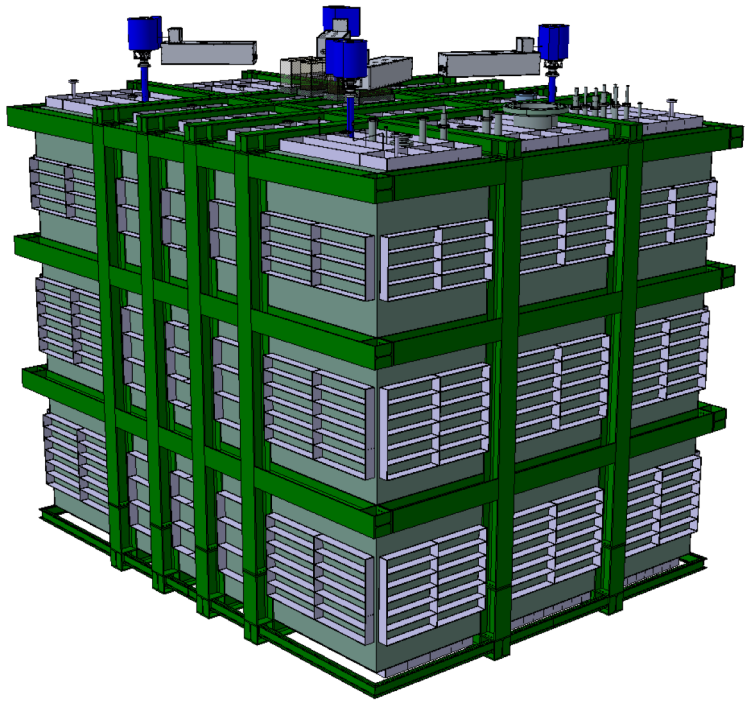
CCM preparing to test PMTs at LANL



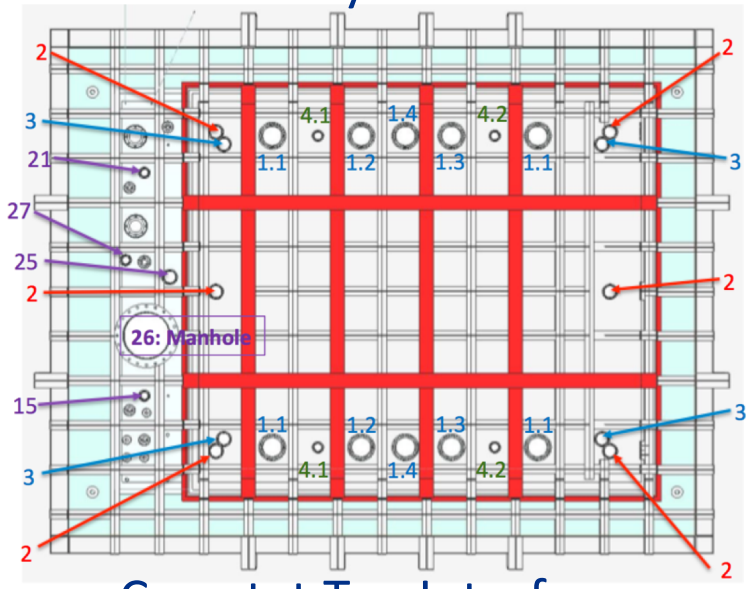
ARAPUCA prototypes

SBND Cryostat

- Outer steel structure + GTT designed membrane cryostat
  - Joint responsibility of CERN, FNAL and INFN
- SBND will be 3rd generation prototype for DUNE designed by CERN:
  - WA105 1x1x3 ➔ protoDUNEs ➔ SBND
  - Steel structure design updated to match LBNF/DUNE as closely as possible
- Status:
  - General agreement between CERN-FNAL-INFN on sharing of responsibilities
  - Final design of steel structure nearly complete
  - Ready to start final design study for membrane cryostat by GTT



SBND Cryostat Model



Cryostat Top Interfaces

Short Baseline Neutrino

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	28-Dec-2018		
PO for COTS ADCs placed	H. Chen	10-Oct-2018	30-Nov-2018	✓	30-Oct-2018
All TPC Components at Fermilab	K. Mavrokoridis	1-Mar-2019	26-Feb-2019		
Complete atf assembly at DAB	J. Zennamo	1-May-2019	8-Apr-2019		
50% of motherboards delivered to Fermilab	H. Chen	15-May-2019	15-Apr-2019		
APAs and CPAs installed in atf	J. Zennamo	15-Jun-2019	23-May-2019		
Field cage assembly complete	J. Zennamo	15-Jul-2019	2-Jul-2019		
Cold electronics installed and tested	H. Chen	23-Aug-2019	8-Aug-2019		
S1: TPC ready to move to SBN ND	A. Schukraft	30-Aug-2019	8-Aug-2019		

SBND Milestones to S-2 Ready to Fill

Intermediate Milestone	Owner	Baseline Date	Forecast Date		Actual Date
GTT Design Study Begins	M. Nessi	1-Feb-2019	1-Jan-2019		
Delivery of warm box steel	M. Nessi	15-Jun-2019	30-Apr-2019		
Warm vessel installation complete	M. Nessi	15-Jul-2019	29-May-2019		
TPC Transport to ND building complete	J. Zennamo	15-Sept-2019	16-Aug-2019		
Cryostat material arrives at Fermilab	M. Nessi	1-Oct-2019	22-Aug-2019		
Cryostat top plug is ready to attach to atf	M. Nessi	1-Nov-2019	23-Sept-2019		
Membrane Cryostat Completed	M. Kim	1-Mar-2020	22-Jan-2020		
Plug welded to cryostat	M. Kim, J. Zennamo	15-Apr-2020	6-Mar-2020		
Cryogenic operation approved	M. Geynisman	1-Jul-2020	1-Jun-2020		
S2: SBND detector is ready to fill with liquid Argon	A. Schukraft	15-Jul-2020	1-Jun-2020		

SBN Director's Review – Dec 2018

- A Director's Review for SBN will be held Dec 17-19 2018

- The charge and review format will be similar to the June 2018 review:
  - Focus on schedule elements and integrated schedule
  - Will include more detail on commissioning plans
  - Session on DOE costs

- Charge is posted on the indico page for this meeting

- Review agenda is being finalized now

- Preparation for review
  - Schedules for both ICARUS and SBND have been updated in October
    - Includes integration of commissioning milestones
  - Updated estimate of DOE costs including commissioning costs

Backup

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	30-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		
I2: detector is filled with liquid argon and ready for physics commissioning (LAr purity adequate for physics has been achieved)	P. Wilson	30-Nov-2019	22-Oct-2019		

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

Intermediate Milestone	Owner	Baseline Date	Forecast Date		Actual Date
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		
I3a: ICARUS detectors are ready for physics data – CRT is operational	P. Wilson	31-Jan-2020	5-Dec-2019		

ICARUS Milestones to I-3a 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		
I3b: ICARUS detectors are ready for physics data – Shielding in place	**P. Wilson**	**28-Feb-2020**	**6-Feb-2020**		

SBND Milestones to S3 Detector Filled

Intermediate Milestone	Owner	Baseline Date	Forecast Date		Actual Date
Laser system installation complete	I. Kreslo	1-Oct-2020	31-Mar-2020		
Detector checkout at 130-150 K complete	M. Stancari	15-Nov-2020	16-Oct-2020		
Vessels filled with LAr, ready for HV	M. Geynisman	21-Dec-2020	30-Oct-2020		
Drift HV operational	A. Schukraft	31-Jan-2021	1-Dec-2020		
PMTs operational	R. Van de Water	31-Jan-2021	20-Nov-2020		
Cryogenics commissioning complete	M. Geynisman	28-Feb-2021	15-Dec-2020		
Cosmic tracks are observed in the TPC	M. Stancari	28-Feb-2021	15-Dec-2020		
S3: SBND detector is filled with liquid argon and ready for physics commissioning (LAr purity adequate for physics has been achieved)	A. Schukraft/M. Stancari	28-Feb-2021	15-Dec-2020		

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	1-Apr-2019		
Slow controls operational for all detector systems	S. Gallopini	15-Sept-2020	17-Jul-2020		
DAQ operational with >5Hz output	W. Badgett	1-Nov-2020	2-Oct-2020		
Detector system timing synchronized with beam	W. Badgett	15-Nov-2020	11-Sept-2020		
Trigger system operational	W. Badgett	15-Jan-2021	15-Dec-2020		
Top CRT panels are installed and ORC'ed	I. Kreslo	31-Mar-2021	11-Jan-2021		
S4a: SBND detectors are ready for physics data – CRT is operational	M. Stancari	31-Mar-2021	19-Jan-2021		

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	8-Feb-2021		
CRT system complete and fully commissioned	I. Kreslo	30-Apr-2021	15-Feb-2021		
S4b: SBND detectors are ready for physics data – Shielding	M. Stancari	30-Apr-2021	15-Feb-2021		