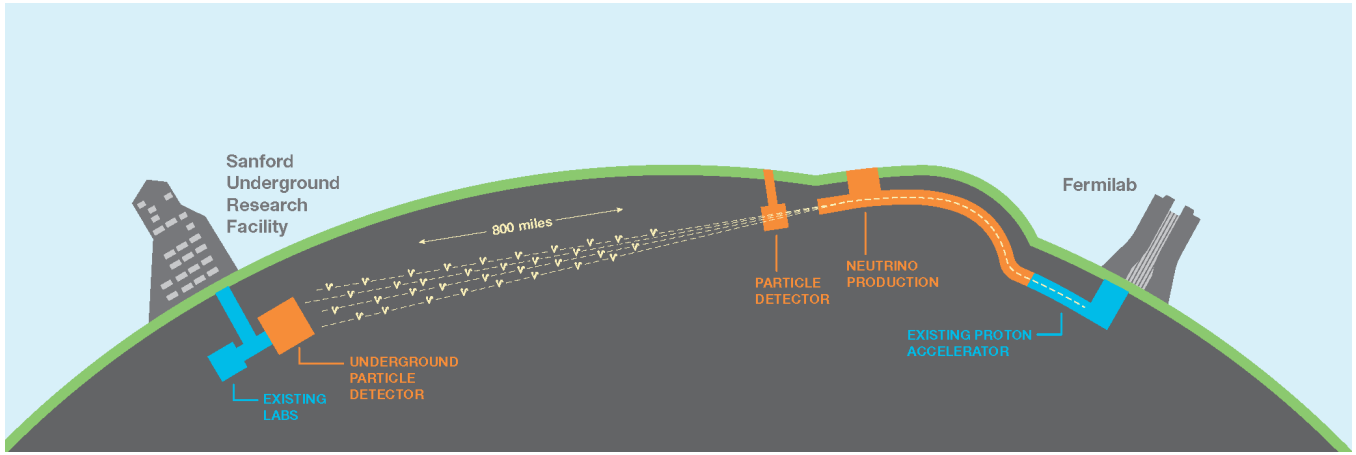


ProtoDUNE-SP Status

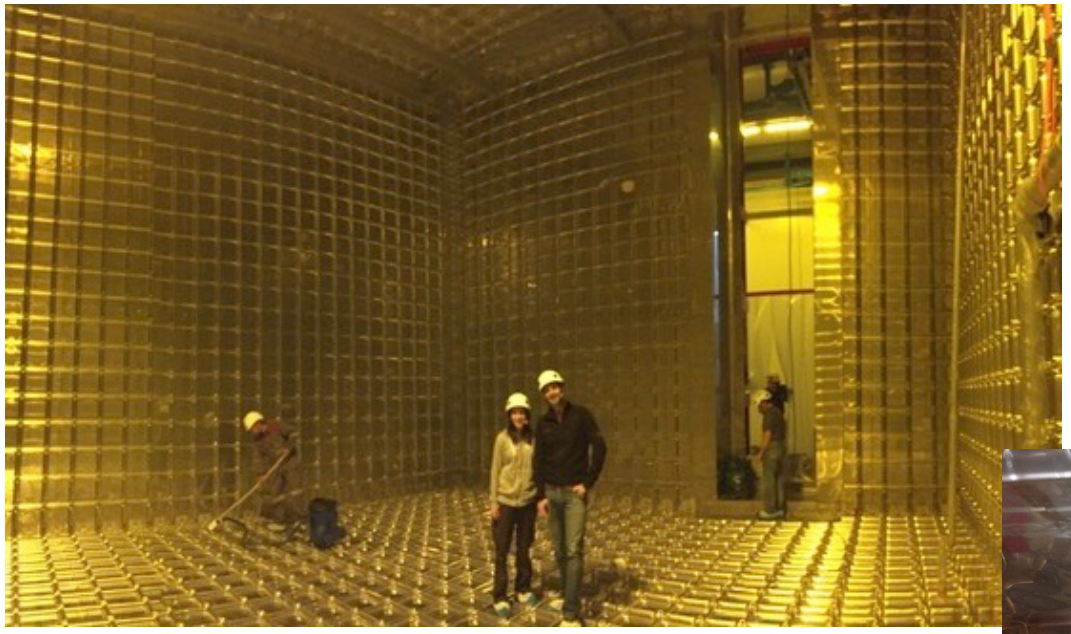
Gina Rameika

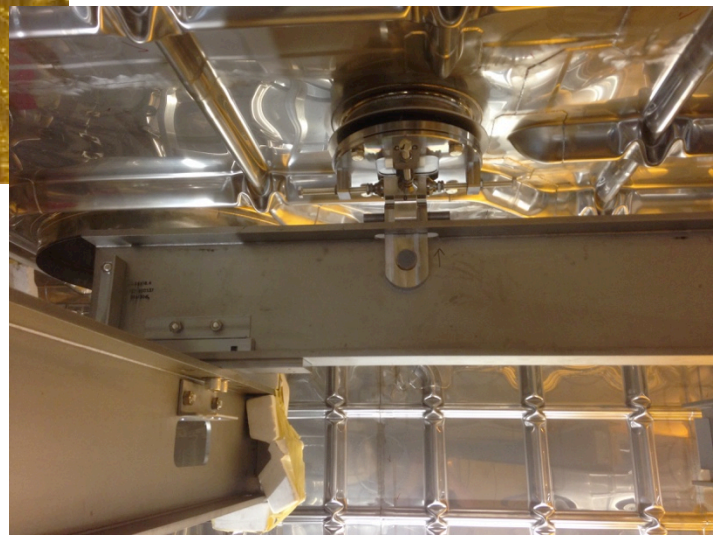
LBNC Meeting

February 19, 2018

Fermilab DUNE

October 2017





Cryostat : leak checked and cleaned;
DSS installed

Major Milestones (tracking for ~1 year)

BNL Cold Electronics Integration Test-stand Operational : 3/8/17 ✅

Submission of Production FEMB Fabrication : 4/19/17 ~~on track~~ ✅

35ton HV Test (Phase 1) Complete : 5/3/17 ~~on track~~ ✅

Ash River Trial Assembly Complete : 6/9/17 ~~on track~~ ✅

35ton HV Test (Phase 2) Complete : 8/24/17 ✅

PSL APA #1 Arrives @ CERN ~~: 6/9/17~~ Now 7/17/17 ✅

First 10 PD modules ready to ship to CERN : 5/9/17 will be @ CERN ~7/20 ✅

Ship APA#1 Electronics to CERN ~~: 5/24/17 tight but doable~~ **Now ~~8/1/17~~** ✅

PSL APA #2 Arrives @ CERN ~~: 9/8/17 10/27/17~~ **Now 11/17/17** ✅

UK APA#1 Arrives @ CERN : ~~9/18/17 10/19/17~~ **Now 1/10/18** ✅

PSL APA #3 Arrives @ CERN: ~~11/9/17~~ ~~**03/02/18**~~ **Now 02/16/18**

UK APA #2 Arrives @ CERN : ~~11/27/17 12/14/17~~ **Now 04/01/18**

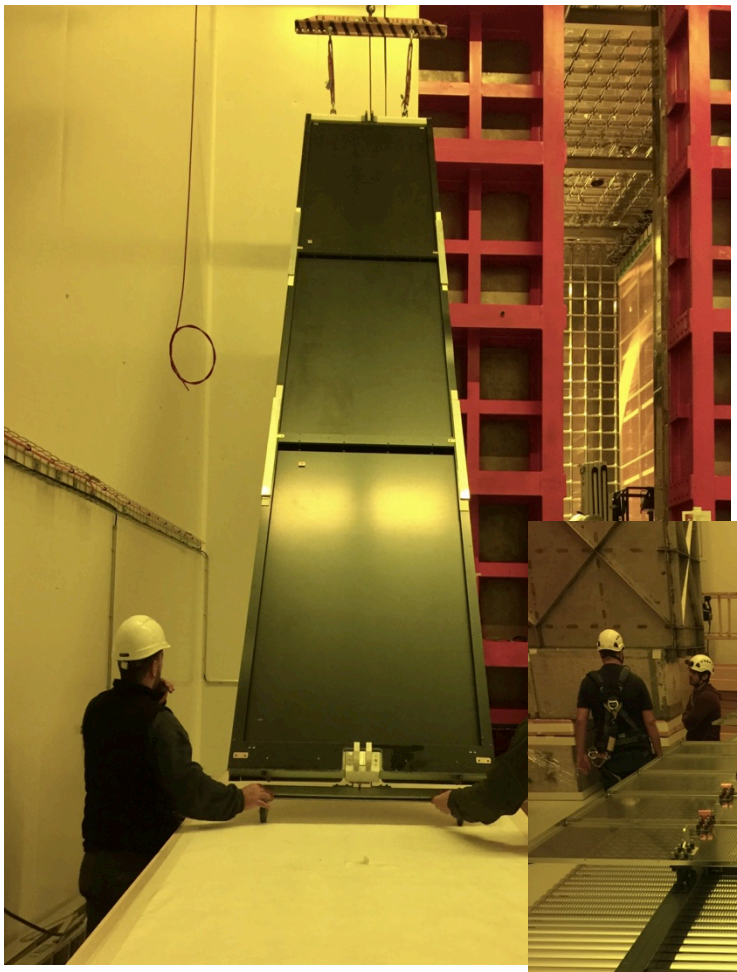
PSL APA #4 Arrives @ CERN: New 04/14/18

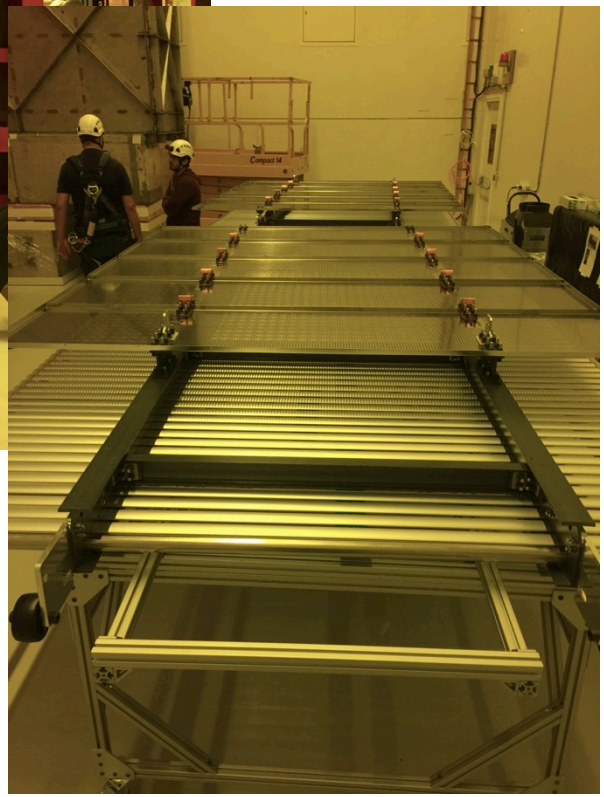
~~UK APA #3 Arrives @ CERN : 1/19/18 **Now 06/27/18**~~

CPA Assembly at CERN (November – January)

October 19, 2017
CPA's leaving ANL

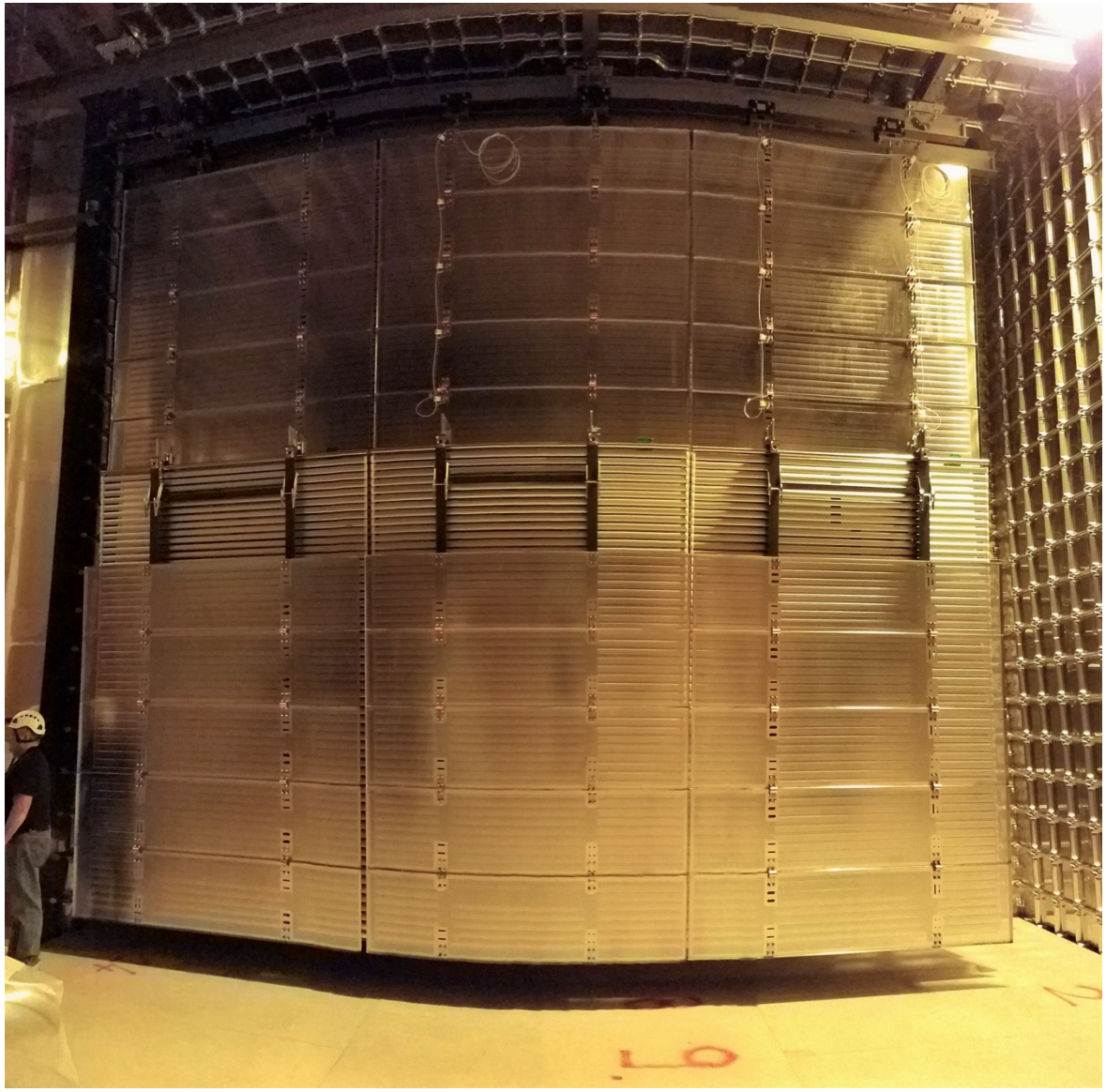
Field cages stored in EHN1





CPA/Field Cage assembly in Clean Room

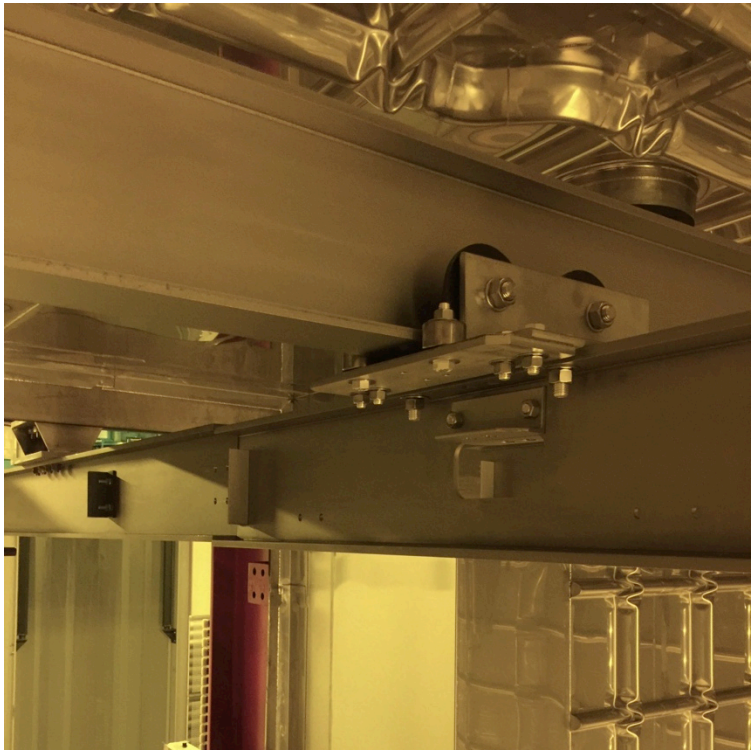
Cathode Plane/Field Cages (CPA/FC)



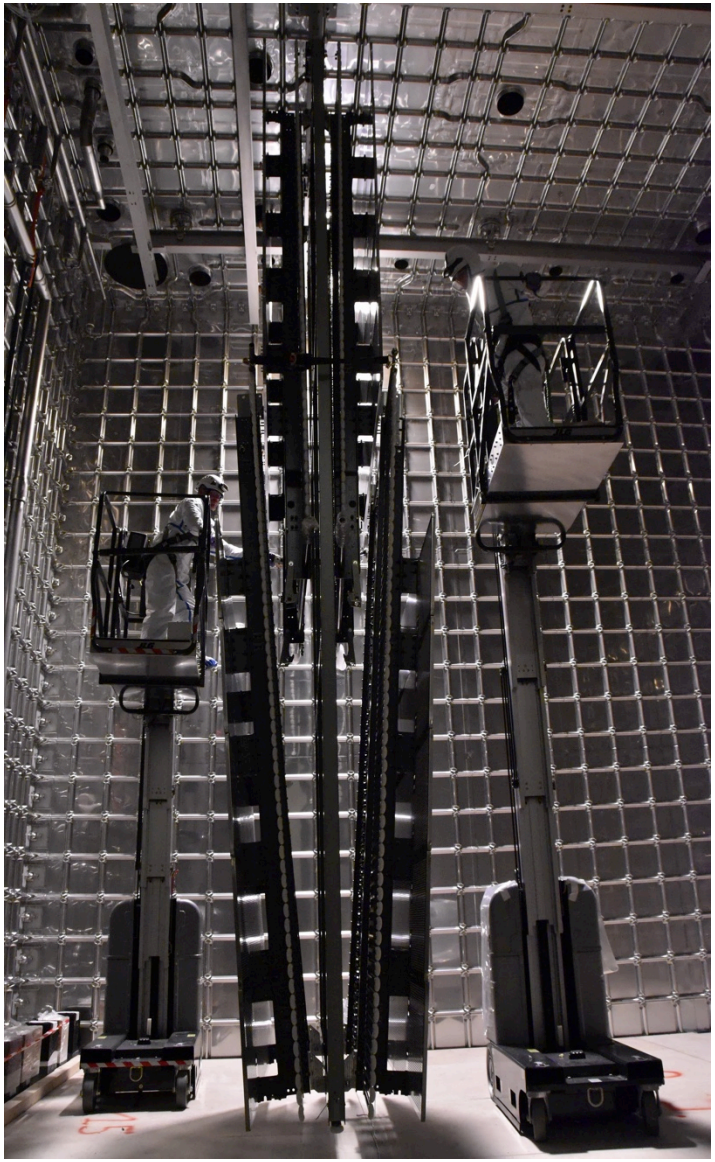
18 individual “panels” assembled
into units of 3;
6 total panels needed
Top and Bottom field cage modules
(12 panels) attached

All units complete and installed in cryostat, February 7

Working inside the cryostat

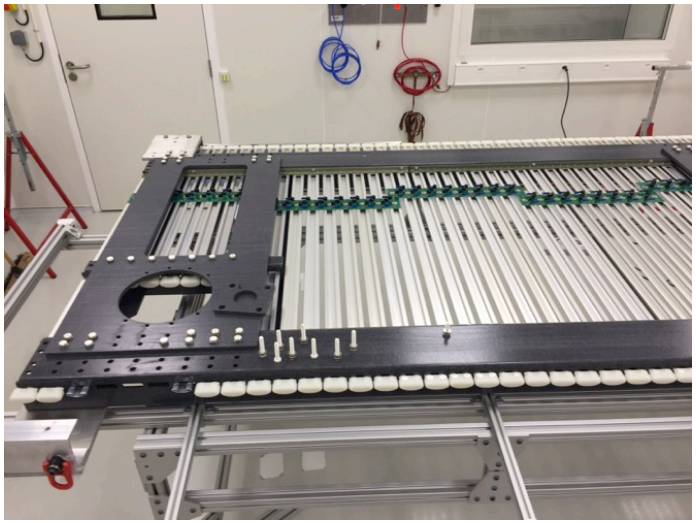


Bridge Beam Trolleys



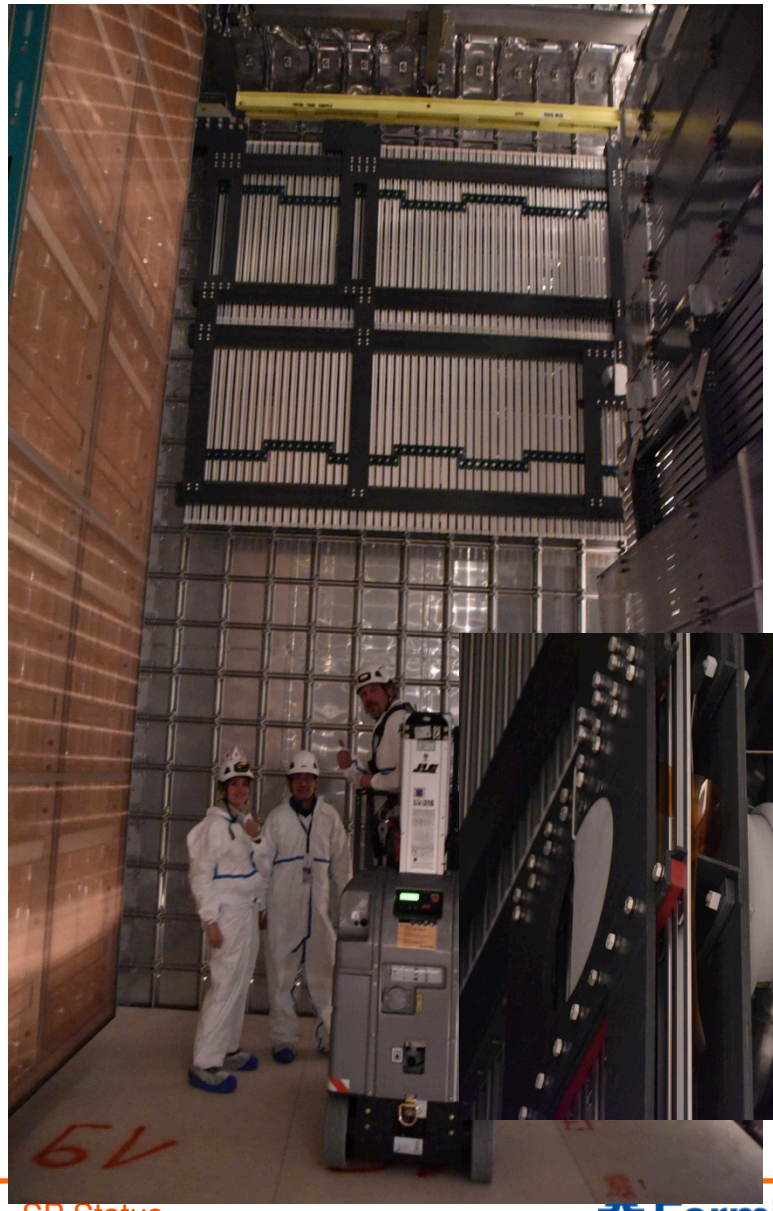
October 2017

Endwall construction in B. 182



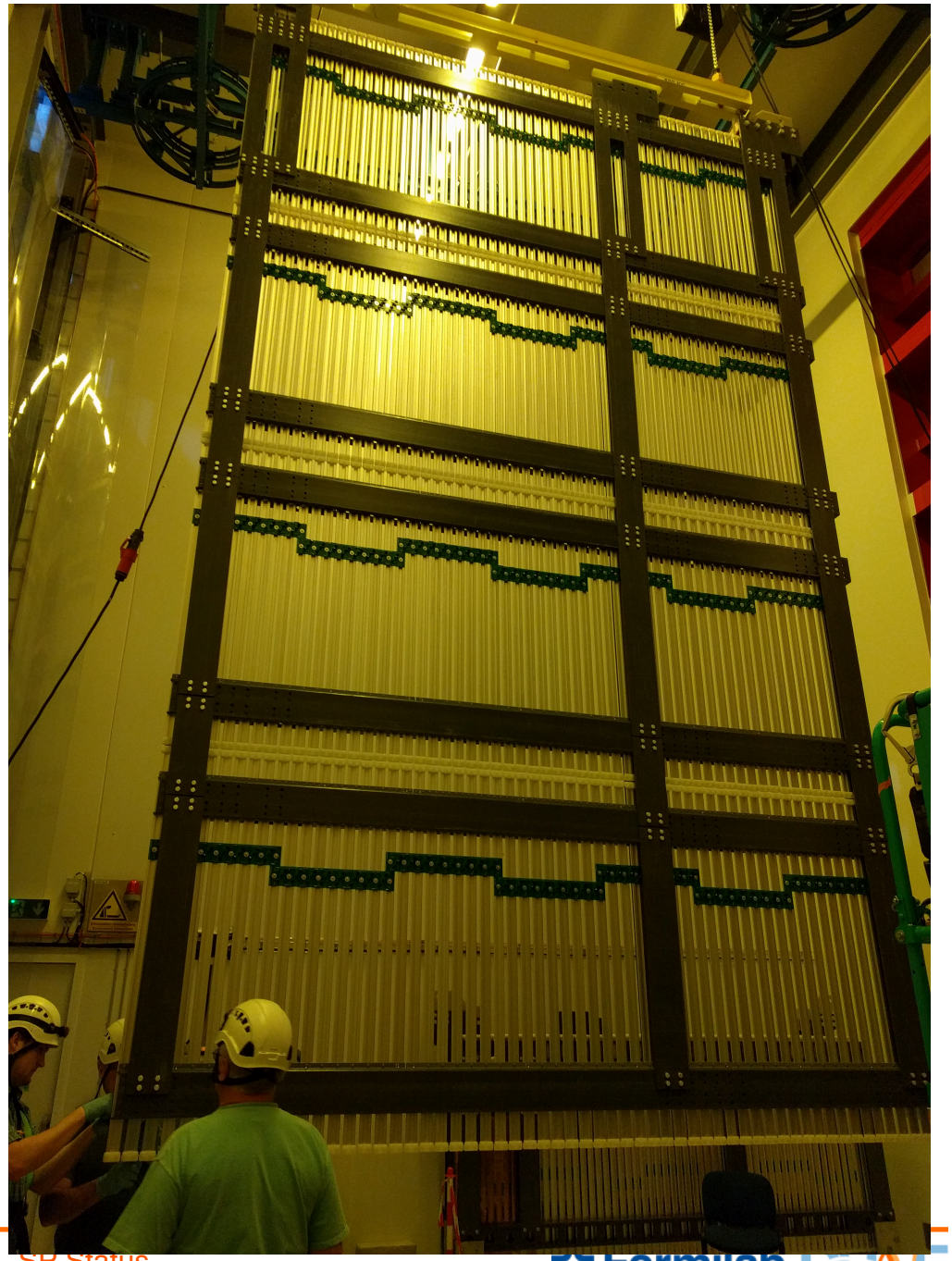
Modules stored in EHN1

Feb.5 Test fit beam plug in end wall

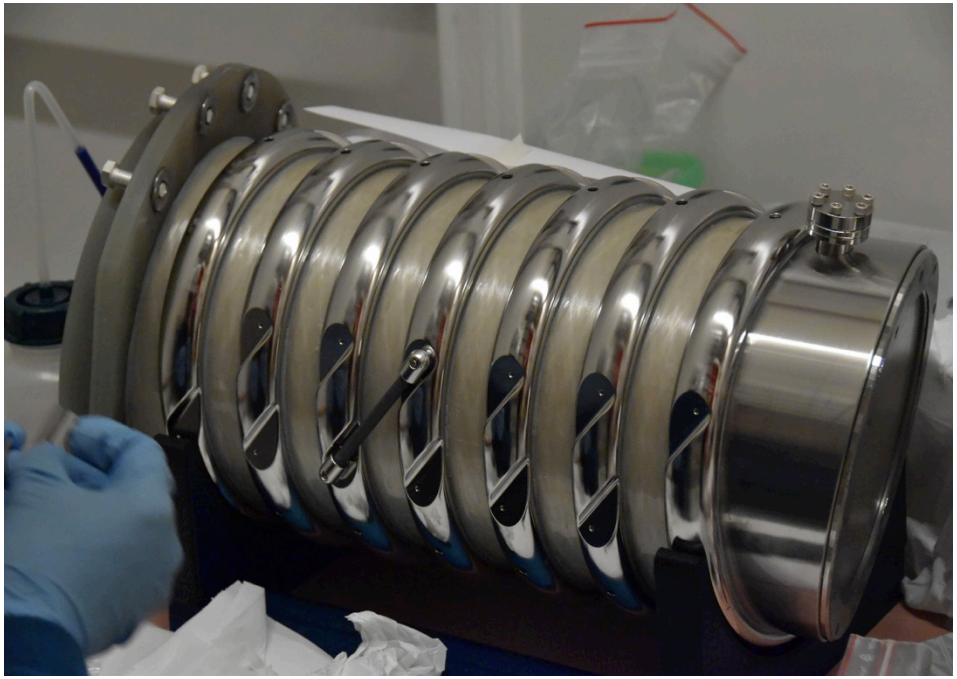


3-d printer plug

February 14
Full endwall assembled



Beam Plug at CERN



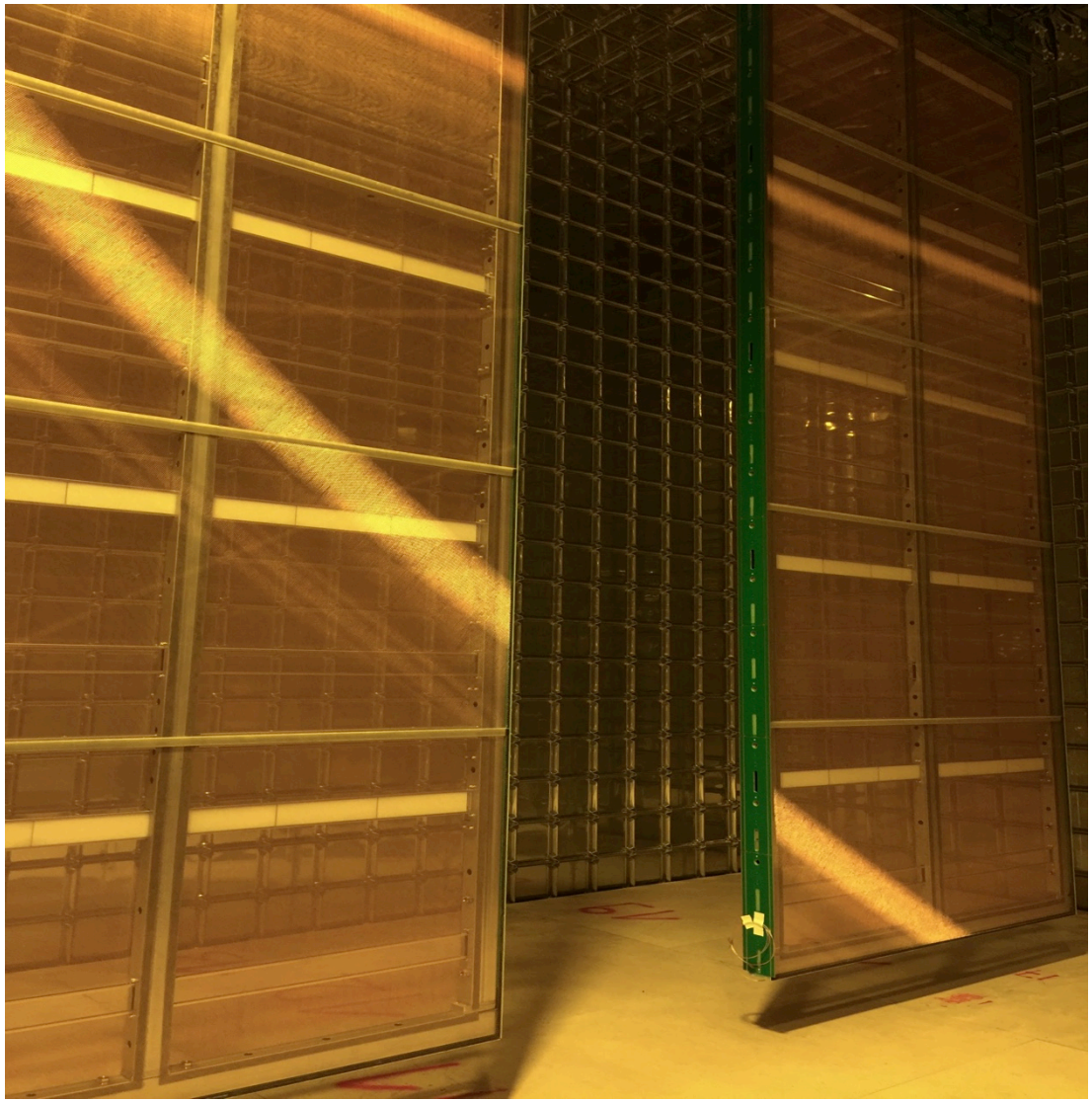
Nitrogen gas controls
on top of cryostat

APA#1 – 2 in Cryostat

October 2017

APA#1

Oct. 2, 2017



APA#3 (UK#1)
Clean Room and Cold Box

October – Winding U plane

January

APA Strategy : We have 4 complete APAs

		Winding		Transport			Cold Box Test Time		In Cryostat	
		Start Winding X	Finish Winding G	Crate	Ship	Arrival at CERN	Start	Finish		
APA#1	PSL#1	2/1/17 A	6/30/17 A	7/7/17 A	7/11/17 A	7/14/2017 A	10/9/2017 A	11/26/2017 A	11/28/17 A	Cold Box finish driven by arrival of APA#2
APA#2	PSL#2	8/9/17 A	10/23/17 A	11/10/2017 A	11/14/2017 A	11/17/2017 A	11/29/2017 A	1/17/2018 A	1/26/18 A	Cold Box finish driven by arrival of APA#3
APA#3	UK#1	8/9/2017 A	12/01/2017 A	1/10/2018 A	1/12/2018 A	1/16/2018 A	1/31/2018 A	2/8/2018 A	2/9/2018 A	Cold Box finish driven by installing Beam Right TPC assembly
APA#4	PSL#3	11/20/2017 A	1/17/2018 A	2/9/2018 A	2/15/2018 A	2/20/2018 A	3/5/18	4/24/18	4/26/18	Cold Box finish driven by arrival of APA#5 and #6 and beam left installation

Our goal is to have two more !

		Winding		Transport			Cold Box Test Time		In Cryostat	
		Start Winding X	Finish Winding G	Crate	Ship	Arrival at CERN	Start	Finish		
APA#5	UK#2	**1/23/2018 A**	3/6/18	3/20/18	3/26/18	**3/29/18**	N/A	N/A	4/10/18	6 week winding time; Working 12 hr days plus weekends
APA#6	PSL#4	**2/8/2018 A**	3/30/18	4/9/18	4/10/18	**4/13/18**	N/A	N/A	4/25/18	*Looks doable!!*
APA#7	UK#3	N/A	N/A	N/A	N/A	N/A	N/A	N/A		APA for Cold Box testing ; this frame may need to ship to CERN in case #6 can't make it

A Actual
Black Confident
Red Aggressive plan

Current plan

1 PSL#3 goes into APA#4 slot (beam left upstream) ; stays in Cold Box until ready for installation
2 UK#2 gets to CERN by early April and is prepared as APA#6
3 PSL#4 arrives at CERN mid-April and is installed as APA#5
4 UK#3 gets completed for test-stand use

What's left to do?

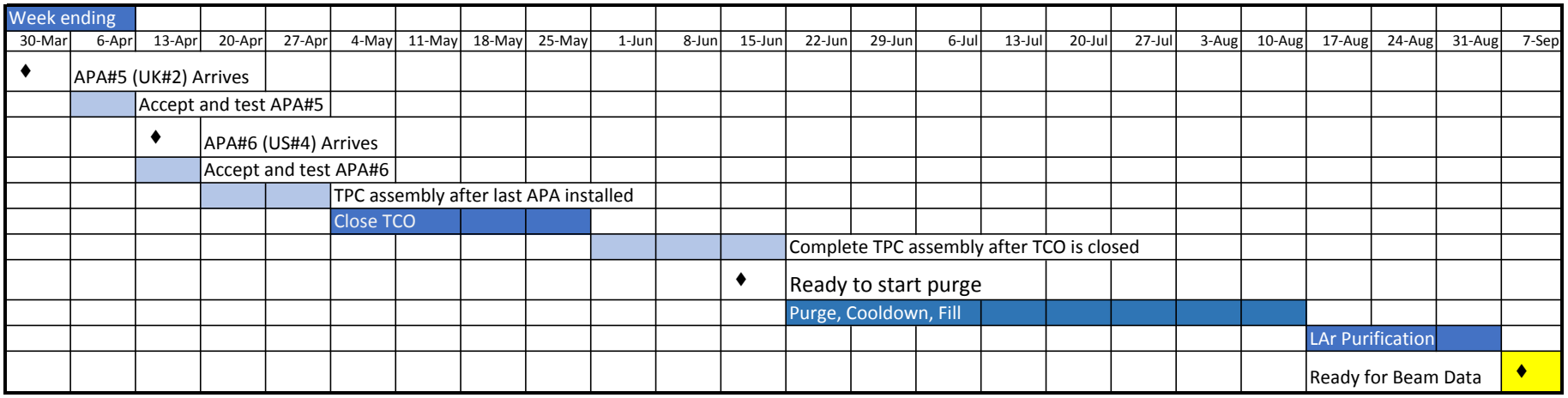
APA#5 (UK#2)

- Complete the U-layer
- Wind and solder G
- Complete cover board and CR board installation
- Prepare for shipping
- Ship - Target end of March

APA#6 (PSL #4)

- Winding V-layer
- Wind U and G
- Complete cover board and CR board installation
- Prepare for shipping
- Ship – Target beginning of April

Schedule to beam time

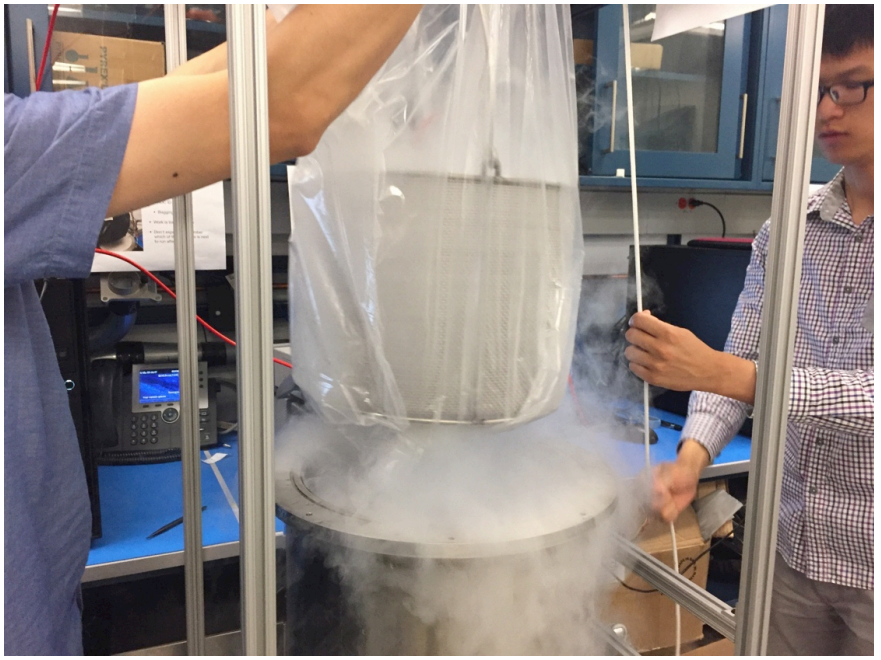


APA's need to arrive early-mid April at the latest

They will get unpacked and inspected,
survey and tension measurements will be abbreviated;
photon detectors and CE will installed and tested locally
(no cold box)
They will then go into the cryostat.

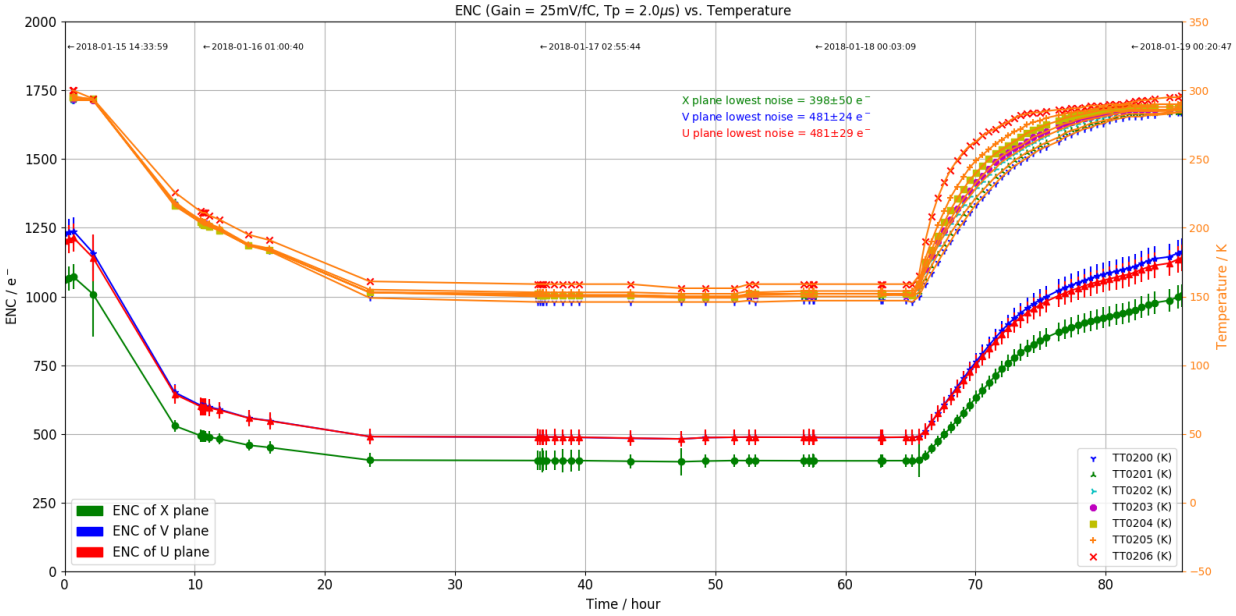
Cold ASIC Testing

- ~1500 front-ends tested and accepted to date
- ~2500 ADCS tested and accepted to date
- Testing strategy : continue to increase the supply of tested chips from which the best 160 are selected at the time needed to send the boards out for assembly in time for testing and delivery of the next APA
  - Final selection for APA#5 – March 2
  - Final selection for APA#6 – March 9

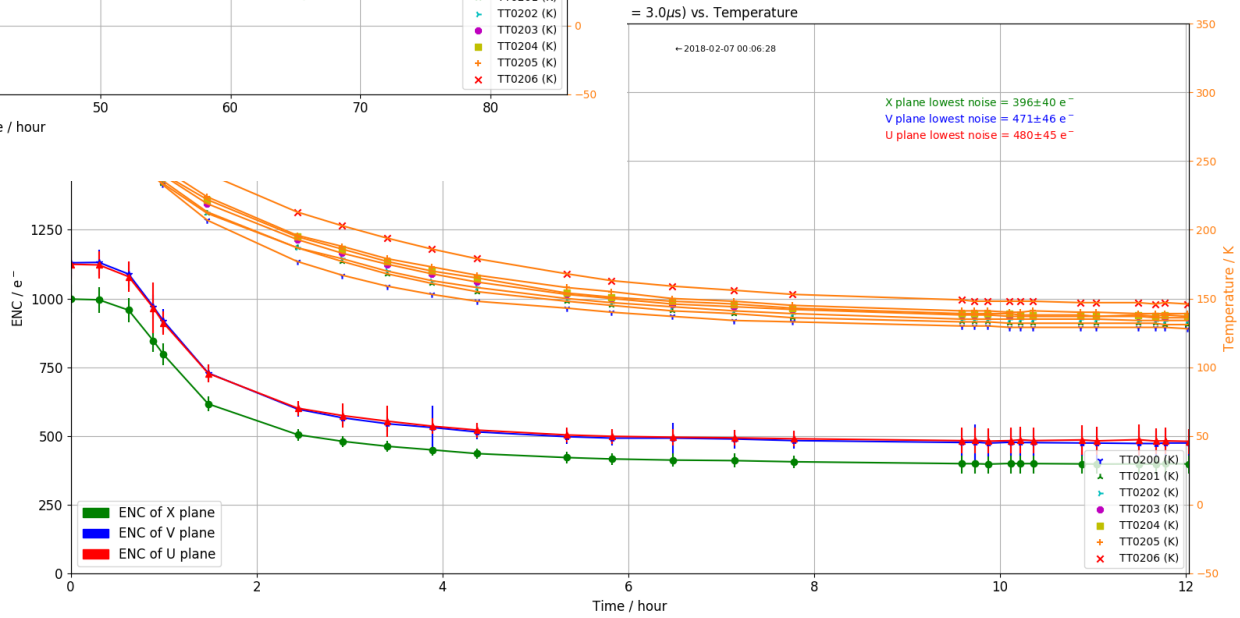


CE Hardware ready to go

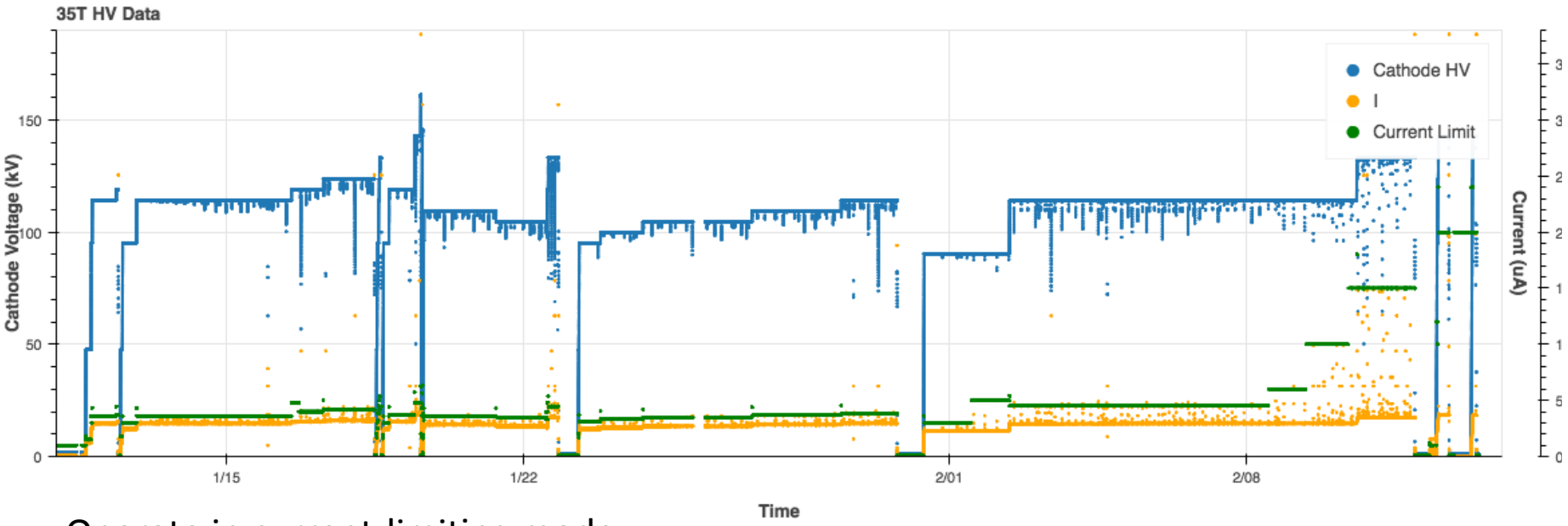
Cold Box testing of Front-end Electronics



Discussion in Breakout Session



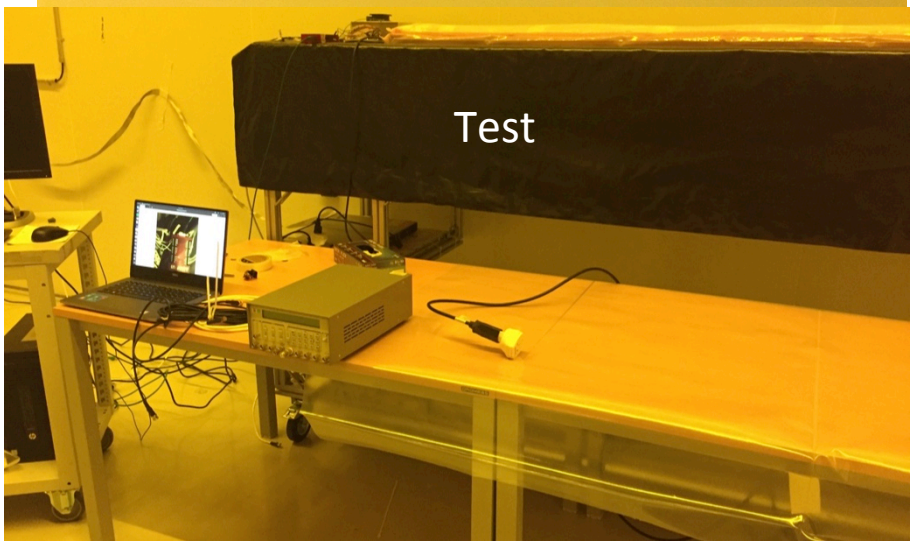
35-ton HV Test

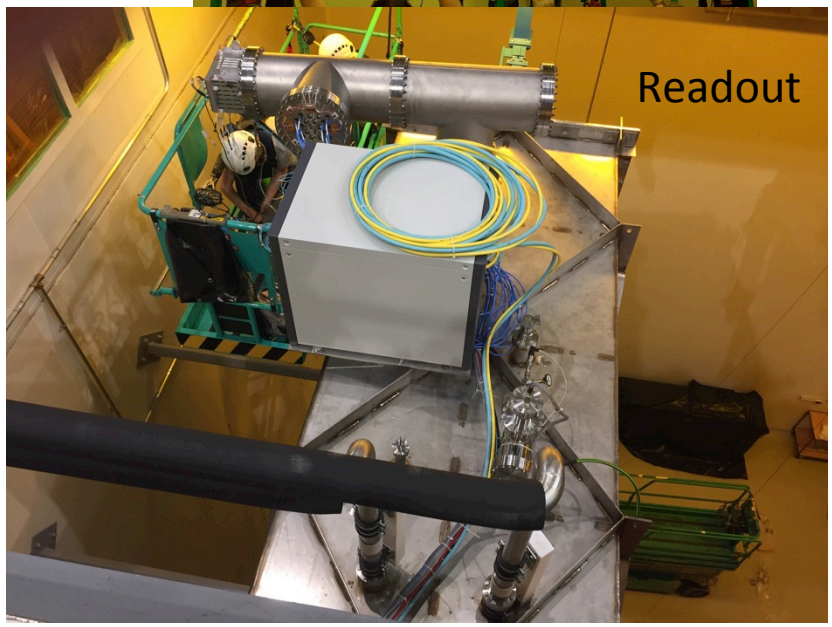


Operate in current-limiting mode

Discussion in Breakout Session

Photon Detectors





DAQ Status

- Taken data with APA3 in cold-box both for cold electronics and photon detectors
  - still a lot to do on stability, especially on the cold electronics data stream
- Monitoring evolving quickly thanks to detector experts feedback (particularly photon detectors)
- Established procedure to copy out data files through FTS
- Integration of timing and trigger system successful, though not yet integrated into main DAQ
- Isolated NP04 network from CERN's network (with controlled open lines)
- Defined strategy to incorporate CRT data into the DAQ stream
- Workshop on artDAQ sw at FNAL (Jan 2018) to finalise the system for data taking has been very useful

- *Still some challenges with firmware for WIBs (BNL standalone vs. BU programed for DAQ integration)*

LBNC Recommendation

The ProtoDUNE management should engage the DUNE collaboration and Executive Committee in a timely way, informing them of the key issues concerning **the number of APAs to be installed** and the concerns surrounding **the beam plug and the high voltage behavior** observed in the 35ton test.

The consequences should be discussed with the collaboration: what they give up by not installing the beam plug and the potential risk to protoDUNE should they decide to install the beam plug.

We have a goal to install 6 APA's.

The 35-ton HV test is complete;

We have as good an understanding as is possible at this point; we will install the beam plug and move on to ProtoDUNE itself for further understanding of HV.

The plan to install the beam plug will be discussed with the Executive Committee on 26 February 2018.

Other on-going activities needed for success

- Cryogenics (CERN)
- Slow control
- High voltage :
  - Feedthrough, power supply, monitoring and control
- Instrumentation and monitoring
  - Temperature sensors
  - Level sensors
  - Cameras
- Triggering
- Beam instrumentation
- Run planning
- Data Quality Monitoring

By next LBNC meeting, construction and TPC installation will be essentially complete; focus will shift to these topics

Lessons Learned (based on my experiences with PD-SP)

- Integration Engineering and Engineering Coordination across sub-systems is essential and should receive high priority in resource planning
- Documentation of engineering analysis and calculations should be done in real time – not months after the fact
- Intra-project engineering design reviews should take place regularly throughout the lifetime of the construction phase
  - Early design reviews may not uncover the real issues or flaws in the design, particularly related to integration
- We will prepare a detailed compilation for sub-systems and integration once the installation schedule pressure subsides (but before we forget…)

Summary

- Major progress in all areas since October meeting
  - APA's 1 – 3 cold box tested; 1 & 2 installed in cryostat
  - APA 3 returned to cold box for re-testing after CE replacements
  - 3 CPA/FC units completed and stored in cryostat
  - 4th APA arrived at CERN today (delayed due to snow storm)
  - 5th APA under construction at Daresbury
  - 6th APA under construction at PSL
  - Beam right end-walls being assembled and stored in clean room
- Beam-right side of detector assembly should begin next week
- Targeting end of April for TCO close
- Targeting mid-June for TPC completion

APA#4 at EHN1

Week-by-week Plan

Task		Dates	29/01/18	05/02/18	12/02/18	19/02/18	26/02/18	05/03/18	12/03/18	19/03/18	26/03/18	02/04/18	09/04/18	16/04/18	23/04/18	30/04/18	07/05/18	14/05/18	21/05/18	28/05/18	04/06/18	11/06/18	18/6/2018
Ash River-Bill Miller			XXXXX							XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX	TCO	TCO	TCO	TCO			XXXXX	XXXXX
Ash River-Curt Lerol				XXX	XXXXX	XXXXX	XXXXX	X				XXXX	XXXXX	XXXXX	XXXXX					XX	XXXXX	XXXXX	XXXXX
Ash River-Charles Cadeau				XXX	XXXXX	XXXXX	XXXXX													XX	XXXXX	XXXXX	XXXXX
Ash River-Tom Wieber										XXX	XXXXX	XXXXX	XXXXX	XXXXX	XXXXX								
Ash River-Jerry Meier			XXXXX	XXXXX	XXXX			XXXXX	XXXXX	XXXXX													
Ash River-Cole Hraban			XXXXX				XXX	XXXXX	XXXX														
PSL - Dan Wenman						XXXXX	XXXXX																
BNL - Bo Yu				XXXXX	XXXXX	XXXXX	XXXXX																
APA #3 Arrives		16-Jan																					
APA#3 Acceptance Test		22-Jan																					
APA#3 PD Installation		18 Jan - 29 Jan	X																				
APA#3 CE Installation		24 Jan - 30 Jan	XX																				
APA#3 Installed in Cold Box		31-Jan	XXX	XXXXX																			
ProtoDUNE APA #3 Wire tension		5-Feb			XX																		
ProtoDUNE APA #3 Roll-in		14-Feb			X																		
CPA #3 Assemble		25-Jan - 30-Jan	XX																				
CPA #3 Attach Bot/Top FC-Cyrostat		31-Jan - 2 Feb	XX	X																			
Redo Floor layout on Beam Right	Russian techs	5-Feb - 8-Feb		XXXX																			
Install CPA/FC#3		7-Feb		X																			
Test fitEndwall/beam plug	test fit; Chng-	7 Feb - 9 Feb		XXX																			
Build and Deploy End Wall 1 & 2		14 Feb - 23 Feb			XXX	XXXXX																	
TPC Hardware Install	Dan Weman	19- Feb 2-Mar				XXXXX	XXXXX																
APA#1-APA#2-Unistrut, APA Hanger		12-13 Feb																					
Fix Beam A (trolley removal)		14 Beam			XX																		
Remove Bridge Beam Trolleys		15 Feb - 16 Feb			XX																		
Install Cable Tray	One person in	15 Feb - 16 Feb			XX																		
Install Warm Hardware on top of cryostat						XXXXX																	
Cable APA 1-3	Manlift in cry	19 Feb - 23 Feb				XXXXX																	
Test APA 1-3	CE; Access wi	23 Feb - 9 Mar				XXXXX	XXXXX	XXXXX															
Build and Install End Wall 3 & 4		5-Mar - 16-Mar						XXXXX	XXXXX														
Deploy Top/Bottom FC		19 Mar - 1 Apr								XXXXX	XXXXX												
APA #4 Arrives		16-Feb			X																		
APA#4 Moves into clean room		26-27 Feb					XX																
APA#4 Acceptance Test		28-Feb 1-Mar					XX																
APA#4 PD Installation		5-Mar - 7-Mar						XXX															
APA#4 CE Installation		8-Mar - 14-Mar						X	XXX														
APA#4 Warm and Cold Test		19-Mar - 13-Apr								XXXXX	XXXXX	XXXXX	XXXXX	XXXXX									
APA#4 Roll-in-Last APA In		25-Apr													X								
APA #5 Arrives		30-Mar									X												
APA #5 Cleanroom-PD, CE		3-Apr - 16-Apr										XXXX	XXXXX	X									
APA #5 Installed		16-Apr												X									
APA #6 Arrives		13-Apr											X										
APA #6 Cleanroom-PD, CE														XXXX	XX								
APA #6 Installed		25-Apr													X								
Protect TPC/ Install new floor		9-Apr - 18-Apr											XXX	XXXXX	XX								
CLOSE TCO		30-Apr - 30-May																					
Cabling APA, Deploy End Wall		31-May - 6 Jun																		XX			
Remove floor, Deploy FC, HV		7-Jun - 22 Jun																			XXXXX	XXXXX	XXXXX
Ship tools to AR, Cleanup		18-22 Jun																					XXXXX

PD-SP Breakout Session (tomorrow 11:30 am)

- Final delivery plan for CE and Photon Detectors
- Cold Box results (CE and Photon)
- Conclusion of 35-ton HV test