Status and plans of the ProtoDUNE-SP (NP04) Experiment

News from the Experiments at CERN

125th Meeting of the SPSC

Flavio Cavanna

4 April, 2017

Content

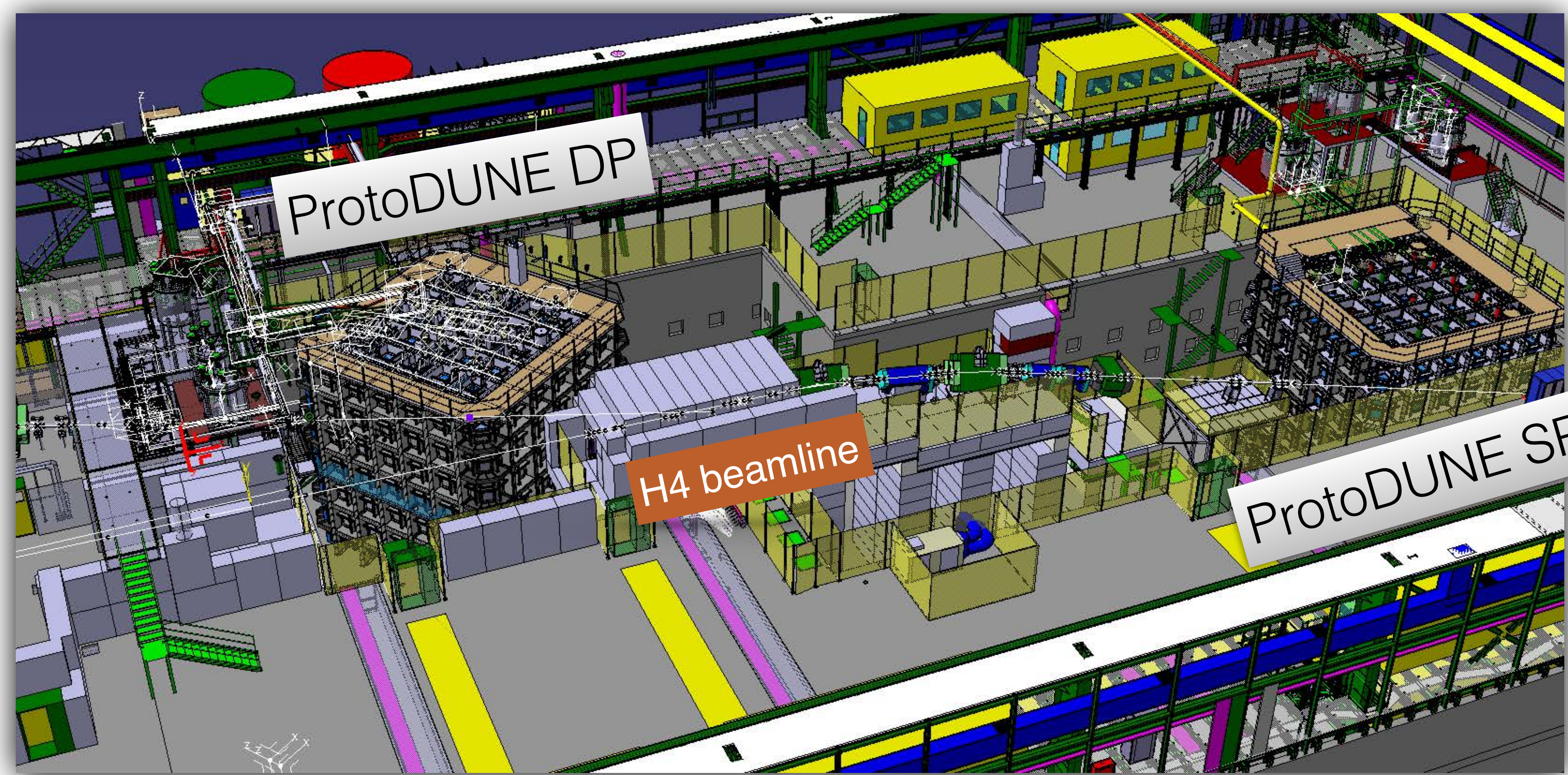
★ **Main Elements of the Roadmap**

- ***the Neutrino Platform at CERN (EHN1 Extension)***
  - The H4 Test Beam Line for ProtoDUNE-SP

this talk

- ***ProtoDUNE Single Phase (NP04) Experiment***
  - ***Organizational Chart (Tasks and Teams on the ground at CERN)***
  - ***Detector Construction in the US***
    - *Design and Construction Status:* APA, CPA, FC, CE, PD
    - Prototyping Planning: *HV-testing, Full scale integration testing, Electronics test stations*
  - ***Detector Installation at CERN***
  - ProtoDUNE SP: plans and advancement in the experimental layout
    - ➡ LArTPC Detector Integration, Test and Installation
    - ➡ Other Detectors: Cryogenics and Argon Instrumentation, Muon Tagger
    - ➡ DAQ and SlowCtrl System
    - ➡ Data Reconstruction and Analysis

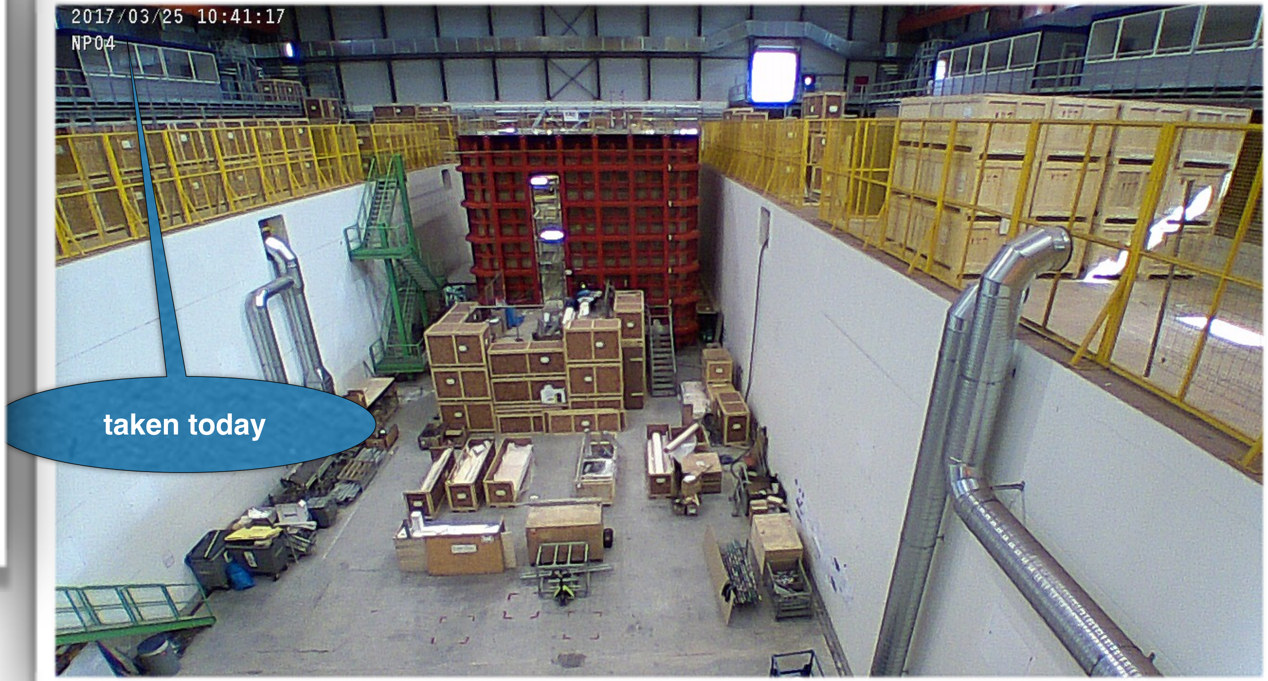
the CERN Neutrino Platform

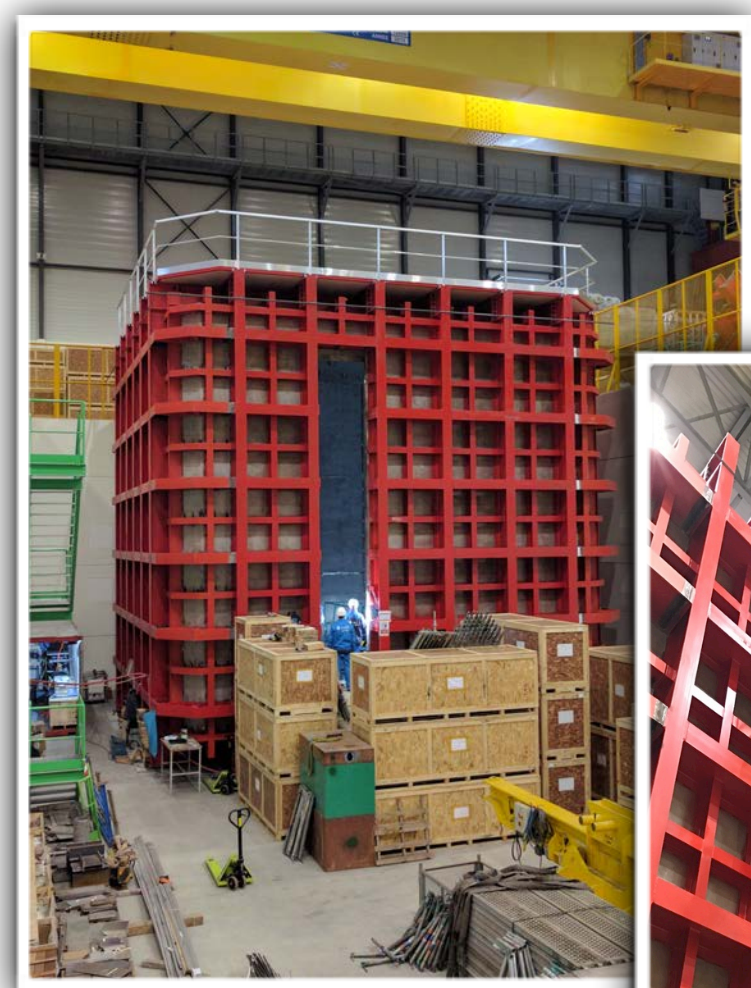


✓ Construction of a new building (EHN1 extension) to host the protoDUNEs prototypes, Cryostat, Cryogenic/Recirculation Plant, H4 tertiary beam line, … and a lot more

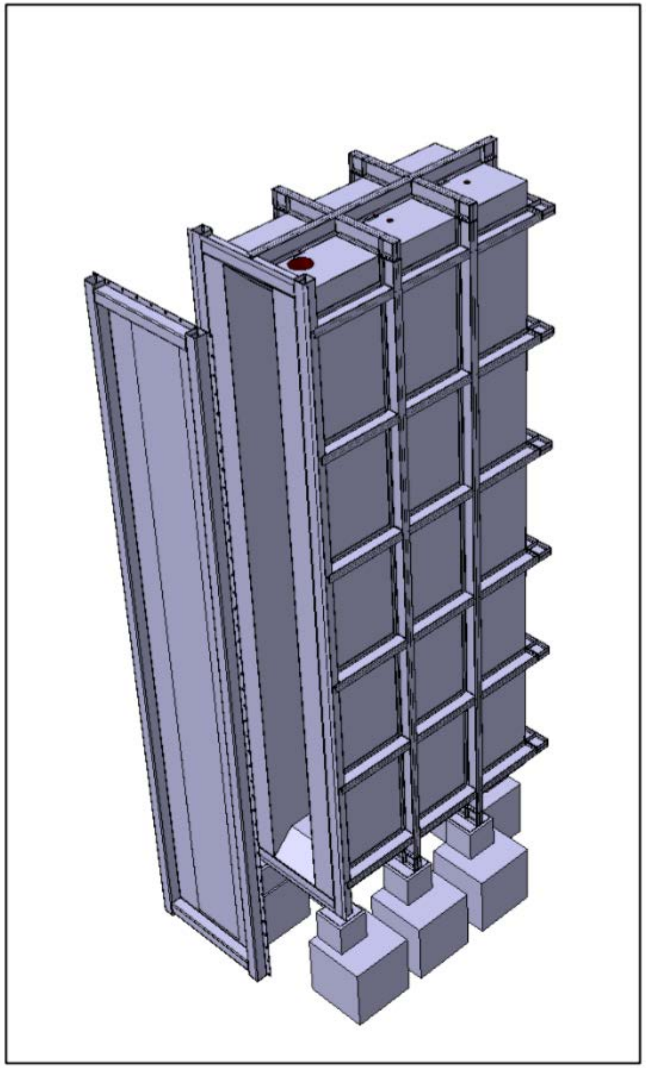
CERN Neutrino Platform

NP04 Cryostat Structure



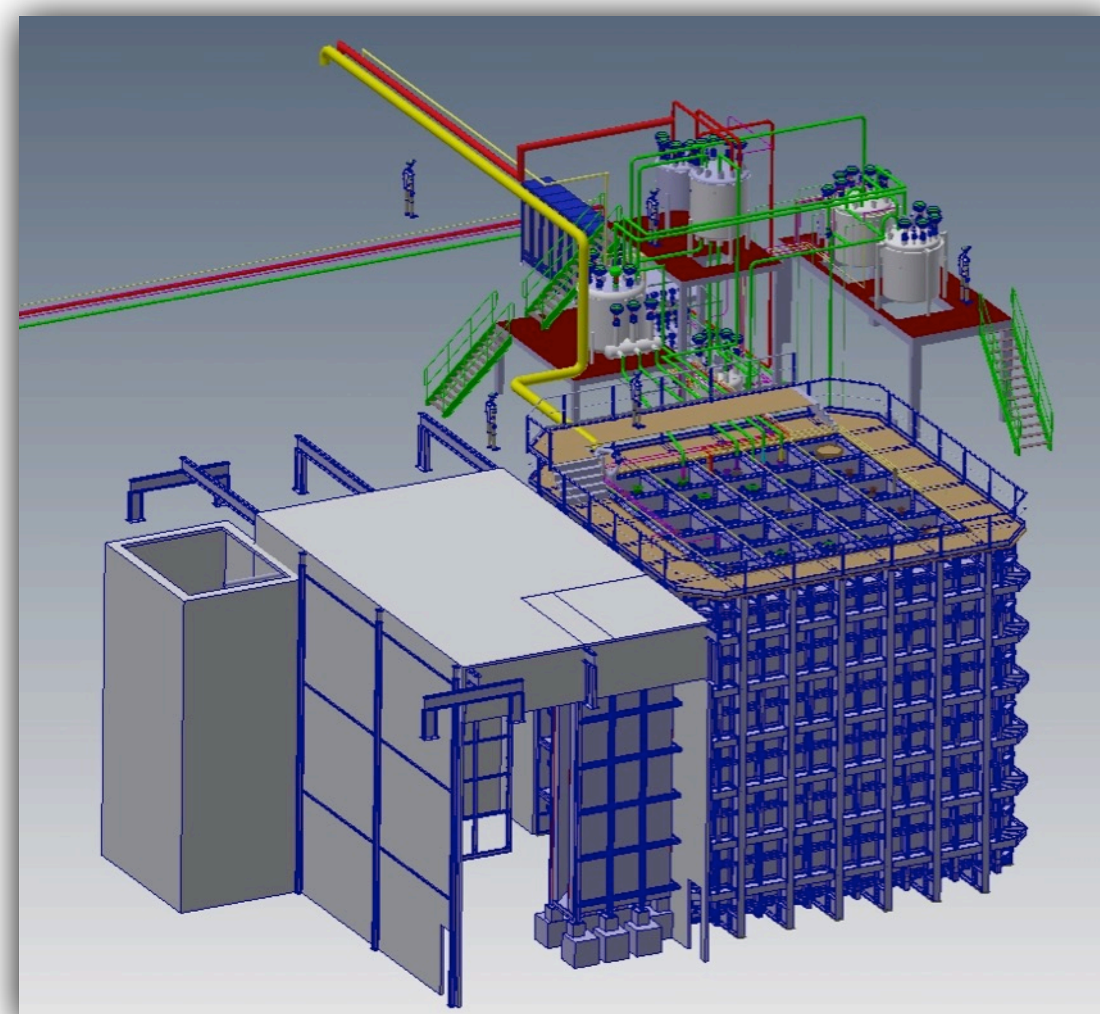


photos of ProtoDUNE-SP:
cryostat external structure completed
internal membrane insulation in progress

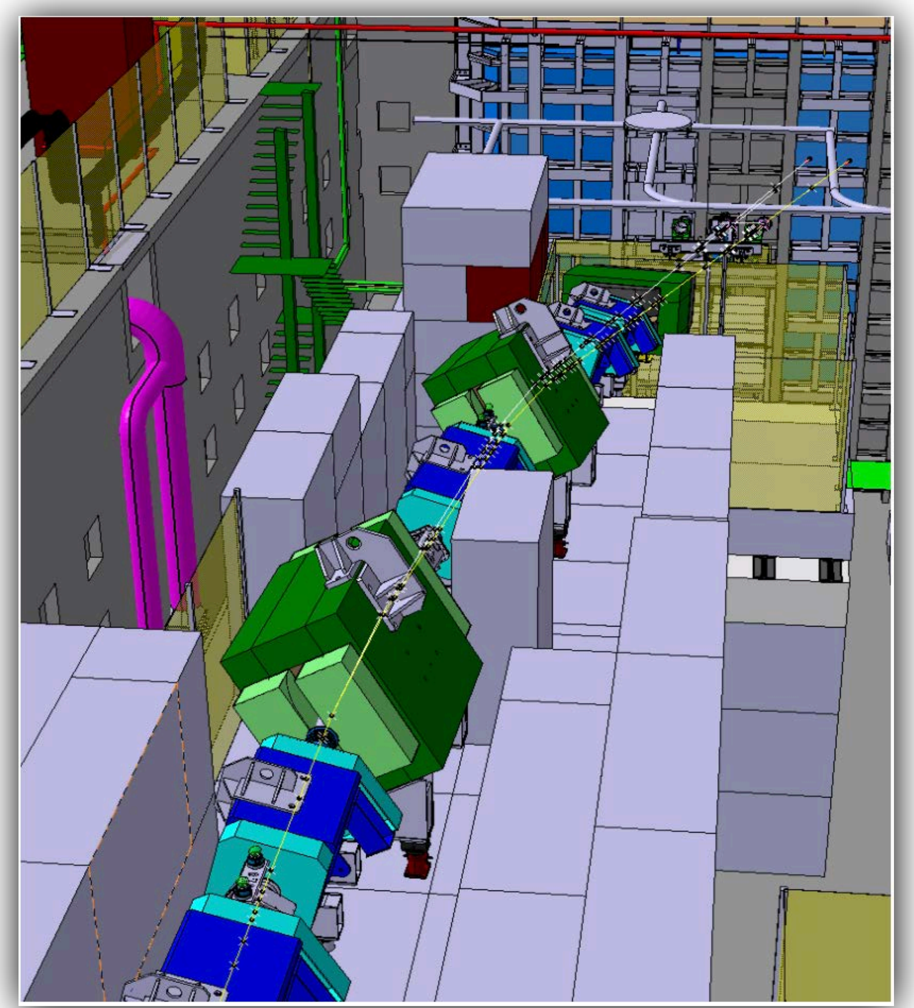


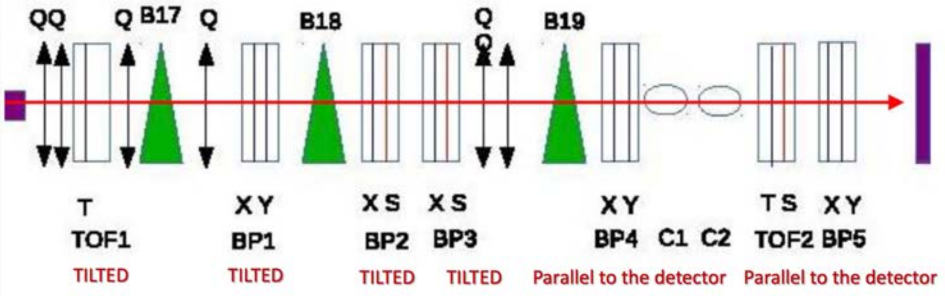
NP04 clean room functional layout and cold test box

NP04 proximity cryogenics



The H4 Test Beam Line at the EHN1 Extension

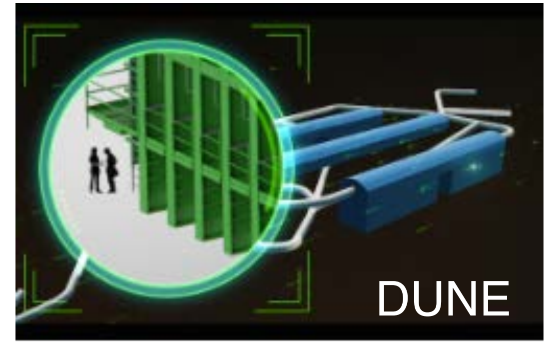




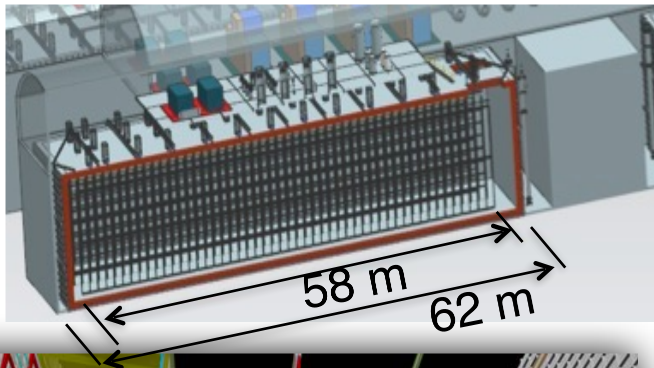
Black: quadrupoles.
Green: bending magnets

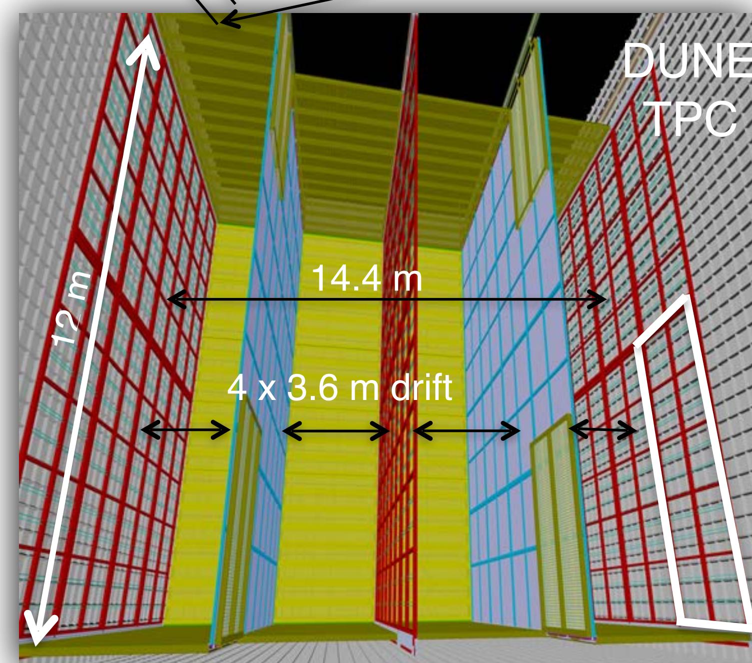
Boxes: detector supports.
- X,Y = Scint. Fibre Tracker
- S = Scint. paddle for trigger
- T = Time-of-Flight detector (either pLAPPD or scintillator)
- C = Cherenkov counters

ProtoDUNE-SP - NP04



In progress





Goals

Engineering validation of the full-scale DUNE detector components

Develop the construction and quality control process

Validate the interfaces between the detector elements and identify any revisions needed in the final design

Validate the detector performance and operation (*this can be achieved with cosmic-ray data)*

Accumulating large samples of test-beam data to understand/calibrate the response of the detector to different particle species *(this will require a run period of approximately three months of stable operation under good beam conditions)*

Improve event reconstruction and detector response models *(this includes some relevant physics measurements)*

Demonstrating the long-term operational stability of the detector *(this is part of the risk mitigation programme ahead of the construction of the first DUNE 10-kton far detector module).*

ProtoDUNE SP

organization

Working Groups formed for major items of activity
Tasks & Teams in each WG identified and implemented

Neutrino Platform
Coordinator:
Marzio Nessi (CERN)
EHN1 Coordinator:
Filippo Resnati (CERN)

Cryostat

External Cryogenics

Detector Infrastructure

DUNE ProtoDUNE SP
Coordinators:
Flavio Cavanna (FNAL)
Christos Touramanis (Liverpool)
Regina Rameika (FNAL-Construction)
Engineering Intergration: Jack Fowler (Duke)
Computing Liason: Ruth Pordes (FNAL)

Detector Construction
Coordinator: Regina Rameika (FNAL)
APA Construction Leader:
Bob Paulos (PSL)
Alan Grant (Daresbury)
HV/CPA/FC Construction Leader:
Victor Gaurino (ANL)
Photon Detector Construction Leader:
Leon Mualem (CalTech)
Cold Electronics Construction Leader:
Matt Worcester (BNL)
Detector Support Structure
Dan Wenman (PSL)
PC4 HV test
Sarah Lockwitz (FNAL)
Ash River Trial Assembly
William Miller (UNM)
DAB Electronics
Linda Bagby (FNAL)

Detector Integration, Testing, and Installation
Coordinator: Roberto Acciarri (FNAL)
Installation Team Leader:
Bill Miller (Minnesota)
Integration/Test Coordinator:
Andrea Zani (CERN)
Electrical/Cabling Coordinator:
Flor Blaszczyk (BU)
Computing Infrastructure Coordinator:
Geoff Savage (FNAL)
Grounding & Shielding Coordinator:
Linda Bagby (FNAL)
Safety Coordinator:
Olga Beltramello (CERN)
APA Commissioning Leaders:
Andrzej Szelc (Manchester)
Serhan Tufanli (Yale)
HV/CPA/FC Commissioning Leaders:
Francesco Pietropaolo (CERN)
Kevin Wood (SBU)
Beam Plug Commissioning Leader:
Cheng-Ju Lin (LBNL)
Photon Detector Commissioning Leader:
Ettore Segreto (Campinas)
Photon Electronics Commissioning Leader:
Zelimir Djurcic (ANL)
Cold Electronics Commissioning Leaders:
Carl Bromberg (MSU)
Matt Worcester (BNL)
Muon Tagging Detector Commissioning Leaders:
Steve Manly (Rochester)
Camillo Mariani (Virginia Tech)

Cryogenics & Argon Instrumentation
Coordinators:
Stephen Pordes (FNAL)
Anselmo Cerbera (Valencia)
Internal Cryogenics & Cryomeasurements leader:
Alan Hahn (FNAL)
Cryogenics Operation PTL Monitor Leader:
LAr Vertical Temperature Monitor Leader:
Jelena Maricic (Hawaii)
LAr Purity Monitor Leaders:
Jiaming Bian (UC-Irvine)
Andrew Renshaw (Houston)
GAr Purity Analyzer Leader:
TBA
Cryostat Internal Cameras Leader:
Mike Kordosky (William & Mary)
Instrumentation Readout Leader:
Flor Blacszcyk (Boston)

DAQ
Coordinators:
Karol Hennessy (Liverpool)
Giovanna Lehmann Miotto (CERN)
Run Control/Systems Monitor Leader:
Wesley Ketchum (FNAL)
Data Monitoring Leader:
Antonino Sergi (Birmingham)
artDAQ Leader:
Kurt Biery (FNAL)
Photon Detector Readout Leader:
Martin Haigh (Warwick)
RCE TPC Readout Leader:
Mathew Graham (SLAC)
FELIX TPC Readout Leader:
Frank Filthaut (NIKHEF)
Trigger System Leader:
Josh Klein (Penn)
Timing System Leader:
David Newbold (Bristol)

Data Reconstruction and Analysis
Coordinators:
Josh Klein (Penn)
Thomas Kutter (Louisana)
Robert Sulej (FNAL/NCBJ)
Calibration Leader:
Igor Kreslo (Bern)
Reconstruction Leader:
Dorota Stefan (CERN/NCBJ)
Detector Performance Measurements Leader:
Bruce Baller (FNAL)
Physics Measurements Leader:
TBD
Simulation and MC Production Leaders:
Leigh Whitehead (CERN)
Anan Mazzacane (FNAL)

Prompt Reconstruction:
Coordinators:
Maxim Potekhin (BNL)
Brett Viren (BNL)

Cosmic Muon Tagging:
Coordinators:
Ed Blucher (Chicago)
Jonathan Link (Virginia Tech)

Beam Configuration and Instrumentation (Joint SP/DP Working Group)
Coordinators:
Yannis Karyotakis (LAPP)
Jonathan Paley (FNAL)
Paola Sala (CERN)

Slow Controls (Joint SP/DP Working Group)
Coordinators:
Anslemo Cervera (Valencia)
Yann Rigaut (ETHZ)
Giovanna Lehmann (CERN)

Cryogenic Systems and Instruementation (Joint SP/DP Working Group)
Coordinators:
Laura Manenti (UCL)
David Montanari (FNAL)
Stephen Pordes (FNAL)

HV Delivery (Joint SP/DP Working Group)
Coordinators:
Sarah Lockwitz (FNAL)
Laura Molina (FNAL)

>30 Institutions involved (12 International)
>100 people active (physicists, engineers)

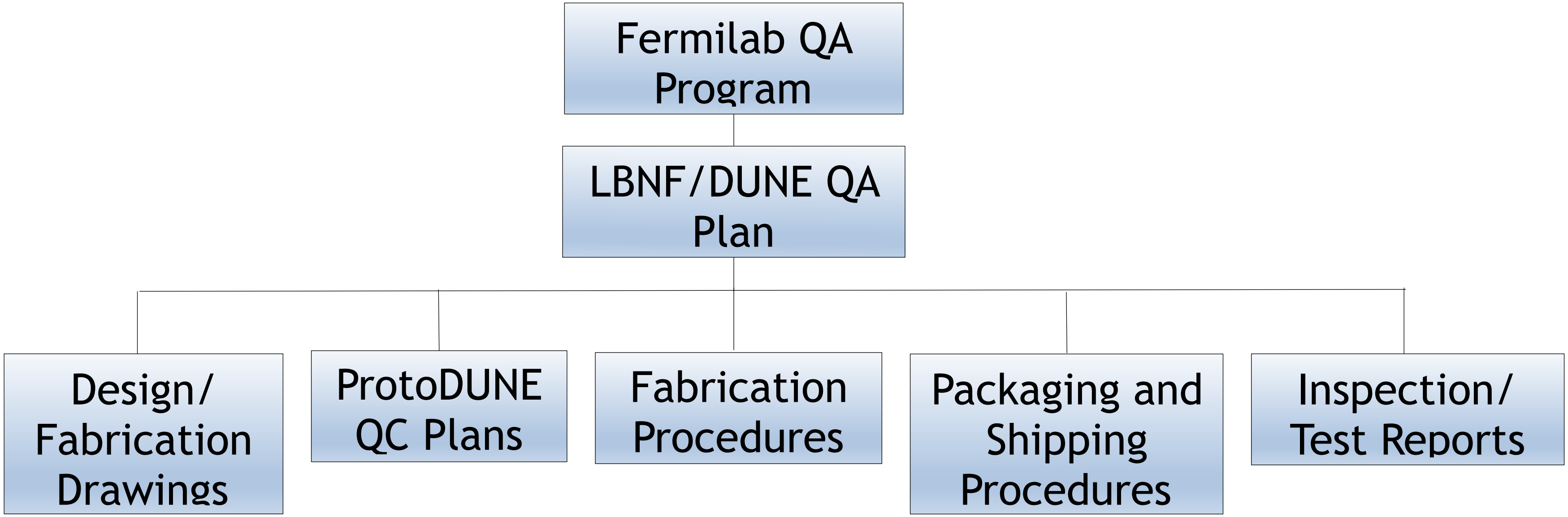
Fermilab DUNE

ProtoDUNE-SP

Detector Construction

- Construction of detector components is now underway and will continue through end of 2017
- Current project focus is on Production Readiness Reviews (PRRs) for each of the major components
  - Main focus of these reviews is formal, written QA/QC plans for the construction activities
  - Chaired by the DUNE QA Manager
  - QA Manager is conducting on order of 20 such reviews between February and the beginning of June

ProtoDUNE-SP Quality Assurance Documentation



QA Manager provides QA input and support to ProtoDUNE subprojects:

ProtoDUNE Current Quality Assurance Activities

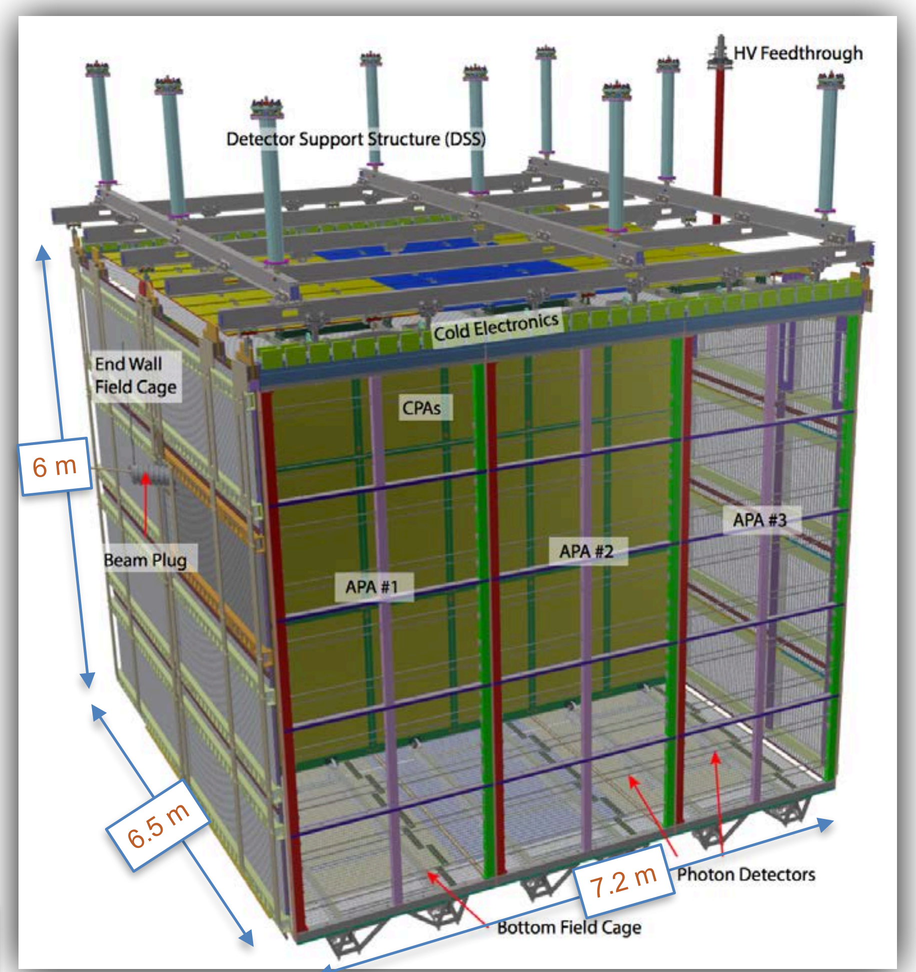
- Developed template for the QC Plan for Project Partners to utilize in fabrication processes.
- Working with ProtoDUNE SubProjects in the development of their QC Plans
- Providing guidance in the development of their fabrication, inspection and testing procedures.

ProtoDUNE-SP

Detector Overview

Main Detector Elements:

- *Time Projection Chamber (TPC),*
- *Front-end and digitizing cold electronics (CE),*
- *Photon Detector System (PDS) and*
- *Data Acquisition (DAQ)*



TPC has:

- **6 APA** units forming two Anode wire planes
- **18 CPA** units forming the HV cathode plane
- **28 FC** modules forming the field cage
- **128 CE** boards for a total of ~15K electronics readout channels
- **60 PD** bars (3 types) of the Photon Detector

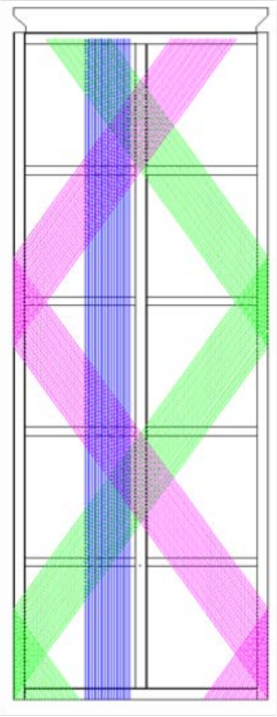
All Full scale modules, Prototype of the single phase DUNE Far Detector.

This modular approach to detector construction enables the construction of detector elements to take place in parallel and at multiple sites (and is essential for the DUNE Far Detector).

APA Construction at UW-PSL, US and Daresbury, UK

US APAs (#1-3)

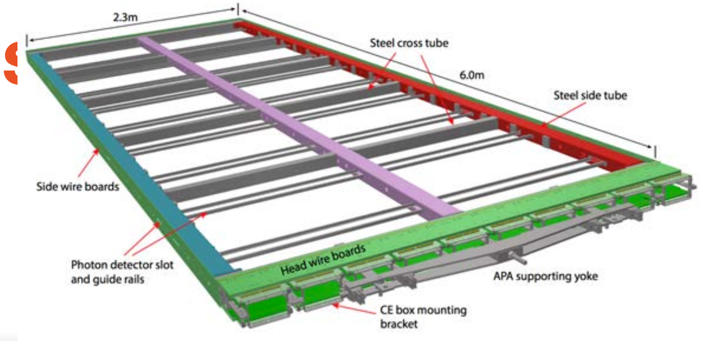
UW-PSL – *Lead Lab*
QA/QC support from
Syracuse
UT-Arlington
Yale



Wire Winding Robot

Each APA : 960 X, 800 V, 800 U, 960 G (un-instrumented) wires

ProtoDUNE-SP detector cons



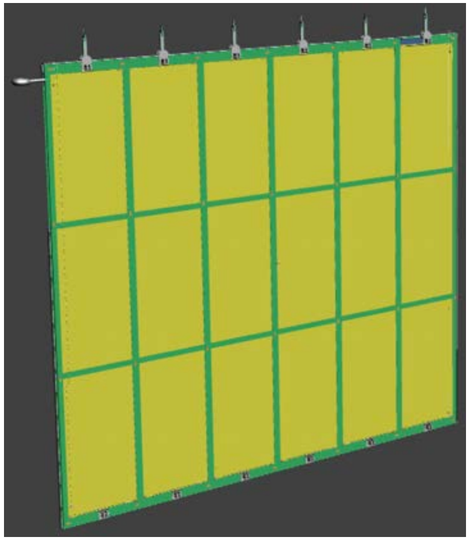
APA Construction at Daresbury, UK

UK APAs (#4–6)

Daresbury
Manchester,
Lancaster,
Sheffield,
Liverpool

Cathode Plane (CPA)

Argonne National Lab, BNL, CERN



CPA: Cathode Plane and HV Bus distribution

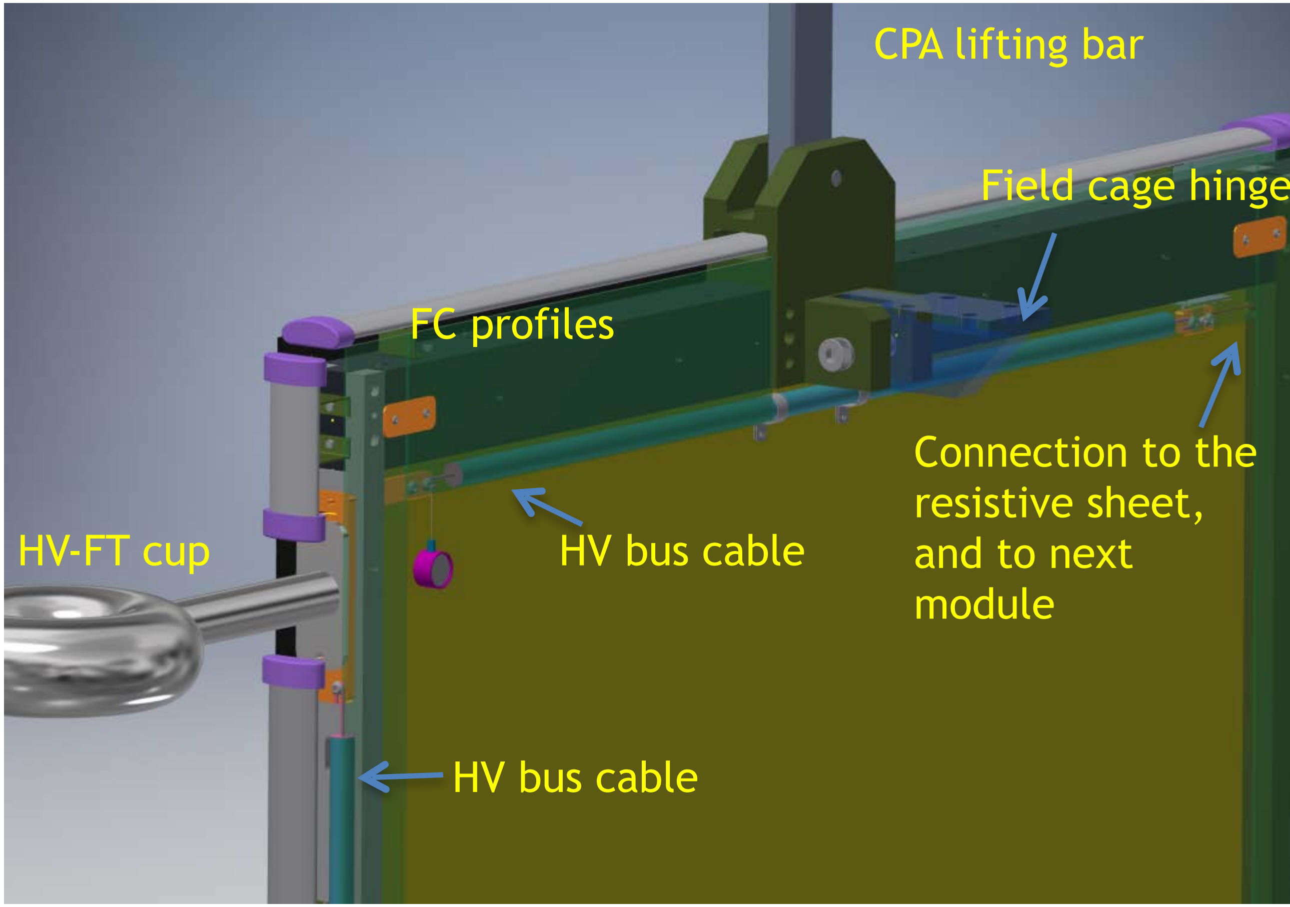
New design BNL, CERN

Resistive Cathode

At full voltage (180kV) there is almost 100J of energy stored in the cathode plane

In the event of a discharge from a cathode edge to the cryostat wall, the voltage on the an all metal cathode collapse very quickly with risk of physical damage to cathode or membrane wall to the cold electronics

To mitigate this risk a new all resistive cathode has been developed using a commercial resistive Kapton film laminated on FR4 substrate

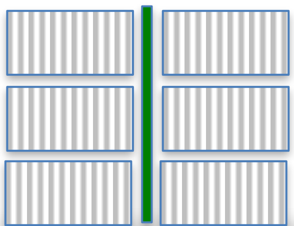


A HV bus cable to distributes the cathode voltage to all of the cathode panels

Field Cage Module Construction

Modular Field Cage
A new design of a modular field cage using extruded, open aluminum profiles held together by pultruded fiberglass beams

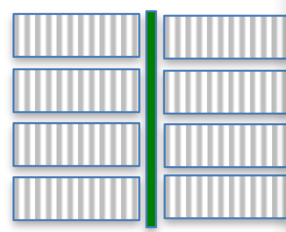
Top and Bottom



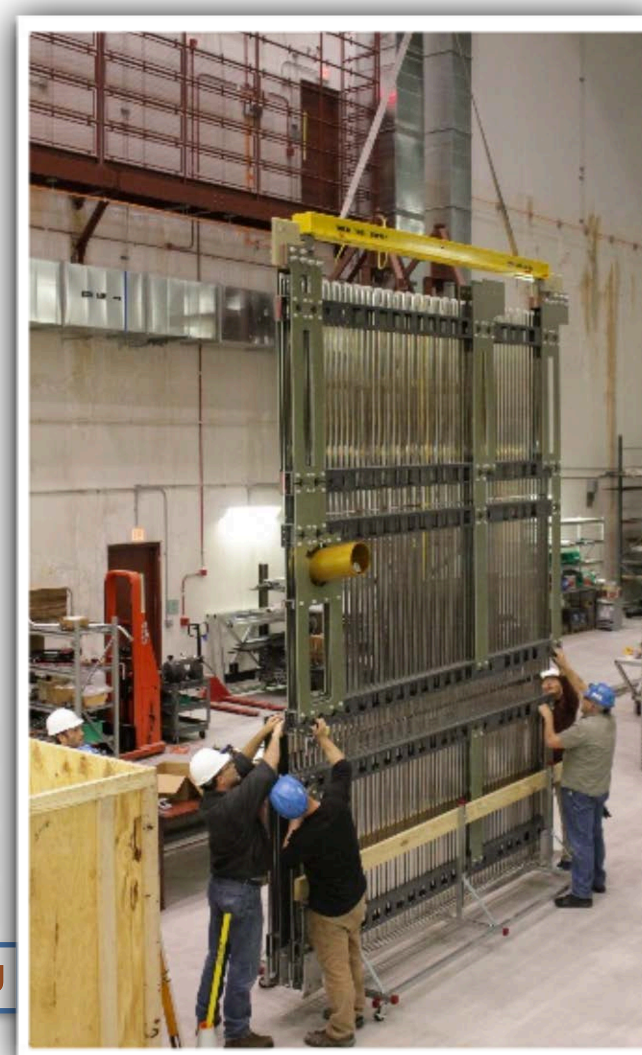
Stony Brook

CERN, William & Mary

Endwalls

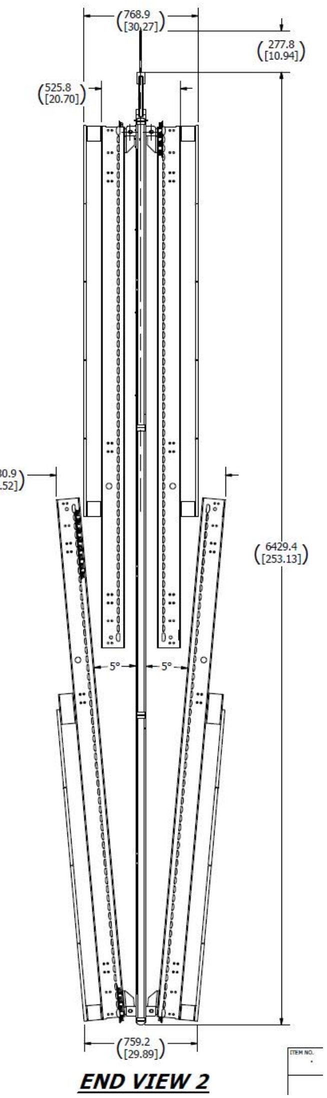


Louisiana State U



Full Scale Trial Assembly at Ash River

CPA-FC Assemblies



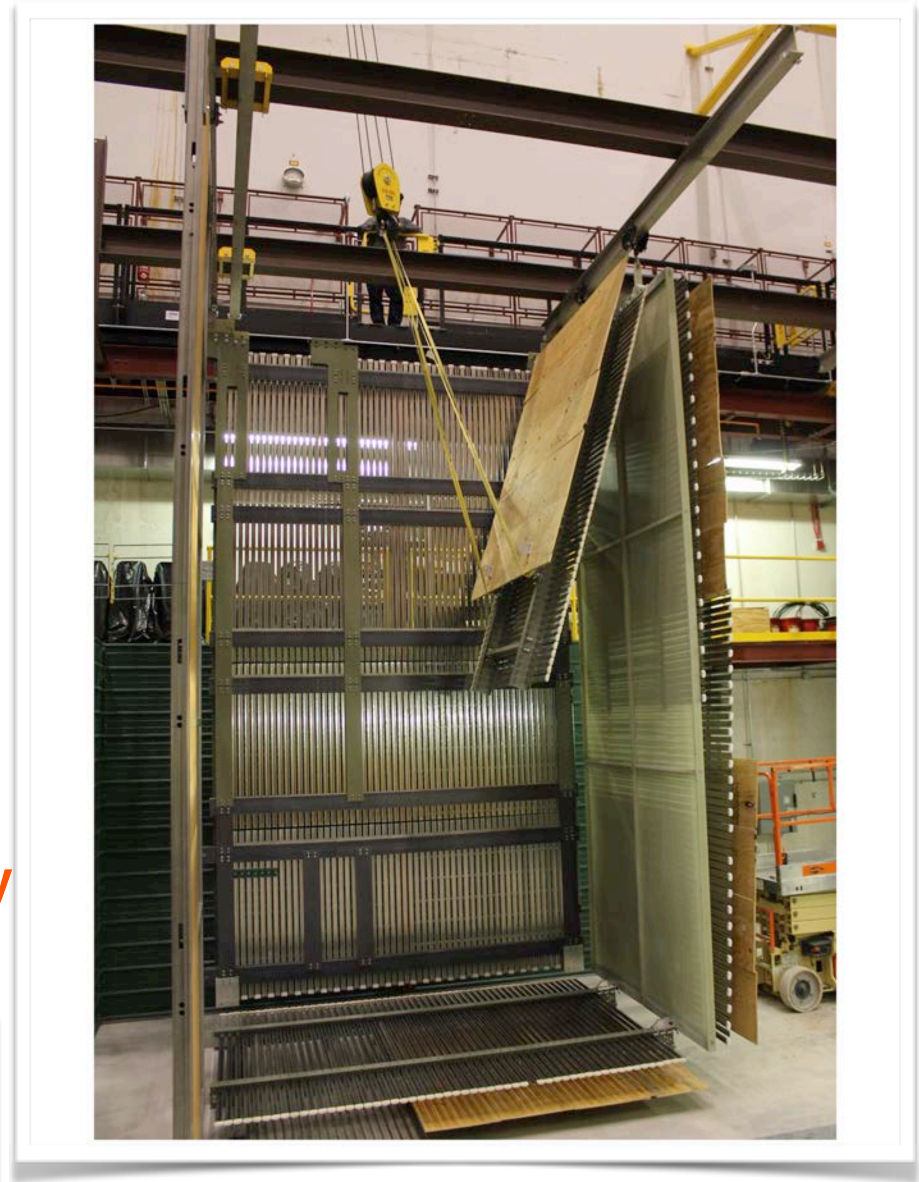
Each composed of a

- CPA (2 columns, 6 units)
- 4 Field Cage Modules

Units are assembled outside of the cryostat and moved into the cryostat through the TCO

Full Scale Trial Assembly at Ash River

1/6 mock-up of protoDUNE-SP
Learn how to deploy field cages
Latch into place
Develop installation procedures including ES&H + QC

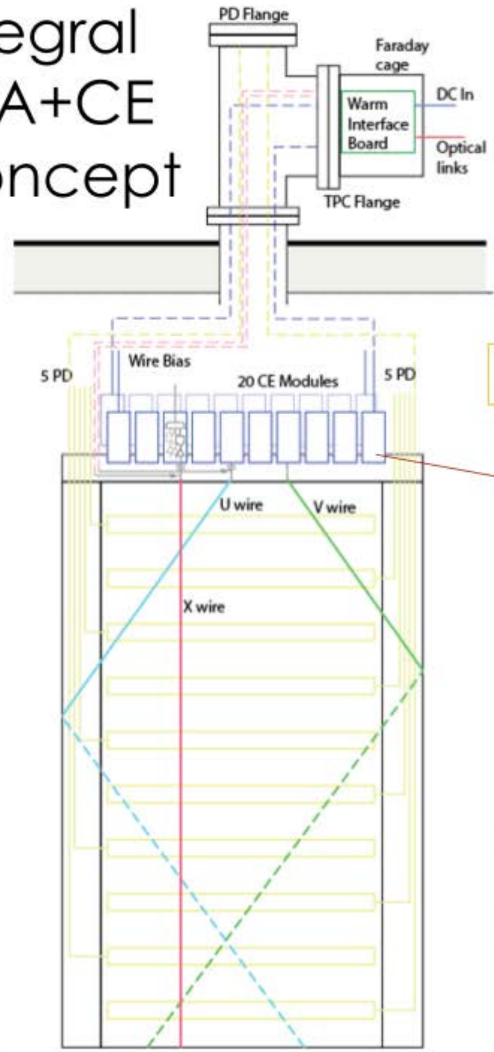


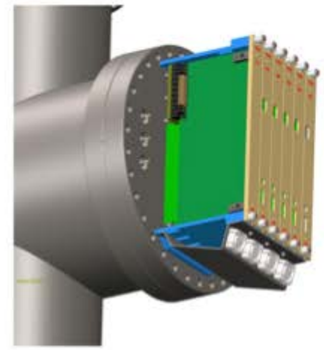
U. of Minnesota

TPC Readout – Cold Electronics with a warm interface

BNL - lead
Boston
Michigan State
U Penn
LSU
U of Florida
UC Davis
Fermilab

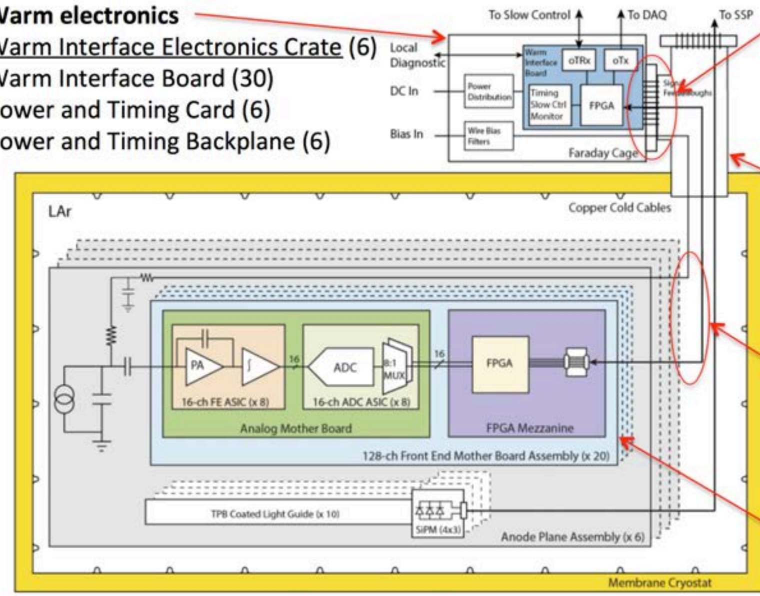
Integral APA+CE Concept





ProtoDUNE-SP

Warm electronics
Warm Interface Electronics Crate (6)
Warm Interface Board (30)
Power and Timing Card (6)
Power and Timing Backplane (6)



CE flange
Flange assembly with cable strain relief and flange PCB for cable/WIB connection (6)

Signal feed-through
Tee pipe with 14" Conflat flanges and crossing tube cable (CTC) support (6)

Cold cable to FEMB
LV and data cable (120+120) and APA wire-bias SHV cable (48)

Front End Motherboard
(FEMB) 128 channels of digitized wire readout enclosed in CE Box (120)

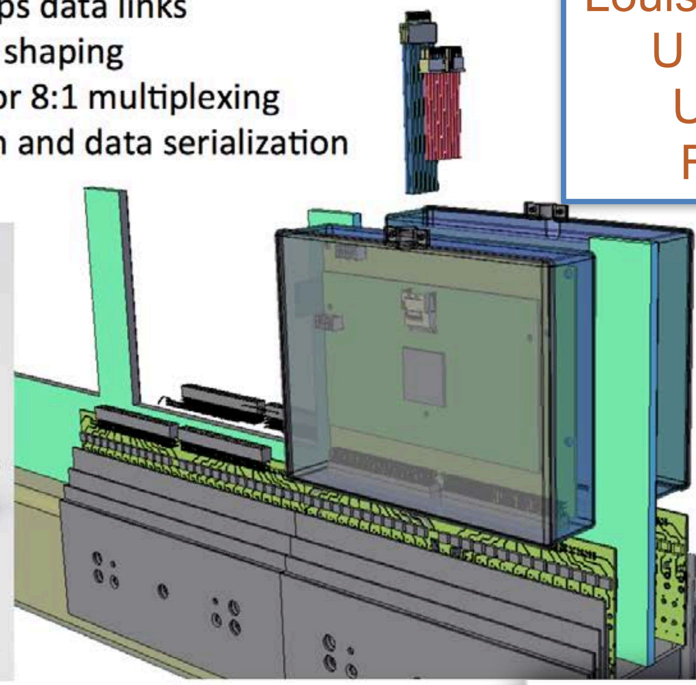
10/12/2016 H. Chen - Cold Electronics Review 23

TPC Readout – Cold Electronics

BNL - *lead*
Boston U
Michigan State U
U Penn
Louisiana State U
U of Florida
UC Davis
Fermilab

FEMB

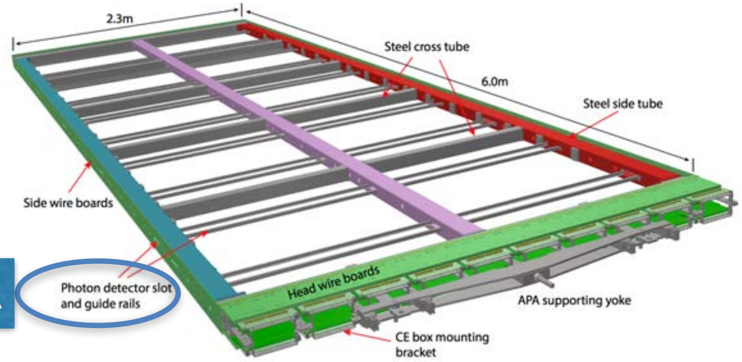
- 128 channels of digitized wire readout, 4x1 Gbps data links
- 8 16-channel FE ASICs: pulse amplification and shaping
- 8 16-channel ADC ASICs: digitization and 16:1 or 8:1 multiplexing
- FPGA mezzanine for ASIC control/configuration and data serialization



FEMB individually enclosed in CE Box: 20 FEMB/APA

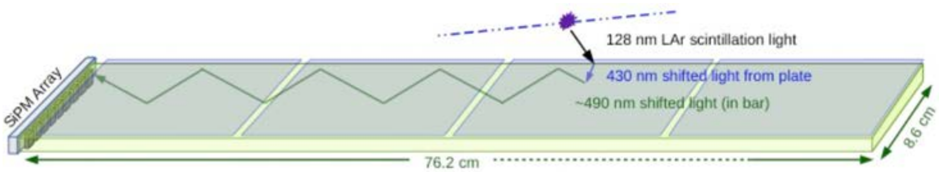
- ESD protection for ASICs and FEMB circuitry and Faraday shield
- Attaches to PSL APA adapter and built-in cable strain-relief
- Low impedance connection from FEMB ground to APA frame

Photon Detection System



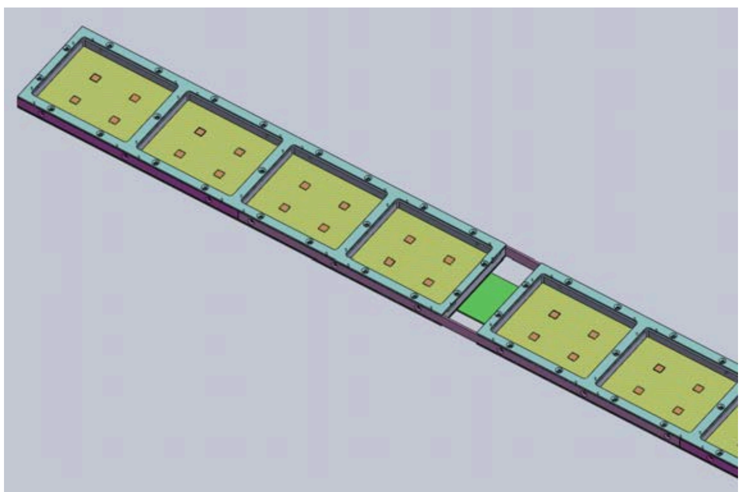
10 PD-bars per APA

Indiana U, FNAL, MIT, ANL, Northern Illinois U, Caltech, Colorado State U, UNICAMP (Br)



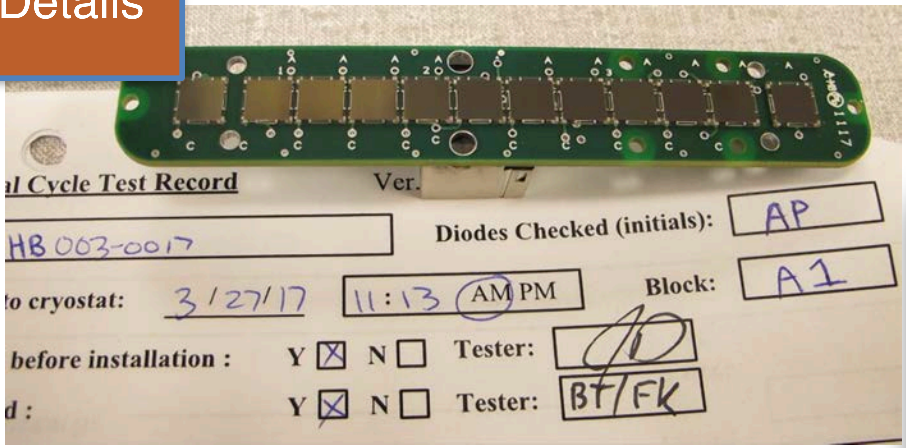
IU photon detector technology (PD-bar Type 1): light guides with wavelength shifting plates viewed by an array of SiPMs

MIT-FNL technology (PD-bar Type 2): diamond polished acrylic light guides with w.l.s. coating by dipping, viewed by an array of SiPMs



Campinas-ARAPUCA technology (PD-bar Type 3): light traps based on dichroic optical filters and double w.l.s. stages viewed by SiPM array (active ganging)

Design Details



ProtoDUNE Installation

- Completed detector components will be shipped to CERN starting in May 2017
- On-site personnel required to install, commission, and operate the ProtoDUNE detector
  - The organization of the ProtoDUNE-SP team has been a major focus of both the collaboration and project over the past year
  - Now a large, highly qualified international protoDUNE-SP team is fully active - with a strong CERN component, as well as Eu and International groups fully integrated with the large US contingent.
  - strong core group of experts is on the ground at CERN and additional resources will join at the time due for specific detector components integration/test/assembly. This will include many student and post-doc attracted by the opportunity of an in-depth experience with LAr detector construction and operation, and by the perspective of remarkable physics achievements
- The on-site ProtoDUNE-SP team also has responsibility for the detector DAQ system and several auxiliary detector systems as well as data reconstruction and analysis

Detector Integration, Test and Installation

stationary at CERN

going to be stationary at CERN

Detector Integration, Testing, and Installation

Coordinator: Roberto Acciarri (FNAL)

EHN1 Coordinator: Filippo Resnati

Installation Team Leader: Bill Miller (Minnesota)
Integration/Test Coordinator: Andrea Zani (CERN)
Electrical/Cabling Coordinator: Flor Blaszczyk (BU)
Computing Infrastructure Coordinator: Geoff Savage (FNAL)
Grounding & Shielding Coordinator: Linda Bagby (FNAL)
Safety Coordinator: Olga Beltramello (CERN)

APA Commissioning Leaders: Andrzej Szelc (Manchester), Serhan Tufanli (Yale)

HV/CPA/FC Commissioning Leaders: Francesco Pietropaolo (CERN), Kevin Wood (SBU)

Beam Plug Commissioning Leader: Cheng-Ju Lin (LBNL)

Photon Detector Commissioning Leader: Ettore Segreto (Campinas)

Photon Electronics Commissioning Leader: Zelimir Djurcic (ANL)

Cold Electronics Commissioning Leaders: Carl Bromberg (MSU), Matt Worcester (BNL)

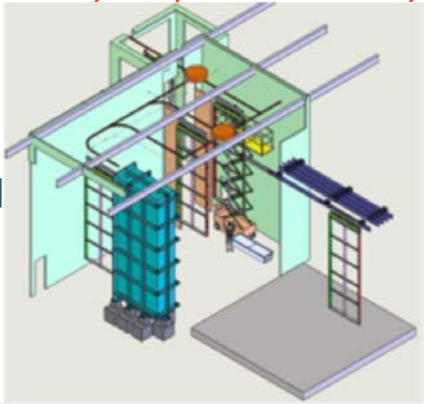
Muon Tagging Detector Commissioning Leaders: Steve Manly (Rochester), Camillo Mariani (Virginia Tech)

Sequence of Detector assembly, test and installation

- Detector components delivery at CERN
  - Detector Integration (Clean Room):
    - *APA + CE + PD (#1→ #6)*
    - DAQ Vert Slice
      - Test in Cold Box at ~LAr T
        - Move into Cryostat through TCO
          - Installation/Assembly in Cryostat:
            - *(APA+CE+PD) + (CPA + FC)*
          - Cabling

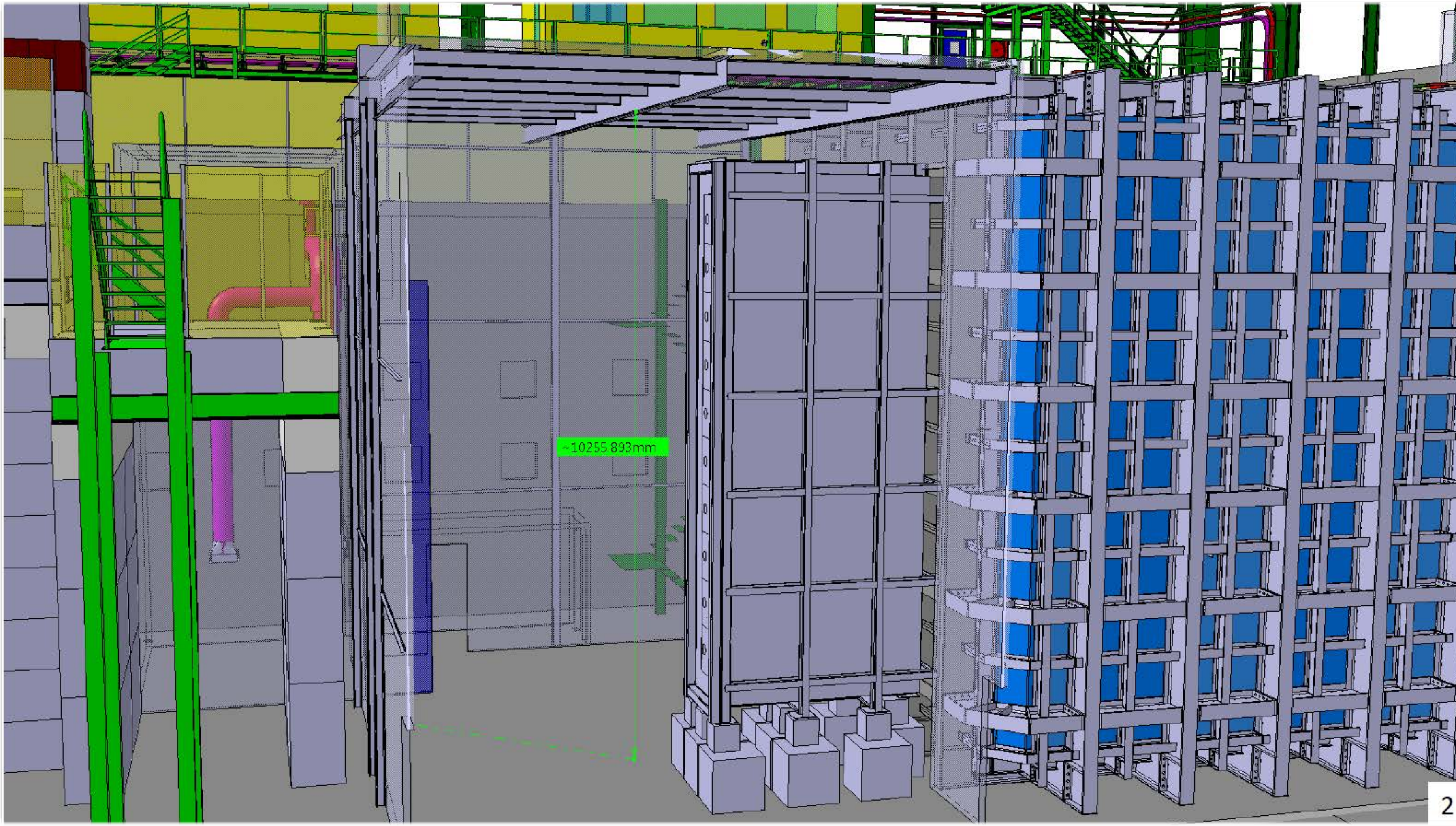
and also:

- Local Computing infrastru
- Grounding
- Safety



Fermilab DUNE

Detector Integration, Test and Installation

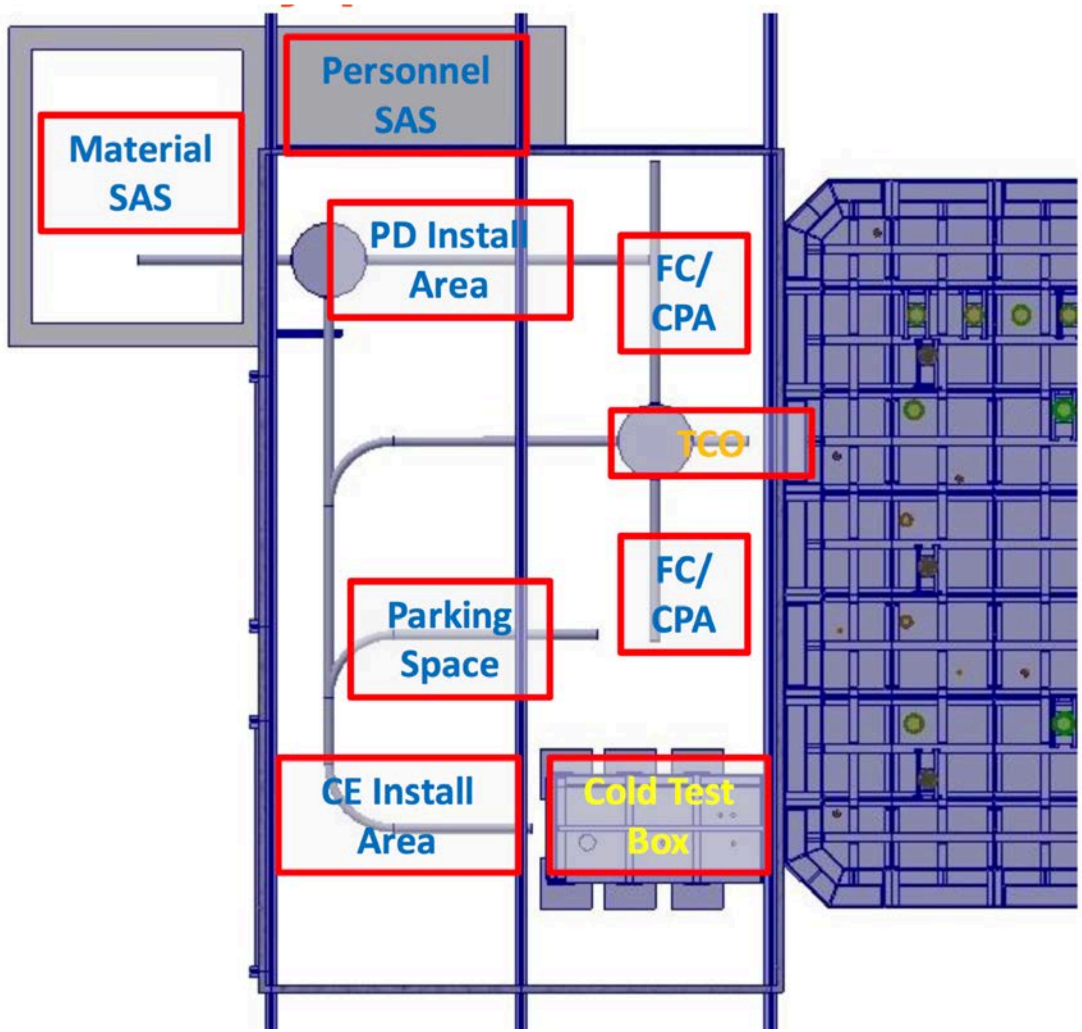


inside the Clean Room and view of the Cold Box

Process outline and areas in the Clean Room (the ITI Lab)

1) APA lowered into the SAS and inspected
2) APA PD Installation
3) APA CE Installation
   - Testing with small test station
4) APA Cold Test (Cold Box)
   - Connected to DAQ vertical slice in the Control Room
5) (APA parked)
6) APA in cryostat, cabling, testing

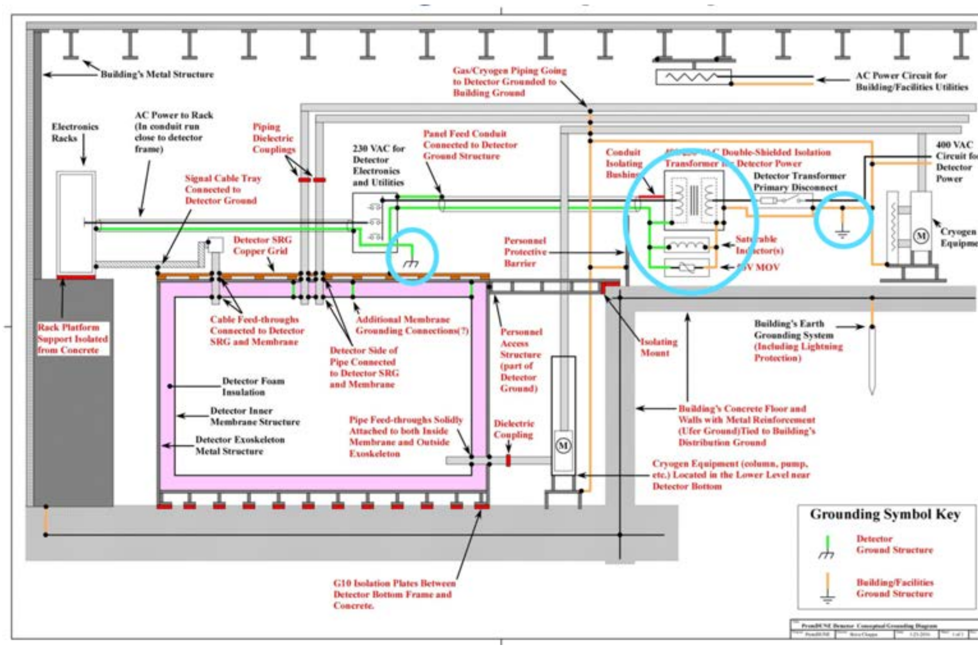
- <u>Can handle 3 APAs in the Clean Room at any time</u>
- CPA/FC assembly and installation



Detector Integration, Test and Installation

Grounding and Shielding in EHN1

- To achieve extremely low noise levels (ENC < 650 e-): building utility noise sources must be minimized and the front-end ASIC preamp ground must be stable.
- An adapted AC power 'isolation' technique is adopted (successfully implemented on the DZero, Atlas, and MicroBooNE experiments).



⇒ *Design of the 'Isolated' grounding scheme (providing a quiet detector ground and immunity from building ground noise):*

- 75kVA 'isolation' double-shielded transformer has been specified
- An Impedance Monitoring System, providing a *fault-alert* when the detector ground and building ground structures are accidentally connected, is almost complete.

DAQ

Coordinators:
Karol Hennessy (Liverpool)
Giovanna Lehmann Miotto (CERN)

Run Control/Systems Monitor Leader:
Wesley Ketchum (FNAL)

Data Monitoring Leader:
Antonino Sergi (Birmingham)

artDAQ Leader:
Kurt Biery (FNAL)

Photon Detector Readout Leader:
Martin Haigh (Warwick)

RCE TPC Readout Leader:
Mathew Graham (SLAC)

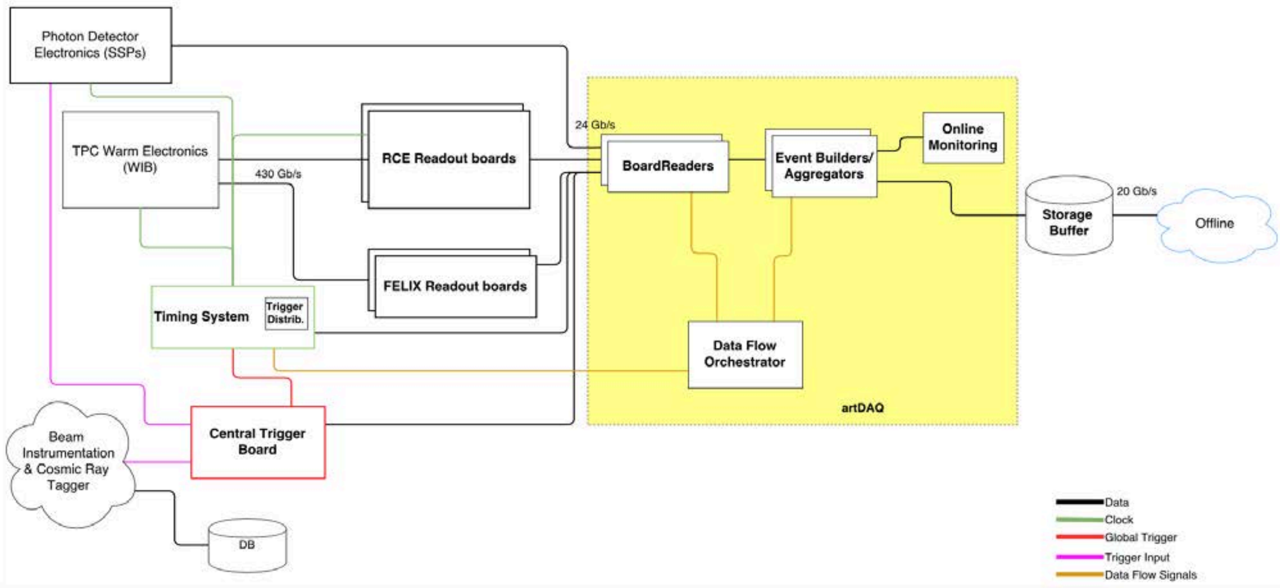
FELIX TPC Readout Leader:
Frank Filthaut (NIKHEF)

Trigger System Leader:
Josh Klein (Penn)

Timing System Leader:
David Newbold (Bristol)

DAQ System

Parameter	Value
Trigger rate	25 Hz
Spill duration	4.8 s
SPS Cycle	22.5 s
Readout time window	5 ms
# of APAs to be read out	6
Single readout size (per trigger)	230.4 MB
Lossless compression factor	4
Instantaneous data rate (in-spill)	1440 MB s^{-1}
Average data rate	576 MB s^{-1}
3-Day buffer depth	300 TB



DAQ System

- **Development** made **at institutes**
  - WIB – RCE development & testing *(Boston, SLAC)*
  - WIB – Timing *(BNL, Boston, Bristol)*
  - WIB – FELIX development & testing *(Boston, Nikhef, CERN)*
  - RCE – Timing development & testing *(SLAC, Bristol)*
  - RCE – Board Reader development & testing *(SLAC, Oxford)*
  - FELIX – Board Reader++ development & testing *(Nikhef, PNNL, CERN)*
  - Timing – Board Reader++ development & testing *(Bristol, Oxford)*
  - Timing BR as trigger for event building *(Oxford, FNAL)*
  - SSP – Timing, SSP Board Reader *(ANL, Warwick)*

- **CERN** is the place to **integrate functioning elements**

A “little int’l collaboration” inside the Collaboration

Cryogenics and Argon Instrumentation

Cryogenics & Argon Instrumentation

Coordinators:
Stephen Pordes (FNAL)
Anselmo Cerbera (Valencia)

Internal Cryogenics & Cryomeasurements leader:
Alan Hahn (FNAL)

Cryogenics Operation PTL Monitor Leader:

LAr Vertical Temperature Monitor Leader:
Jelena Maricic (Hawaii)

LAr Purity Monitor Leaders:
Jiaming Bian (UC-Irvine)
Andrew Renshaw (Houston)

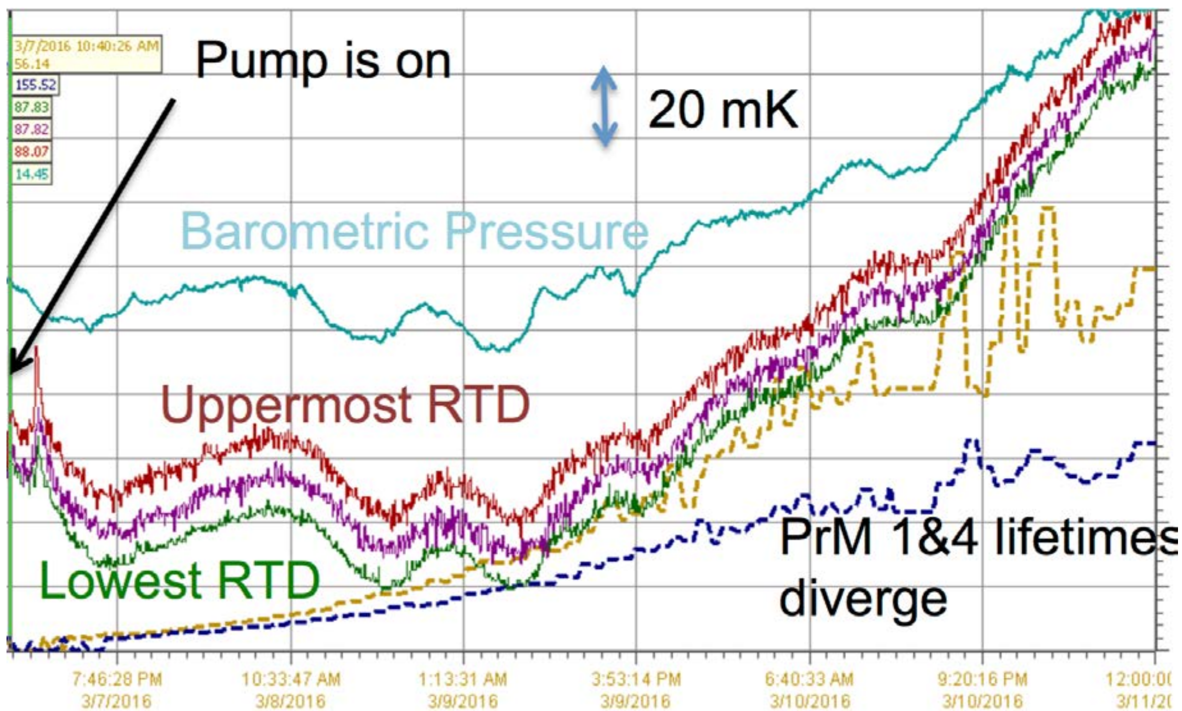
GAr Purity Analyzer Leader:
TBA

Cryostat Internal Cameras Leader:
Mike Kordosky (William & Mary)

Instrumentation Readout Leader:
Flor Blacszcyk (Boston)

Pressure, Temperature, Purity on the same plot

(example from the 35t prototype run)

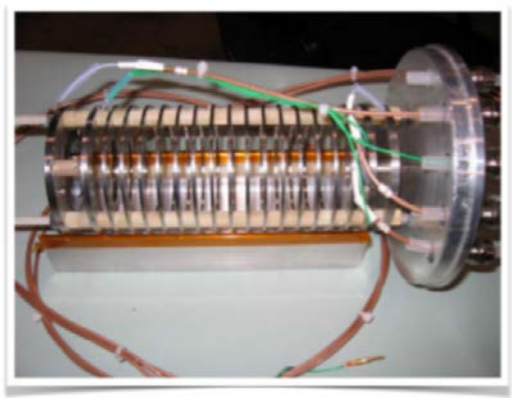


Cryogenics and Argon Instrumentation

Monitoring devices and sensors will be located inside the cryostat for periodical or continuous monitoring of some fundamental parameters of the liquid and gaseous argon content and for the monitoring of the detector functionality

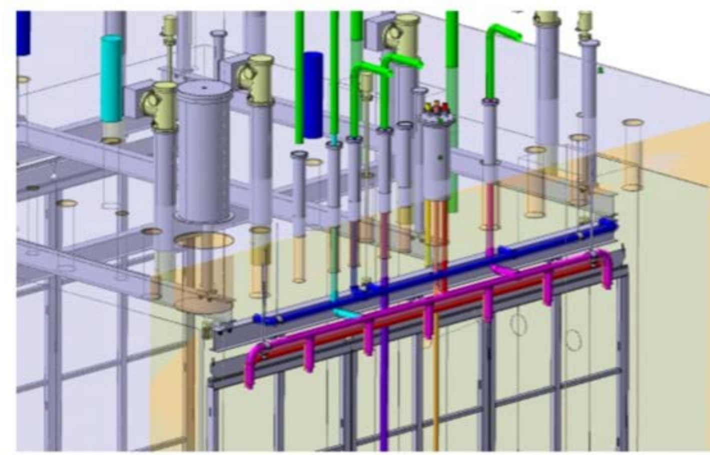
Purity Monitors

(from Icarus - under refurbishment)
Precise measurement of the impurity concentration in LAr (sensitivity in the tens of ppt range)



Vertical Temperature Gradient Monitor

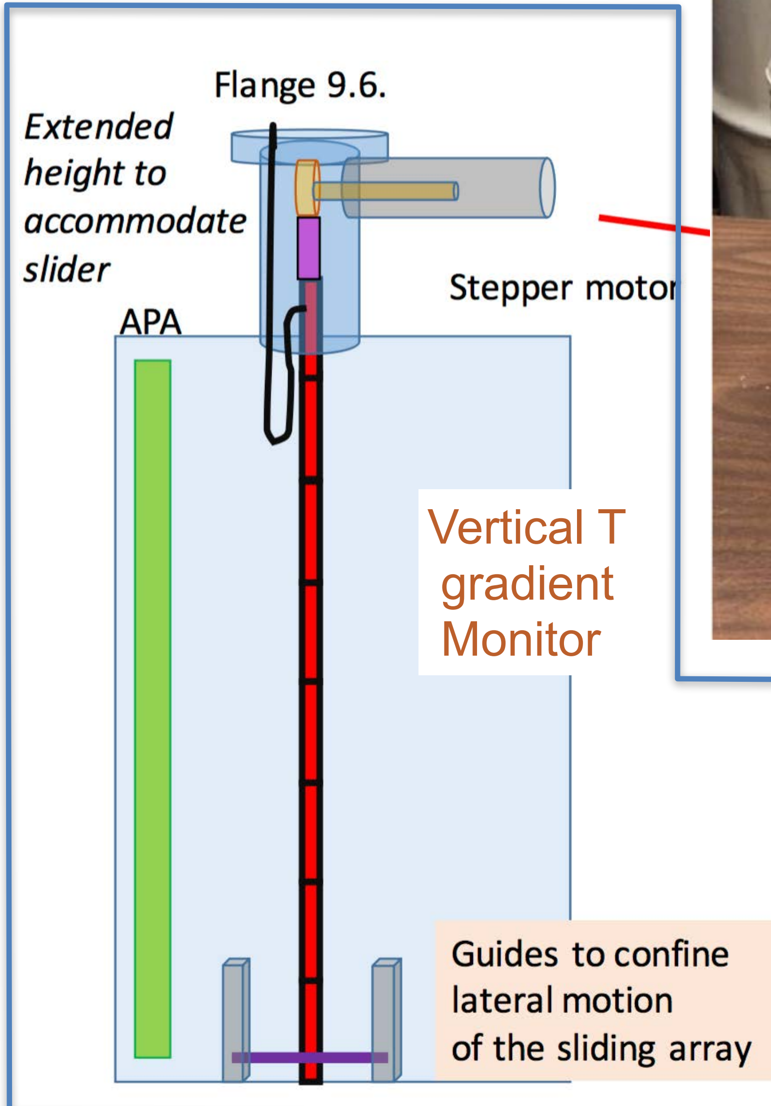
Precise (<30mK) monitoring the temperature gradient as a function of LAr depth - important as input for fluid dynamics modeling

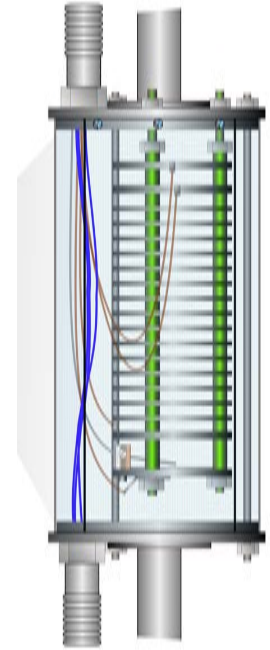


CryoWebCam

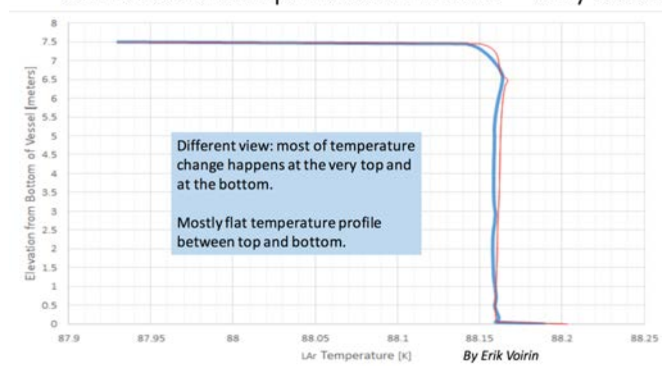
overall detector inspection (developed and provided by pDUNE DP)

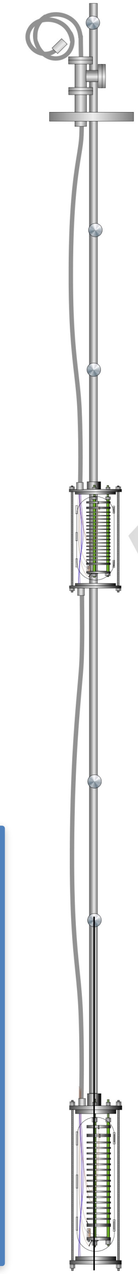
Cryogenics and Argon Instrumentation





Simulated Temperature Profile – very stable





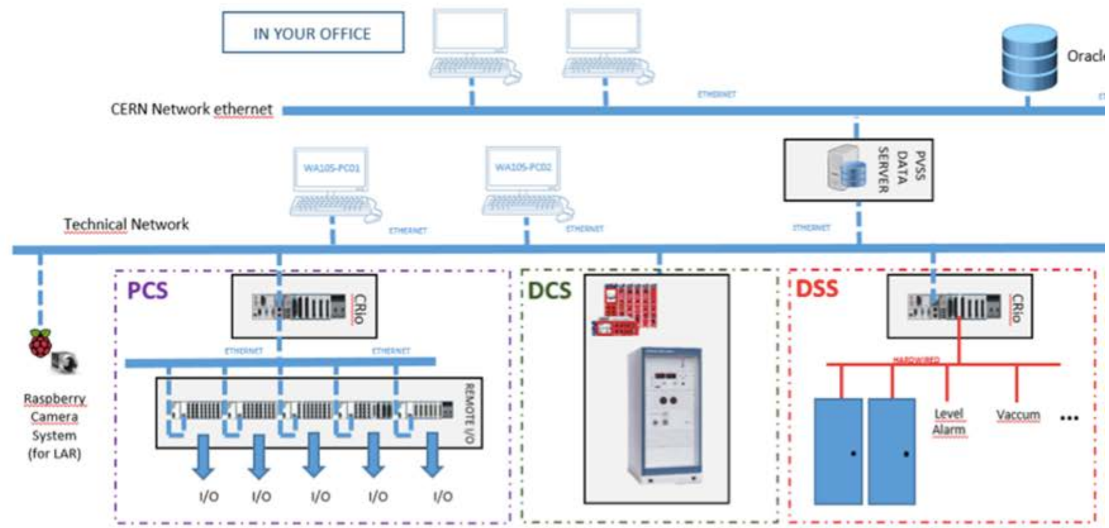
Slow Control System

Slow Controls
(Joint SP/DP Working Group)

Coordinators:
Anslemo Cervera (Valencia)
Yann Rigaut (ETHZ)
Giovanna Lehmann (CERN)
F. Blaszczyk - BU

- ***Control:***
  - all power supplies, lighting, cameras, heaters/fans
- ***Monitor:***
  - voltages and currents of every system inside the cryostat
  - temperatures in the cryostat: fine grained temperature gradient rods + additional probes
  - "live" purity indicator
  - impedance monitor (for grounding status)

Front-End
Back-End



PCS (Process Control System): dedicated for the process and monitoring of the experiment, PVSS & Unicos. Similar to the Lar of Canfranc PCS & MCS Magnet of LHC experiments	DCS (Detector Control System): dedicated for the High & Low voltage crate, PVSS & JCOP Framework. Similar to the LHC DCS application.	DSS (Detector Safety System): dedicated for the safety of the experiment, high reliability, hardwired cabling, PVSS & Unicos. Similar to the NA62 DSS.

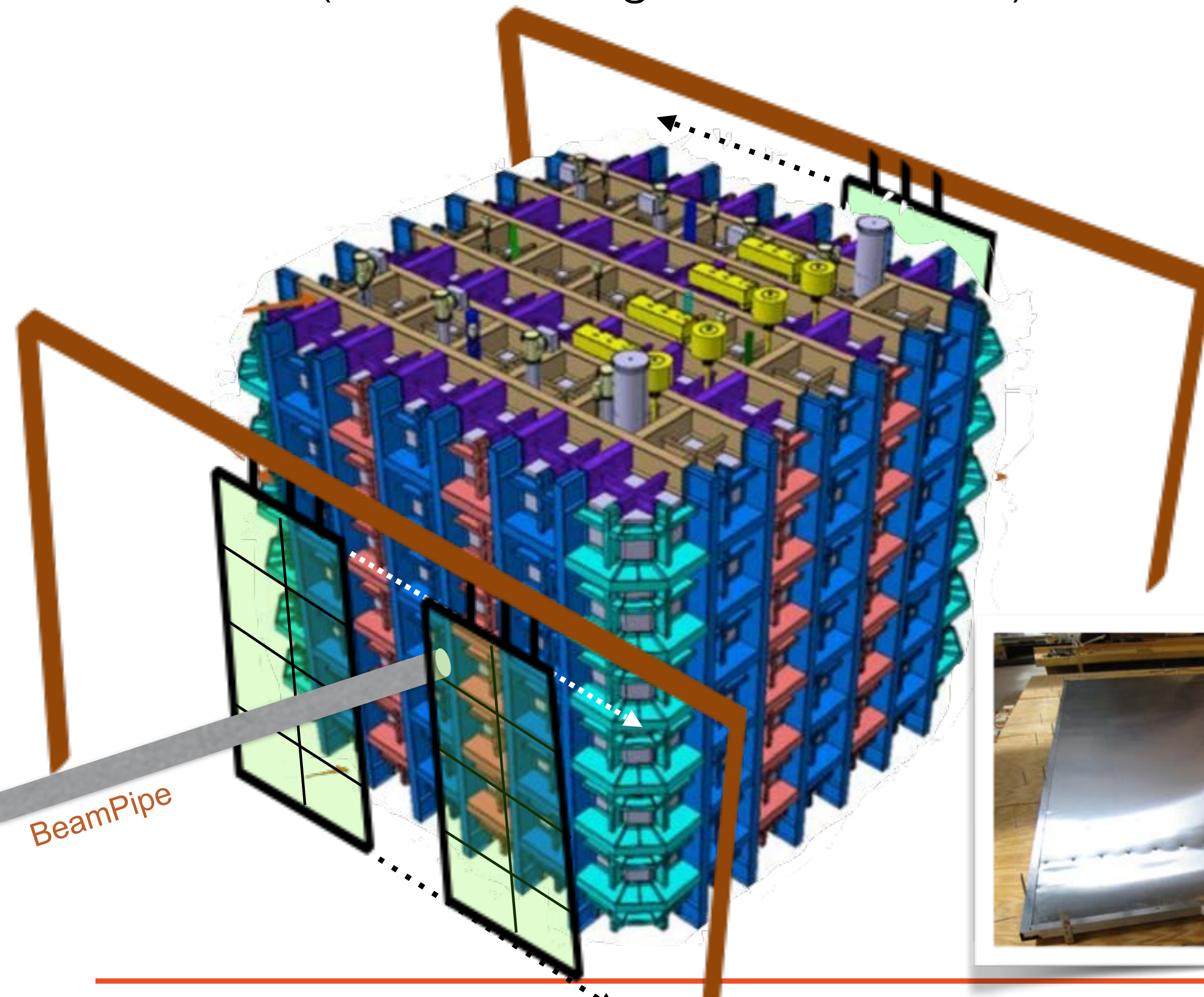
External Muon Tagger

necessary for detector calibration

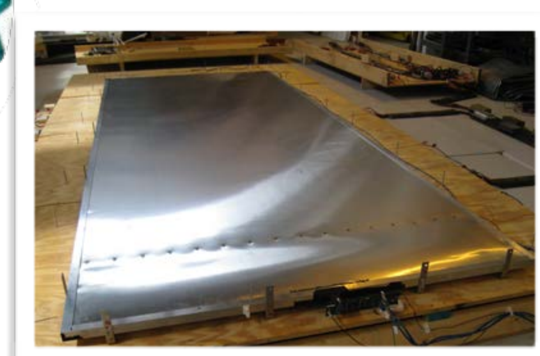
Cosmic Muon Tagging:

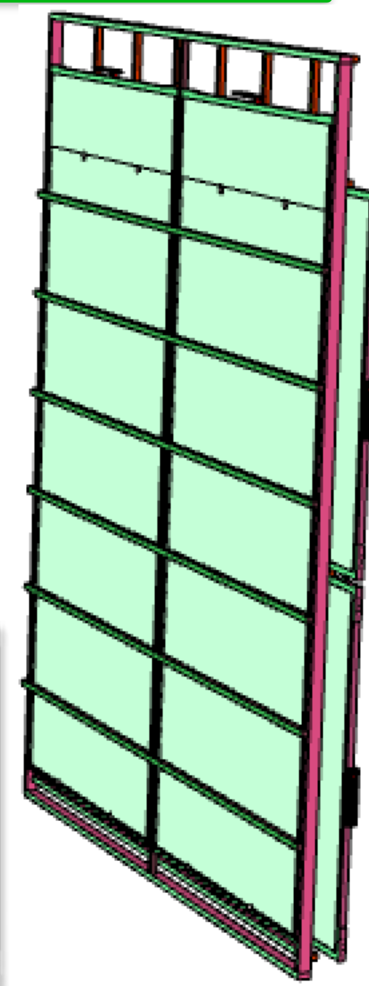
Coordinators:
Ed Blucher (Chicago)
Jonathan Link (Virginia Tech)

24 (+ 8 spare) fully equipped Modules available
(in Strasbourg - from DChooz)



3 movable structures each made of **2 frames** with **(2x+2y)** modules (x,y strips)





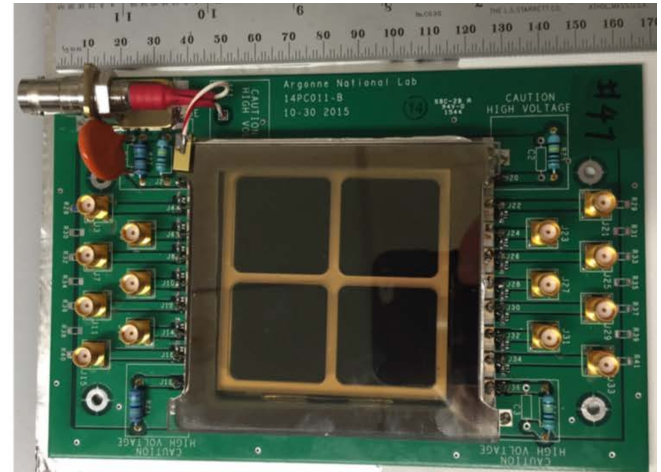
H4 Beam Line Instrumentation

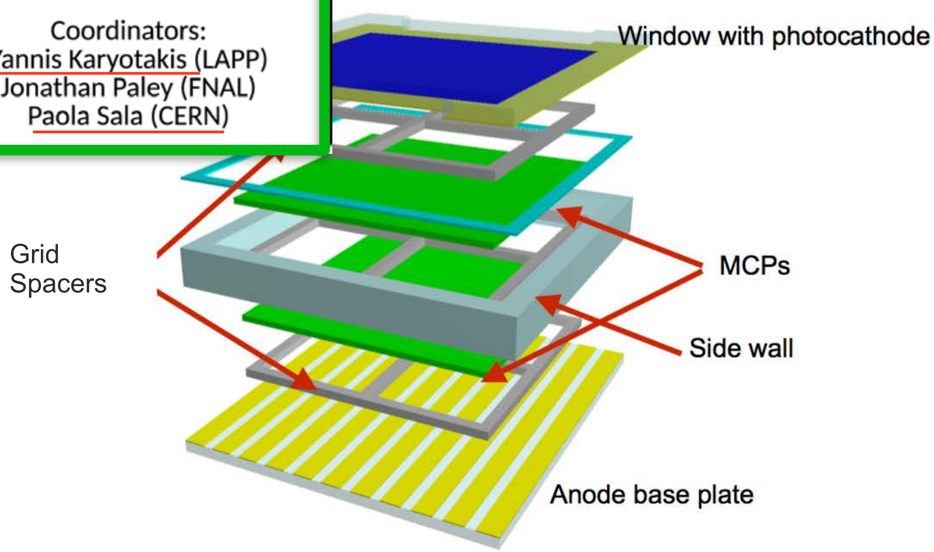
pLAPPD: high time resolution ToF

- MCP-based photodetector, capable of 20 ps timing resolution.
- Testing one pLAPPD (~5.e5 gain, ~10% QE) from Argonne to get operational experience, develop DAQ, etc.

Beam Configuration and Instrumentation (Joint SP/DP Working Group)

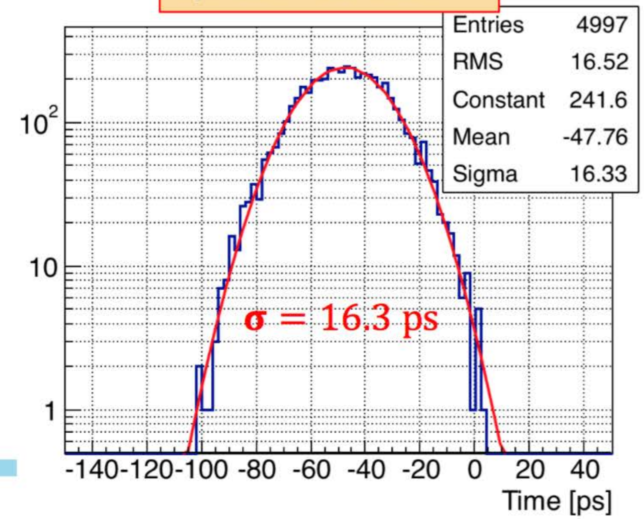
Coordinators:
Yannis Karyotakis (LAPP)
Jonathan Paley (FNAL)
Paola Sala (CERN)





6×6 cm^2 'small tile' blowout

Transit time spread resolution



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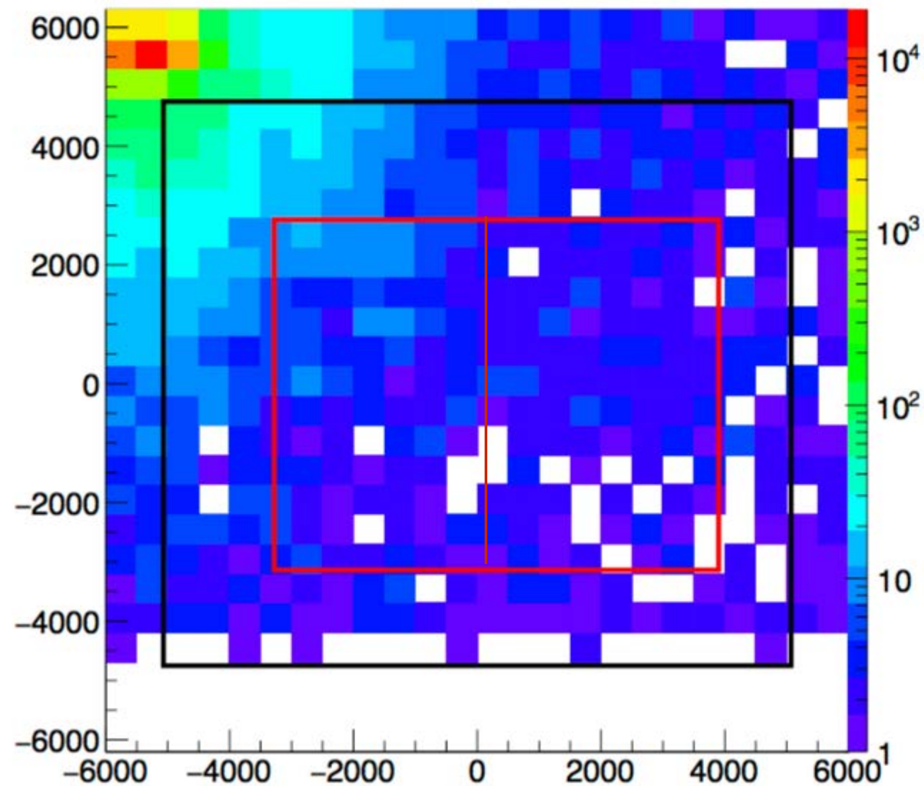
H4 Beam Line: rates and halo (MC)

Table 5.3: Particle rates (Hz).

Momentum (GeV/c)	e^{+-}	K^{+-}	μ^{+-}	p^{+-}	π^{+-}	total
-7	57	7	2	3	138	207
-6	62	5	2	2	113	185
-5	72	3	2	2	87	166
-4	93	2	2	1	72	170
-3	11	0.5	1	0.5	26	39
-2	13	0	0.5	0.1	16	27
-1	18	0	0.2	0	4	22
-0.4	8	0	0	0	0.1	8
0.4	7	0	0	0	0	7
1	18	0	0	4	4	27
2	13	0.2	0.5	9	15	38
3	11	1	1	11	31	56
4	92	3	2	17	81	196
5	74	6	3	19	99	200
6	63	9	3	24	127	226
7	52	13	2	27	157	252



Muon halo intensity at the cryostat face
for muons originating from the H4 beamline

Data Reconstruction, Calibration and Analysis

(1) **Detector Performance Measurements:**

- First demonstrate that the performance of the ProtoDUNE detector is sufficient to make physics measurements (input to DUNE TDR)
  - Signal to Noise Ratio (SNR)
  - LAr Purity and range-based PID
  - Space charge
  - Calorimetric Reconstruction

(2) **Physics Measurements:**

- Few selected physics topics for an expedite analysis output *(goal: public presentation in ~6 months after run end)*
  - pion cross-sections in the 1 to 7 GeV range
  - el.m shower content in hadron shower (compensation in LAr)

Data Reconstruction and Analysis

Coordinators:
Josh Klein (Penn)
Thomas Kutter (Louisana)
Robert Sulej (FNAL/NCBJ)

Calibration Leader:
Igor Kreslo (Bern)

Reconstruction Leader:
Dorota Stefan (CERN/NCBJ)

Detector Performance Measurements Leader:
Bruce Baller (FNAL)

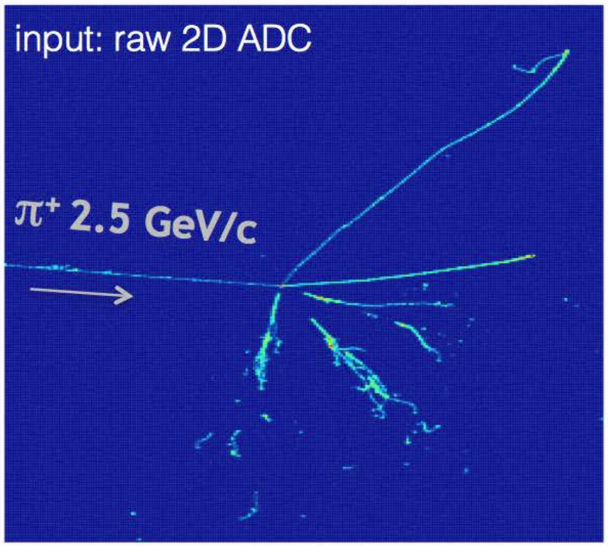
Physics Measurements Leader:
TBD

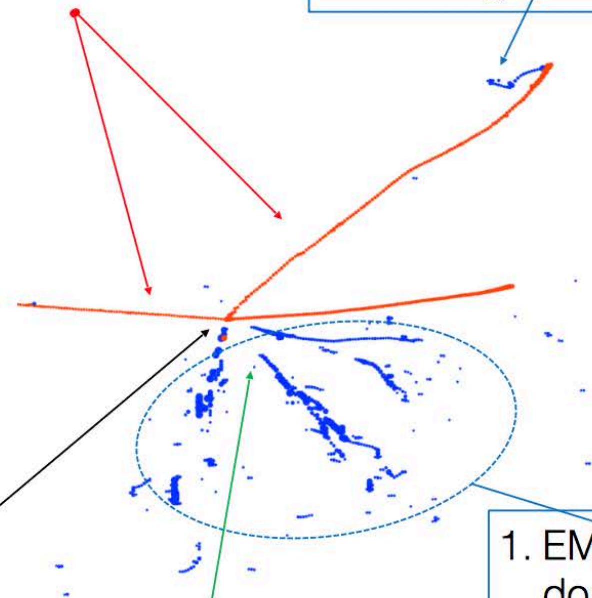
Simulation and MC Production Leaders:
Leigh Whitehead (CERN)
Anan Mazzacane (FNAL)

ProtoDUNE's beam events reco: status/plan

3. hadron tracks reconstruction:
➝once EM separated, efficient standard algorithms

2. Michel selection: advanced
➝labeling with CNN





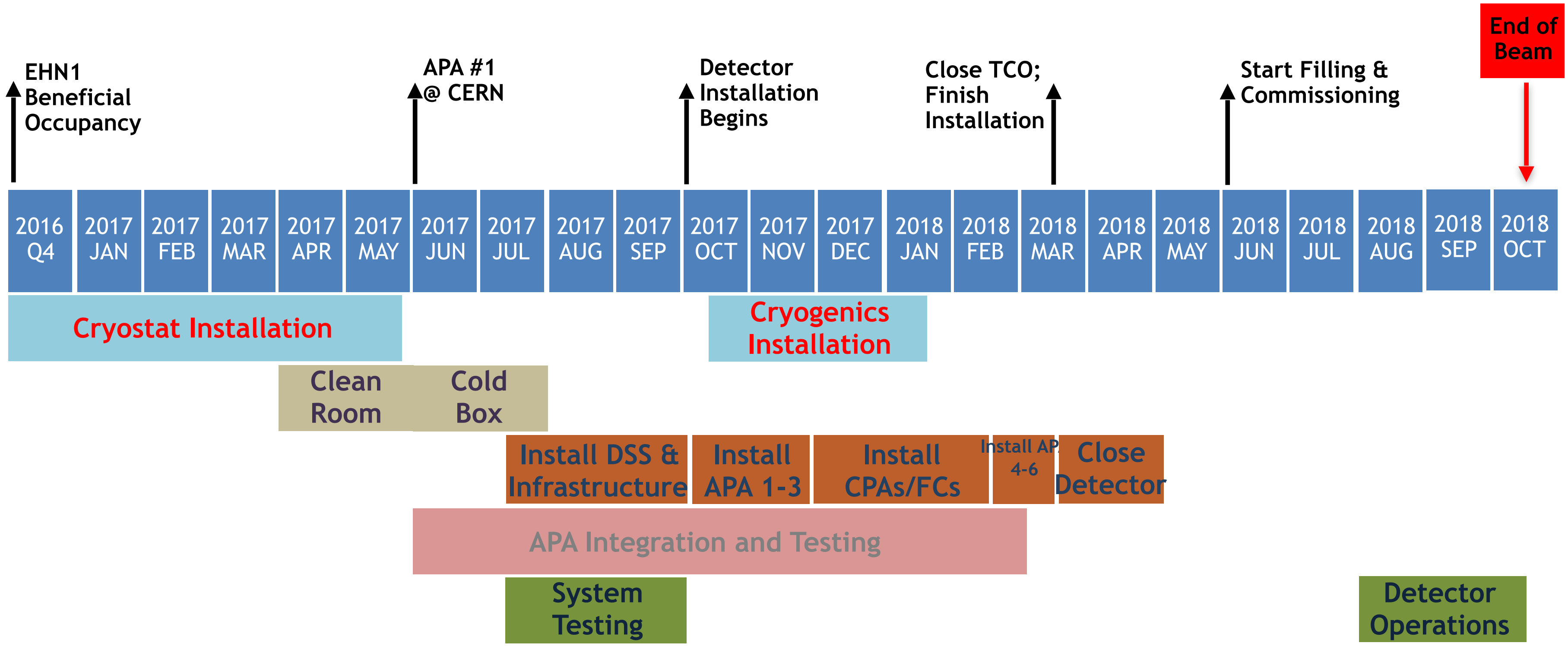
1. EM selection: quite done
➝labeled with CNN

4. interaction vertex:
➝reconstructed with standard tracking
➝or „todo": labeled with CNN

5. „Todo": EM cascade start finding
➝most significant for e/γ separation and ν_e selection

- EM shower displacement from the vertex
- 1m.i.p. vs 2m.i.p. dE/dx in the initial part

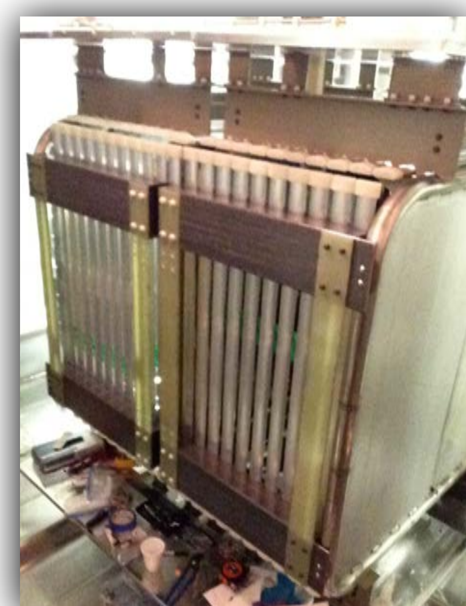
ProtoDUNE-SP Schedule



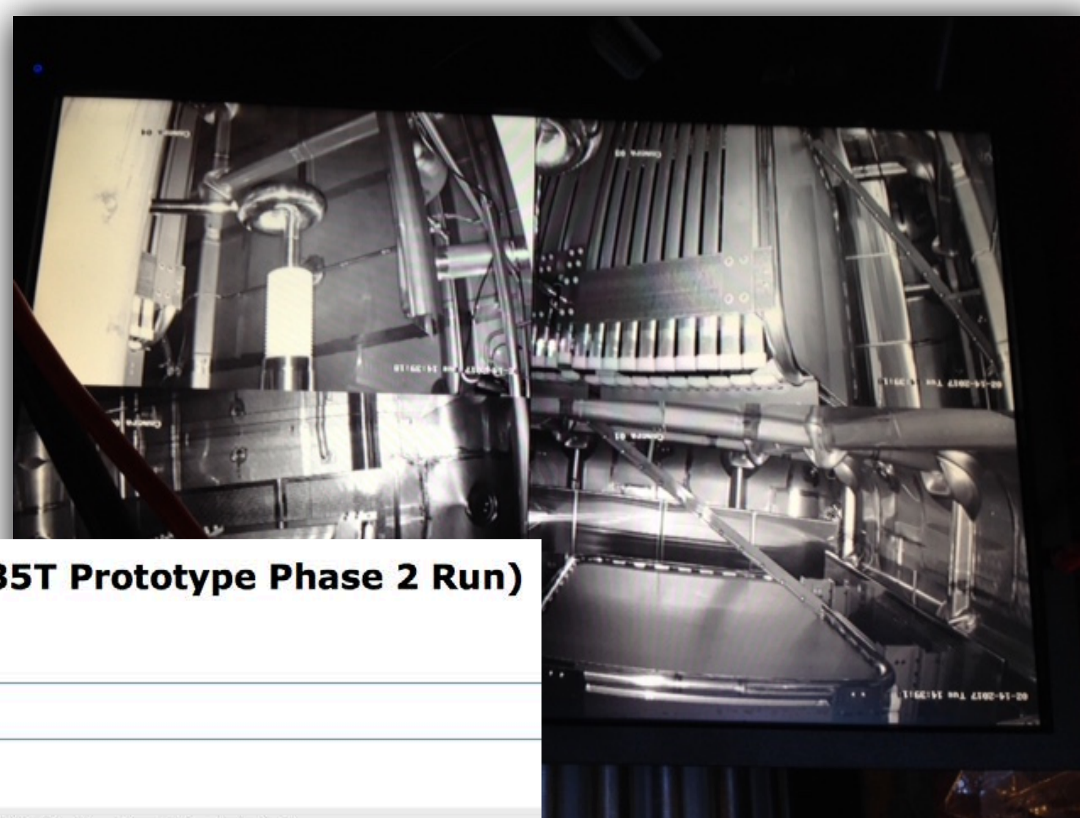
Conclusion

- All detector elements are either in production or ready to start (QA/QC & PRR)
- A detailed plan of activity, under extremely tight time schedule constraints, has been put in place for detector integration test & assembly at CERN.
- Functional DUNE Working Groups are addressing the major tasks and have extended and qualified participation.
- Key activity coordinators are on the ground at CERN - more and more will move here in the next few months.
- At this point in time, the protoDUNE-SP installation plan remains on schedule for being ready for beam data in July-August 2018.
- ***Next four months at CERN:***
  - fast transitioning from facility preparation to actual detector assembly, test and installation; this challenge anticipates even more intense effort and full dedication from the ProtoDUNE-SP team.

High Voltage Test at the 35t



Instrumented with cameras and PMTs
Monitoring current draw as voltage is ramped up
Have ramped to 40kV in air with no sign of breakdown



DUNE 35T (formerly LBNE 35T Prototype Phase 2 Run)
Electronic Logbook

Logbook Shifts Members

Entries
Search
RSS

#9370 **Field Cage HV Test** 04/02/2017 09:12:51 Alan Hahn (ahahn)

Entry Subject: *HV still holding at 190 kV*
Title says it all.

Sarah Lockwitz: status of our 35t test. We have been holding -190 kV (just over -180 kV on the cathode) for over a day now.

BackUp

LBNF/DUNE Quality Assurance Manager Responsibilities

- Performs assessments of the Proect’s, Partner’s and Contractor’s organizations and Quality Assurance Plans
- Ensures that LBNF/DUNE QA program is established, implemented and maintained
- Assist Partners and Contractors to establish, implement and maintain quality inspections and acceptance tests
- Report progress of LBNF/DUNE QA program implementation to Project Management
- Report QA/QC issues and progress of resolution to Project Management

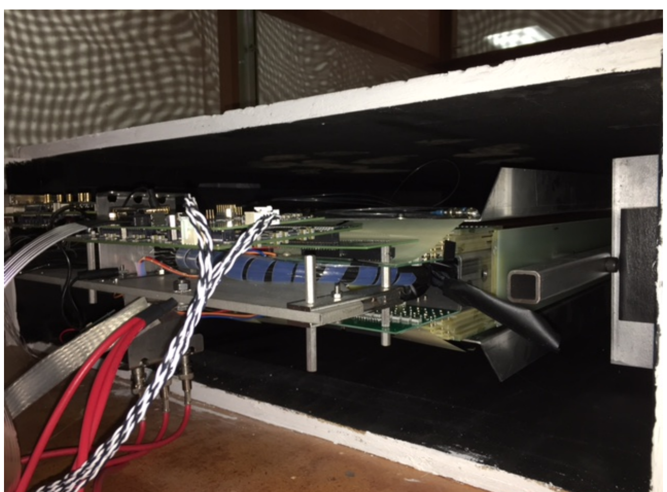
Electronics Testing – FNAL and BNL

FNAL

- RF Shielded room with isolation transformer
- Warm test
- Will test full electronics chain (with small APA)

BNL

- Cold test (LN2)
- Also tests full chain with "40%" APA



Data Reconstruction, Calibration and Analysis

Physics Measurements

- Hadronic cascade energy reconstruction
- EM fraction in hadronic cascade MC model testing
- Ultimate goal: π^0 reconstruction & measurements (γ conv. distance, dE/dx, π^0 mass)