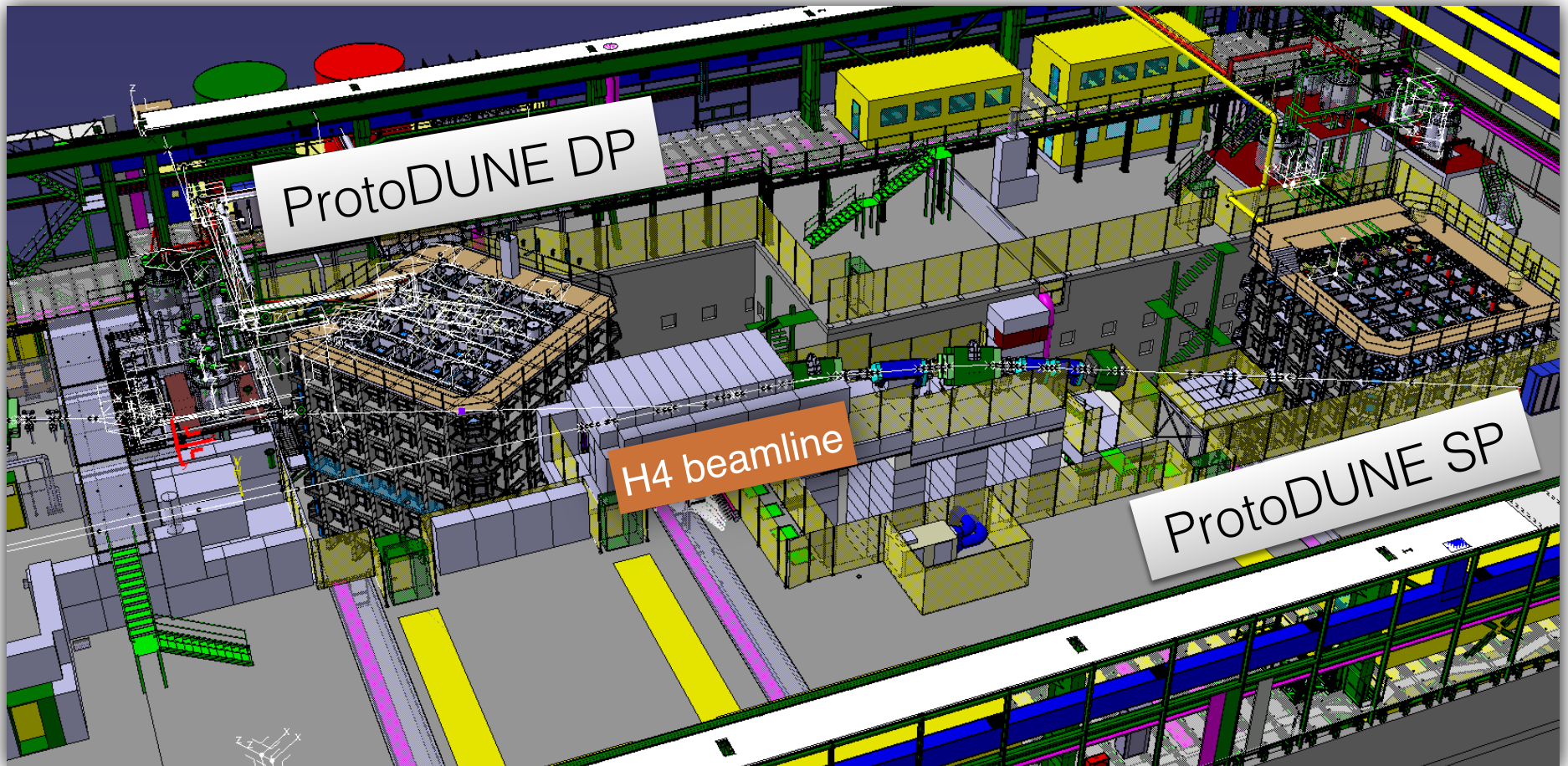


# ProtoDUNE-SP Status

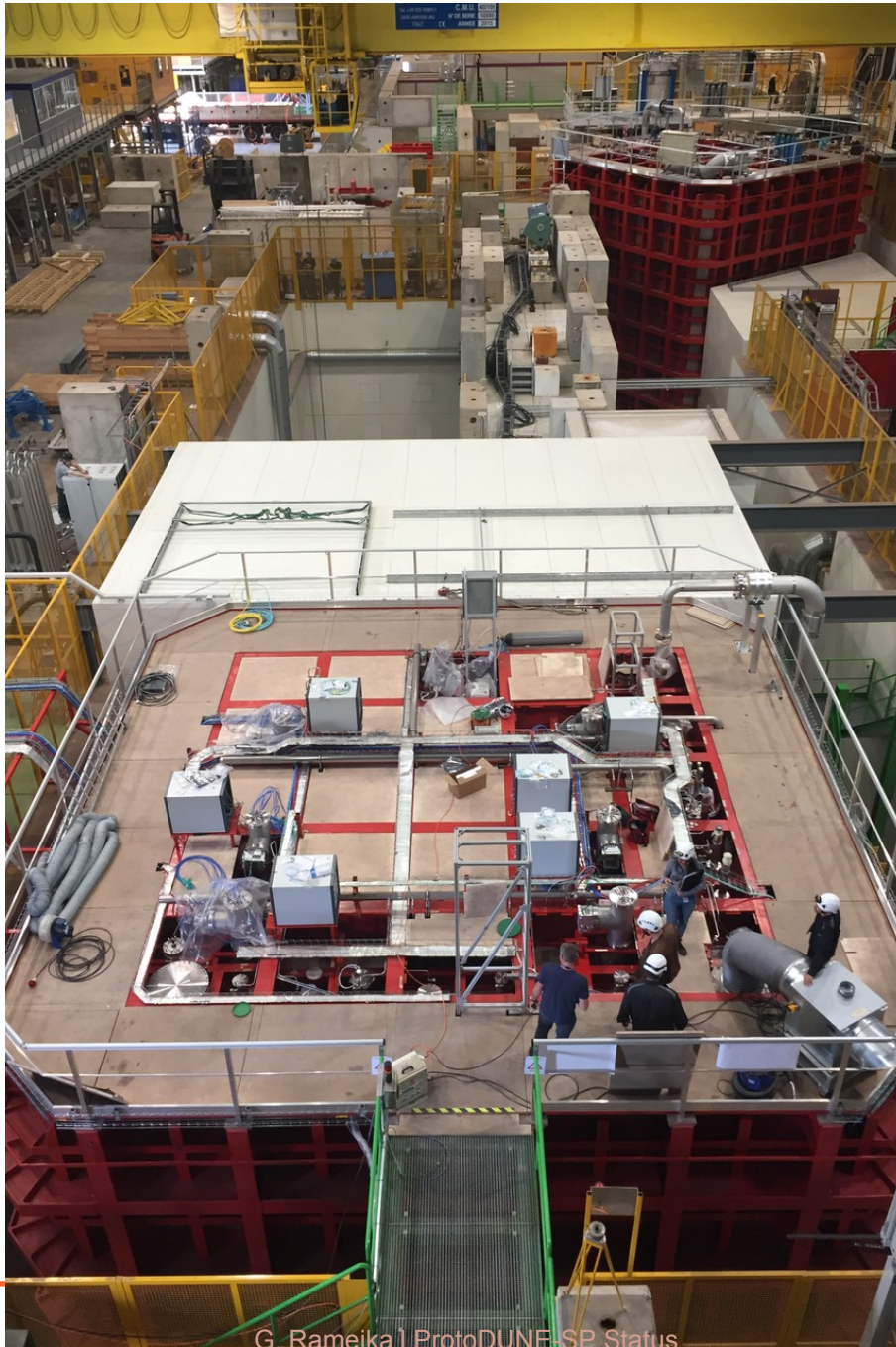
Gina Rameika

Data Exploitation Readiness Review

10-11 May 2018

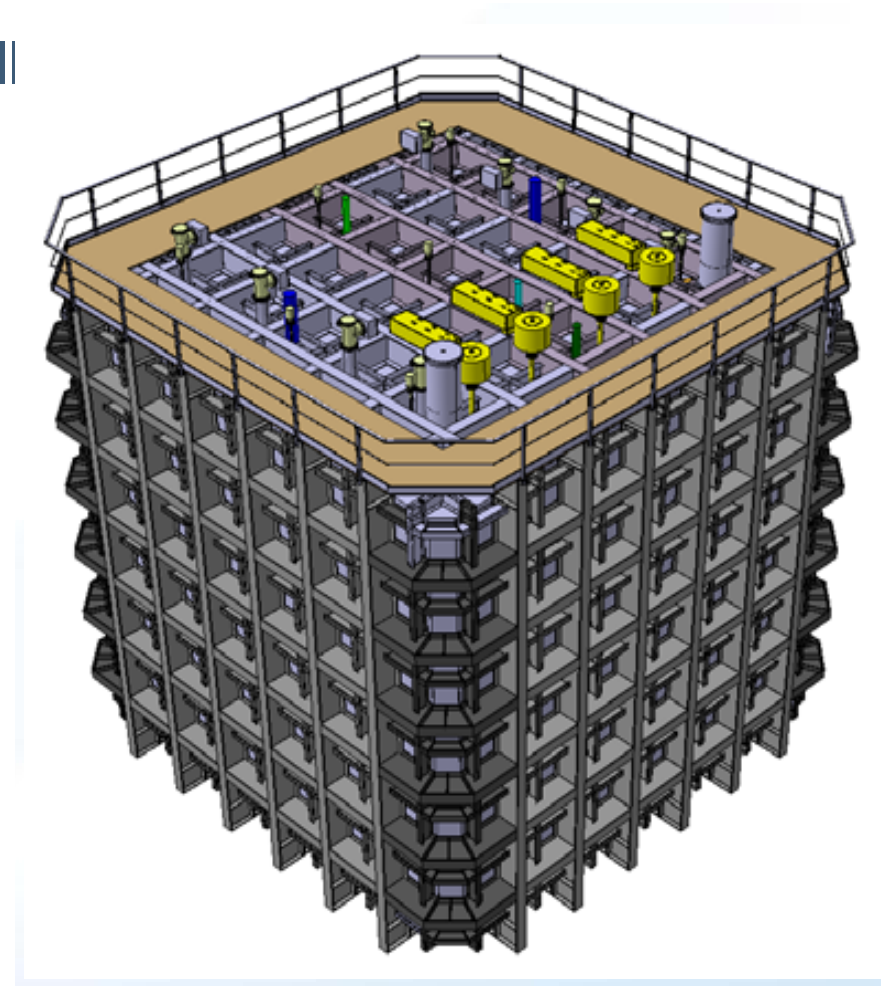


A new building (EHN1 extension) to host protoDUNE SP (and protoDUNE DP):  
Detector Assembly & Test Facility/Clean Room, Cryostat, Cryogenic/Recirculation Plant,  
H4 tertiary beam line, External Instrumentation, DAQ and Slow Control Computing



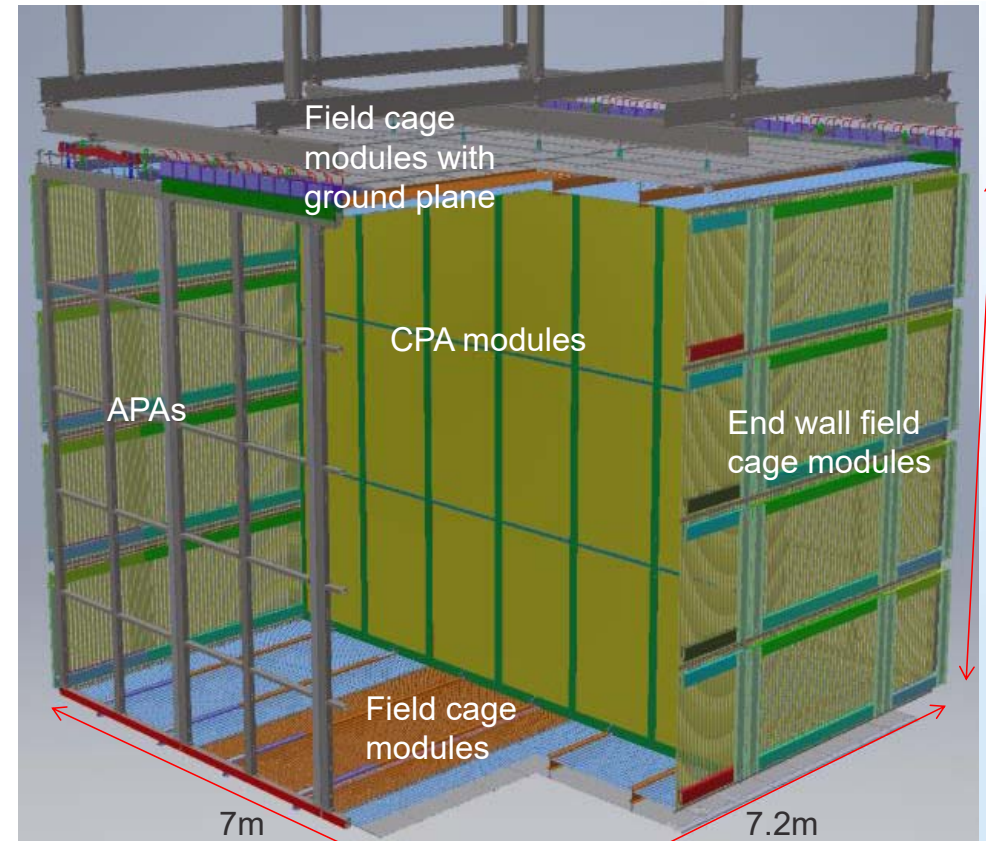
# Detector Overview

- Cryostat located in the EHN1 Hall will hold 760 tons of liquid argon
- Cryostat and cryogenics being provided by CERN via the CERN Neutrino Platform
- Main Detector Elements covered in this talk include: Time Projection Chamber (TPC), Front-end electronics and a Photon Detector System



# Single Phase Time Projection Chamber

- Prototype of a DUNE single phase far detector module (10kT). Full scale modules, but only half height (single layer of APAs).
- TPC has 6 APAs, 6 CPAs, 28 field cage modules, 15K readout channels
- Active volume: W: 3.6m (x2), H:6m, L (along beam direction): 7m; 300 ton active mass



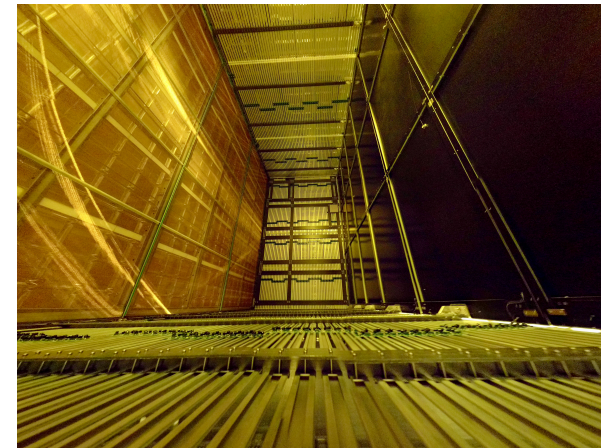
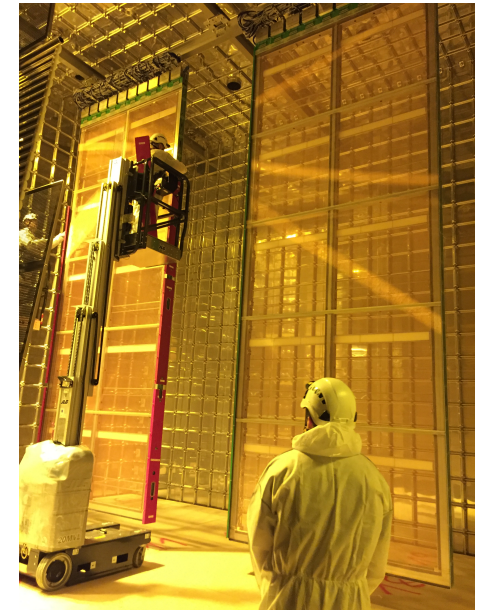
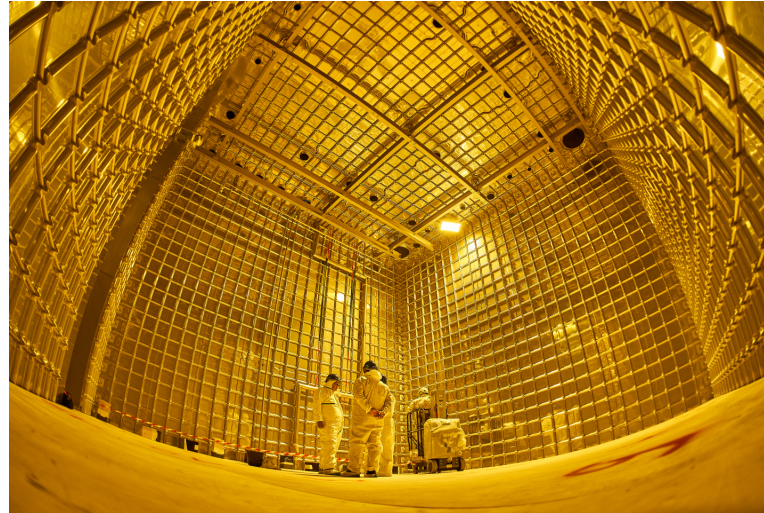
# High Level Strategic Goals of ProtoDUNE-SP

- The ProtoDUNE program has four main aims, all of which are important components of the DUNE far detector development program :
  - prototyping **the production and installation procedures** for the single-phase/dual-phase far detector design;
  - validating the design from the perspective of **basic detector performance** – this can be achieved with cosmic-ray data alone.
  - accumulating large samples of **test-beam data** to understand/calibrate the response of the detector to different particle species.
  - demonstrating the **long-term operational stability** of the detector as part of the risk mitigation program ahead of the construction of the first two 10-kton far detector module.

# Construction Sub-system Teams

- Anode Plane Assemblies (APA): UW-PSL, UK - Daresbury, Manchester, Liverpool, Sheffield, Lancaster
- Cathode Plane Assemblies (CPA): Argonne National Lab, CERN
- Field Cages: Stony Brook University (top/bottom), Louisiana State University (endwalls), CERN (profiles, assembly)
- High Voltage: Fermilab, College of William and Mary, Kansas State University, University of Houston
- Beam Plug: Lawrence Berkeley NL
- Photon Detectors: Caltech, Indiana University, Fermilab, MIT, Colorado State University, Argonne NL, Northern Illinois University
- Cold Electronics: Brookhaven NL, Stony Brook University, Florida State University, Michigan State University, Louisiana State University
- Assembly and Integration: University of Minnesota, Brookhaven NL, CERN
- Cryogenic Instrumentation : UC-Irvine, University of Houston, Hawaii, IFIC-Valencia, FNAL , CERN

# A quick look at a very busy year

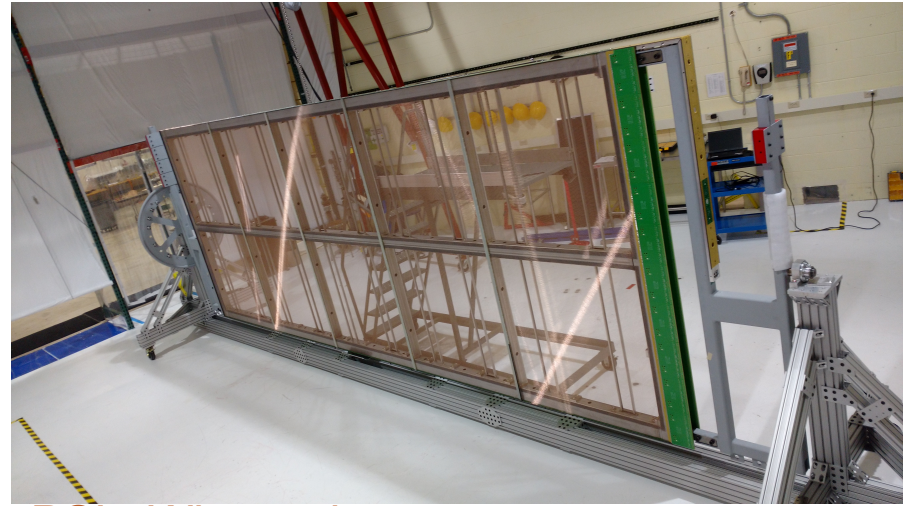




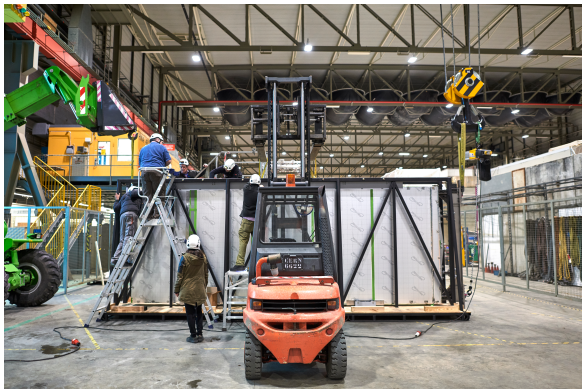
# Anode Plane Assembly (APA)



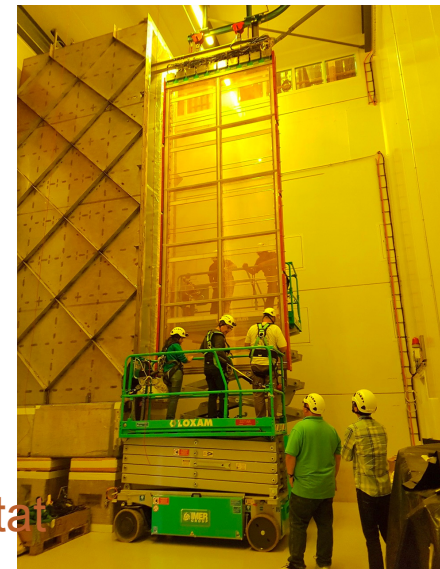
Daresbury, UK



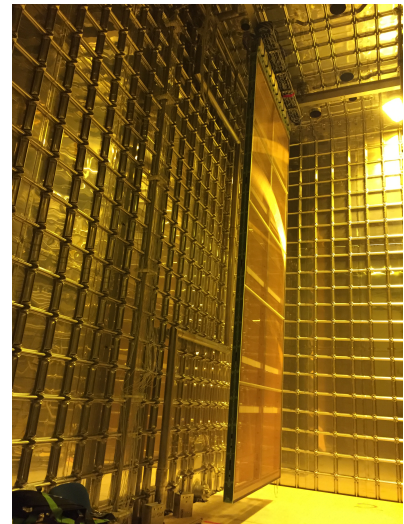
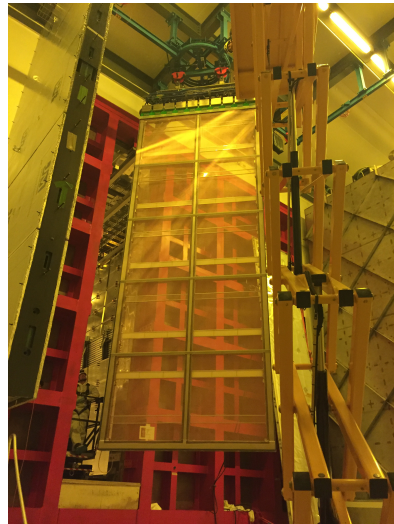
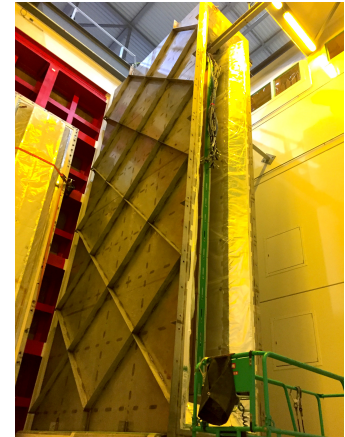
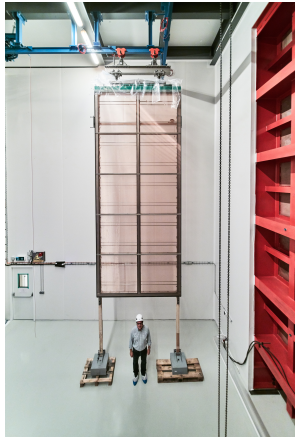
PSL, Wisconsin



At CERN: QC, Integration, Cold Test, insertion in cryostat

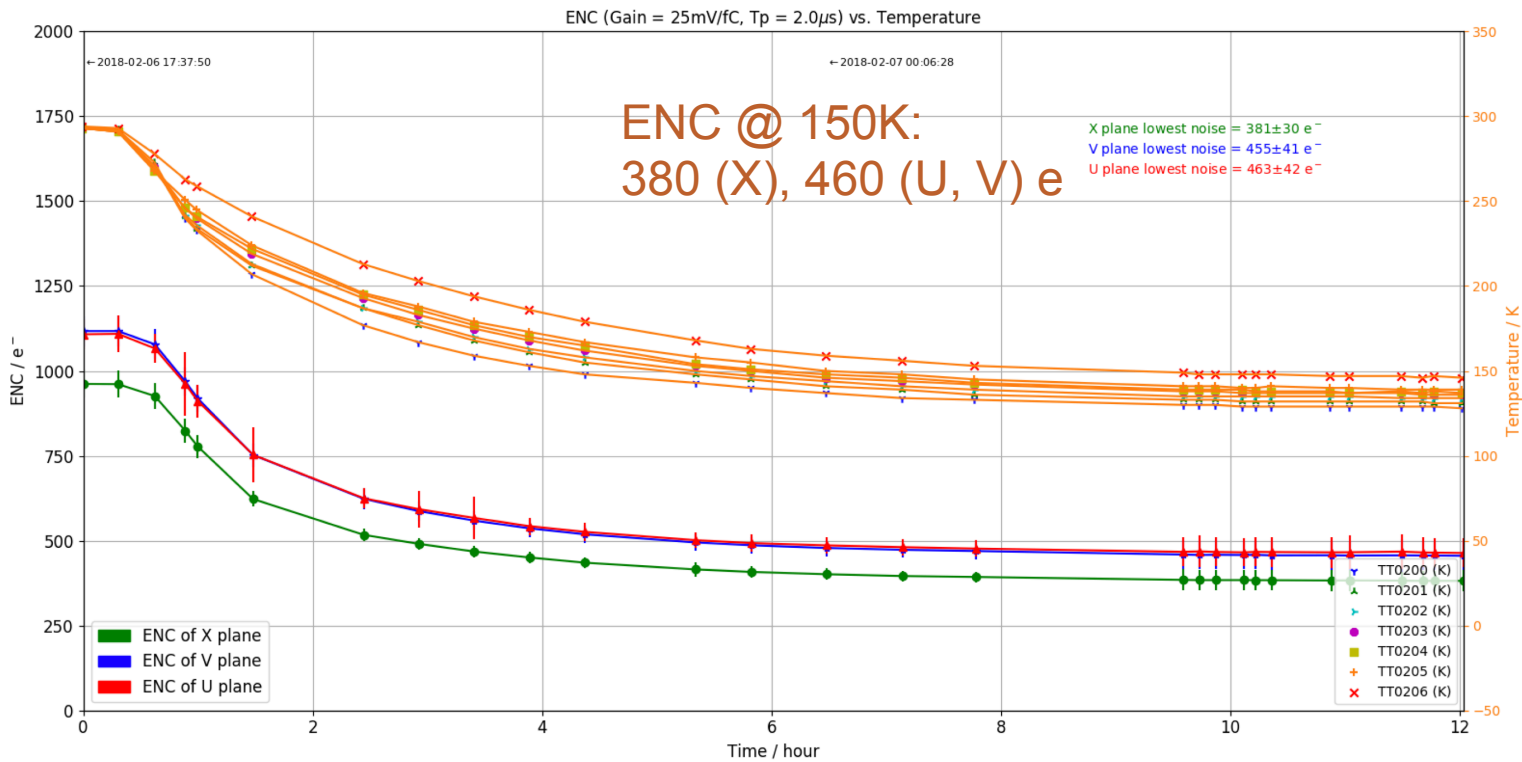
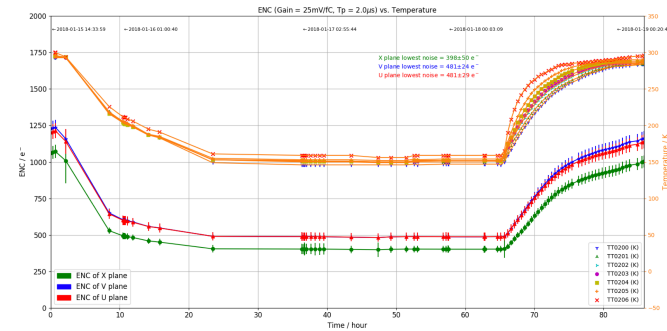


# Clean Room & Cold Box

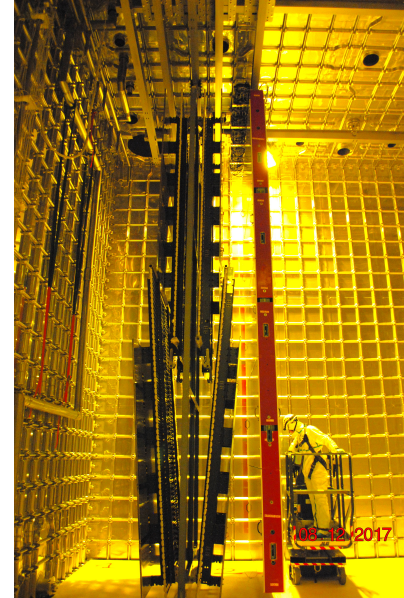
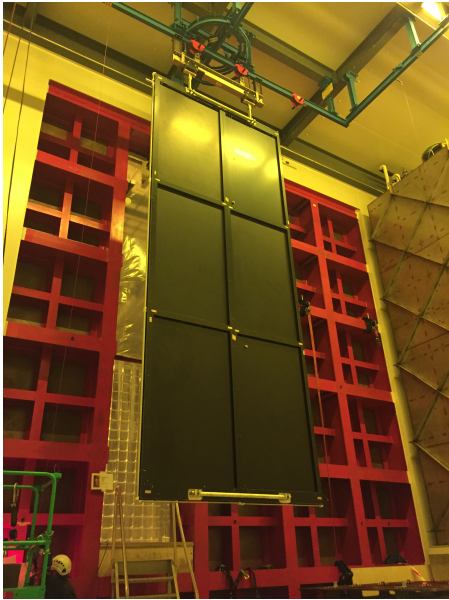


How clean? About class 100,000  
How cold? Smooth weekly cycles down to 150K

# APA cold tests (LN<sub>2</sub>)

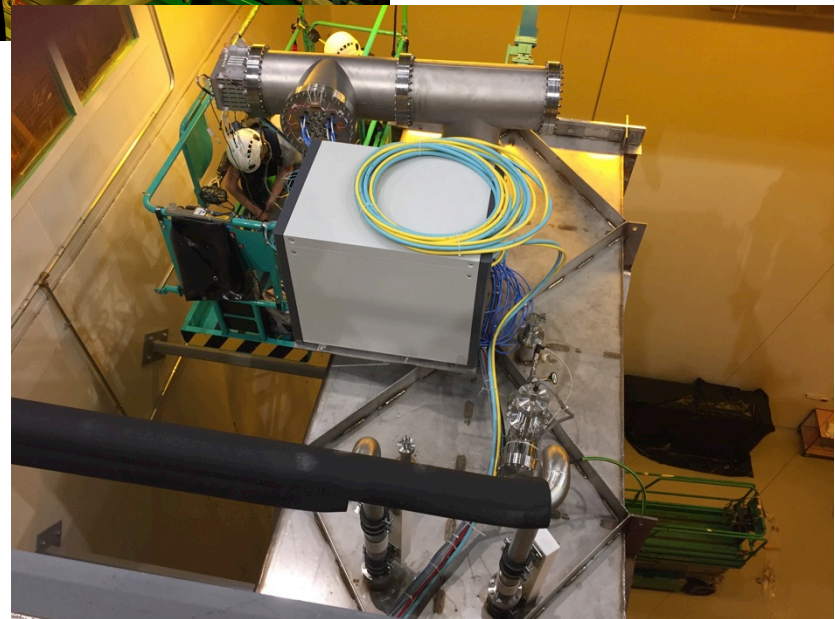
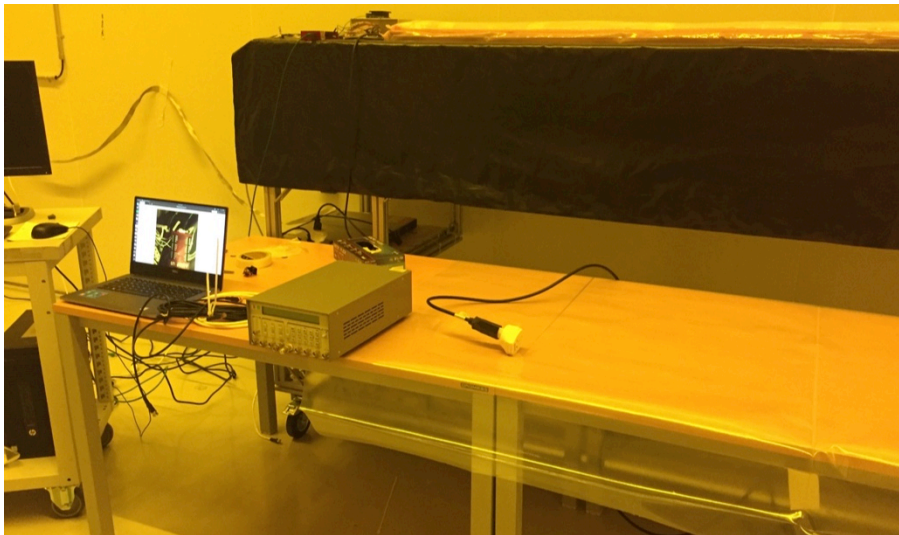


# Cathode, Field Cage



# Photon Detectors

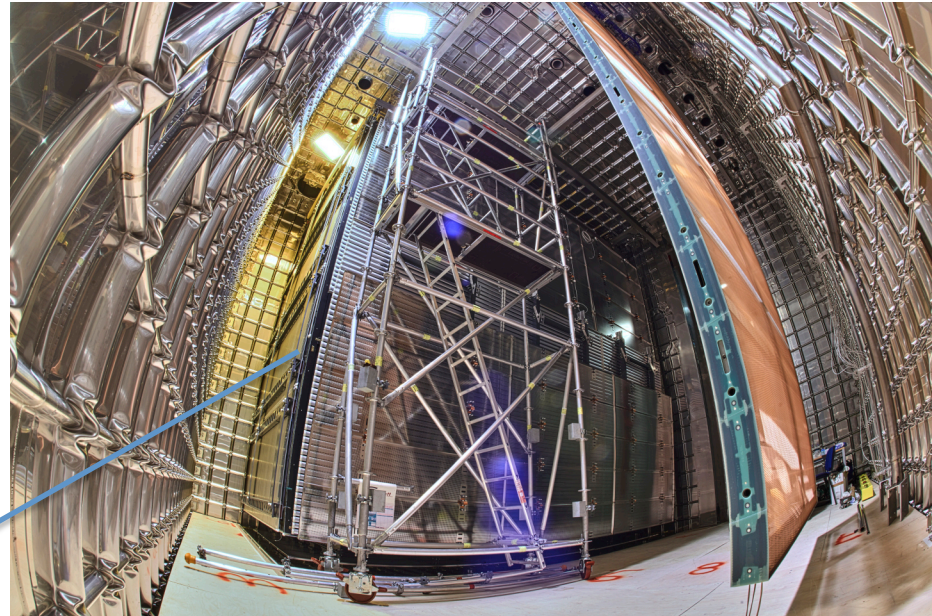
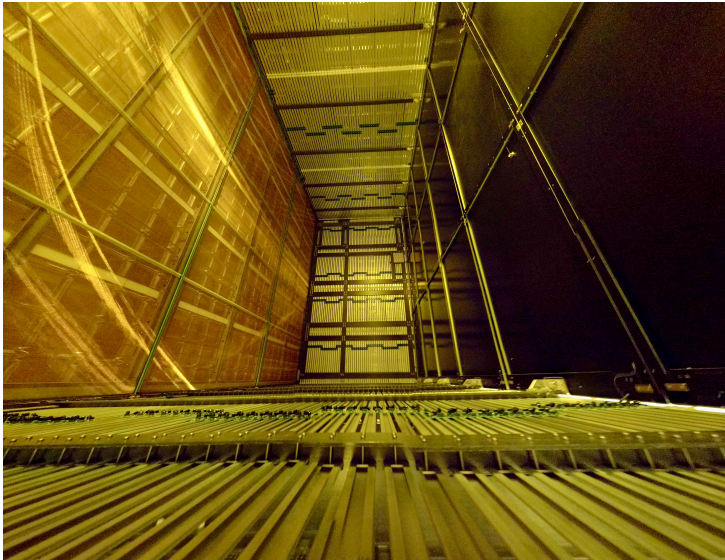
- System Overview
  - 3 “flavors”
    - Dipped bars
    - WLS bars
    - Arrapuca (2)
      - 1 in APA#3
      - 1 in APA#5





# The TPC today

The beam-side (Saleve side) drift volume completely assembled & connected, ready for operation



Second drift volume :

- All elements installed and cabled
- Field cages deployed after TCO close

# Cryogenic Instrumentation



Purity Monitors

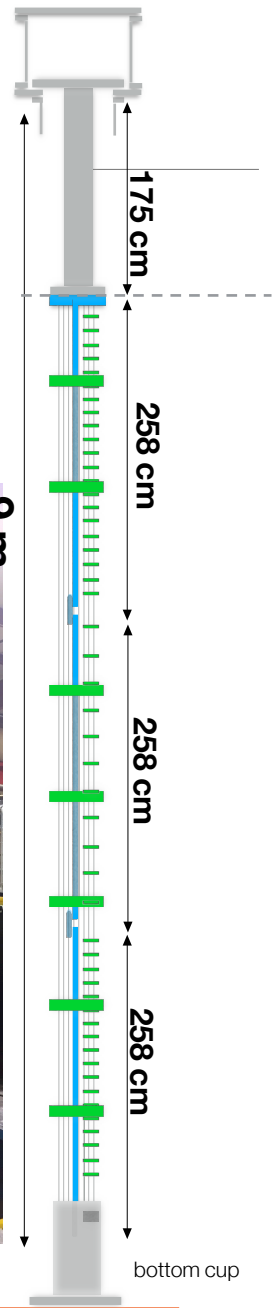
+ level monitors, gas analyzers, c



Temperature probes

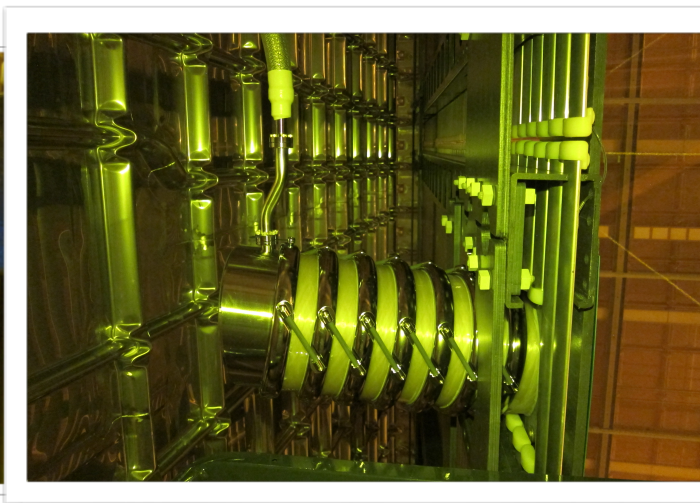
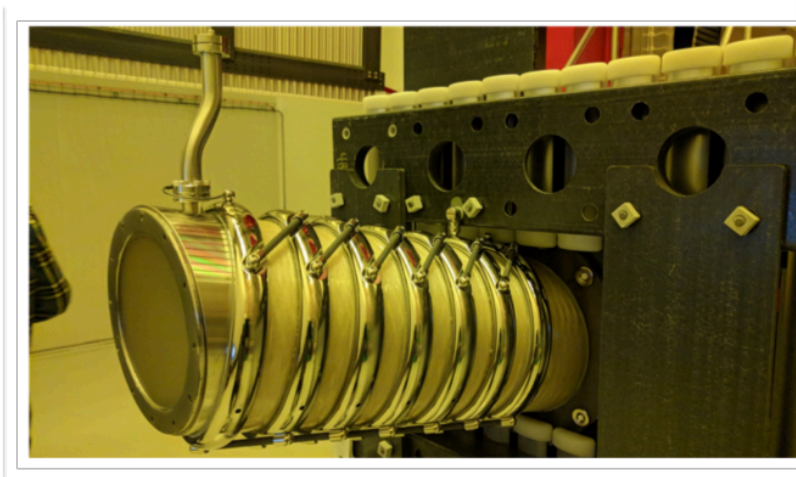
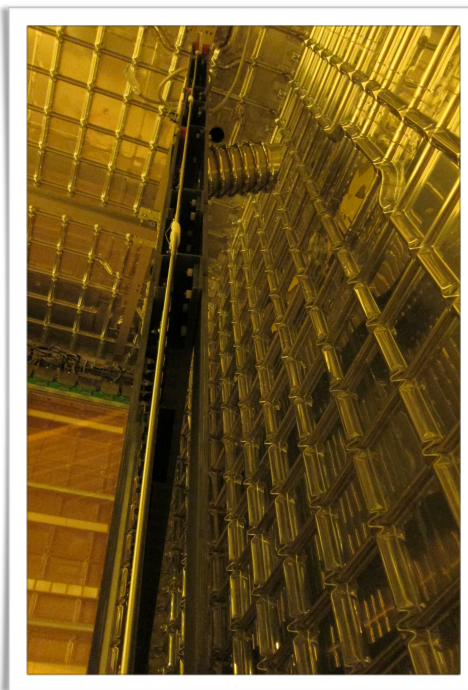
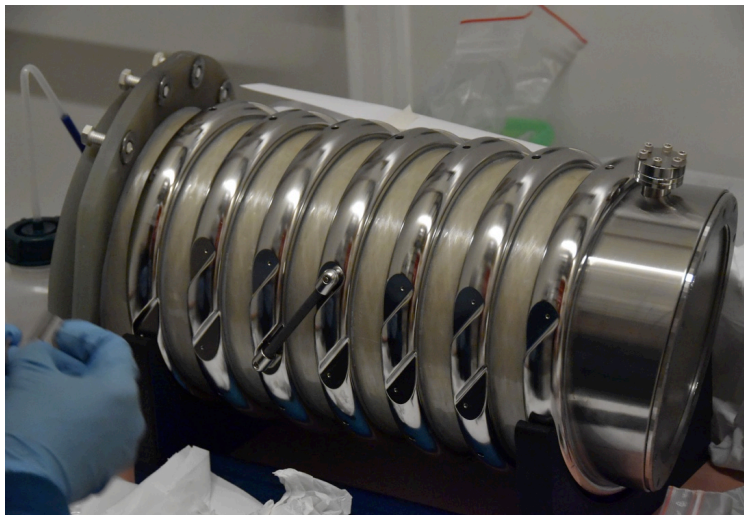


9 m





# Beam Plug

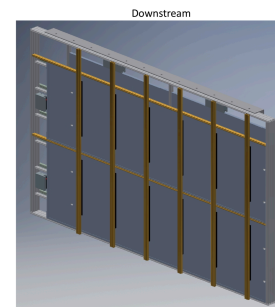
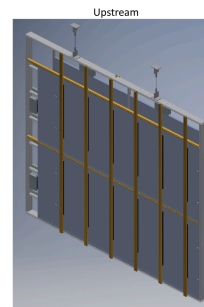
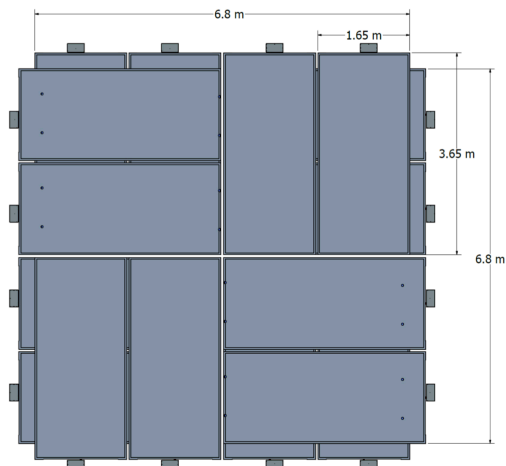
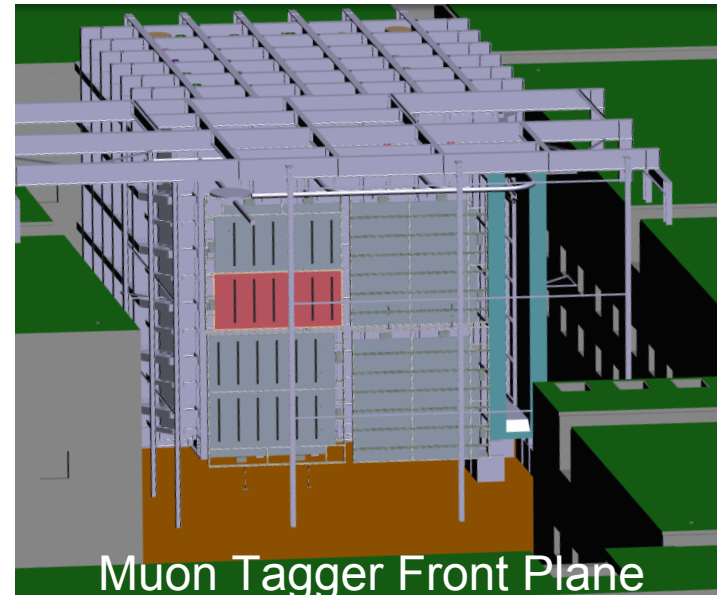
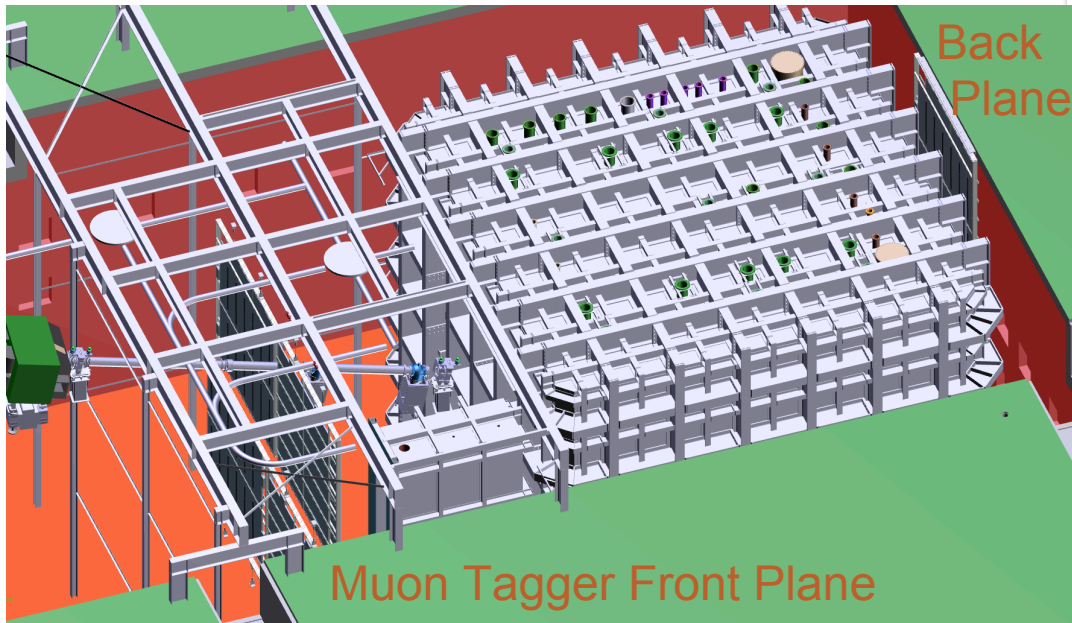


# Closing the Temporary Construction Opening



# Muon Tagger

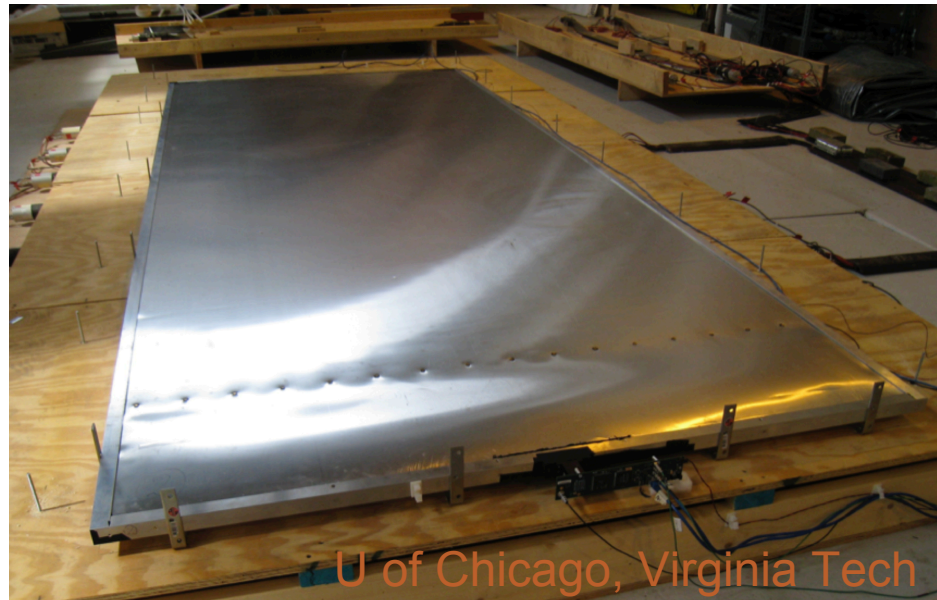
Univ of Chicago, Virginia Tech,  
Univ Minnesota, Univ Rochester, FNAL



Muon Tagger  
Modules

# Installation outside the Cryostat Muon Tagger

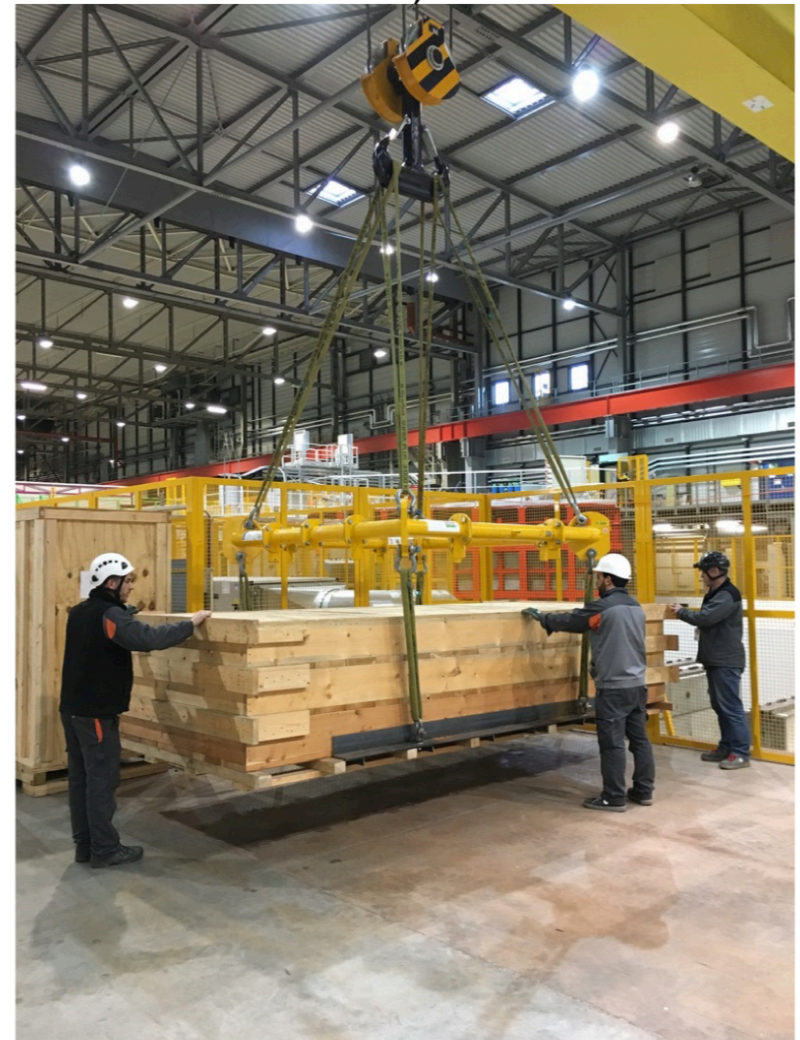
## D-Chooz Scintillator Paddles



Each Paddle  
(3.2x1.6 m<sup>2</sup>) :  
2 scintillator layers  
segmented in 5 cm  
wide strips  
(staggered)

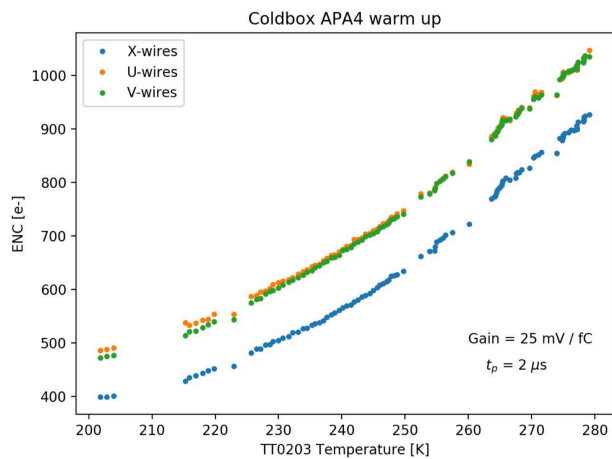
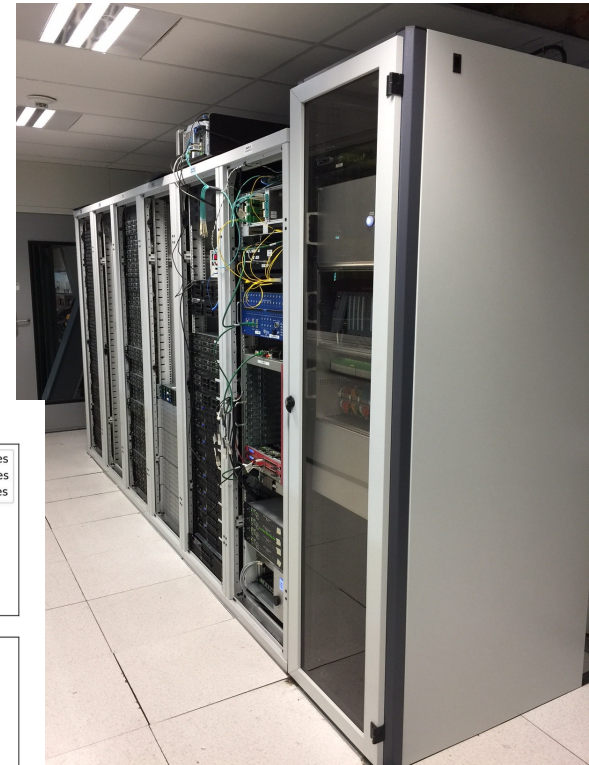
All 32 Paddles for  
protoDUNE-SP Muon  
Tagger at CERN (Jan.17)

EHN1, CERN

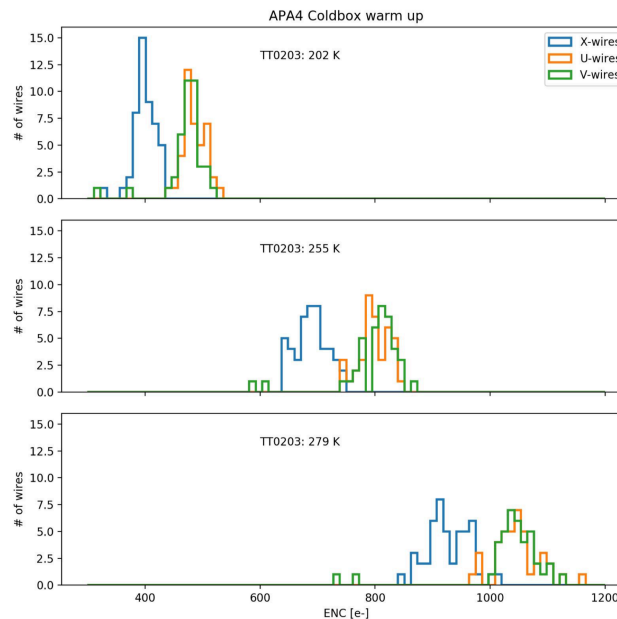


# DAQ

- Data in at 480 Gb/s: performs compression, trigger selection
- Two readouts: RCE and FELIX
- Data sent to artDAQ EB farm
- All hardware installed; 20 Gb/s link to CERN IT in use since Fall
- Cold Box read out successfully; online monitoring operational



Tracked APA wire noises from 200K - 285K (Mar 23 ~10 am - midnight).



# protoDUNE-SP Installation, Commissioning and Run

