Experimental Area Layout for DAQ and its Operation for ProtoDUNE-SP

Geoff Savage

ProtoDUNE-SP DAQ Review at CERN

3-Nov-2016

Introduction

- Identify the physical locations of DAQ elements at EHN1
  - Counting house (barracks)
    - Infrastructure – racks, power, cooling
    - Computers - servers, disks
    - Subsystem crates – ATCA (RCE), timing, trigger
  - Top of cryostat - SSP modules, Warm interface boards
  - Cold box
    - Test APA+PD+CE unit before installation in cryostat
- Network
- Timeline/Schedule

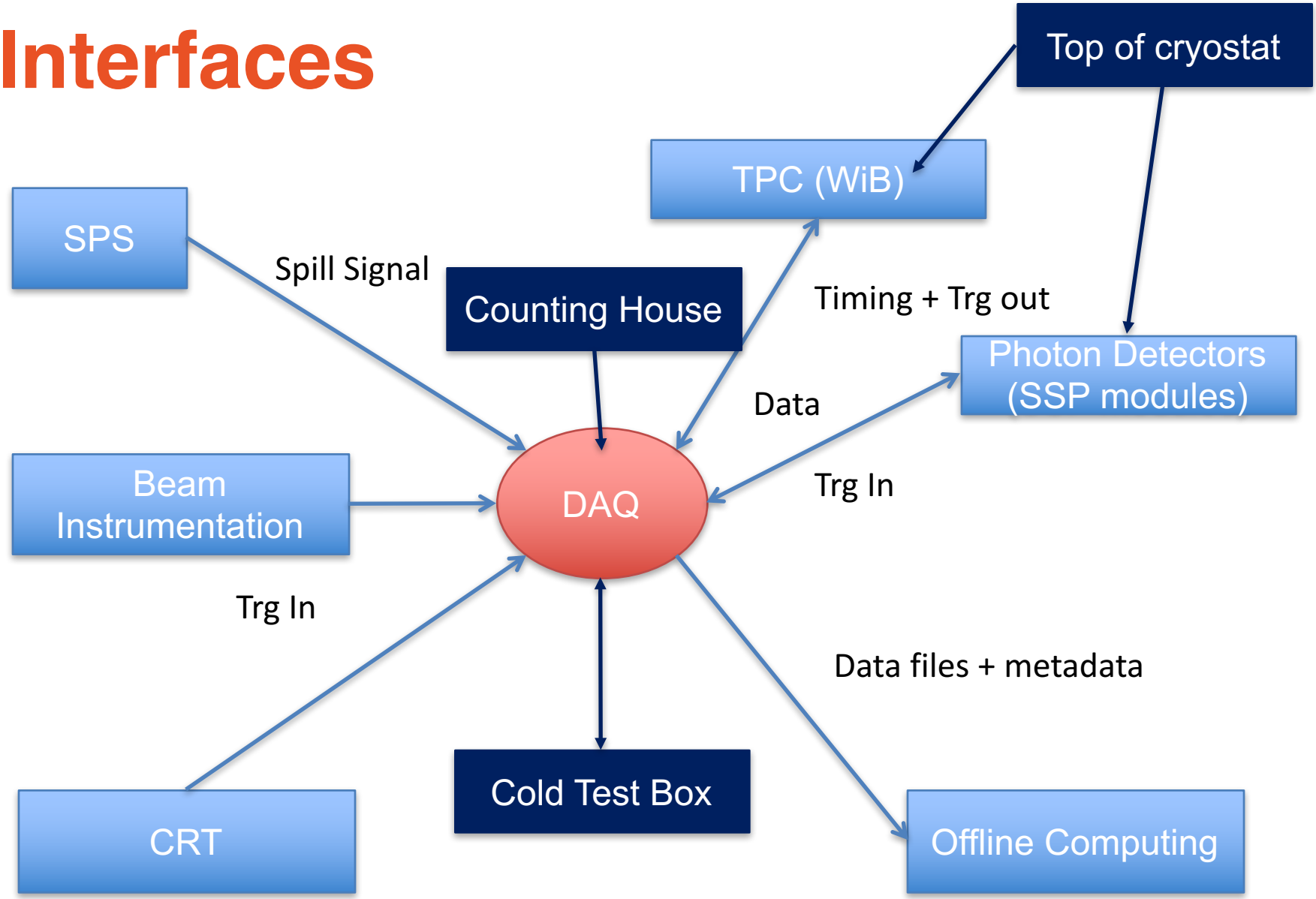
Credits/References

- **Images/Drawings are from other presentations**
- Today's DAQ Review
- Long Baseline Neutrino Committee (23-Oct-2016)
  - https://indico.fnal.gov/getFile.py/access?contribId=26&resId=0&materialId=slides&confId=13100
  - The presentation by Prof. Marzio Nessi. "The CERN Neutrino Platform and ProtoDUNEs".
- Cold Electronics Review (12-Oct-2016)
  - https://indico.fnal.gov/conferenceOtherViews.py?view=standard&confId=12749
- Photon Detector System Review (02-Aug-2016)
  - https://indico.fnal.gov/conferenceOtherViews.py?view=standard&confId=12081
- EHN1-Neutrino Platform Facility
  - http://cenf-ehn1-np.web.cern.ch

Outline

- Geography of EHN1
- Interfaces
- Description of design
- Component testing and risks
  - Many of these two items are covered in other talks
- Timeline/Schedule
- Conclusion

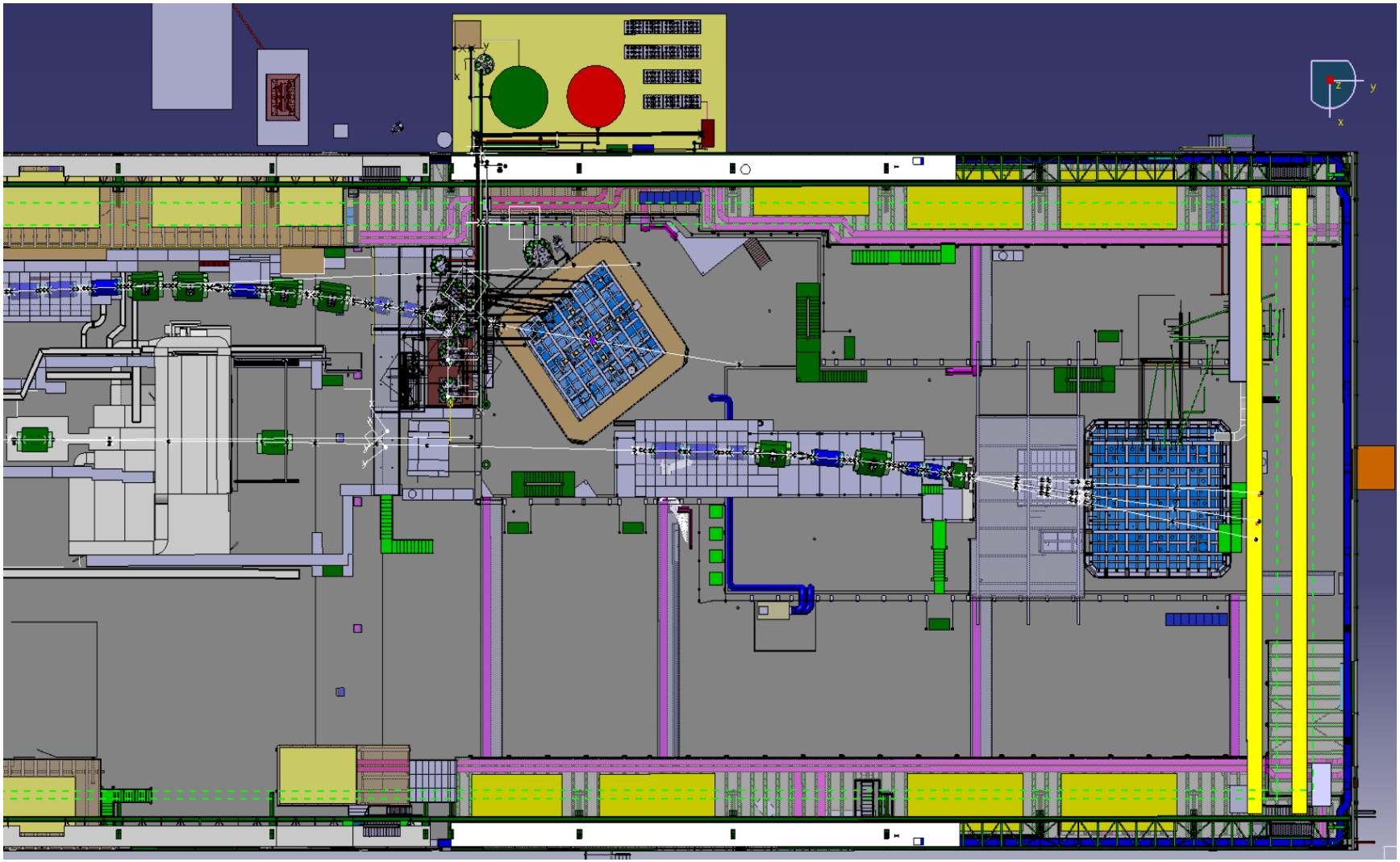
Interfaces

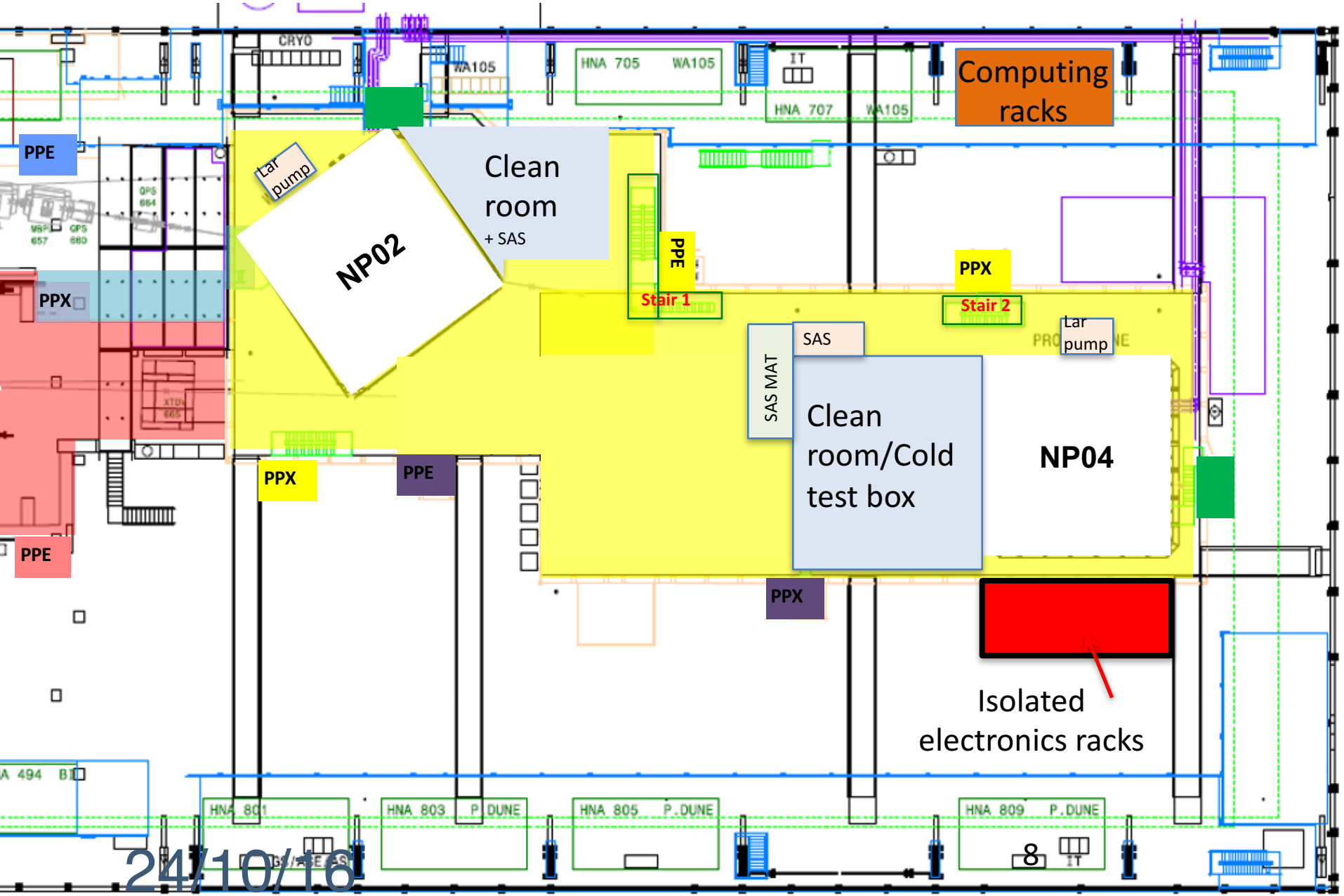

Top of cryostat
TPC (WiB)
SPS
Spill Signal
Counting House
Timing + Trg out
Photon Detectors (SSP modules)
Data
Beam Instrumentation
DAQ
Trg In
Trg In
Data files + metadata
Cold Test Box
CRT
Offline Computing

Interfaces

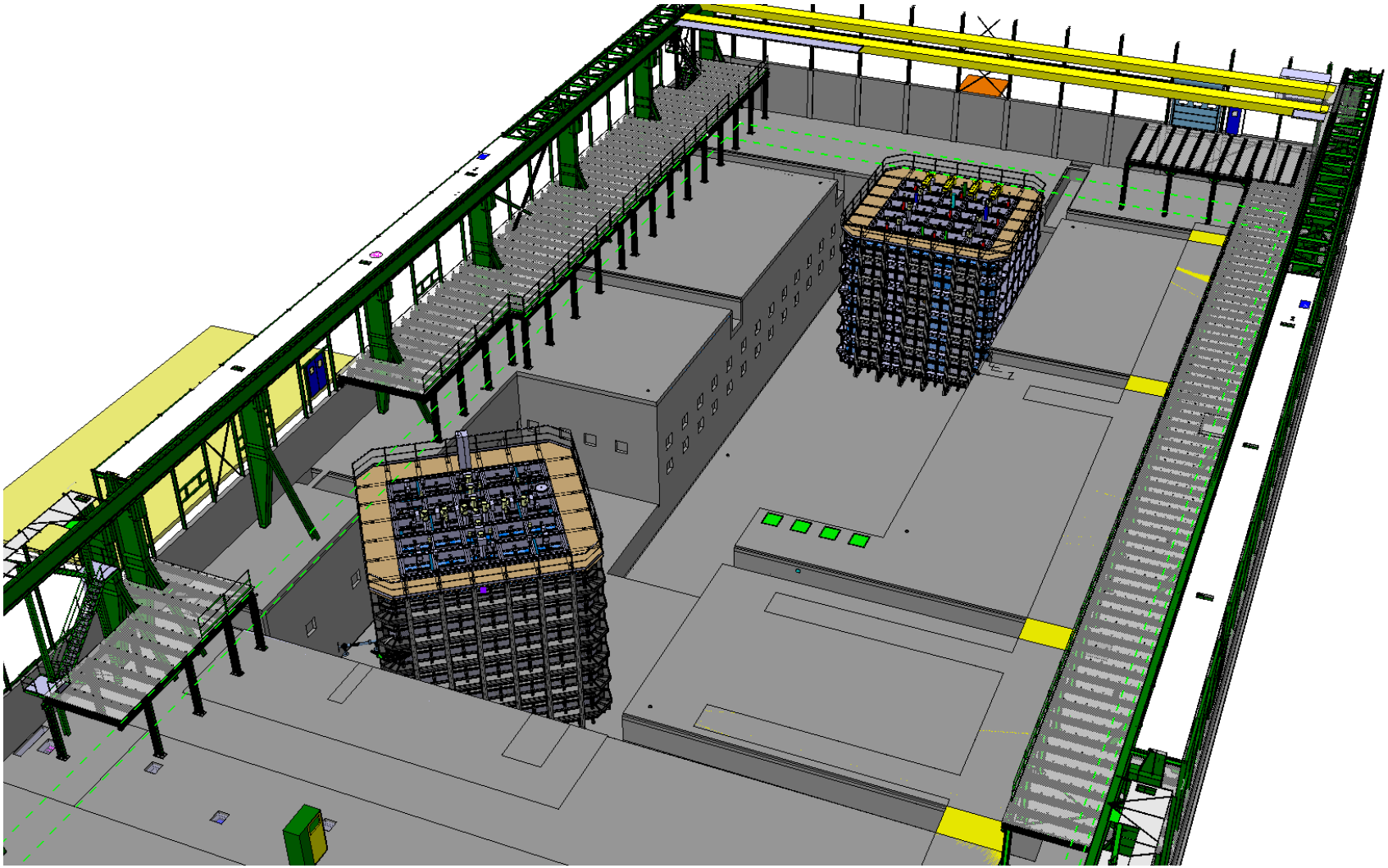
- Cold box
  - Test APA+PD+CE unit before installation in cryostat
- DAQ
  - Counting house (barracks) – racks, servers, disks, ATCA crate
  - Top of cryostat – SSP modules, warm interface boards
- Network

EHN1 Layout

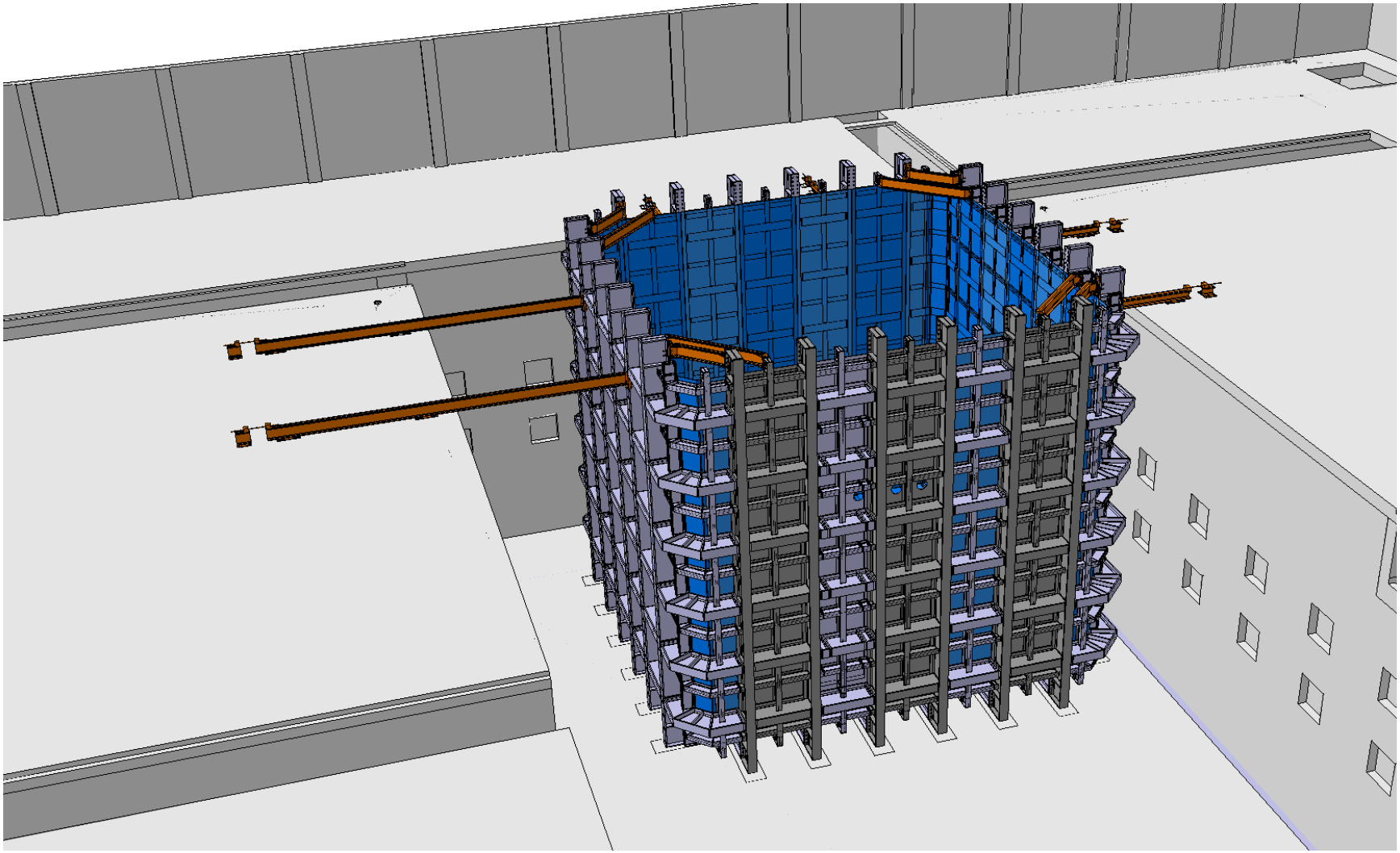



CRYO
WA105
HNA 705 WA105
IT
HNA 707 WA105
Computing racks
PPE
Lar pump
Clean room
+ SAS
NP02
PPE
Stair 1
PPX
Stair 2
Lar pump
SAS
SAS MAT
Clean room/Cold test box
NP04
PPX
PPE
PPX
PPE
PPX
Isolated electronics racks
HNA 801
HNA 803 P.DUNE
HNA 805 P.DUNE
HNA 809 P.DUNE
24/10/16

EHN1 in 3D



Cable Channels



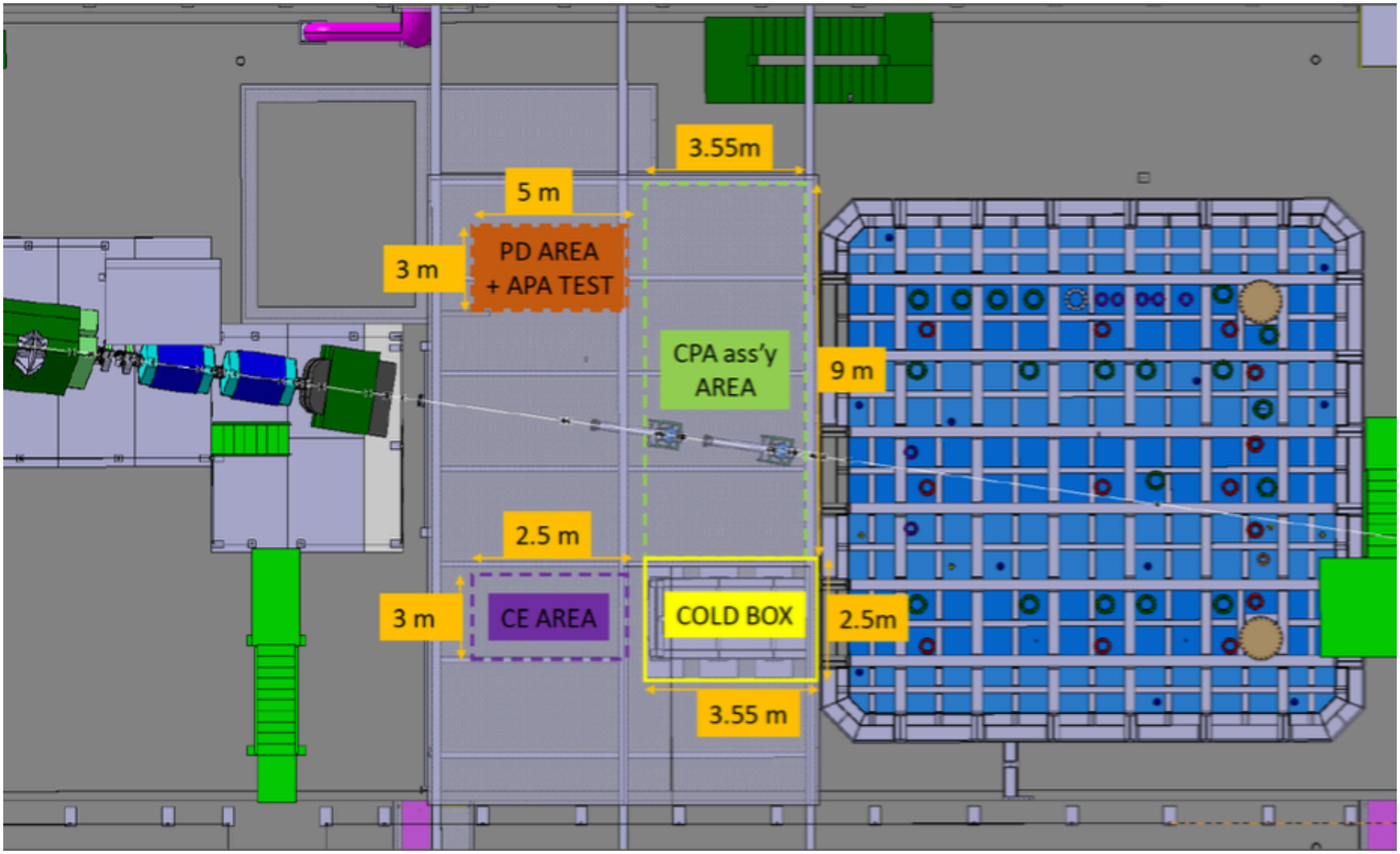
EHN1 Geography Summary

- Beam travels left to right
- Two experiments in the same hall
  - NP02 – protoDUNE dual phase (DP)
  - NP04 – protoDUNE single phase (SP)
- Counting house in upper right corner
- Electronics racks in lower left corner
  - I am not aware of DAQ connections to these electronics racks
- Cold test box sits in the clean room in front of cryostat
- Cables routed to the top of the cryostat via the cable channels

Description of Design

- Cold box (two ways to readout)
  - DAQ readout
    - Warm interface board
    - RCE readout
    - Computers running artDAQ
  - Electronics mobile test cart (BNL)
- DAQ locations are connected via network
  - Counting house
  - Top of cryostat – fiber connections

Cold Box


3.55m
5 m
3 m
PD AREA
+ APA TEST
CPA ass'y
AREA
9 m
2.5 m
3 m
CE AREA
COLD BOX
2.5m
3.55 m

Electronics Mobile Teststand

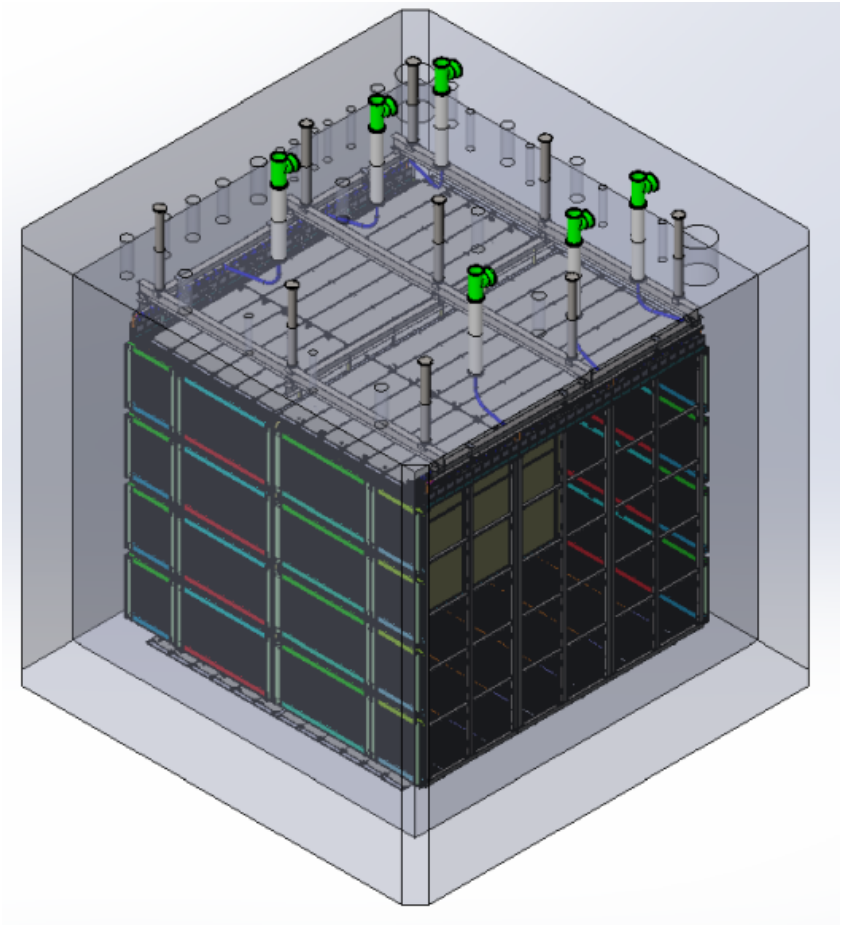
- Mobile teststand cart
  - Laptop DAQ (simple set of Python scripts and ROOT for analysis)
  - WIB + cable adapter connected to DAQ via gig-E
  - LV power supply capable of 5V/3A

- Can be positioned at the bottom of APA where FEMB are being installed at the top
  - Full checkout of FEMB including LV power and I/O from WIB and high-speed data to WIB over 7m cable bundle

Cold Box Summary

- RCE readout of APA+CE requires
  - Counting house infrastructure in place
    - RCEs are located in an ATCA crate
  - Readout fibers from cold box to counting house
- Vertical slice test
  - Matthew Worcester (BNL), Theresa Shaw (FNAL)
  - “Cold Box at CERN will allow vertical slice test of wire and photon detectors on production APA wire frames”
  - “Cold Box will incorporate a full scale warm feedthrough and use cables and readout identical to the production system”
  - “Power and Grounding will follow the same plan as for the detector electronics; the cold box will be isolated from building ground and will be powered with detector referenced power supplies”

Top of Cryostat

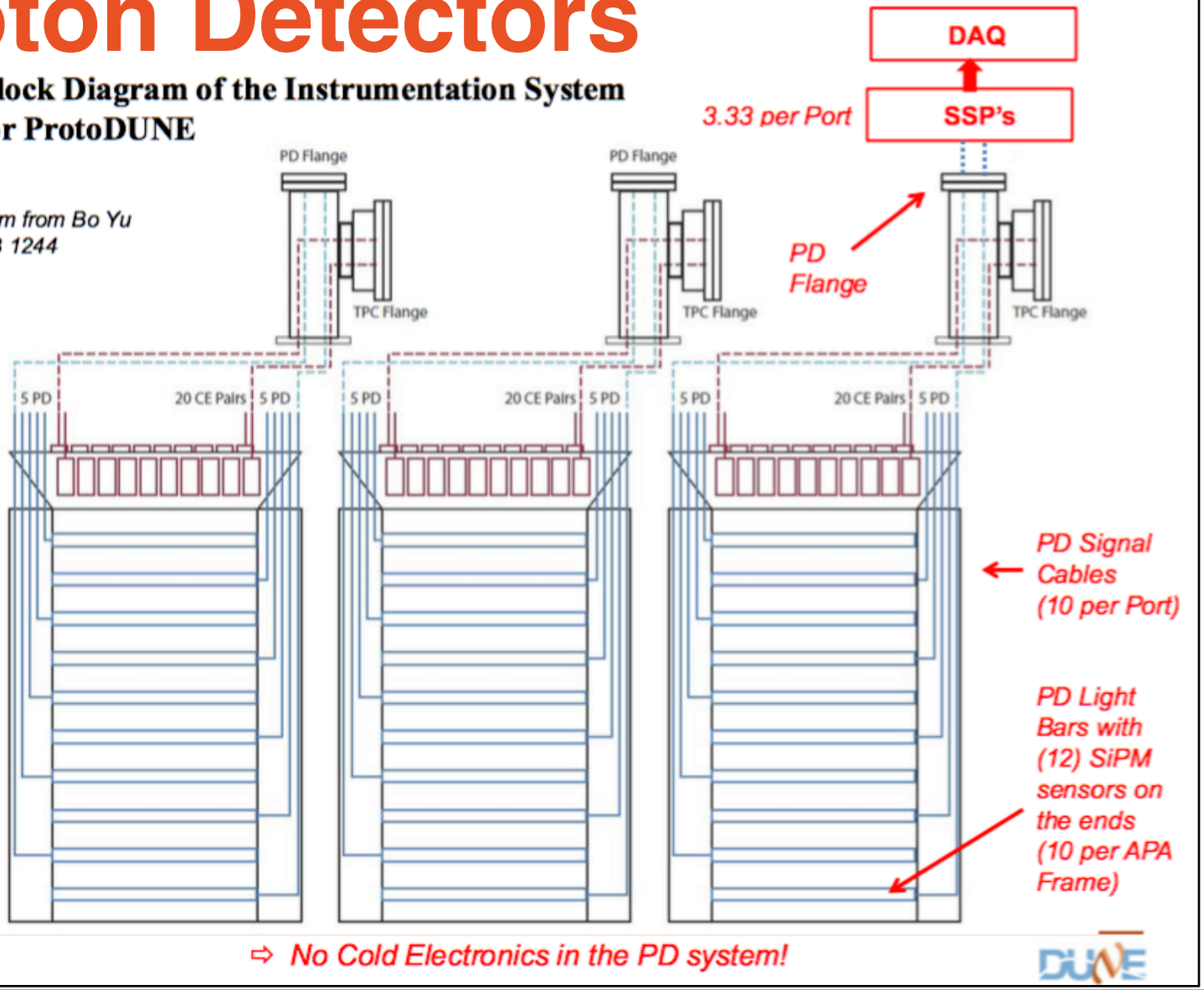


- 24 SSP modules
  - Keep cables from proton detector flange to SSP module as sort as possible
  - 4 modules near each of the six feed throughs
  - Communication via ethernet
    - Readout and configuration
    - Copper cables
    - Switch with fiber uplink
- 6 Warm interface board crates
  - Fiber uplink per crate back to counting house

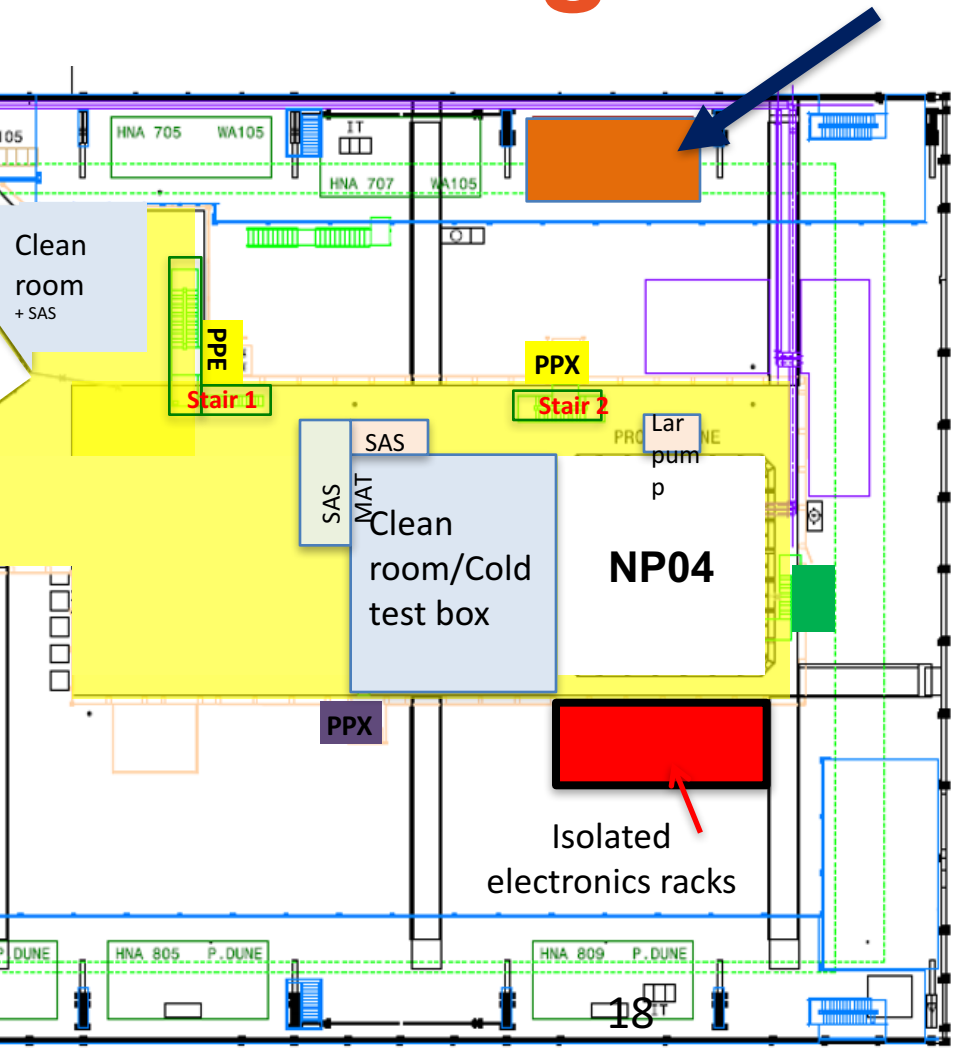
Photon Detectors

- **Block Diagram of the Instrumentation System for ProtoDUNE**

Diagram from Bo Yu DocDB 1244



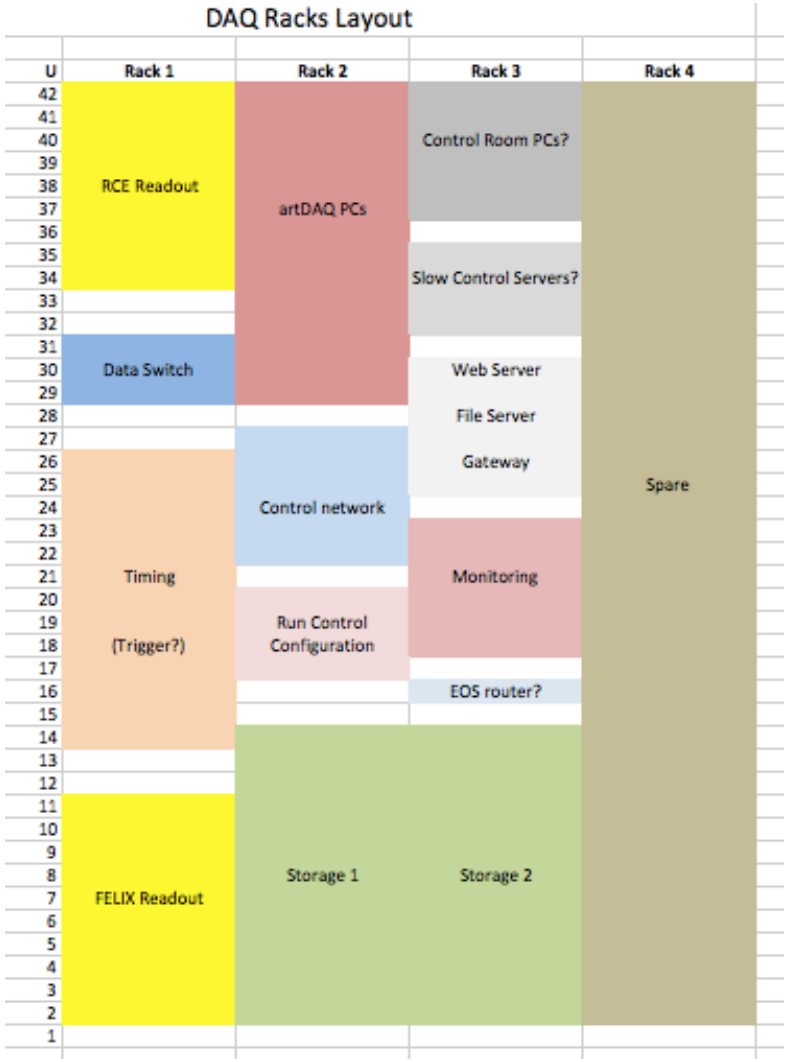
Counting House



- We will have cooling power (water) for 18 racks, each consuming up to 18KW
  - 6 cooled racks to the DAQ (3 SP and 3 DP) in one counting room
  - 12 cooled racks for computing farms (~3000 cores) in a second counting room
- M. Nessi

DAQ Racks in Counting House

- Network switches
  - Fiber and copper ports
  - Data network
  - Control network
- Crates/modules
  - ATCA (RCE)
  - Timing and Trigger
  - FELIX
- Computer servers (~15 units)
  - More info on next slide
  - Readout
  - Monitoring
  - Operations
- Disk storage



Computers in Counting House

- Readout computers
  - Data comes in from readout units (RCEs, SSP modules)
  - Data goes out across the network to event builder computers
- Event builder computers
  - Data comes in from readout computers to event builder application
  - Event fragments from all readout units are collated into an event
  - Events are written to disk storage
- Monitoring
  - Detector (histograms)
  - Data flow and software health (artDAQ)
  - Computer hardware and operating system (ganglia)
- Operations
  - Web server
  - Databases
  - Gateways
  - File server
  - Interactive login

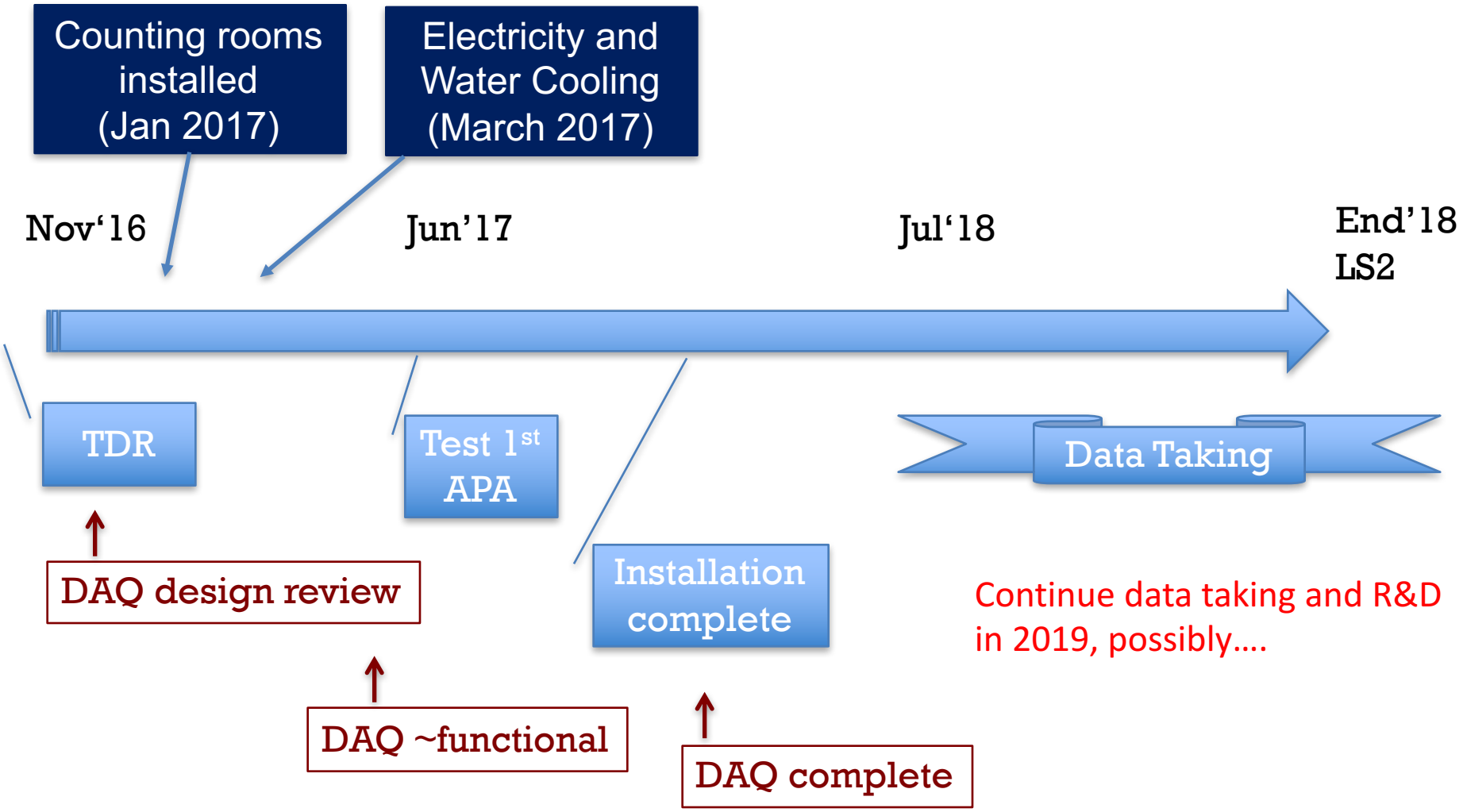
Component testing

- DAQ related test stands
  - See Karol Hennessy's talk tomorrow (04-Nov-2016)
- Racks, power, cooling
  - Neutrino platform support personnel
- See Kurt Biery's talks on artDAQ
  - Network bandwidth needed
  - Disk write/read speeds with artDAQ
  - Transfers from disk to offline

Risks

- Network undersized
  - Full network not needed until all the detector units are installed in the cryostat
  - Apply more financial resources to upgrade network
- Disks not fast enough to support needed read/write rates
- Also see Kurt Biery's talk later today

ProtoDUNE Timeline



Conclusion

- DAQ infrastructure at EHN1 provided by Neutrino Platform
- Charge elements addressed
  - (3) Does the design lead to a reasonable production schedule, including QA, installation and commissioning? Does the DAQ schedule allow sufficient time for testing of other components?
    - DAQ will be in place for APA testing in the cold box
    - Test stands support initial component testing
      - Changes to DAQ components, software and hardware, at test stands will be integrated into EHN1 installation
  - (9) Are the DAQ system analyses sufficiently comprehensive for safe handling, installation and operation at the CERN Neutrino Platform? Is the installation plan sufficiently well developed?
    - Equipment locations are identified
    - Equipment infrastructure being developed and installed by the Neutrino Platorm