

# ProtoDUNE Overview and Update on Organization

Eric James

LBNC Meeting

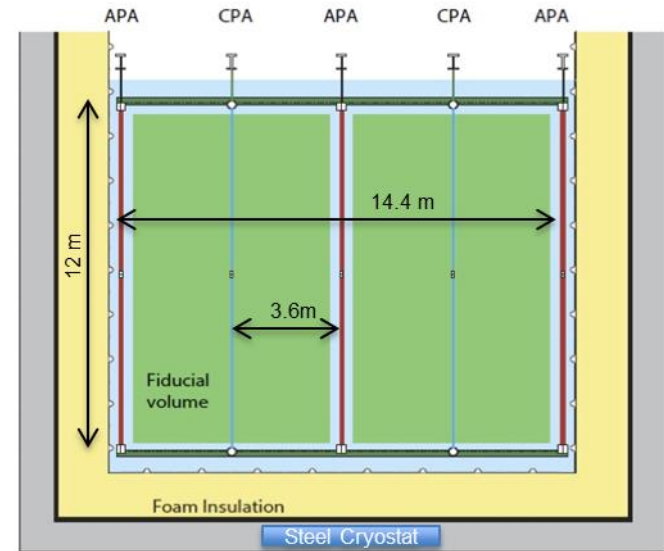
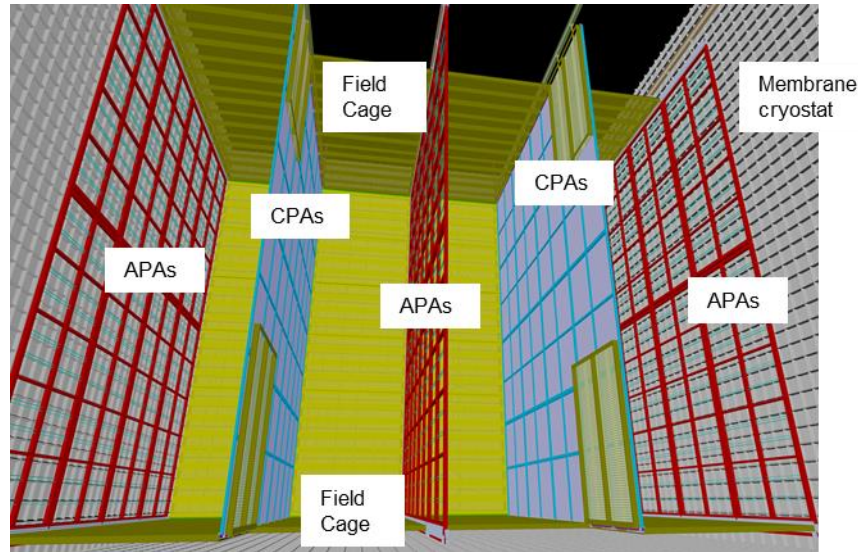
23 March – 25 March 2017

# DUNE Project Scope

- Design, construct, and install four 10-kton fiducial mass Liquid Argon detectors for operation within the deep underground area of the Sanford Underground Research Facility (SURF) in South Dakota.
- Design, construct, and install a near neutrino detector underground at Fermilab to provide the necessary inputs for constraining systematic uncertainties on the precision measurements to be extracted from the deep underground detectors.

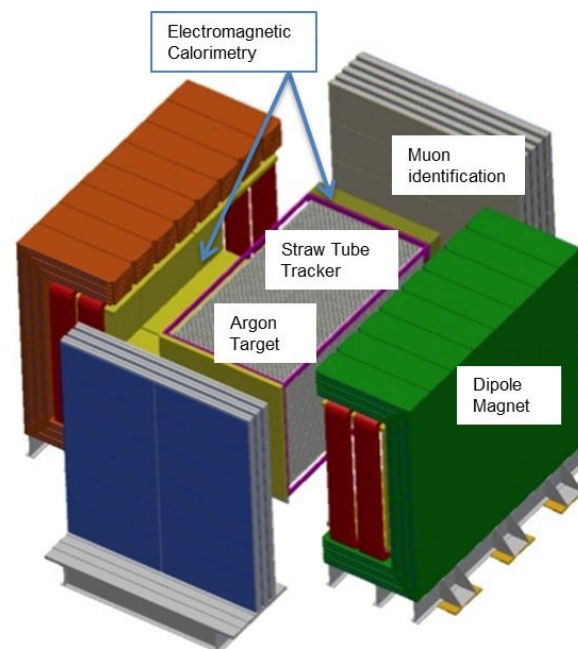
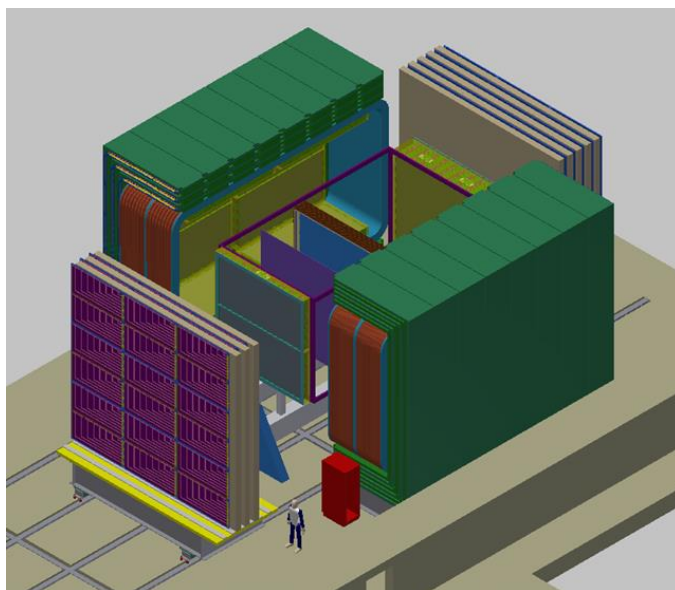
Note: conventional facilities, beamline, and cryogenics infrastructure are within scope of the LBNF project

# Far Detector Conceptual Design



- Detector Parameters (One 10-kton Module)
  - 58 m x 12 m x 14.4 m (~50 times larger than ICARUS)
  - Alternating Anode and Cathode Plane Assemblies resulting in four 3.6 m drift volumes
  - Modular design to facilitate underground transport and installation

# Near Detector Conceptual Design



- Detector Parameters

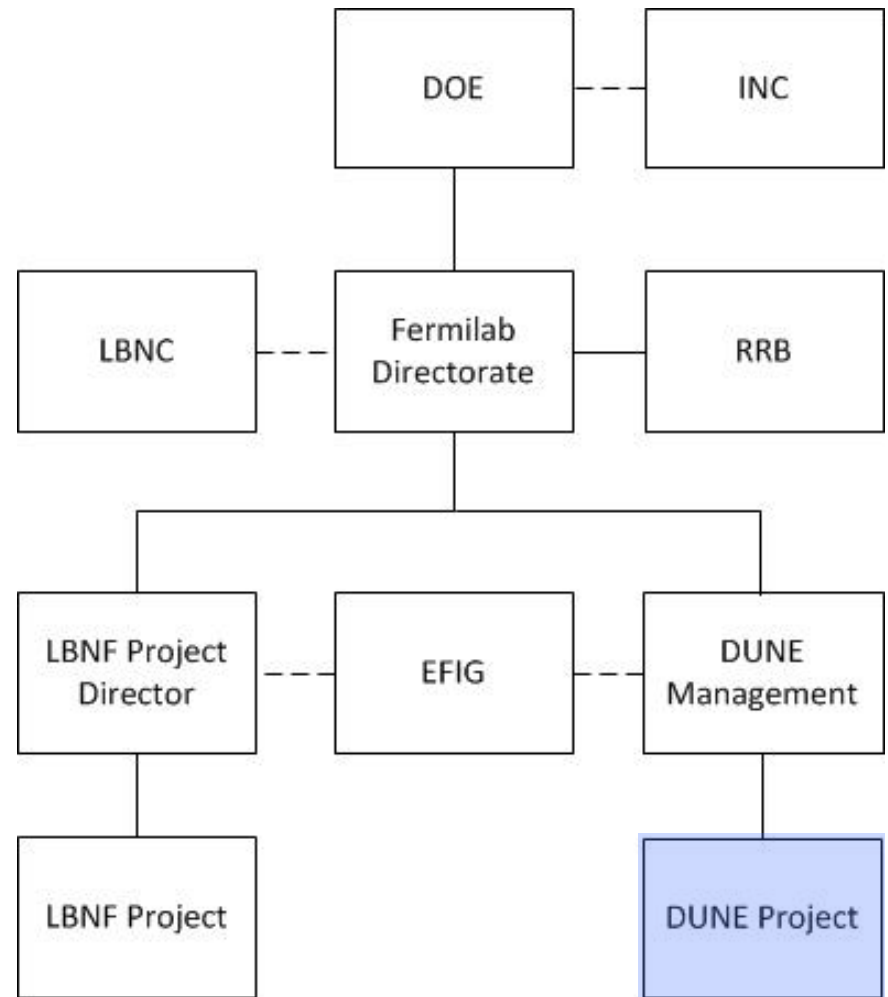
- 3.5 m x 3.5 m x 7 m Straw Tube Tracker
- $4\pi$  electromagnetic calorimetry and muon ID in dipole B field (0.4T)
- Pressurized Argon Target

# DUNE Project

- DUNE is an international project managed by the DUNE collaboration incorporating some DOE contributions
  - Roughly 25% DOE / 75% non-DOE



Steve Kettell:  
DUNE Project  
Coordinator



# Detector Requirements

- Requirements on the detectors are derived from the high-level scientific requirements
- A well-developed set of detector requirements was in place at the time of CD-1R.
- Since then, we have reviewed and updated far detector module engineering requirements (focusing on the global requirements with direct tracebacks to the scientific requirements)
- Updated requirements documentation can be accessed directly from the review website ([link](#)).

# DUNE Collaboration Priorities

- Construction and operation of the ProtoDUNE detectors at CERN
- Preparation of the DUNE Technical Design Reports (TDRs)
  - Needed for at least the first two far detector modules by early 2019
  - Must be accompanied by credible funding model for detector construction
- These are the key activities that get DUNE to the planned installation of the first 10-kton far detector at SURF in the early 2020's and ensure its leadership position within the international landscape for the CP-violation measurements

# DUNE Far Detector Prototyping

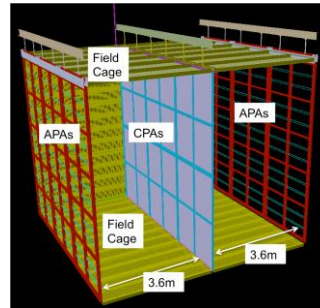
## Single-Phase

35-TON



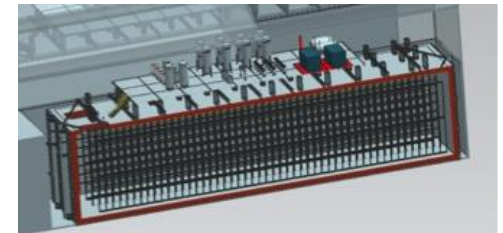
2016

ProtoDUNE-SP



2018

DUNE Reference Design



2024

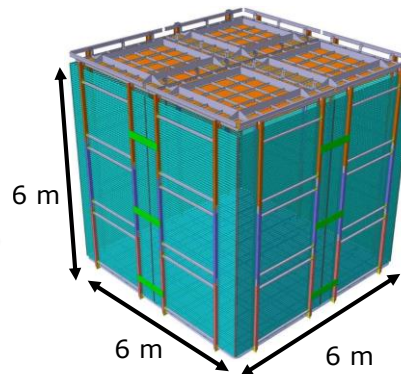
## Dual-Phase

WA105 (1x1x3 m<sup>3</sup>)



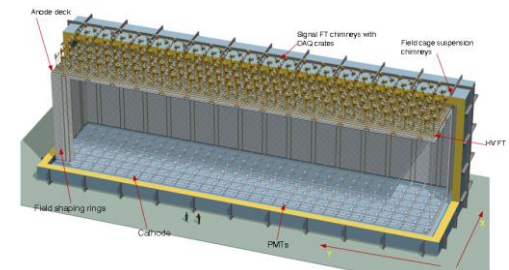
2017

ProtoDUNE-DP



2018

DUNE Alternative Design



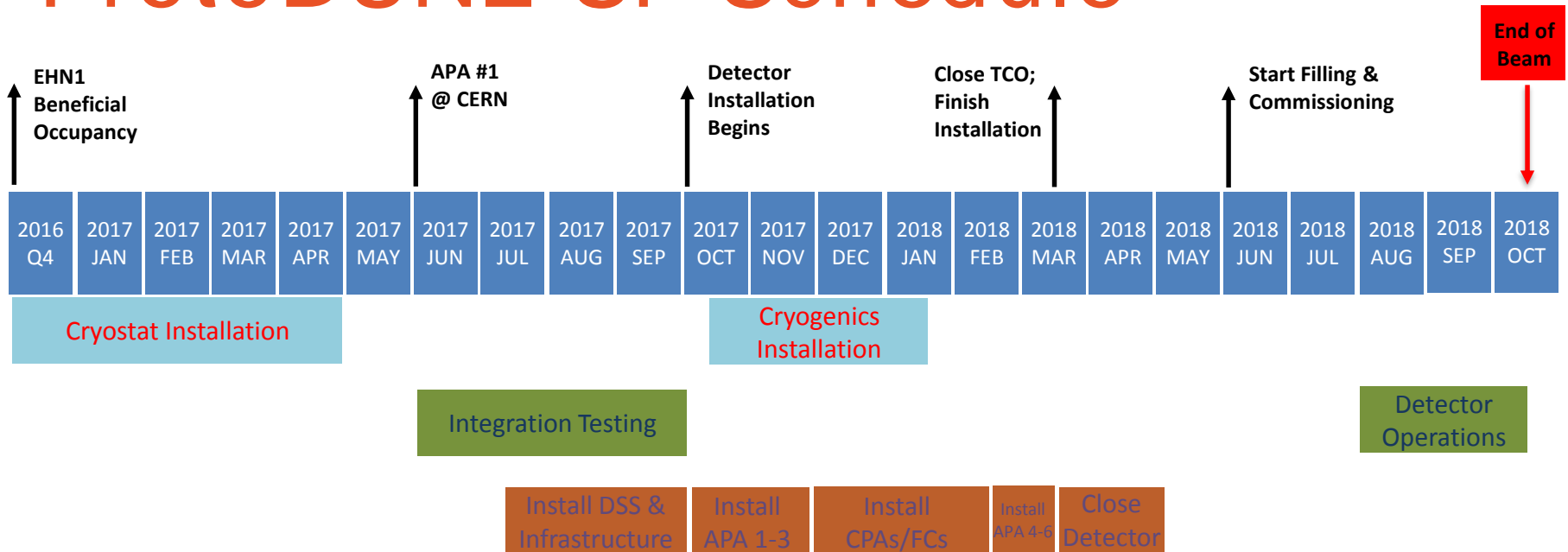


# ProtoDUNE Goals

- Mitigation of risks associated with current detector designs
- Prototyping of construction facilities needed for production of detector components
  - ProtoDUNE detectors are assembled from same full-scale components used to construct the far detector modules
- Early detection of potential issues with construction methods and detector performance
- Obtaining required calibration of detector response to particle interactions in test beam

New document summarizing objectives of the ProtoDUNE program in the context of baselining the Far Detectors (DUNE DocDB #2765)

# ProtoDUNE-SP Schedule



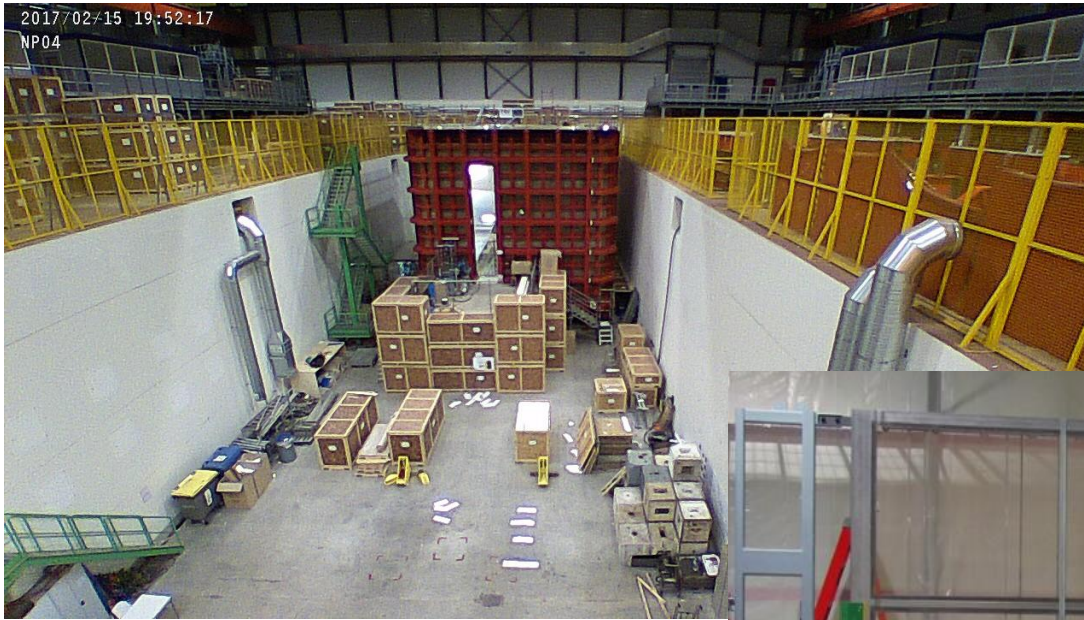
ProtoDUNE-DP schedule looks similar

# Design Reviews

- Over the past year the project has conducted a series of reviews incorporating external reviewers focused on the designs of the different ProtoDUNE subsystems

| Subsystem                                                    | Design Review             |
|--------------------------------------------------------------|---------------------------|
| Anode Plane Assemblies (SP)                                  | July 13-14 2016 (PSL)     |
| Cathode Plane Assemblies, Field Cage Assemblies, and HV (SP) | November 9-10 2016 (CERN) |
| DAQ (SP)                                                     | November 3-4 2016 (CERN)  |
| Photon Detector (SP)                                         | August 2-3 2016 (Chicago) |
| Cold Electronics (SP)                                        | October 12-14 2016 (BNL)  |
| Detector Support Structure (SP)                              | November 7-8 2016 (CERN)  |
| Dual-Phase Design                                            | April 24-25 2017 (CERN)   |
| Cryo/Beam Instrumentation (SP)                               | April 26-27 2017 (CERN)   |

# Current Activities I



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NP04

← Assembly of ProtoDUNE-SP Cryostat at CERN



Construction of first ProtoDUNE-SP Anode Plane Assembly at PSL →

# Current Activities II



ProtoDUNE-SP Integration Tests

# Current Activities III

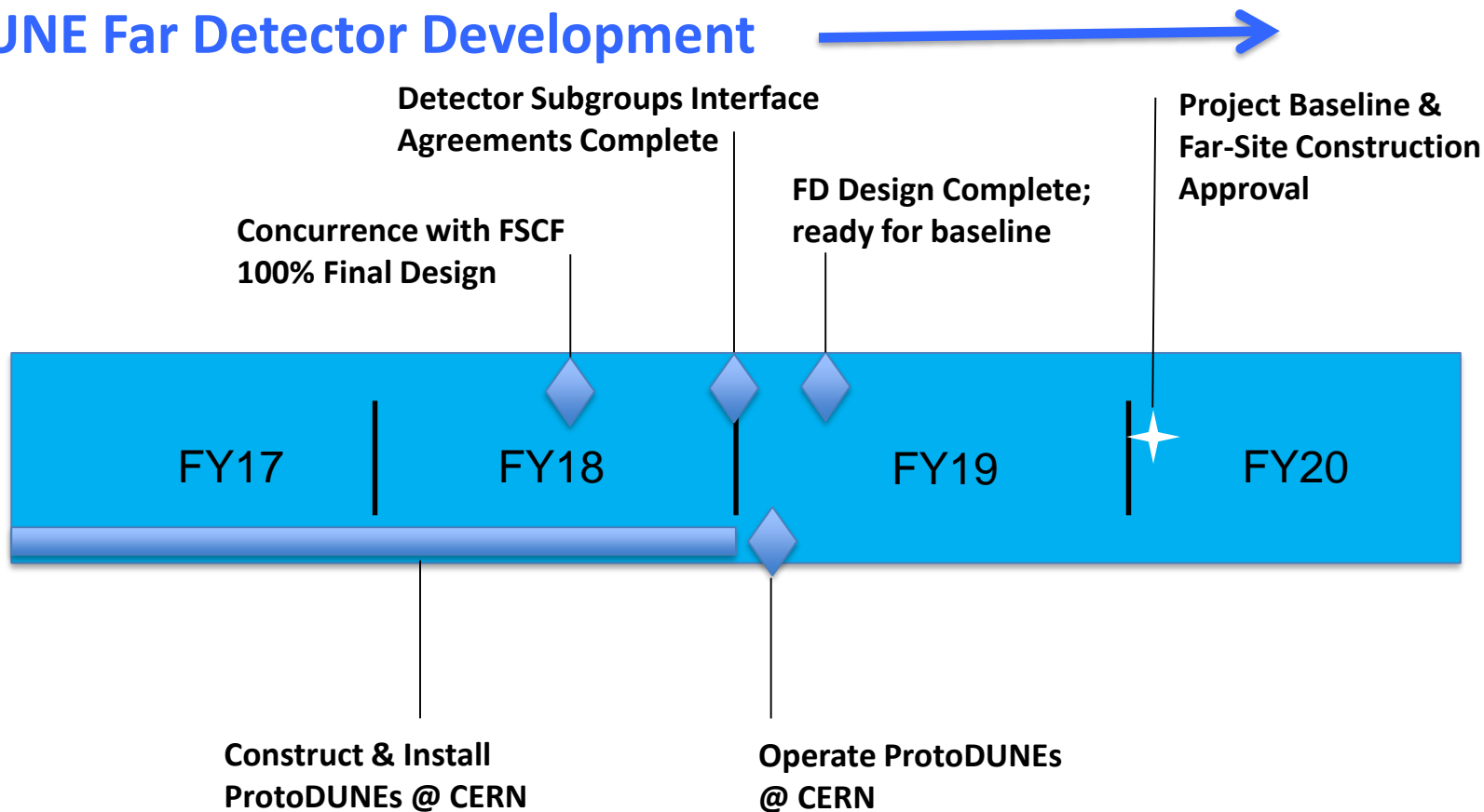
Operation of DP 1x1x3 m<sup>3</sup> Prototype



Iceball, which formed on outside of steel support structure during gas cooling, has delayed beginning of operations (more details in subsequent presentations)

# Path to Technical Design Reports

## DUNE Far Detector Development



## ProtoDUNEs

# ProtoDUNE 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
  - The first of these reviews took place in late February targeting construction of the ProtoDUNE-SP Cathode Plane Assemblies
  - QA Manager will conduct on order of 20 such reviews between now and the beginning of June

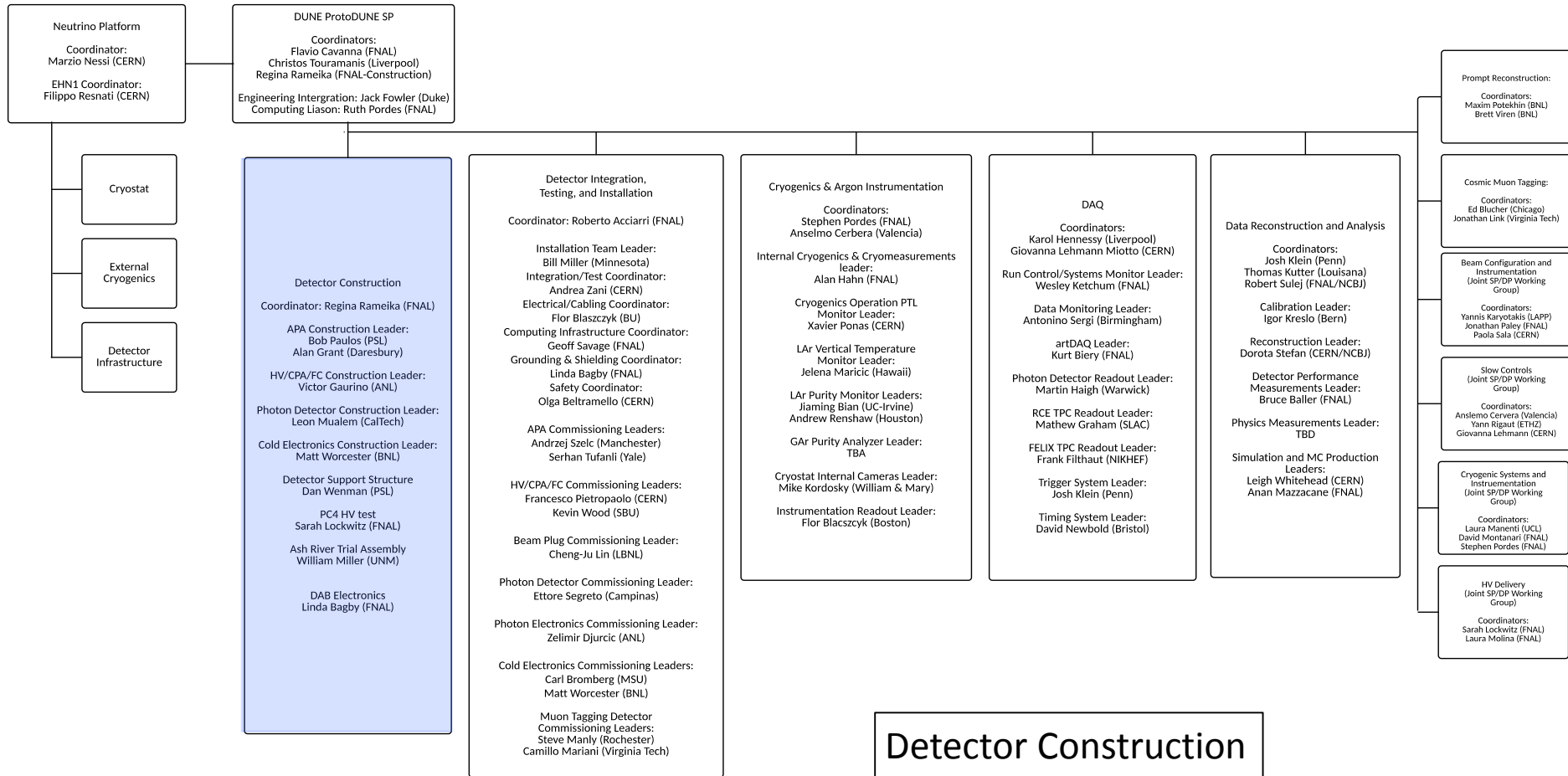


# ProtoDUNE Installation

- Completed detector components will be shipped to CERN starting in May 2017
- Large, on-site teams required to install, commission, and operate the ProtoDUNE detectors
  - The organization of the ProtoDUNE-SP team has been a major focus of both the collaboration and project over the past year
  - Project has worked with Fermilab and the DOE to identify operations resources needed to support this large team on the ground at CERN
- 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

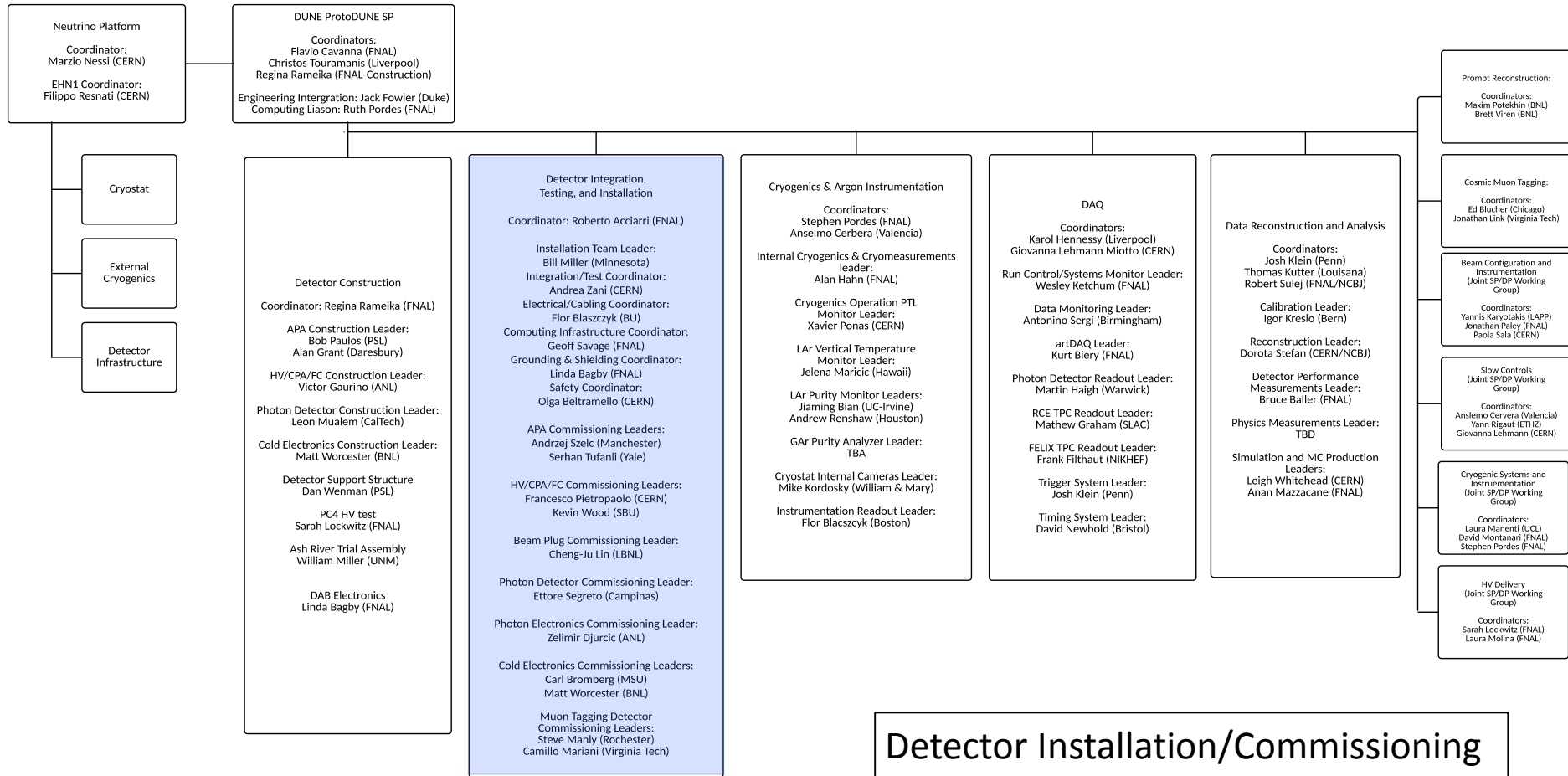
# ProtoDUNE-SP Organization

ProtoDUNE  
09.FEB.17



# ProtoDUNE-SP Organization

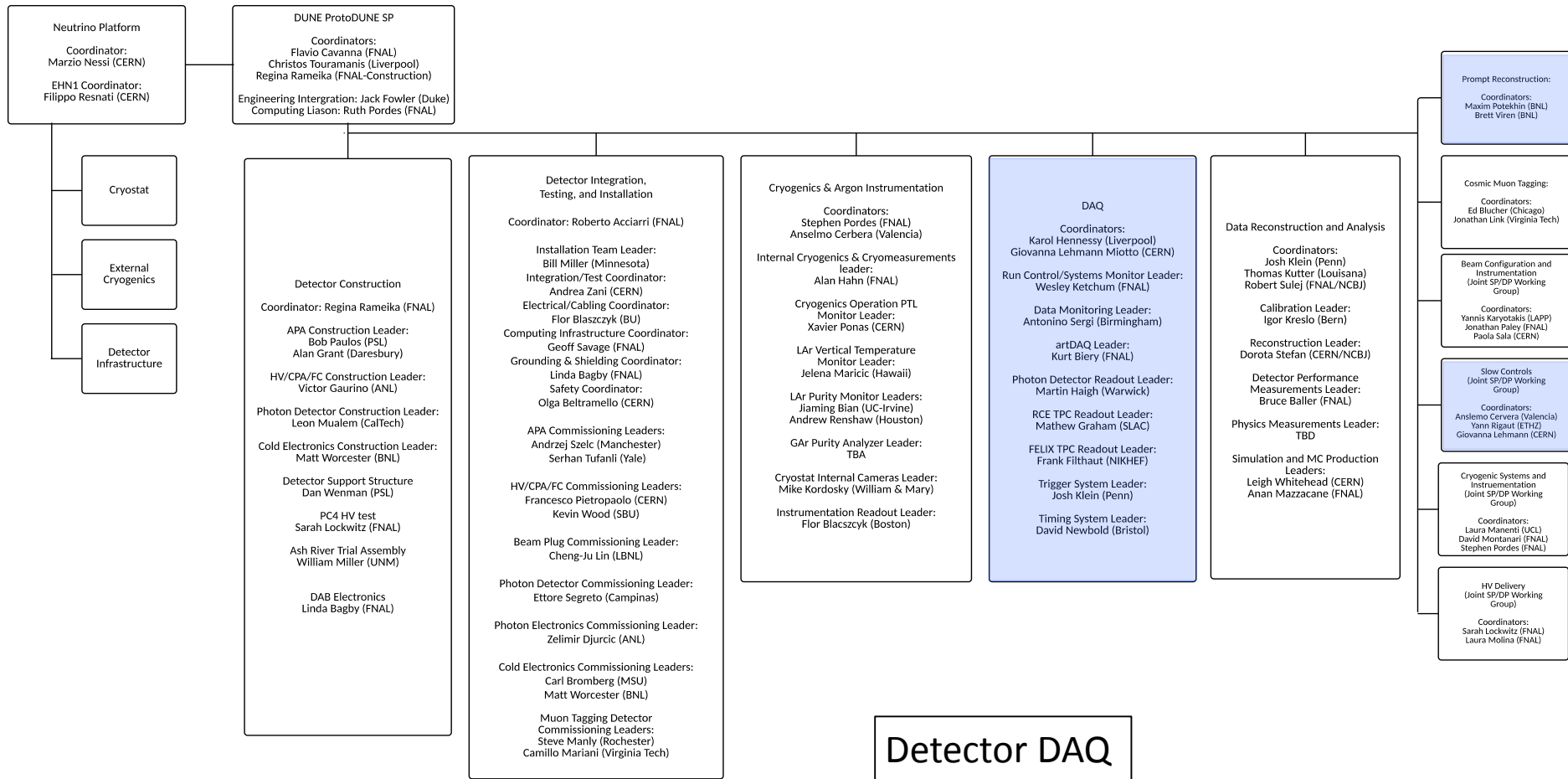
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Detector Installation/Commissioning

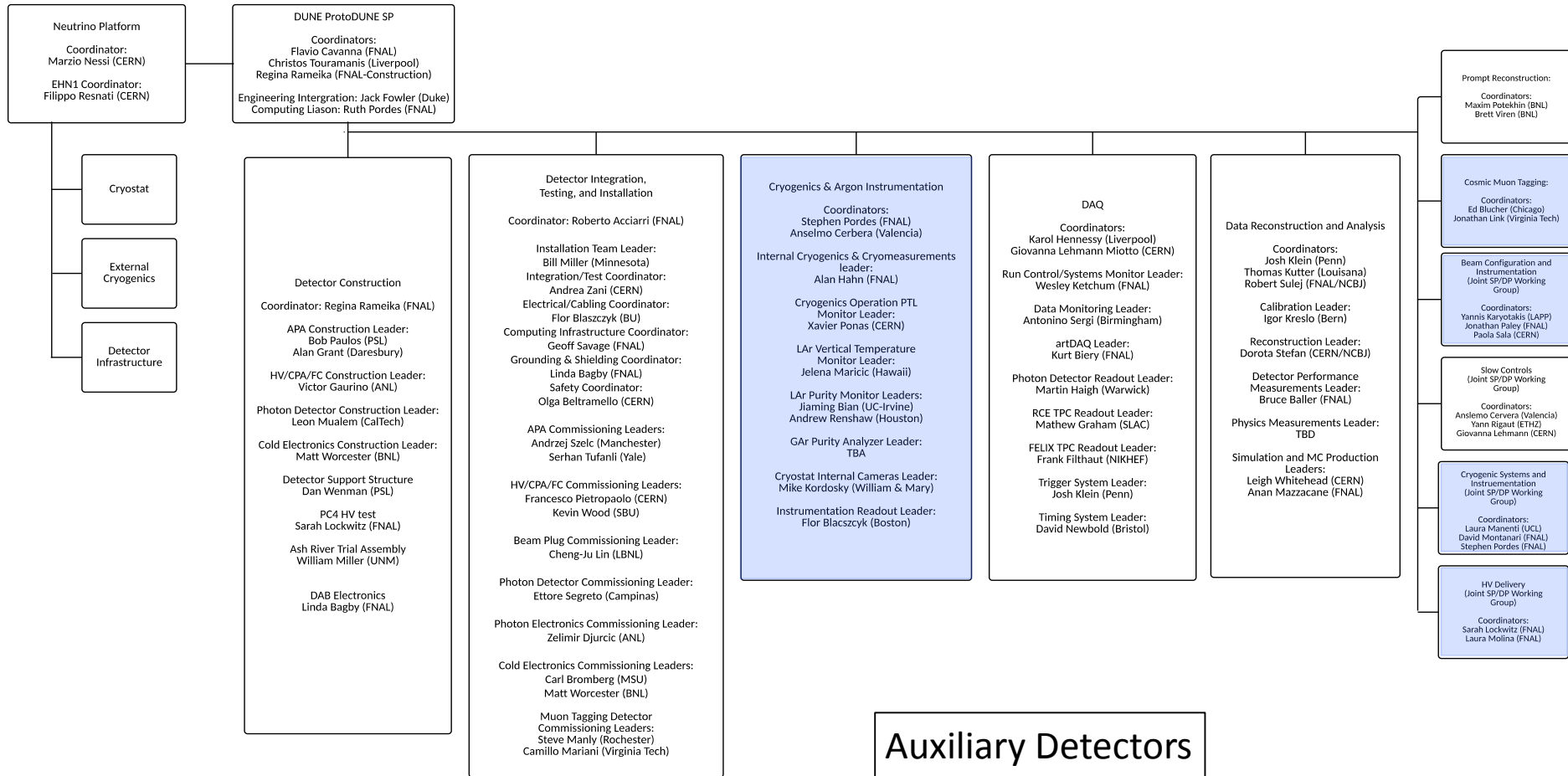
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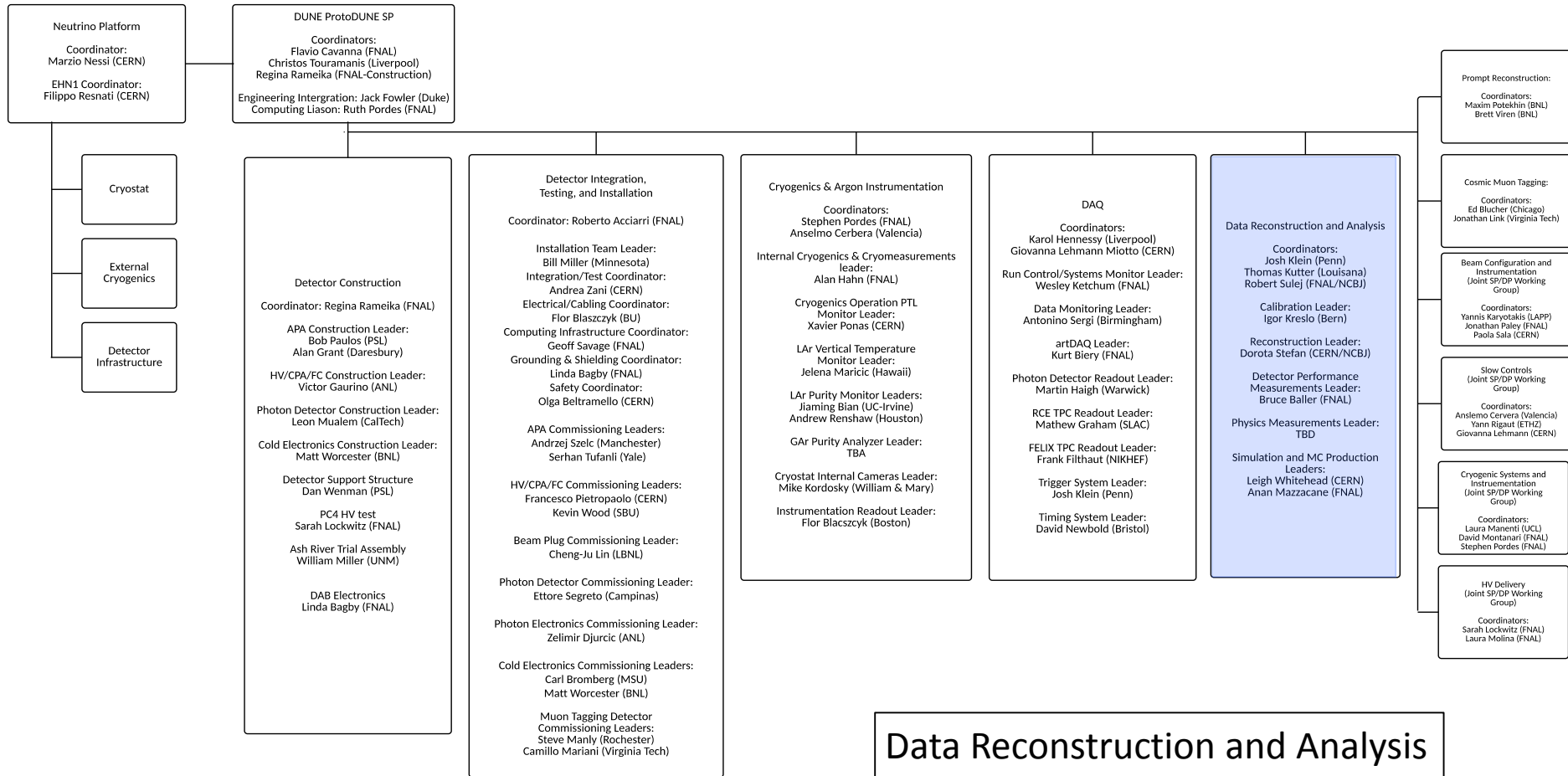
# ProtoDUNE-SP Organization

ProtoDUNE  
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# ProtoDUNE-SP Organization

ProtoDUNE  
09.FEB.17



Data Reconstruction and Analysis

# Far Detector Development

- Concurrent with the construction and installation of the ProtoDUNE detectors, the project needs to remain focused on a number of key activities related to design of the far detector modules
- In particular,
  - The layout of penetrations on top of first far detector cryostat needs to be finalized by this summer to keep design work on schedule
  - Interfaces between the detector and conventional facilities need to be iterated on in conjunction with final design work for far site facilities
  - Further development of detector installation and integration plan needs to occur on the time scale of the TDRs

# Milestones

- DUNE Project Office will maintain a milestone-driven schedule covering all detector activities
- An initial version of this schedule focusing on the ProtoDUNE activities (both SP and DP) has been developed over the past year
- ProtoDUNE milestones are updated regularly based on the status of this schedule

ProtoDUNE milestone-driven schedule can be found in DUNE DocDB #2202



# Risks

- DUNE Project Office will maintain a risk registry for the overall detector construction effort and be responsible for ensuring risk management across the project
- Risk registries are in place for both ProtoDUNE-SP and ProtoDUNE-DP
- Review of ProtoDUNE-SP risks at February 3<sup>rd</sup> workshop (similar workshop for ProtoDUNE-DP planned for April)

ProtoDUNE-SP and ProtoDUNE-DP risk registries can be found in DUNE DocDB #2320

# Review Recommendations

- DUNE Project Office also takes responsibility for acting on and responding to LBNC recommendations that pertain to the detector design and construction efforts
- Similarly, takes responsibility for acting on internal design review recommendations

Summary of tracked LBNC recommendations can be found in DUNE DocDB #2750

# ES&H and QA

- ES&H and QA Managers are shared resources of LBNF, DUNE-US, and DUNE Project Offices
- Both are participating in ProtoDUNE design and Production Readiness Reviews
  - Production readiness reviews chaired by QA manager
- ES&H manager working closely with CERN ES&H team to ensure that delivered ProtoDUNE detector components can be installed and operated at CERN
  - Working to establish equivalencies between US & European standards (e.g. for evaluating cables as to whether they meet fire safety requirements)

# Summary

- DUNE is focused on its highest priority near-term objectives
  - Operating the ProtoDUNE detectors at CERN in 2018
  - Preparing Technical Design Reports for the first two far detector modules in advance of far detector baselining in 2019
- Collaboration resources are being focused on these two parallel efforts