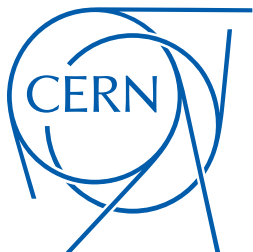


Status of single phase and dual phase DUNE prototype detectors at CERN

Leigh Whitehead

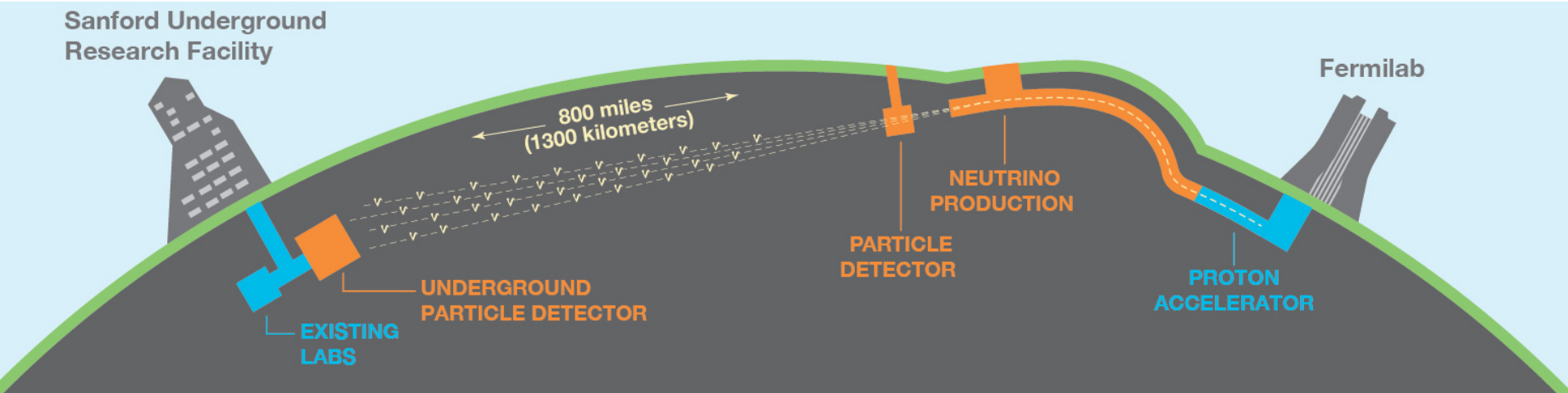
For the DUNE Collaboration



July 6th 2018
ICHEP 2018 - Seoul



The DUNE Experiment

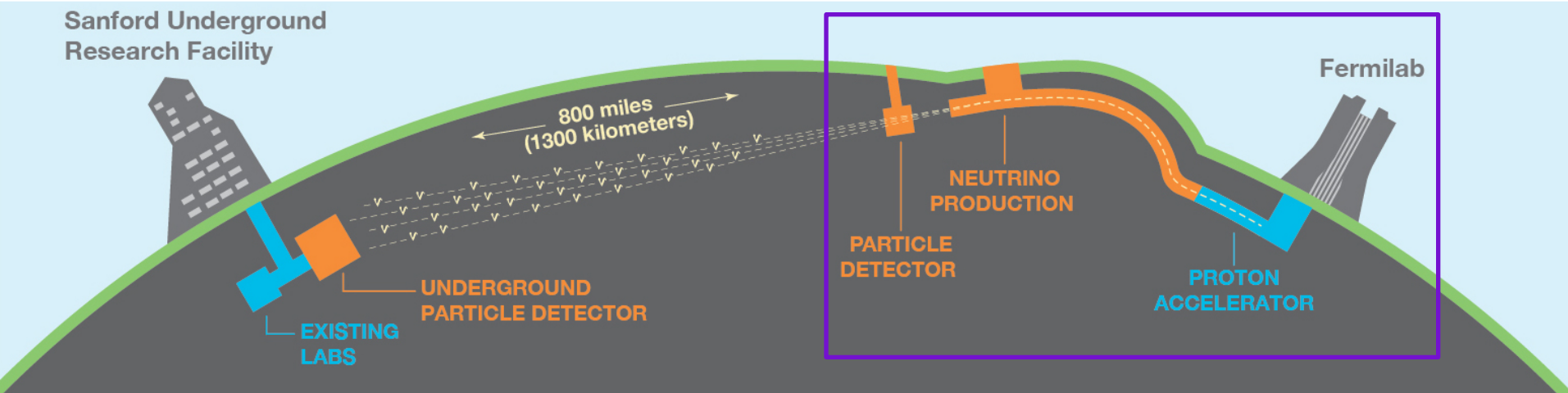


DUNE is a next-generation neutrino oscillation experiment

Observe ν_e appearance and ν_μ disappearance at long baseline using a wideband beam to measure θ_{13} , CPV, and neutrino mixing parameters in a single experiment.

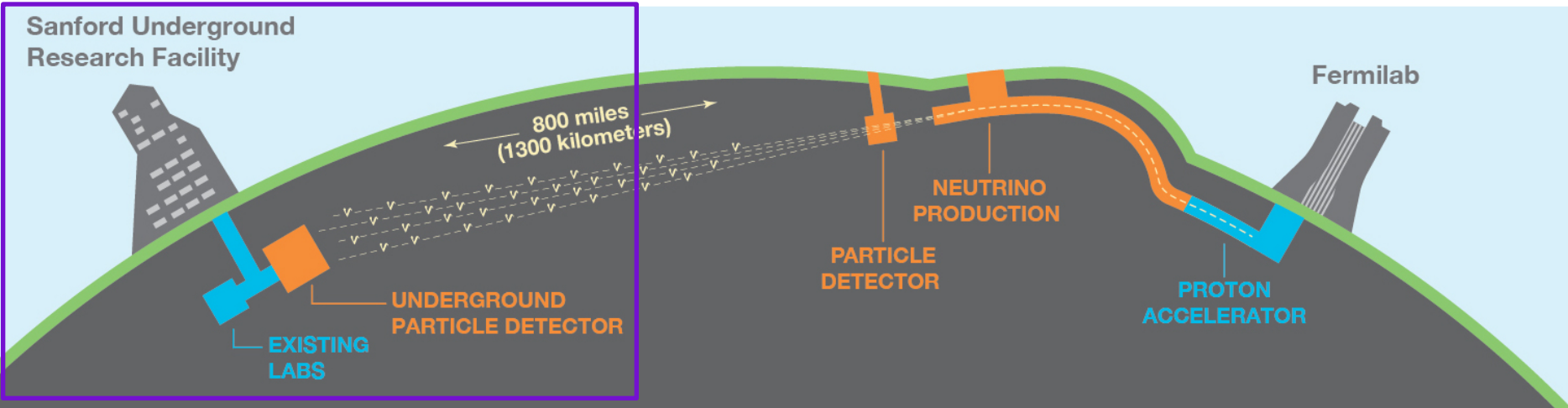
See talk on Monday by J. Yu for more details

The DUNE Experiment



- Fermilab located near Chicago
- 60 – 120 GeV proton beam
- 1.2 MW neutrino beam, upgradable to 2.4 MW
 - Focused by three magnetic horns
 - See LBNF talk from yesterday by H. Schellman
- Near Detector to measure the initial beam composition

The DUNE Experiment



- SURF located 1300km from Fermilab in South Dakota
- 4 x 10kt liquid argon TPCs (LArTPC)
- Detectors located 1.5km underground
- First 10kt module will be single phase
- Dual phase TPC option for the following modules

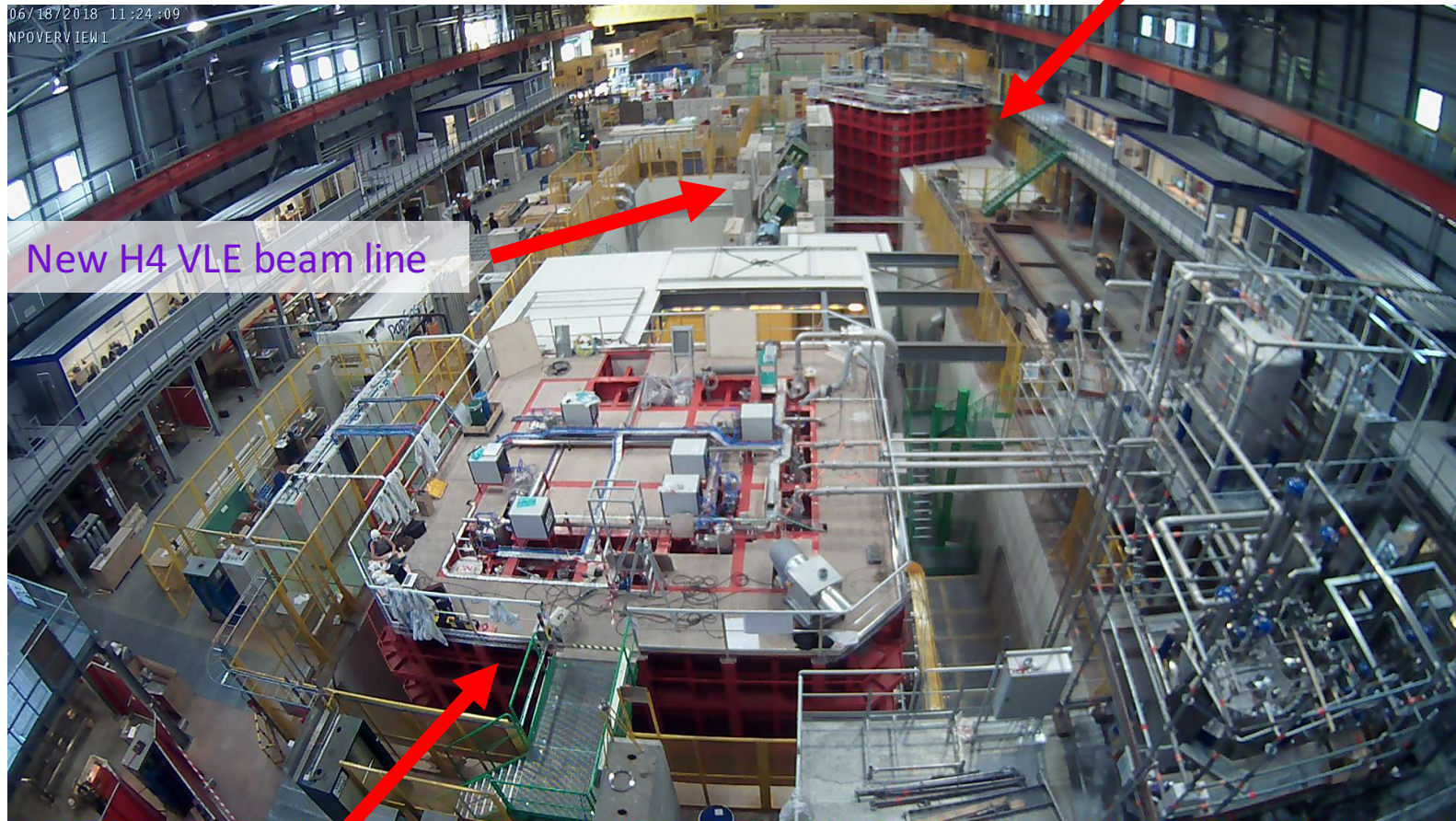
The ProtoDUNEs at CERN

- The DUNE FD LArTPCs will be by far the biggest ever built
- ProtoDUNEs are a step in the R&D path for the DUNE FD
 - Test all of the engineering solutions and installation procedures
 - Use full-size components identical to those planned for DUNE FD
- Each protoDUNE contains 800t of LAr – biggest ever to date!
 - Validate LArTPC technologies
 - Demonstrate long-term performance and stability
- Charged particle test-beams to characterise detector response with particle energies in the region of interest for DUNE
 - Of the order 500 MeV to 7 GeV

The CERN Neutrino Platform

- ProtoDUNEs hosted at CERN in a new facility

ProtoDUNE-DP



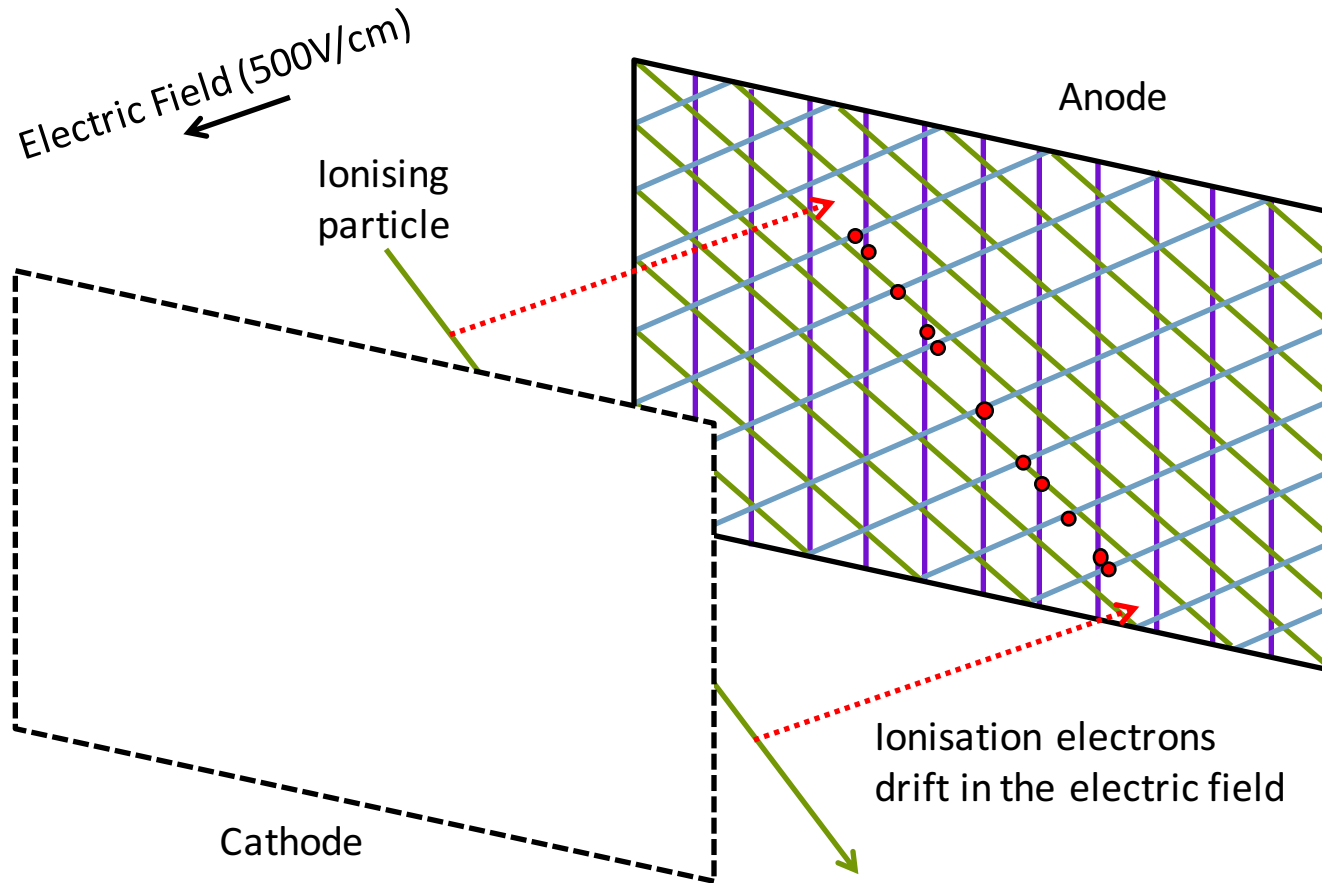
New H4 VLE beam line

ProtoDUNE-SP

Keep up to date here: <http://cnf-ehn1-np.web.cern.ch/multimedia/images>

Single Phase LArTPC

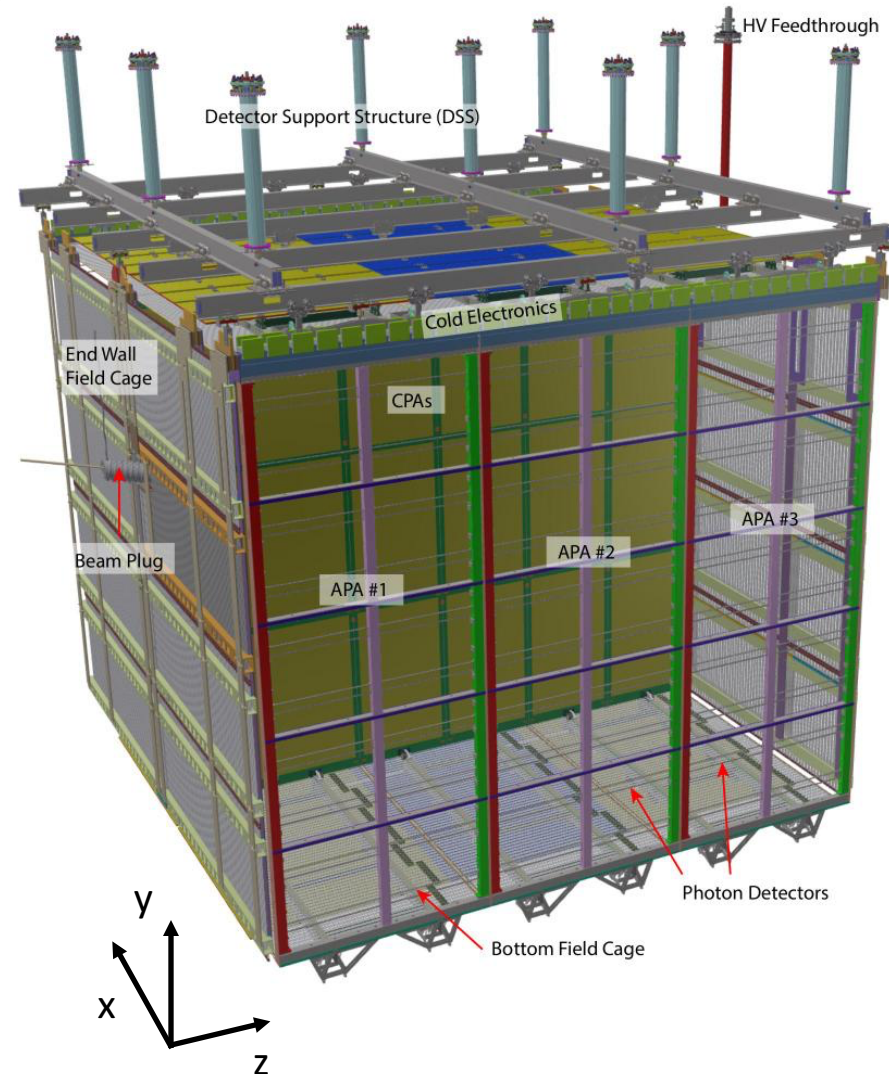
- Detector fully submerged in liquid argon



Drifting electrons produce signals (•) in the blue and green induction wires and are collected by the purple wires

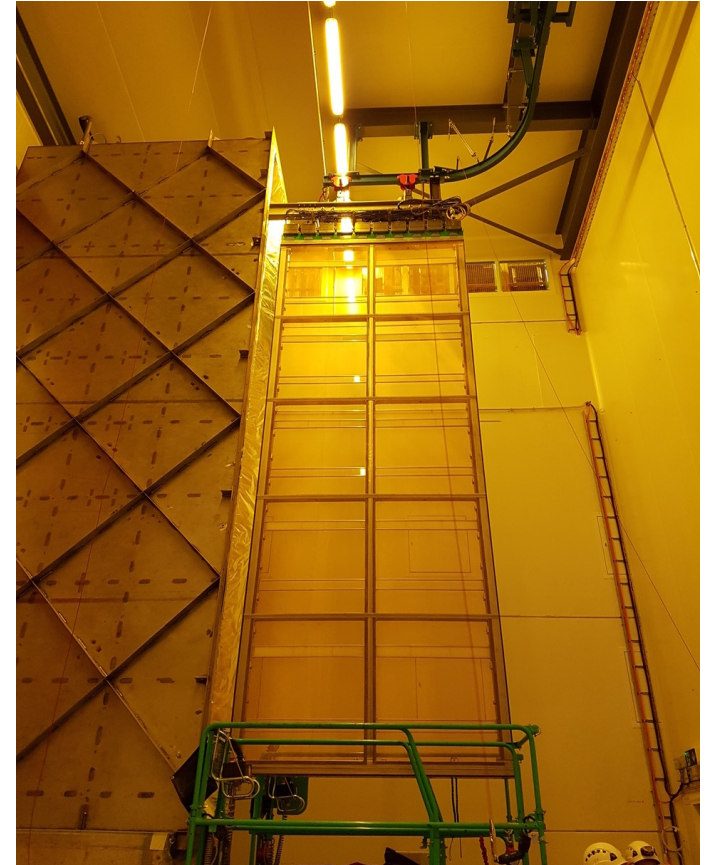
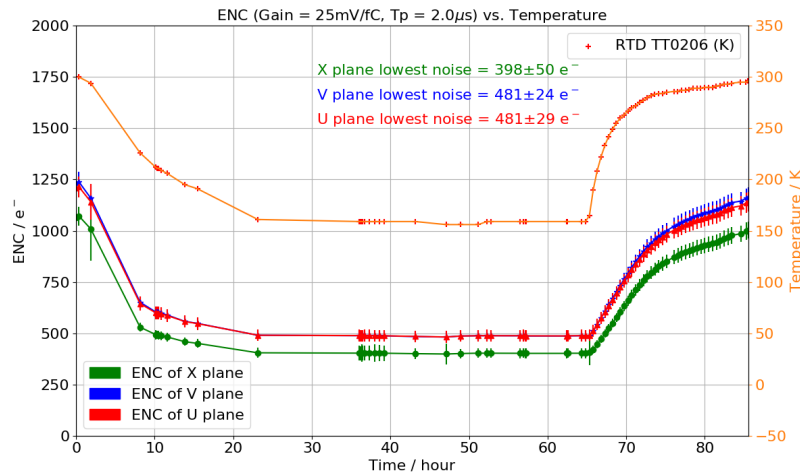
ProtoDUNE-SP

- Two drift volumes either side of a central cathode
- Active volume $7.2 \times 6 \times 7\text{m}^3$
- Read out by six anode plane assemblies (APAs)
 - Three wire planes
 - Ten photon detectors



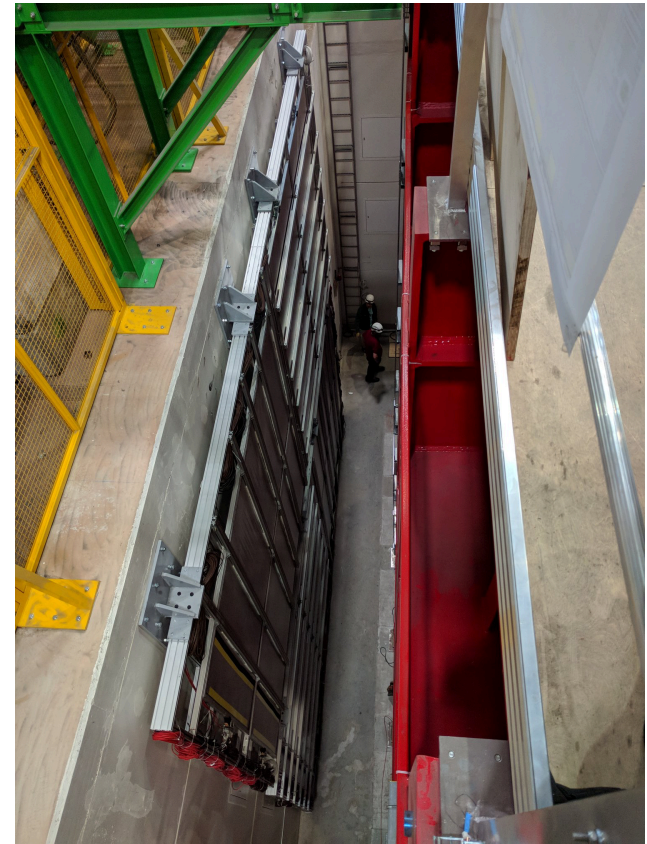
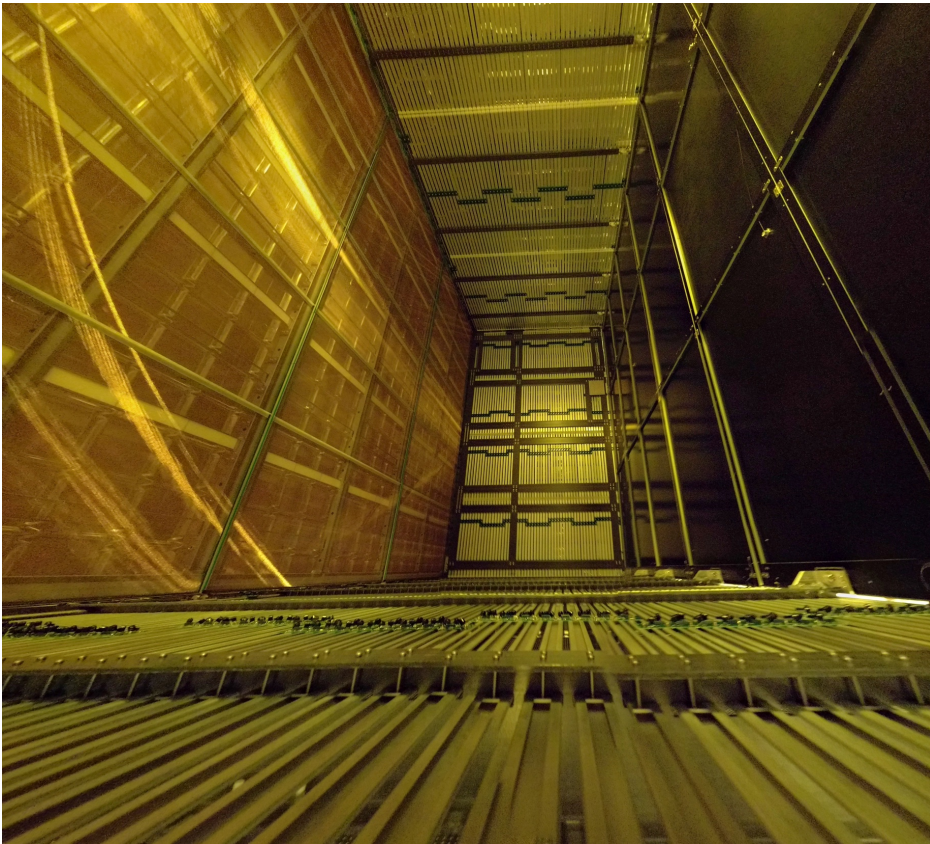
ProtoDUNE-SP: Cold Box

- Contains 6 APAs identical to those that will be used in DUNE
 - Four constructed at PSL (US)
 - Two from Daresbury Laboratory (UK)
- The APAs, with cold electronics, were tested in a cold box on arrival at CERN
 - Filled with gaseous nitrogen at $\sim 150\text{K}$



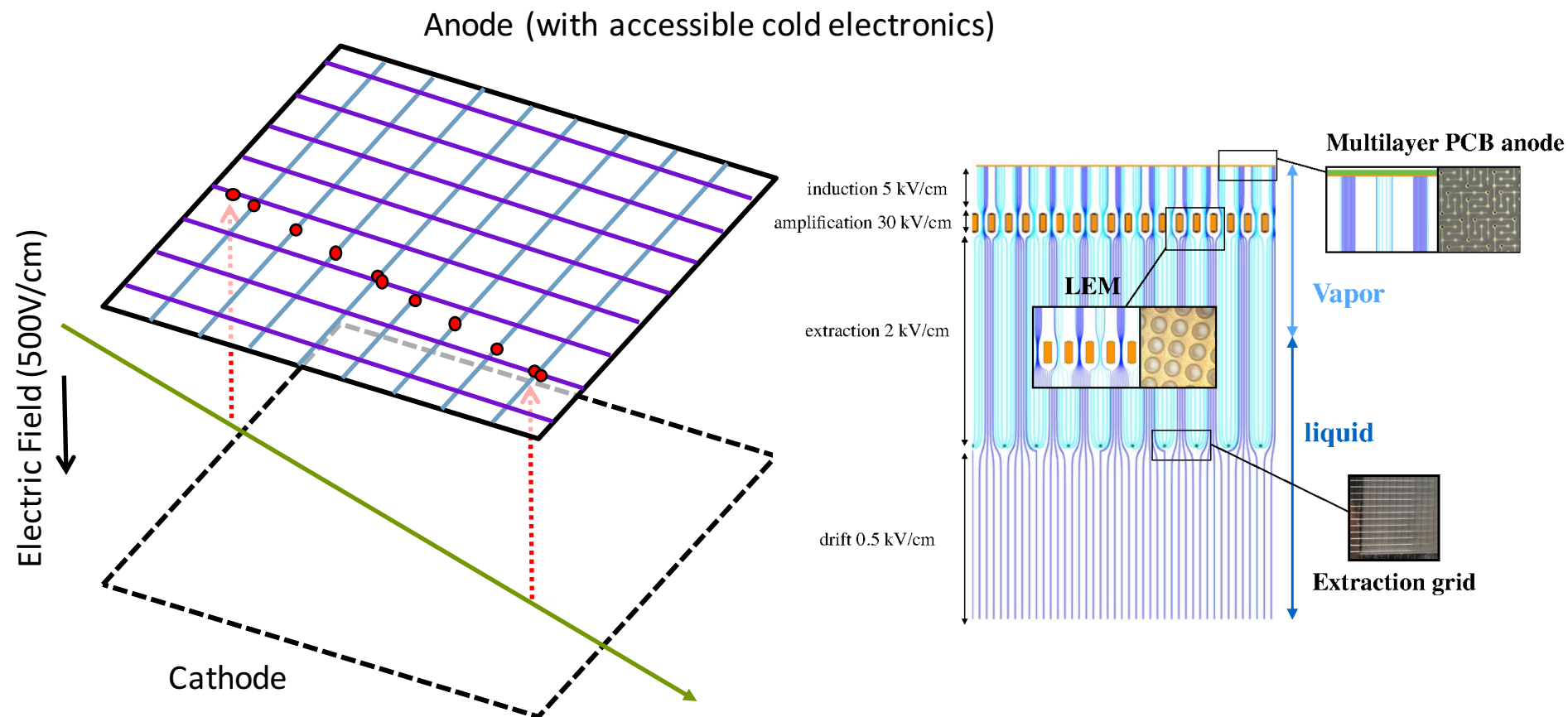
ProtoDUNE-SP: Current Status

- All components successfully deployed inside the cryostat
 - The cryostat has been closed and purging with gaseous argon begins on Monday 9th July



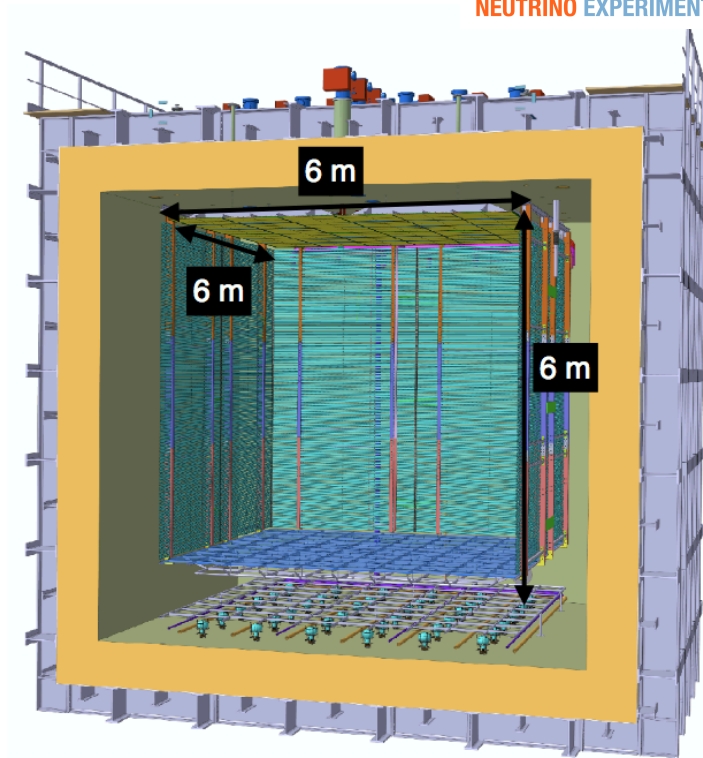
Dual Phase LArTPC

- Charge extracted from liquid argon into the gas phase
- Charge amplified in the gas stage before collection



ProtoDUNE-DP

- Single active $6 \times 6 \times 6 \text{m}^3$ drift volume
 - Four charge readout planes collect charge in two independent views
 - PMT array underneath cathode for scintillation light collection



- $3 \times 1 \times 1 \text{m}^3$ ran from July – November 2017
 - See talk by L. Molina Bueno later in this session

[3x1x1 article: arXiv:1806.03317](https://arxiv.org/abs/1806.03317)

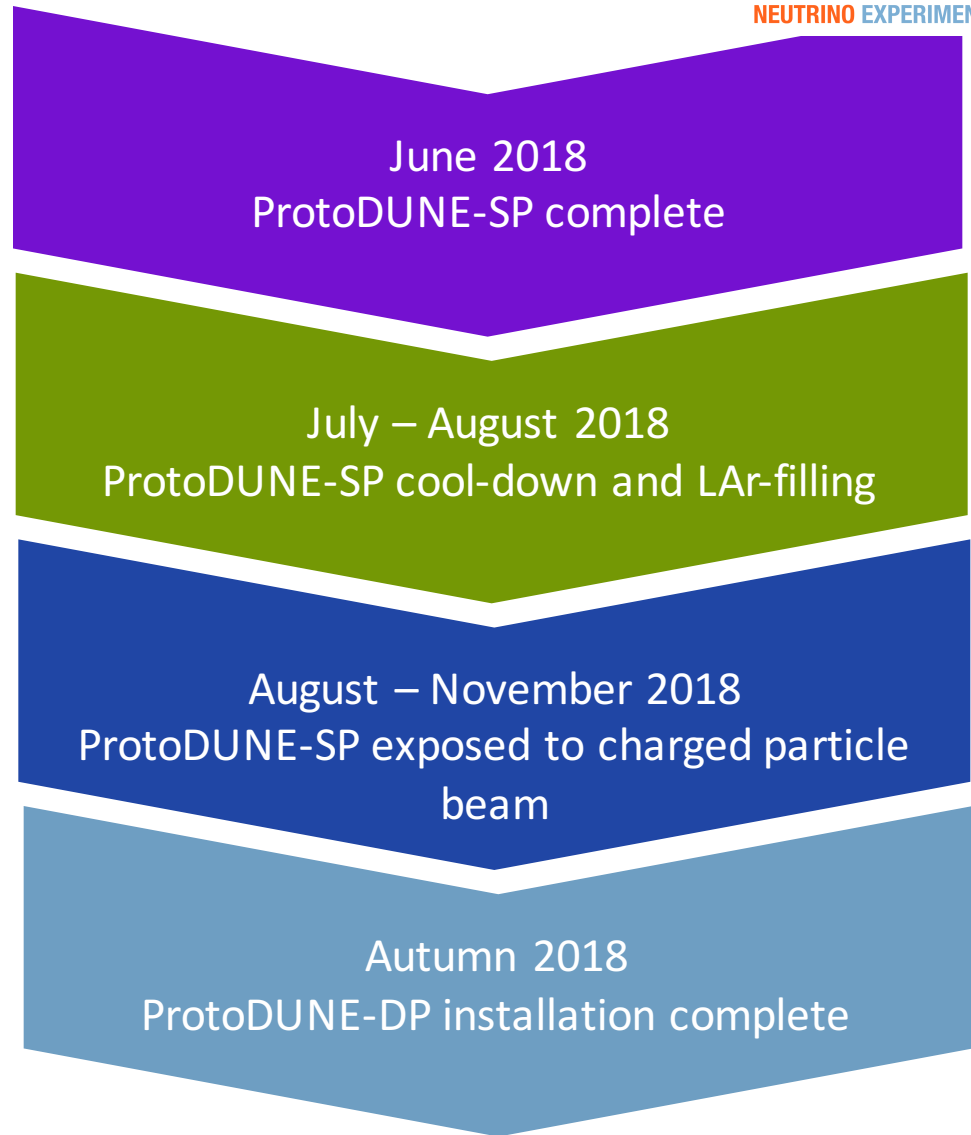
ProtoDUNE-DP: Current Status

- Construction of the field cage inside the cryostat complete
- Stable operation at 150kV over half the field cage
 - Demonstrated 500 V/cm
- Construction of 3m x 3m charge readout planes (CRP) underway
- First CRP complete and inside the cold box for testing



Moving Forwards

- Beam for single phase starts in August
 - This is only two years after the first parts of the cryostat were welded together!
- Detectors will run through 2019
 - Collect cosmic ray muons
- Primary physics analysis
 - Charged pion cross section in LAr



Summary

- Very impressive progress, from nothing to full detectors in roughly two years
- Look forward to results from the protoDUNEs this time next year

