

ProtoDUNE-SP Installation/Commissioning Planning

Christos Touramanis
LBNC Review
24 March 2017



16/03/2017



protoDUNE-SP structure & organization

Organization, schedule, planning covered by E. James & in Breakout II (4)

ProtoDUNE
09.FEB.17

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

DUNE ProtoDUNE SP

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

Cryostat

External
Cryogenics

Detector
Infrastructure

Talk by
M. Nessi

Detector Construction

Coordinator: Regina Rameika (FNAL)

APA Construction Leader:
Bob Paulos (PSL)
Alan Grant (Daresbury)

HV/CPA/FC Construction Leader:
Victor Gaurin (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)

Talk by
R. Rameika,
Breakout I (1)

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 Tufanlı (Vale)

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 Djuric (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:
Xavier Ponas (CERN)

LAr Vertical Temperature
Monitor Leader:
Jelena Maricic (Hawaii)

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

GA R Purity Analyzer Leader:
TBA

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

Instrumentation Readout Leader:
Flor Blaszczyk (Boston)

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Mathew Graham (SLAC)

FELIX TPC Readout Leader:
Frank Filthaut (NIKHEF)

Trigger System Leader:
Josh Klein (Penn)

Timing System Leader:
David Newbold (Bristol)

Breakout II (2)

Data Reconstruction and Analysis

Coordinators:
Josh Klein (Penn)
Thomas Kutter (Louisiana)
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)

Talks by
A. Norman,
T. Yang,
Breakout I (4),
III (5)

Prompt Reconstruction:
Coordinators:
Maxim Poteshkin (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
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Coordinators:
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Yann Rigaut (ETHZ)
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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
>100 active physicists & engineers

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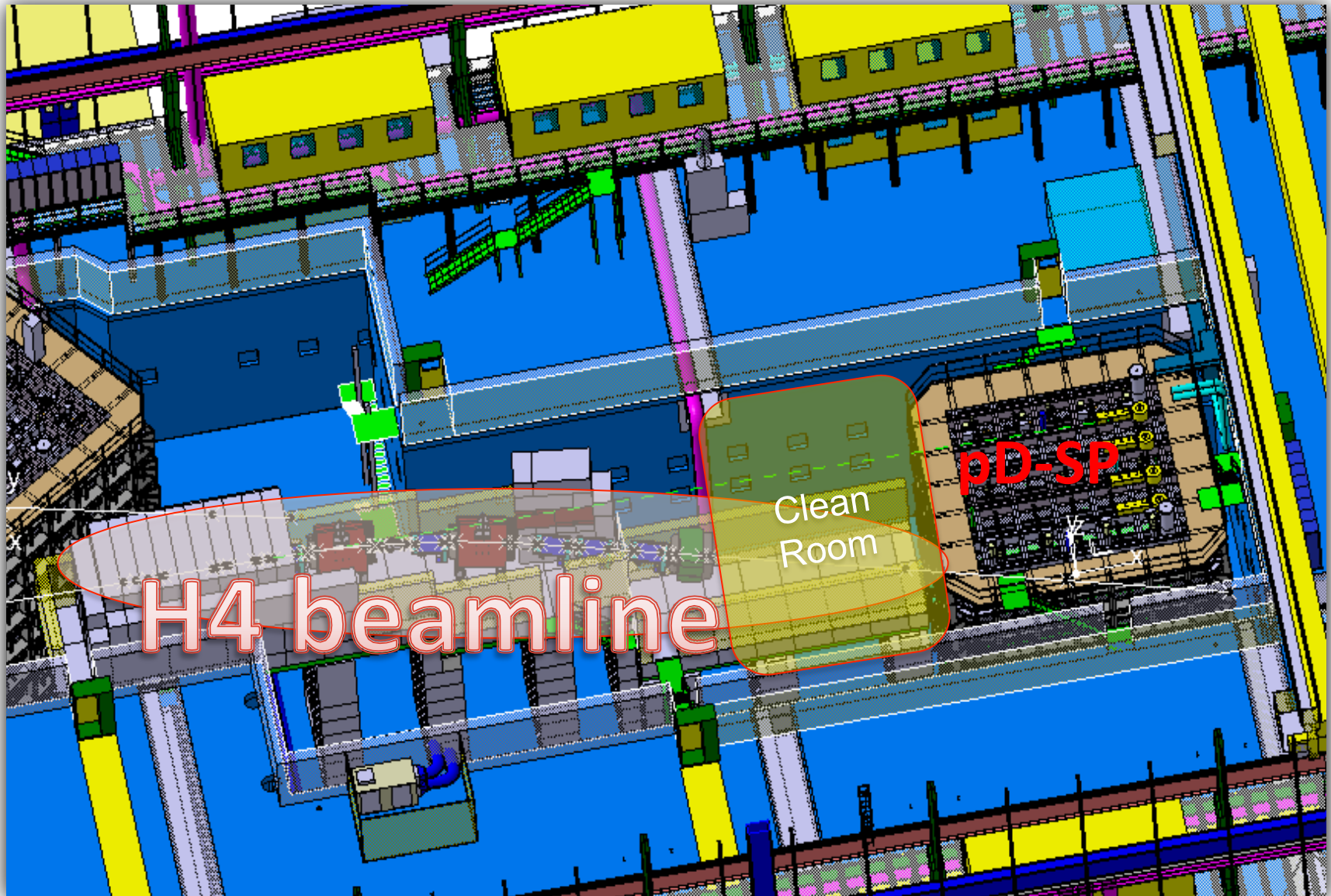
Tasks

- Set up of the Clean Room & associated facilities
- Reception, testing, integration, commissioning & QA of TPC elements and subsystems
- Installation inside the cryostat, cabling, final testing
- Cabling, grounding, safety

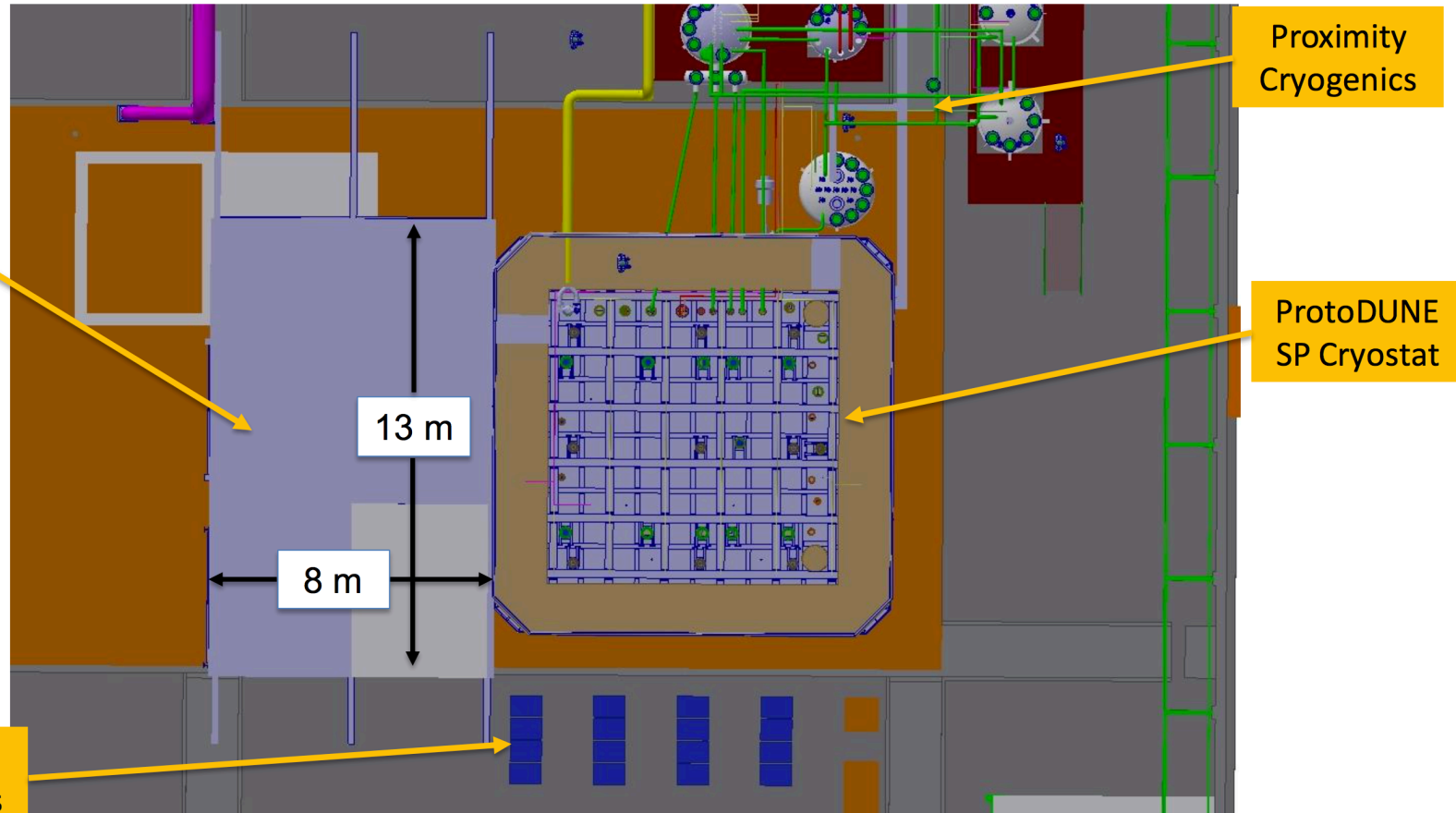
People

- Only the leaders/organizers are listed here
- They will provide full-time cover at CERN in the appropriate periods
- Will be supported by other staff, postdocs, students
- Red underline: already resident at CERN

ProtoDUNE-SP final area layout

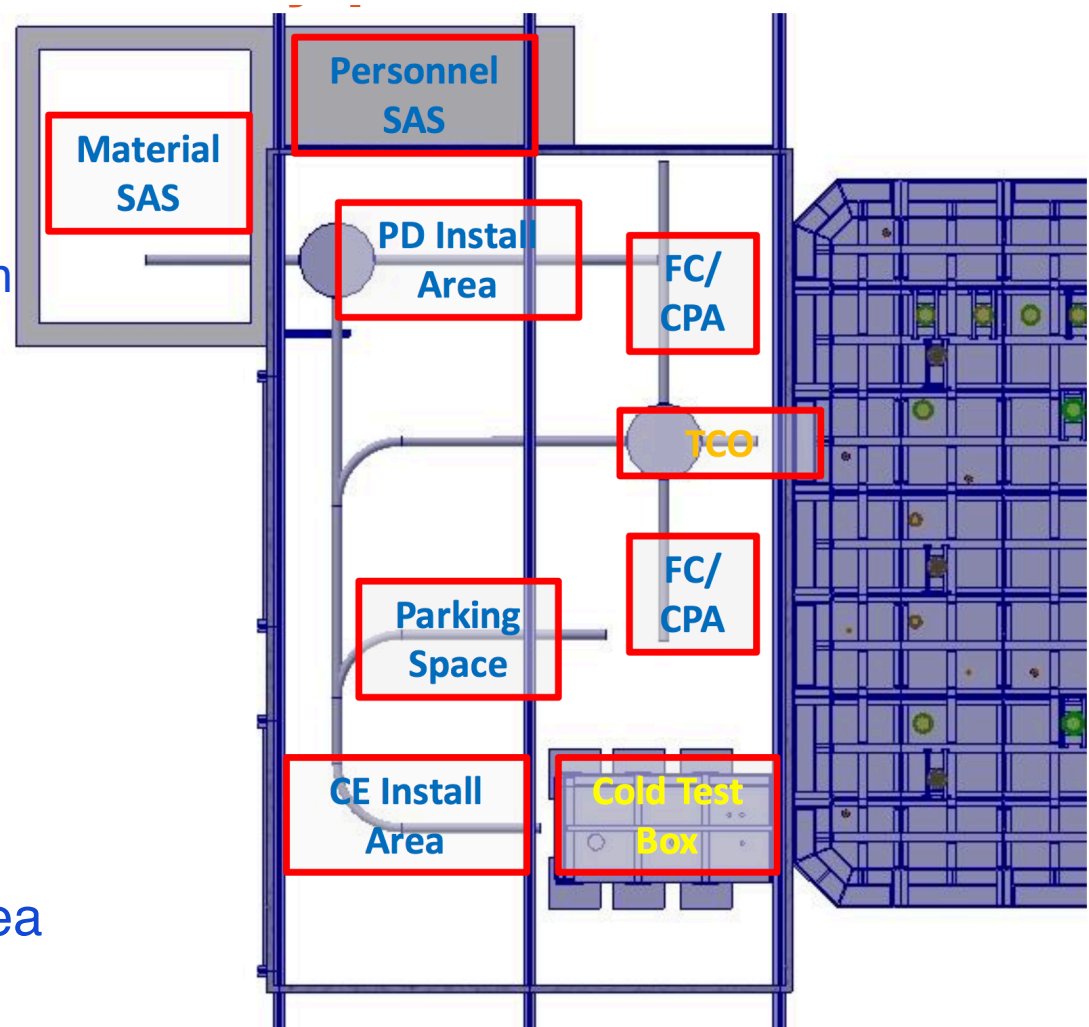


Plan view of the Clean Room in front of the Cryostat

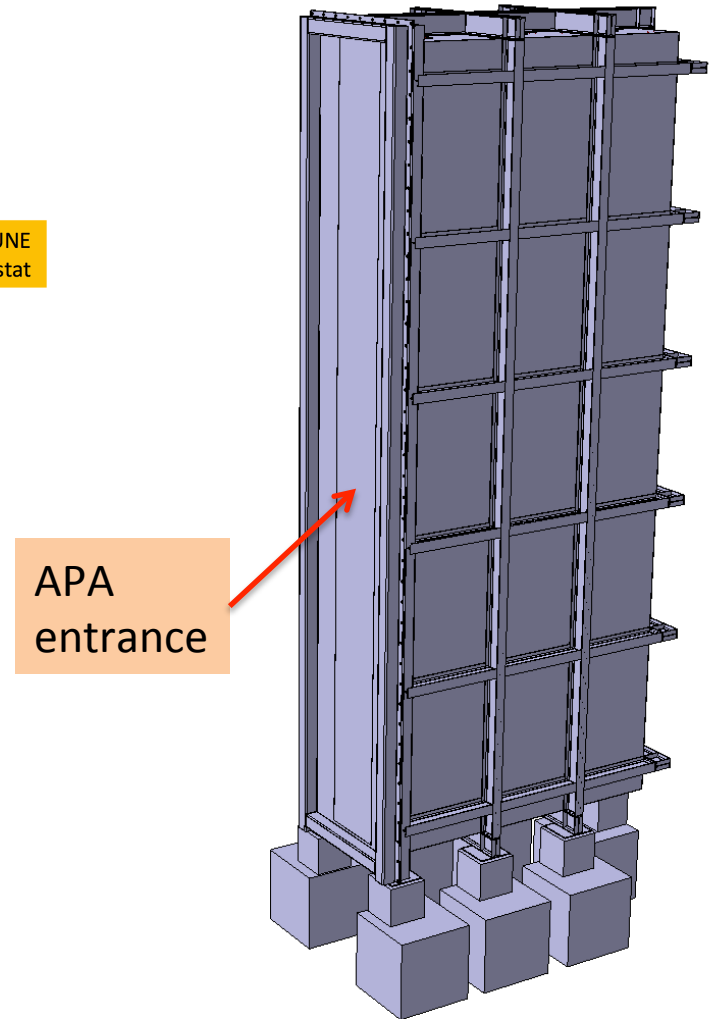
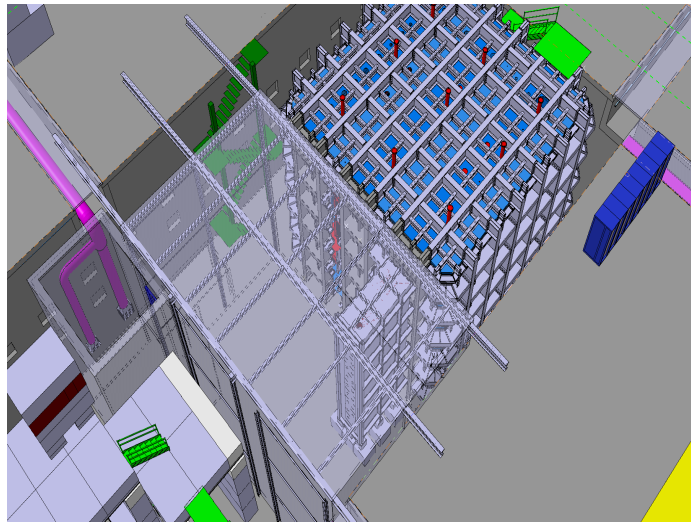
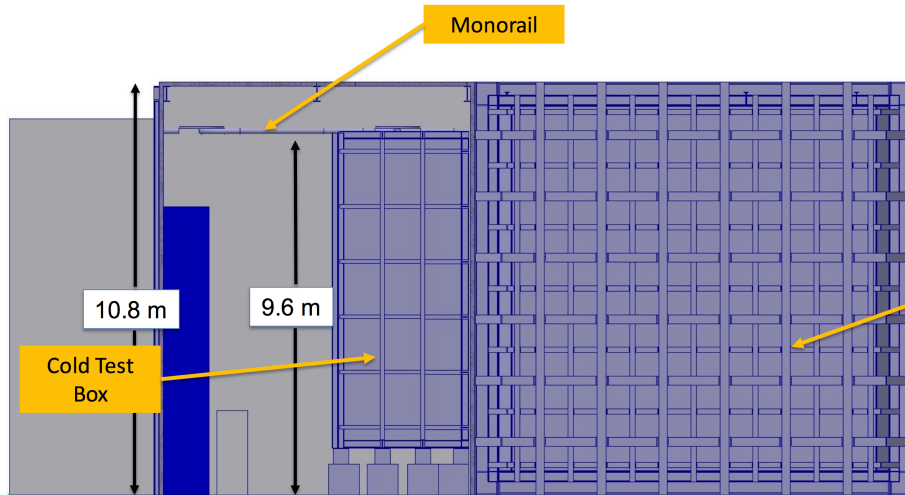


Process outline and areas in the Clean Room

- APA lowered and inspected in SAS
- APA PD Installation
- APA CE Installation
 - Testing with small test station
- APA Cold Test
 - Connected to DAQ vertical slice in Control Room
- (APA parked)
- APA in cryostat, cabling, testing
- Can work on multiple APAs
- CPA/FC assembly (other area option being explored), installation



Inside the Clean Room (elevation view); Cold Box



Milestones & dependencies

External dependencies (we have no direct control):

- Cryostat; external cryogenics; infrastructure
- TPC elements delivery: (APA, CE, WI, ...)

Internal dependencies:

- Clean Room & Cold Box readiness
- TPC auxiliary instrumentation
- Availability of specialised equipment
- Planning and optimised procedures
- Documentation
- ESH approvals
- **Manpower availability at CERN at the required quantity and expertise at all times**

Planning assumptions

APA#1

- 3 weeks reception, fitting PD and CE
 - 1 month installation in Cold Box & warm tests
 - 1 month cold tests
 - 1 month to fit production electronics and install inside cryostat
- Learning, debugging, optimising

APAs #2 - #6: reception to installation in cryostat in 5 (4?) weeks

CPA/FC/HV

While operations are in principle independent from those for the APAs, space and access create dependencies which have to be properly examined and mitigated. We are exploring the use of an additional space for CPA assembly and preparation.

Major Milestones

25-Apr-17	PD-SP design reviews complete	(on track)
25-Apr-17	Installation Review	(on track: 19/21-Apr-17 Workshop)
28-Apr-17	Ash River trial assembly complete	(on track)
30-Aug-17	Cold testing APA#1 complete	(on track w/prorotype electronics)
27-Sep-17	APA#1 installed in cryostat	(on track)
03-Nov-17	First row of APAs installed in cryostat	(on track)
12-Jan-18	APA#4 installed in cryostat	currently 02-Feb-18
07-Mar-18	Ready to close TCO	possibly; resolving overlaps
18-Apr-18	Detector Installation Complete	possibly; resolving overlaps
18-Jul-18	<i>Cryostat close/test/purge/cooldown/fill</i>	<i>external to PD-SP</i>
01-Aug-18	purity, stability of LAr established	
22-Aug-18	Detector commissioned & ready for operations	

To note since last LBNC (I)

- **Weekly ITI meeting** started 01-Dec-16: open to all; leaders of relevant groups and activities invited. Team building, information flow, coordination.
- Recorded in a **spreadsheet** the **periods** that collaborators intend to spend **at CERN** working on PD-SP. Following evolution of milestones and plans we are now launching an update round.
- Working to develop fully, and document all **procedures**.
- Recent **appointment** of Neutrino Platform Coordinator (Filippo Resnati) very positive.

To note since last LBNC (II)

- Working closely with Olga Beltramello (CERN/EP Safety Officer) and Letizia Di Giulio (new Neutrino Platform Safety Contact), making rapid progress in **ESH** matters.
 - Obtained exception for cold cables
 - Tailored protoDUNE safety course designed
 - Ongoing contacts to establish correspondence in ESH regulations between CERN and Fermilab (e.g. APA welding certification).
- Flor Blaszczyk (Auxiliary instrumentation readout leader and Electrical/Cabling coordinator) now **resident** at CERN.
- Revised **weekly meeting** on **cryo, ESH, DCS**

To note since last LBNC (III)

- Established a robust, comprehensive **naming convention** for elements of the detector (APAs, CPAs, feedthroughs etc) for clarity and to enhance cable labeling integrity.
- Detailing operations plans to understand and **resolve conflicts** in time, space and equipment.
- Developing mitigation strategies for possible/known **late delivery** of TPC elements, aiming to limit milestones slipping.
- Identifying and working on remaining challenges, e.g. the use of **lift or scaffolding** for the last operations on the TPC after TCO closure (access to all points as required; moving and finally extracting all devices through the manhole).

Current issues

- Clean Room structure: order placed recently; expected delivery end March; expected Clean Room ready end April.
- Cold box: aiming for 50-100mbar overpressure; sides may require some strengthening; waiting for input from CERN cryo group; last details to be settled before order can be placed, in the coming weeks.
- Exact time of internal cleaning of the cryostat.
- DSS has been delayed, will be installed inside the cryostat in the first half of June. Cryo pipes inside the cryostat will be installed in the second half of June.
- Racks have been bought, expected delivery in April.

None of the above presents a risk to the milestones shown earlier.

People already resident at CERN

DUNE ProtoDUNE SP
 Coordinators:
 Flavio Cavanna (FNAL)
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 Regina Rameika (FNAL-Construction)
 Engineering Intergration: Jack Fowler (Duke)
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- Excellent progress in all fronts
- Extremely smooth and efficient operation of this group with crucial activities at CERN, Fermilab, SLAC, Penn, and newcomers Bristol, Birmingham and beyond
- DAQ design review took place at CERN last November and the closeout was very positive.
- Overall in good shape, in line with no recommendations from the last LBNC!
- At CERN activities are hosted in an ATLAS computing lab and a system is used for R&D.
- The DAQ co-conveners will show details, including milestones, risks and some mice pictures in the dedicated breakout session.

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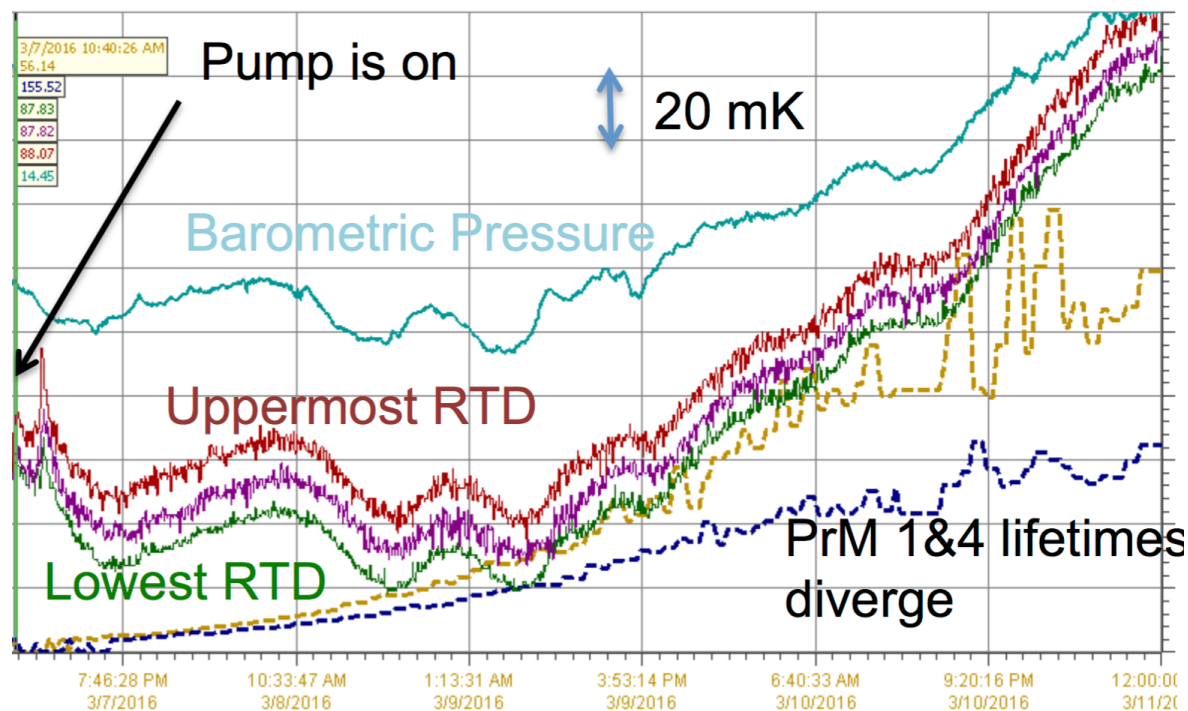
Mike Kordosky (William & Mary)

Instrumentation Readout Leader:

Flor Blaszcyk (Boston)

Pressure, Temperature, Purity
on the same plot

(example from the 35t run)



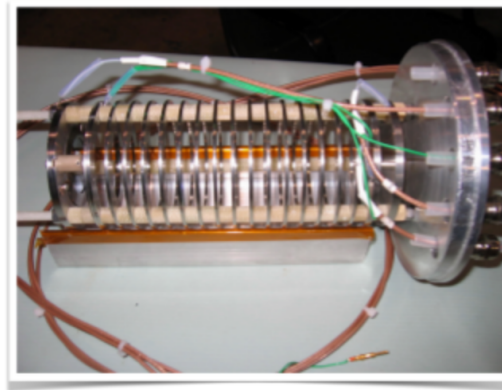
Cryogenics and Argon Instrumentation

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

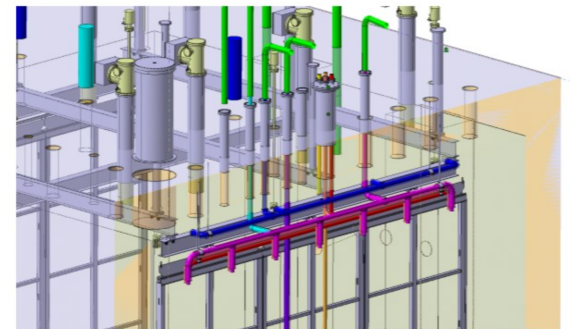
(from Icarus - under refurbishment)

Precise measurement of the impurity concentration in LAr (sensitivity in the tens of ppt range)



Vertical Temperature Gradient Monitor

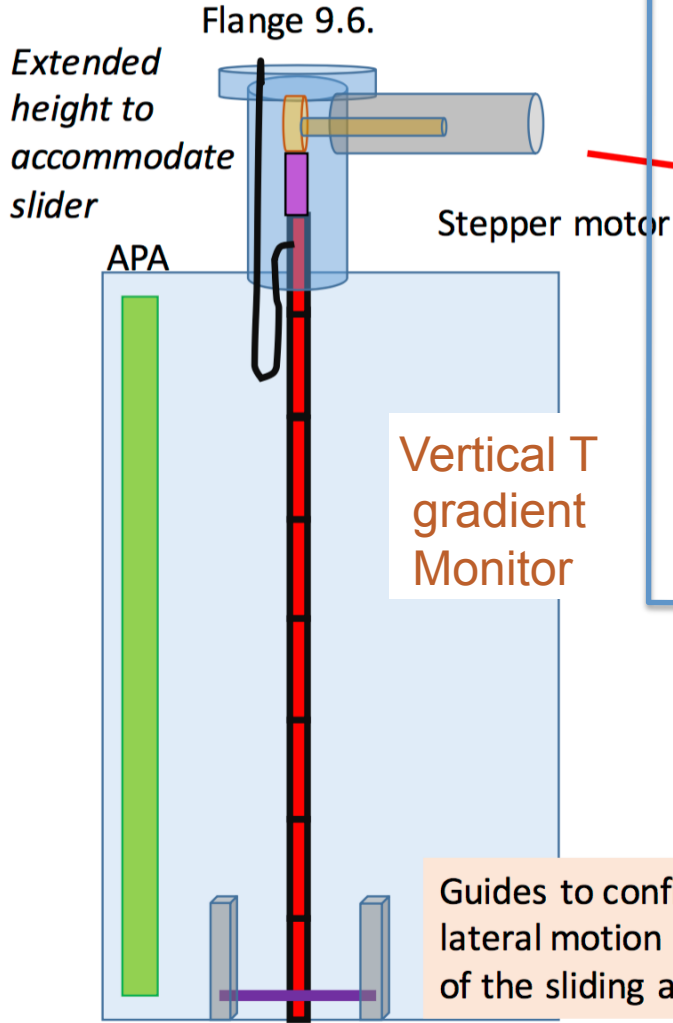
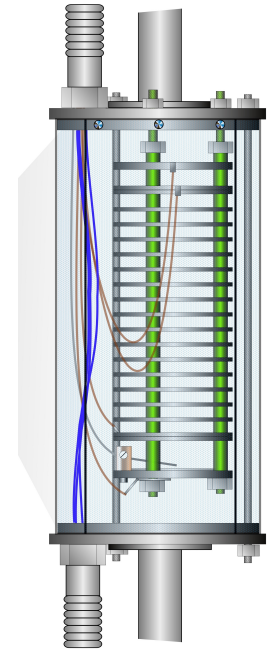
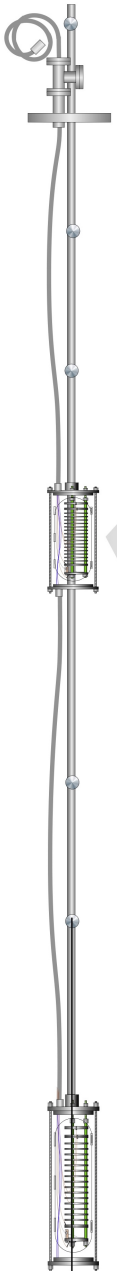
Precise (<50mK) monitoring the temperature gradient as a function of LAr depth - important as input for fluid dynamics modeling



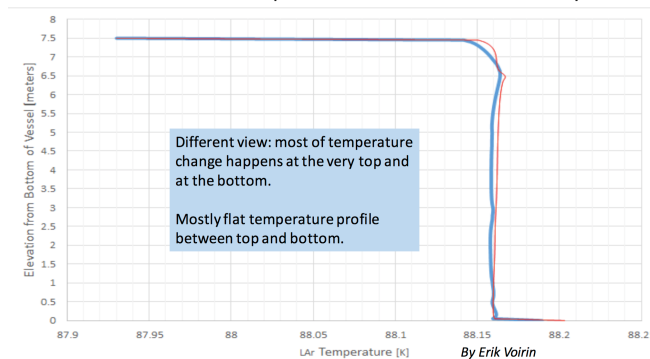
CryoWebCam

overall detector inspection (developed and provided by pDUNE DP)

Cryogenics and Argon Instrumentation



Simulated Temperature Profile – very stable



Other systems

Three systems are progressing well and do not present any significant threats to the timely delivery of the project:

- Slow Control, based on widely used hardware and software solutions from CERN and making good progress
- External muon tagger using the University of Chicago scintillator bar planes made originally for Double-Chooz, whose mechanical and DAQ integration do not present any real challenges.
- H4 beamline instrumentation: the group has recently received attention and is now working smoothly. Intense activity is ongoing on matters of integration, the CERN-provided hardware will be available on time

Response to LBNC Recommendations

Review Date	Item Description	Due Date	Status	Actions
23-Oct-16	Schedule an installation review in a timely way to ensure that issues associated with the cryostat design and installation of APA, CPA and FC are covered	23-Mar-17	closed	An Installation workshop is planned for April 19-21 to bring all of the relevant design teams and installation groups together.
23-Oct-16	Engage in discussions with CERN personnel and ProtoDUNE-DP experts on the safety systems with high priority	23-Mar-17	closed	Active discussions are ongoing. Several design/analysis documents have been provided to the CERN safety personnel

Risk Updates

Phase	Detector Subsystem	Owner	Risk	Prob.	Impact	Pre-mitigation Schedule Impact (weeks or months)	Mitigation Strategy	Comment
Installation	Photon Detectors	Mualem	Photon detector electronics are delayed	Medium		3 months	start with less photon detector readout than planned	If readout electronics are not available, commission with what is available and add more as they are available, since they are all outside of the cryostat.
Installation	Cold Electronics	Worcester	Full set of warm components not available on the required timescale.	Medium		None	Begin data taking with less TPC readout than planned. Multiple cycles of prototype components have been validated from the vendors planned for final production.	If warm components are not available, instrument all APAs on schedule and install warm components when available. Increase manpower to test/install as needed.
Installation	Cold Electronics	Worcester	New noise sources, beyond 35-ton noise are introduced in ProtoDUNE-SP. 35-ton high noise state excitation from power supply sensing is a misdiagnosis.	Low		None	Plan for substantial integration testing for full chain of ProtoDUNE cold electronics components. Begin taking data with high-noise while debugging.	Full Chain integration tests of new components planned at both FNAL (in Faraday-shielded room) and BNL (in cold box) during fall 2016. Full chain integration testing of the fully integrated APA modules is also planned at CERN prior to installation. Final integration testing will be done in a Faraday-shielded cold box with the readout electronics attached to the real DAQ system.
Installation	Installation, Integration	Fowler	Overlooked issues complicate installation	medium		3 months	Installation procedures vetted using the Mechanical Trial Assembly at Ash River in Fall 2016	Attempting to make test facility mimic EHN1 space restrictions as closely as possible. Produce and test installation tooling with the Mechanical Trial Assembly
Installation	Installation, Integration	Fowler	Damage to APA wires during installation	medium			Bill is considering a plate to cover the APA wires during work in the clean room.	harder to mitigate in cryostat. Need good procedures.
Installation	Installation, Integration	Cavanna, Touramanis, Shaw	Grounding plan is flawed or improperly implemented	medium		3 months	Terra has vetted the grounding plan with the G&S committee.	The Onsite ProtoDUNE team may need to add additional resources to make sure the G&S plan is properly implemented. This may require additional technical help from FNAL or elsewhere.
Installation	DAQ	Hennessy, Miotto	New interfaces cause delays in full DAQ spec, production	medium		1-2 months	use of trigger input spares, more manpower	late integration of CRT, pLAPPD, SSP, WIB
Installation	Management	Kettell	Duration of components installation at CERN is underestimated.	Medium		2 months	Develop detailed plan that includes CERN and US engineers and techs. Ash River Trial assembly	duplicates #21
Installation	Management	Dave	US funding needed for construction and installation of the detector is delayed	High		5-6 months	Seek help from international partners	There are real risks and stresses in LBNF/DUNE related to the FY17 CR
Installation	CE, PD, APA, CPA, FC	external	Delay in EHN1 availability or cryostat availability	medium		2 months	EHN1 delay may slow down DAQ development. Major delay will slow down integration tests at CERN.	DAQ will start development in separate lab space. Major delay is a problem
Installation	CE, PD, +	Shaw	Failure of electronics components due to Electrostatic Discharge (ESD)	low		1 month	Develop ESD handling procedures for components which can be damaged	During installation the electronics may be susceptible to ESD damage. Proper handling techniques, such as a controlled discharge through a resistor or keeping connector pins at a known reference will minimize any possible damage.
Commissioning	CPA/FC/HV	Guarino	HV feedthrough does not hold required voltage in ProtoDUNE-SP	low	high	0 months	Current feedthrough design has been tested at CERN	
Commissioning	Photon Detectors	Mualem	Noise levels greater than expected	medium	medium	3 months	Mitigate by investigating and eliminating sources during installation and commissioning tests	Should attempt to test PD readout in proximity to cold electronics (most likely pickup source) as soon as parts are available, before the cold box testing at CERN.
Commissioning	Cold Electronics	Worcester	Warm interface electronics are found to be a source of electronics noise.	medium	low	3 months	Allow for separate path through the WIB to bypass the DC/DC voltage converters. Disable the crate cooling fans and cool the Warm Interface Electronics Crate with separate air flow.	input connectors on WIB that bypass converters are already planned for diagnostic purposes; but this would require purchase and installation of new power supplies and warm cables. Fans will be removable and slots for separate air flow provided in the WIEC.
Commissioning	Installation, Integration	Cavanna, Touramanis	improper cabling leads to high noise or data loss	low		3 months	Provide additional manpower to plan and to implement cable labelling/routing. Provide additional manpower to test all aspects of cabling.	If high noise is detected in the detector while warm after closing, it may take a long time to debug.
Commissioning	DAQ	Hennessy, Miotto	DAQ pushed beyond specifications due to reduced data-taking time	medium		1 month	shorter drift, lower trigger rate, no inter-spill data	reduced physics dataset (risk is to dataset rather than causing delays)
Commissioning	DAQ	Hennessy, Miotto	Timing/trigger board production delays	low		1 month	use of prototypes, self-triggering, more manpower	

• Organizational updates

- The PD-SP Deputy Coordinator position has been deprecated
- Added Muon Tagging Detector Commissioning entry into DITI
 - Commissioners: Steve Manly (Rochester), Camillo Mariani (Virginia Tech)
- Cryogenics Systems and Instrumentation team: Stephen Pordes (FNAL) appointed co-coordinator in the place of Alan Hahn
- Measurements, Computing, Software completely reorganised following Dec. 2016 DUNE Computing Retreat:
 - Data Reconstruction and Analysis (DRA) group created
 - Conveners: Josh Klein (Penn), Thomas Kutter (LSU), Robert Sulej (FNAL/NCB)
 - Computing Liaison appointed in the coordination team: Ruth Pordes
- New Prompt Reconstruction team created
 - Coordinators: Maxim Potehkin (BNL), Brett Viren (BNL)