

Dual Phase CRP (interim) Consortium

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- Forewords
- Description and Requirements
- Interfaces to other consortia
- Strategy and work ongoing with ProtoDUNE-DP
- Milestones
- Risks and concerns

LBNC Review
Feb. 19th 2018

Collaborating Institutes involved in the Charge Readout Planes (CRP) of ProtoDUNE-DP:

- LAPP, Annecy
 - CEA, Saclay
 - ETH Zurich
-
- CRP consortium was not set up in 2017 like the others due to unavailability of the foreseen Leading Institute.
 - An interim structure has been proposed in **January 2018** to provide the necessary material for the Technical Proposal
 - However in the mean time some inputs for a first version of WBS have already been prepared last October

CRP organization and topics

Invar Frame

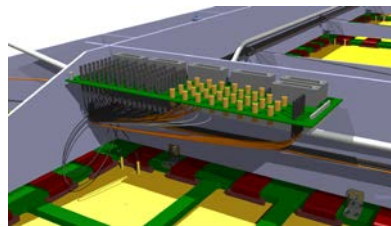
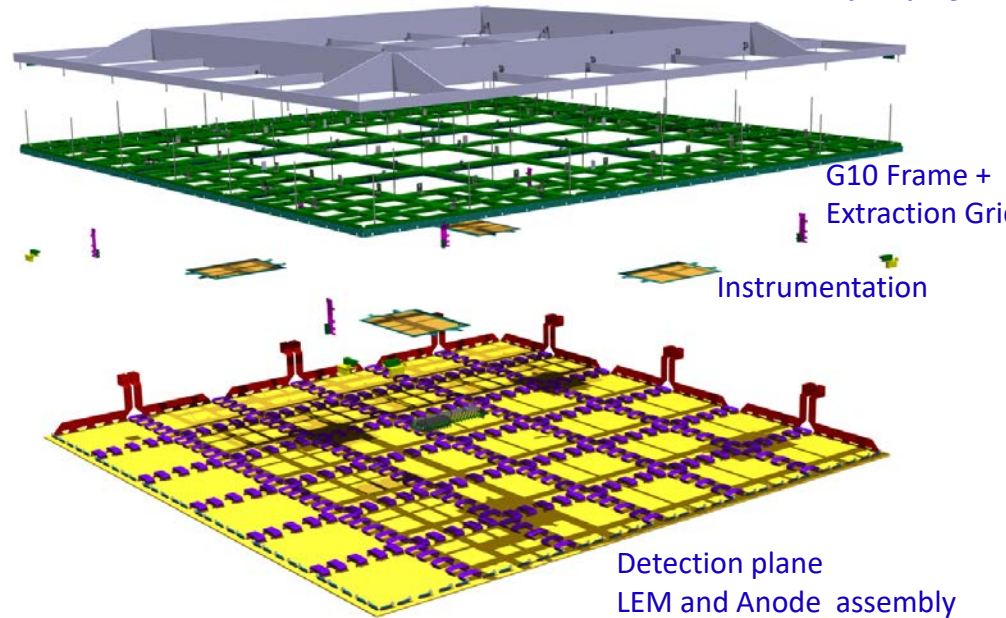
❑ Mechanical frames

❑ Extraction grid

❑ LEM and Anodes

❑ **Instrumentation:** level meters, distance meters, temperature probes

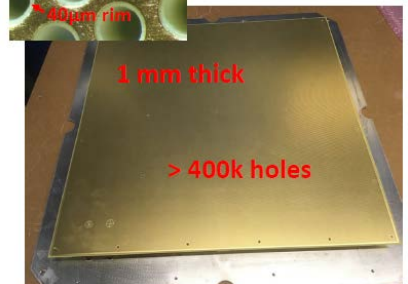
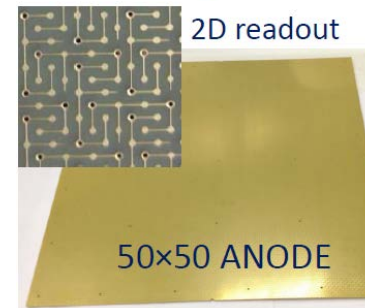
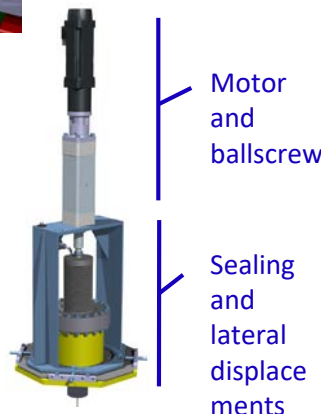
❑ **Internal cabling:** to patch panels (LEM HV, slow control instruments)



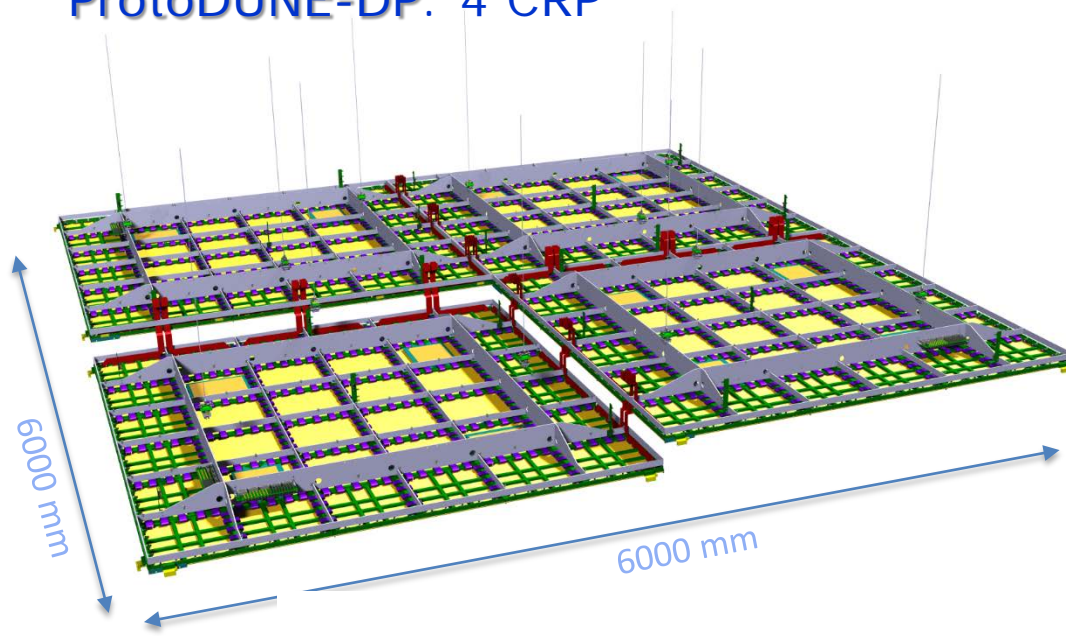
❑ **Suspension** and control system

❑ Assembly and Transport

❑ Integration and installation

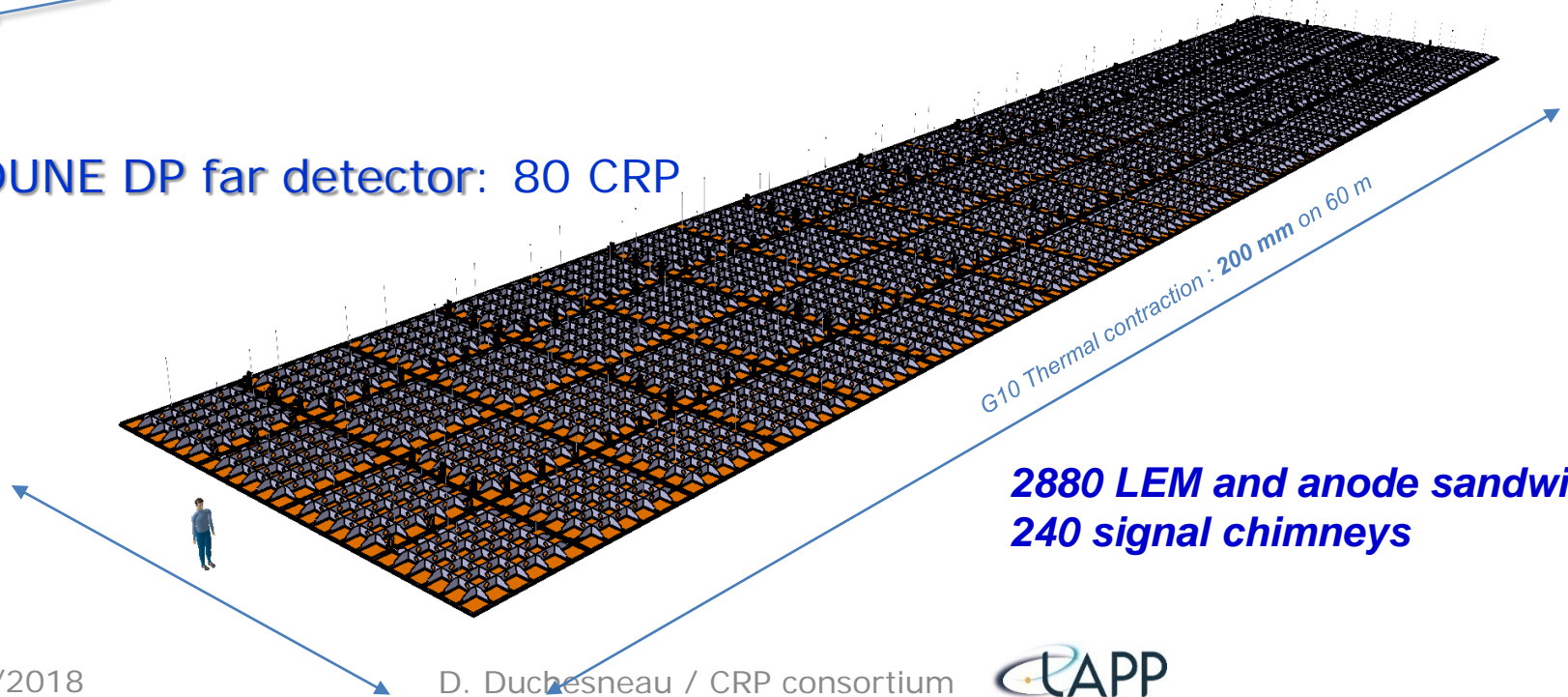


ProtoDUNE-DP: 4 CRP



- **Modularity**
 - *Each module is completely independent with individual drive and extraction grid*
- **Simplified drive system**
 - *Isostatic suspension system*
 - *Same as the 3x1x1 already tested*

DUNE DP far detector: 80 CRP



2880 LEM and anode sandwiches
240 signal chimneys

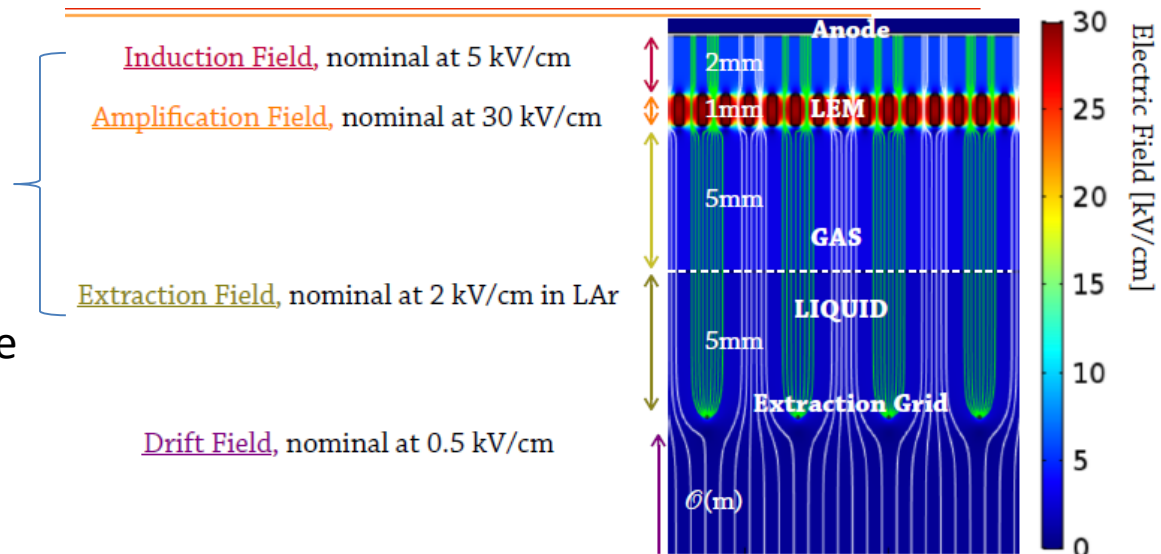
Requirements

Mechanics and automatism

- Planarity tolerance on a 9m² detection plane is +/-0,5mm
- Vertical position tolerance is +/-0,5mm (note: there was a typo in the previous version)
- Range of vertical displacement +/- 20 mm
- CRP lateral inter-distance < 10mm

Charge multiplication and collection

- Nominal Operating voltages on LEM to get a gain of about 20
- Stable running without discharge



Interfaces

First versions are under preparation, more in the coming weeks

Readout electronics: (DocDB 6751)

concerns the cabling of the signal cables on the bottom part of the cold flange of the Signal chimneys

Joint Cryogenics Instrumentation and slow controls (DocDB 6760):

Concerns the power supplies for LEM and extraction grid, the cameras, LED ribbons, temperature sensors, distance meters.

=> CRP instrumentation feedthroughs

Drift HV (DocDB 6754)

at the level of design requirements. They include the system for maintaining the proper distance between the top most field shaping profile to the extraction grid to keep the proper extraction field and to protect the contact between the two systems

Facility, integration facility and installation interfaces not yet ready.
still under discussion

After the operation of the 3x1x1 demonstrator in 2017:

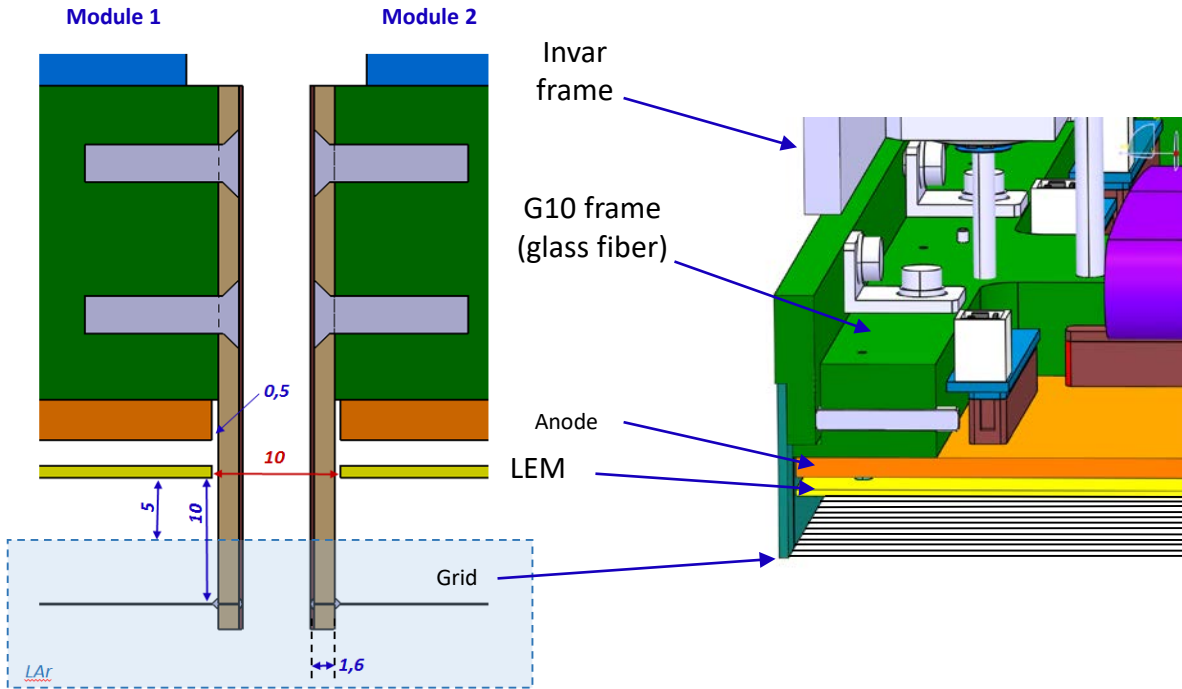
3 issues related to CRP design of the 3x1x1 observed:

- Extraction grid cannot reach more than 5kV without discharging
- A short circuit between the extraction grid and 1 of the 12 LEMs
- LEM high voltages: difficult to keep a stable running conditions at 30 kV/cm for more than several hours

=> Optimisation of design and additional tests on going to avoid similar issues than with ProtoDUNE-DP

- Extraction grid design and fabrication process
- Extraction grid HV connection
- New LEM design
- Construction of cold box to test CRP

CRP : the extraction grid



Different design and fabrication process wrt the 3x1x1 demonstrator.

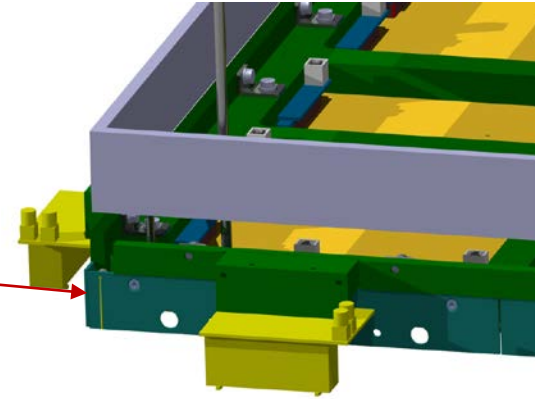
=> Full description of the new design, QA tests and expected QC can be found at the NP02/PD-DP PI meeting of November:

https://indico.cern.ch/event/677027/contributions/2782690/attachments/1560436/2456563/2017-11-17_NP02_PD-DP-PI_Meeting.pdf

Design optimisation

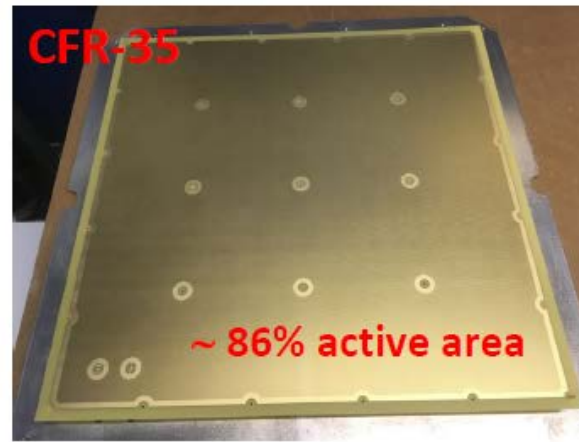
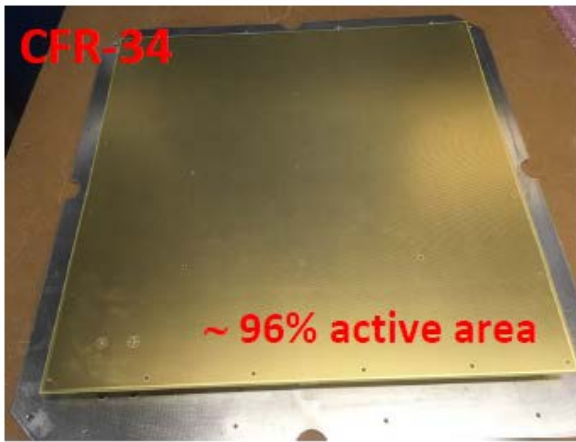
Extraction grid HV connectors

- A connection to avoid sparking has been developed and optimised
- Test in cold GAr will be performed at high voltage in different configurations



New LEM design:

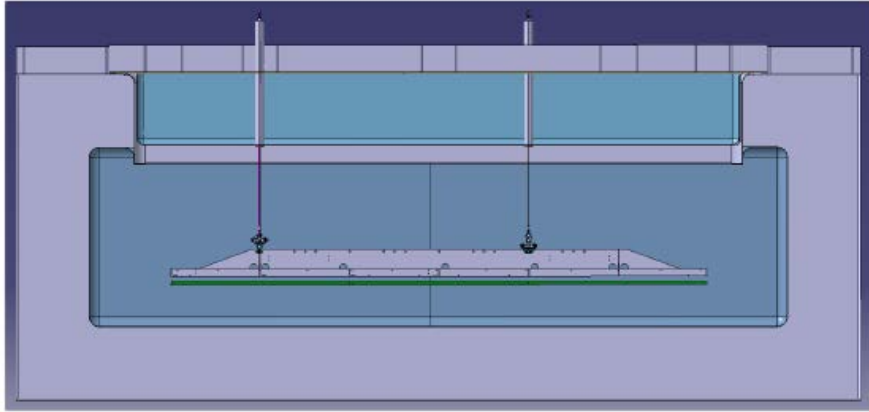
- Operated all LEMs on the 3x1x1 (except the 4 in the corner) up to 31 kV/cm for some time (~h)
- Operated individual 3x1x1 LEMs at 32 kV/cm
- A different design has been validated to achieve higher fields : larger guard rings



Tests performed at Saclay: CFR35 offers a safe design with an improved stability and reaches the required HV up to 3.5 kV

For DUNE, possibility to pursue optimizations of the active area is envisaged

Cold box to test each CRP:



Electrical and mechanical tests of each final CRP in nominal thermodynamic conditions:

- Characterisation of the operation voltage of each LEM
- Characterisation of the operation voltage of the extraction grid
- Test the planarity of the CRP itself
- Test the tensioning of the extraction grid wires
- Test the HV contacts and connections (LEM & grid)

Under preparation: to be ready on time for first CRP

Set of milestones to recover the delay with this consortium:

- Feb 2018: Table of Content for TP/TDR
- March 2018: Define the main interfaces
- April 2018: Draft of Technical Proposal

Other key milestones essentially driven to get ProtoDUNE-DP CRP in a running configuration to allow inputs to the TDR:

- Q1 2018: First CRP assembled with new LEM design
- Q2 2018: First CRP tested in the cold box
- Q3 2018 : Second CRP completed
- Q3 2018 : Install and cable the CRPs in Cryostat

- Q1 2019: Complete the validation of the CRP design
- Q1 2019: Confirm performance with ProtoDUNE data
- Q2 2019: Contribution to DUNE TDR

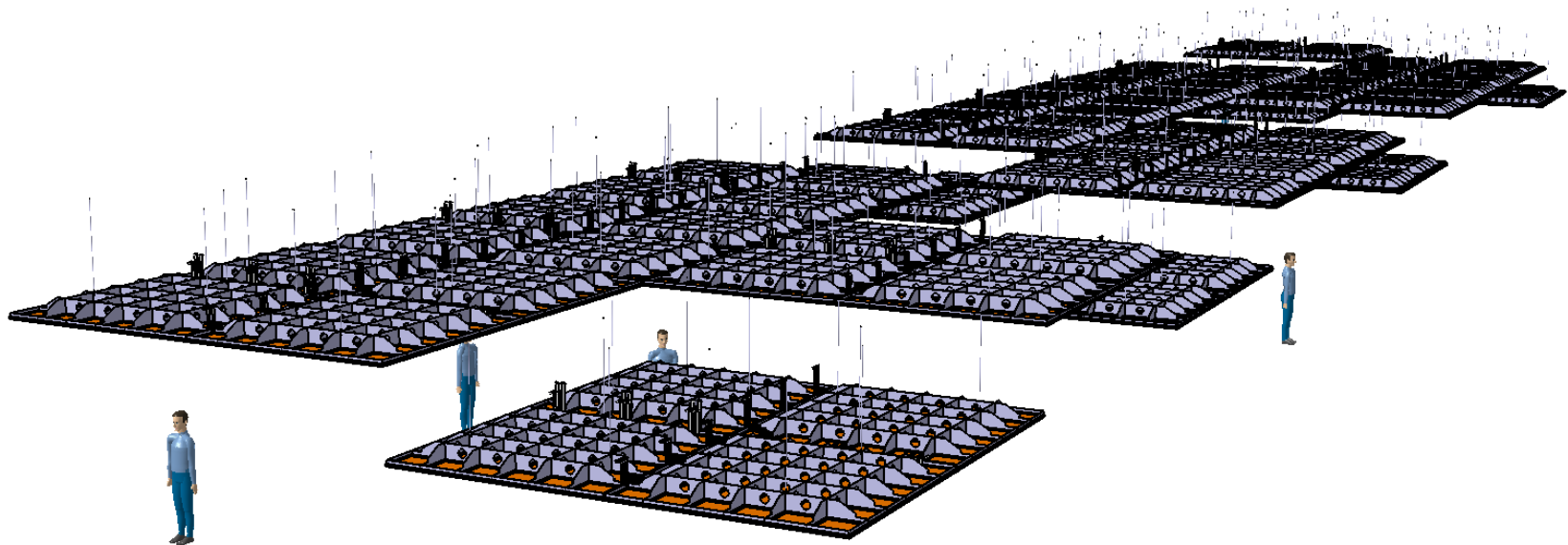
The main challenges are:

On the consortia side:

- Completing on time the milestones and documents with the difficulties due to the delay in forming the consortium
- Expanding the consortia membership and involvement

On the detector side:

- Having the necessary resources to get all components and the CRP fully assembled and tested before end of 2018
- Operating ProtoDUNE-DP on the time scale necessary for providing useful inputs to the TDR



The End