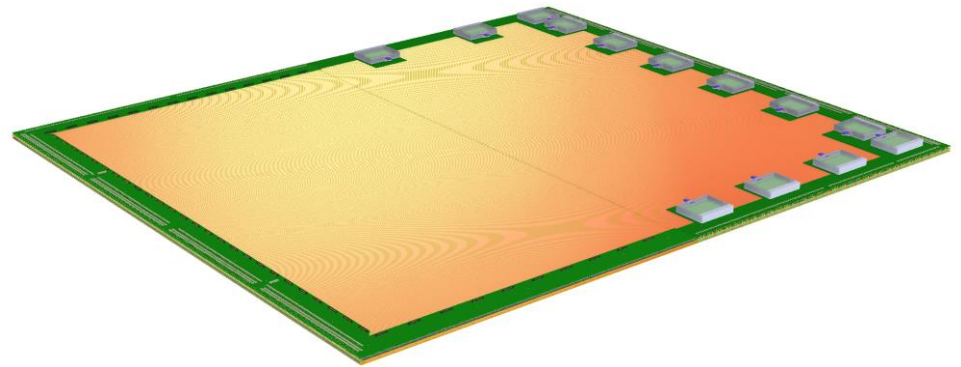
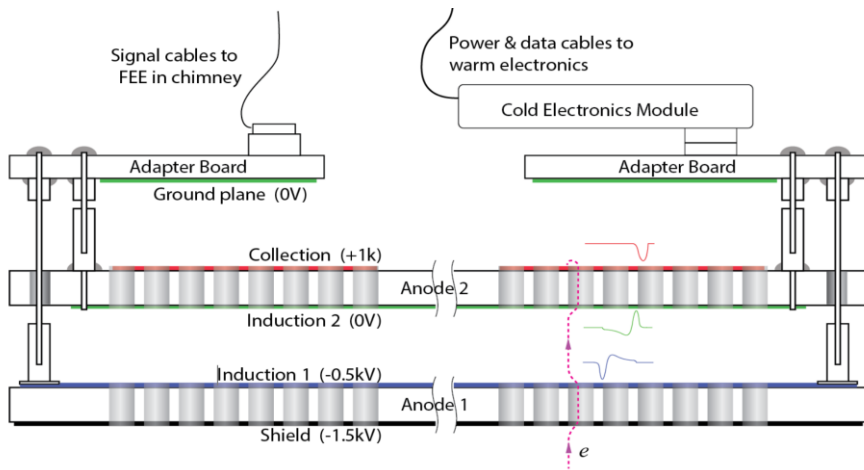
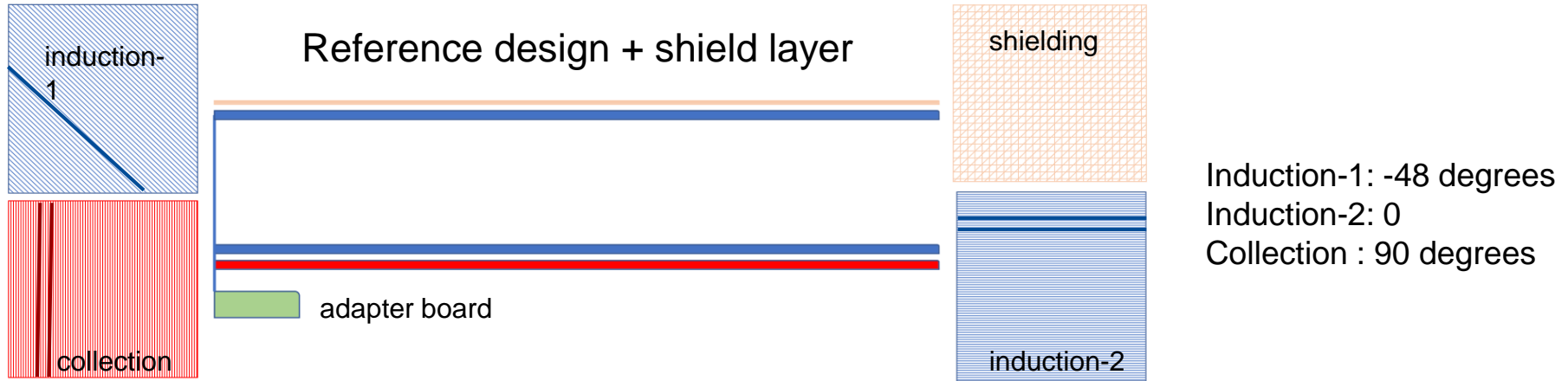


# Cold-box tests

Elisabetta Pennacchio, IP2I  
Top Electronic CDR  
04/06/2021

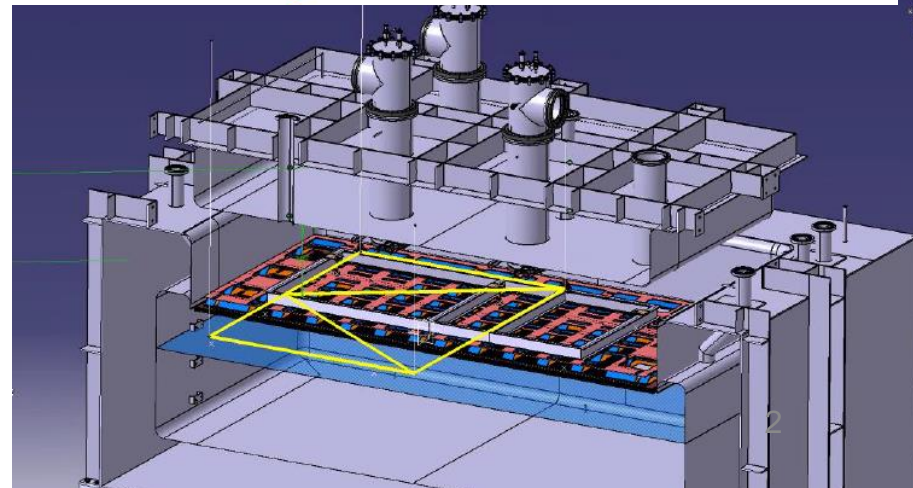


# Anode PCB for the first cold-box tests in 2021

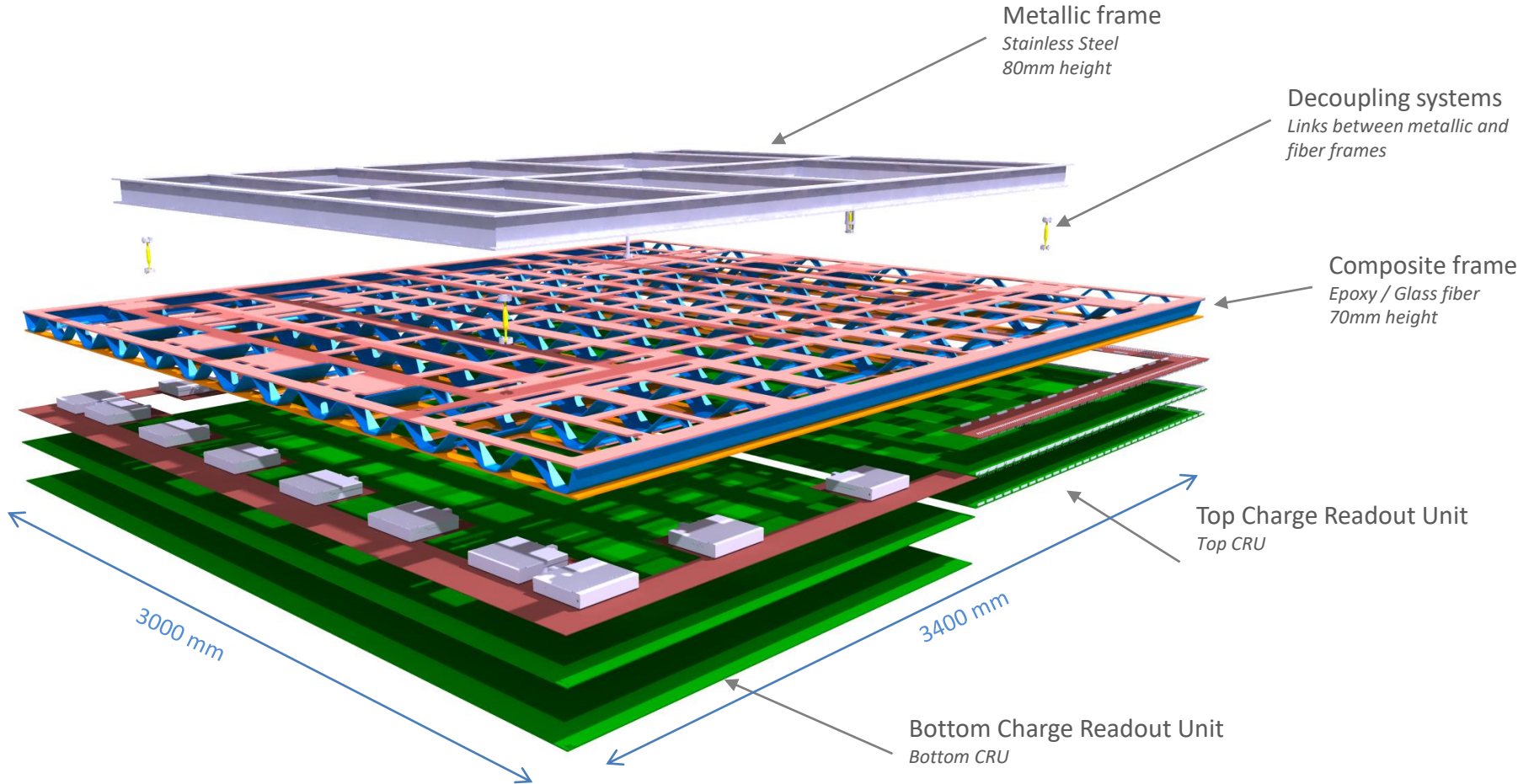


Configuration allowing assessing simultaneously the 2-views and 3-views performance in the same anodes setup to be used for the first CRP tests in 2021 →

**CRP shared as 1/2 top, 1/2 bottom CRPs**

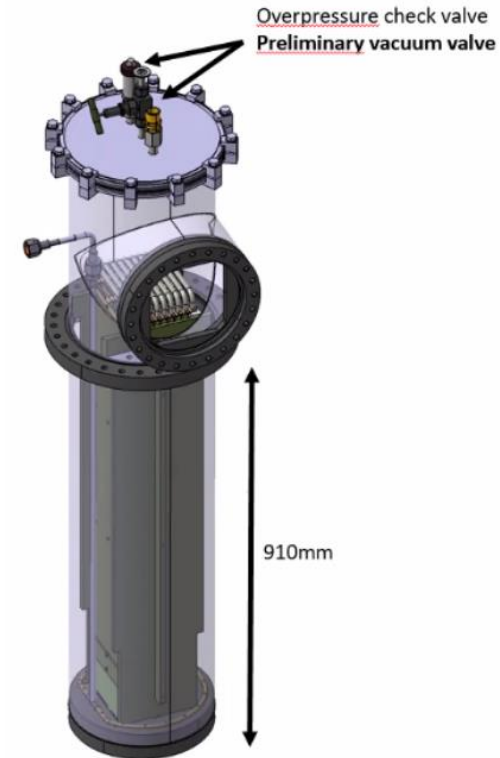
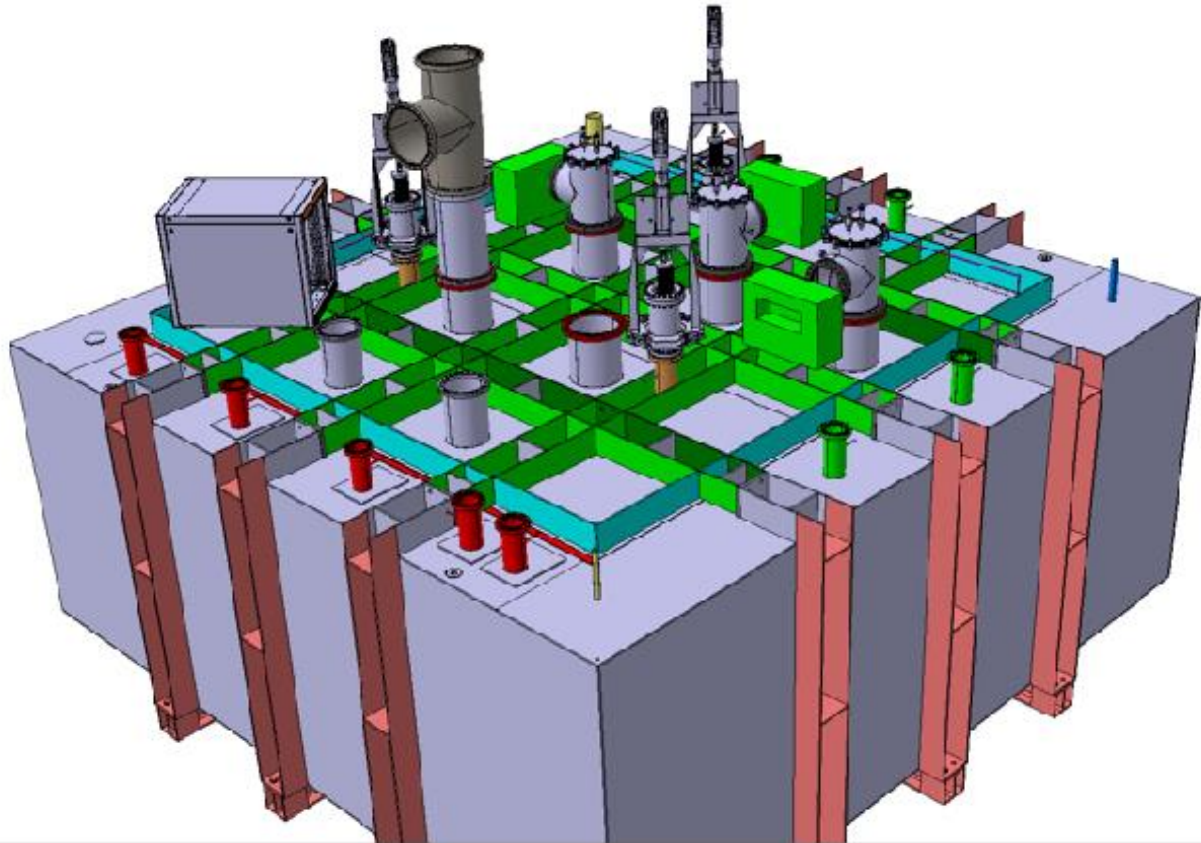


# Shared CRP (top/bottom drift electronics for first cold-box tests)



## Cold-box roof

Mini-chimneys of same size but shorter length (910 mm) than in ProtoDUNE-DP  
Procured by IJCLAB



Goals and requirements for the cold-box tests at CERN have been presented at FD2-VD Bottom Electronics conceptual design review (May 28<sup>th</sup>).

Slides are available [here](#)

# TOP drift electronics

- The **top drift electronics essentially unchanged with respect to the dual-phase design** documented in the TDR and deployed and validated in 3x1x1 and in ProtoDUNE-DP NP02.
- Foreseen to use for top drift: **DP analog FE cards with the same cryogenic ASICS**, plugged at the bottom of the **signal feedthrough chimneys** and the **digital FE electronics and associated timing distribution system located in the uTCA crates** on the cryostat roof.

## From VD proposal document:

TABLE I. Top drift charge readout electronics: units counts

Quantity	2-view Configuration	3-view Configuration
1.5m x 1.7m CRU in the top drift	320	320
Anode channels per CRP	2432	3200
Channels per FE card or AMC card	64	64
FE cards or AMC cards per CRP	38	50
Number of SFT	105	105
FE card slots per SFT	50	50
Installed FE cards per SFT	38	50
uTCA crates	320	400
WR-MCH	320	400
40 Gb/s data links	320	400
Anode channels in the top drift	194,560	256,000

## Minor interface aspects already worked out (talks by Dario, Fabien, Slavic)

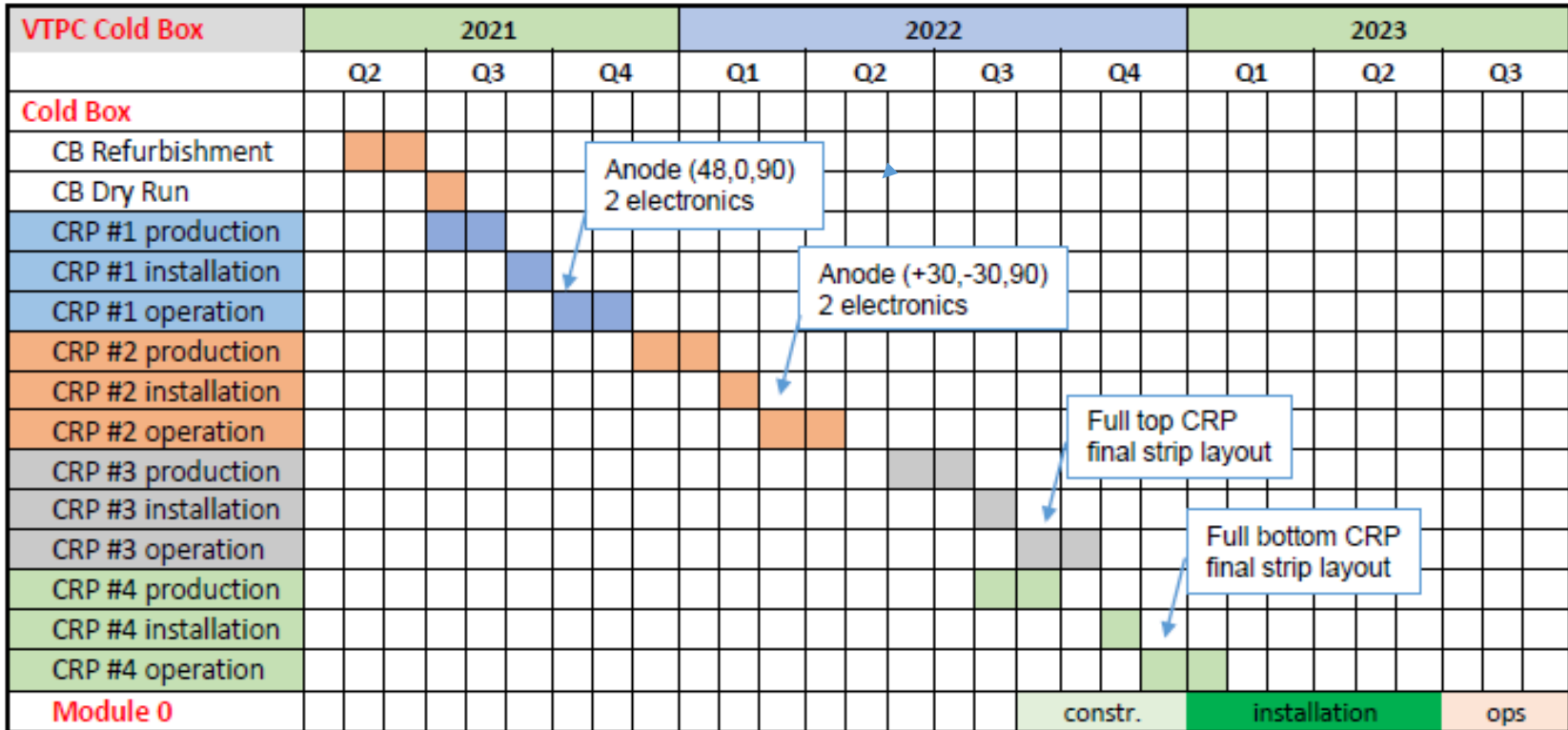
- Signal feedthrough chimneys which are now larger and containing more cards
- Removal of some passive components on the cryogenic front-end cards → produced and tested
- ADC Dynamics adjusted to bipolar mode → produced and tested

# CRP test plan for Cold-box and Module 0

Preliminary plan given in the answer to the LBNC after April 28<sup>th</sup> review

The CRP plan for 2022 includes:

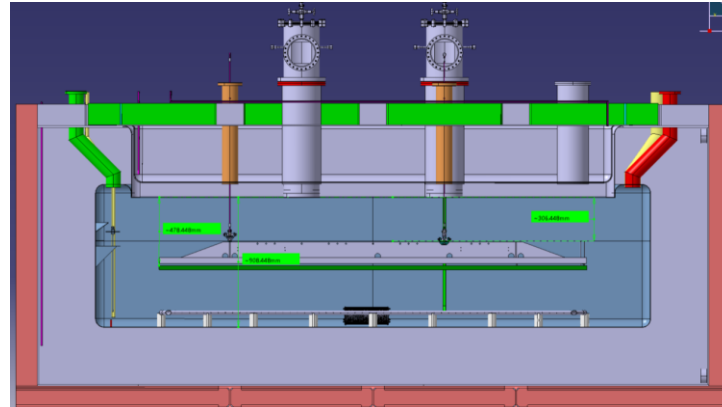
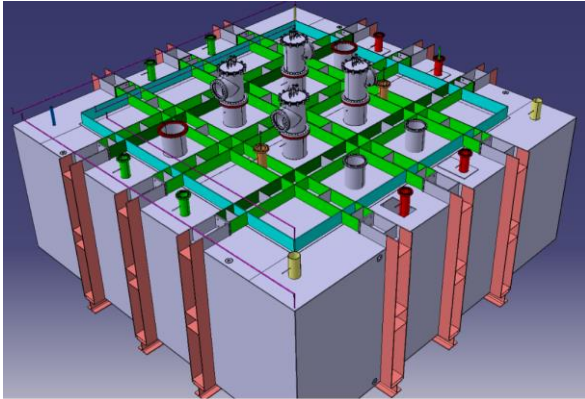
- Construction and installation of a second CRP to test different strip orientation in March 2022
- Followed by a third final top CRP after decision on strip orientation in May 2022
- A fourth (final bottom CRP) is expected possibly from US by Fall 2022



These tests will allow a complete definition and fully instrumented module-0 <sup>6</sup>

# Top Drift Electronic Electronics Consortium activities (2021)

- Intensive activity to support and perform the top drift CRPs cold-box tests



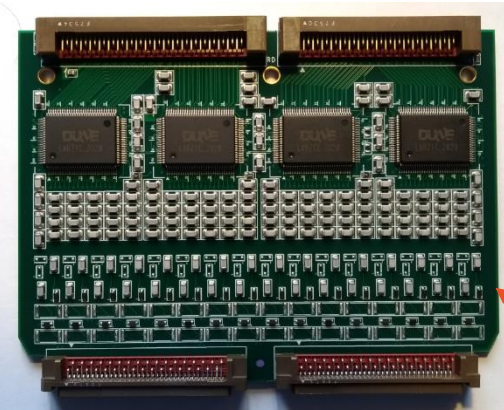
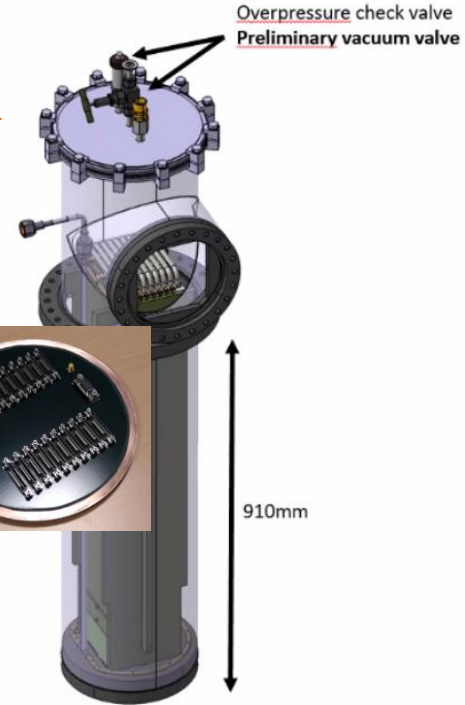
- The list of TDE components to be provided is defined (see next page)
- Production of the components quantities for full top-drift CRP test in 2022, with 3 views.
- In 2021, for initial tests only  $\frac{1}{2}$  CRP has to be equipped (CRP sharing among top and bottom drift electronics) → **electronics cards already produced with VD modifications and tested.** Completion of procurement for full top CRP in progress, to be completed by the summer

- In addition, support to protoDUNE-DP electronics for the HV extender tests has to be insured by the same group → this implies also keeping NP02 electronics untouched and alive with spares and maintenance

# List of TDE components

Quantities purchased/procured for full top drift CRP test

- Mini-chimneys: 5
- Warm + cold Flanges PCBs : 5+5
- Blades: 50
- Cryogenic FE Cards: 50
- uTCA digitization cards: 50
- uTCA crates: 5
- White Rabbit timing end nodes: 5
- Low voltage power supply + distribution system (clone of NP02 system left untouched)
- Associated Cabling (LV, VHDCI, fibers)





# Post-procurement tests

- ❑ Most of the material has been already QC tested.
- ❑ The general procedure foresees, before bringing the material to CERN:
  - a) to apply the same QA/QC and calibration procedure which was applied in 2018 to all the FE cards and the AMC cards produced for protoDUNE-DP with the test setup described in the dual-phase TDR (see QC presentation) → after completion of QC entering now in the calibration phase
  - b) uTCA crates and WR timing end-nodes crates are also qualified with the same QA/QC procedures used in 2018
  - c) Cold and warm flanges to be tested for continuity of all channels
  - d) The clone LV distribution system has been already qualified with similar QA/QC tests as in 2018
- ❑ Next slides will be focused on the description of **the optical fiber infrastructure at EHN1**, and on the organization of the integration tests of all components

# uTCA crates connectivity

- Moved from 10Gbit MCH (NP02) to 40 Gbit MCH (DUNE) foreseen to support continuous streaming (12bit, 2MHz) at 15Gbit/crate

NP02 Crate with 10 Gbit MCH



Crate with new 40 Gbit MCH Lyon



- Foreseen for the first cold-box test in 2021, which has a very tight schedule, to take data not on continuous streaming but in external trigger mode (which can be in common with BE) relying immediately on the existing NP02 DAQ infrastructure: minimal effort in the short time available, using a reliable and fully tested system → low bandwidth <10 Gbit
- Even if this initial configuration will be using at the beginning only 3 crates (connected at 40 Gbit but exploiting a small bandwidth in this mode) **we are procuring and setting up now the cold-box network infrastructure designed for a full TOP CRP data taking (5 crates at 40 Gbit) in high bandwidth continuous streaming mode (5x15=75 Gbit) to be exploited in 2022 in a full VD DAQ integration test**

# Optical Fiber infrastructure

## DAQ room

QSFP+ SR4 Transceiver Module

X5 40Gb

X5 10 Gb

Patch panel

30m

Backbone  
Fibers bundle

## Cold-Box

Patch panel

10m

uTCA

uTCA

uTCA

uTCA

uTCA

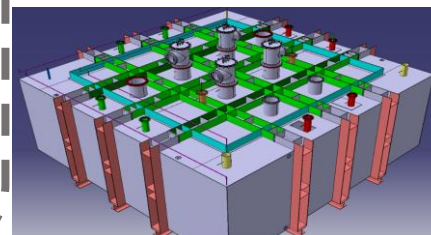
*to be installed in the DAQ room*

*in 2021 this system has to run in parallel with NP02, supported by the existing NP02 DAQ material which can be used for both setups*

**40Gbit links:** baseline solution

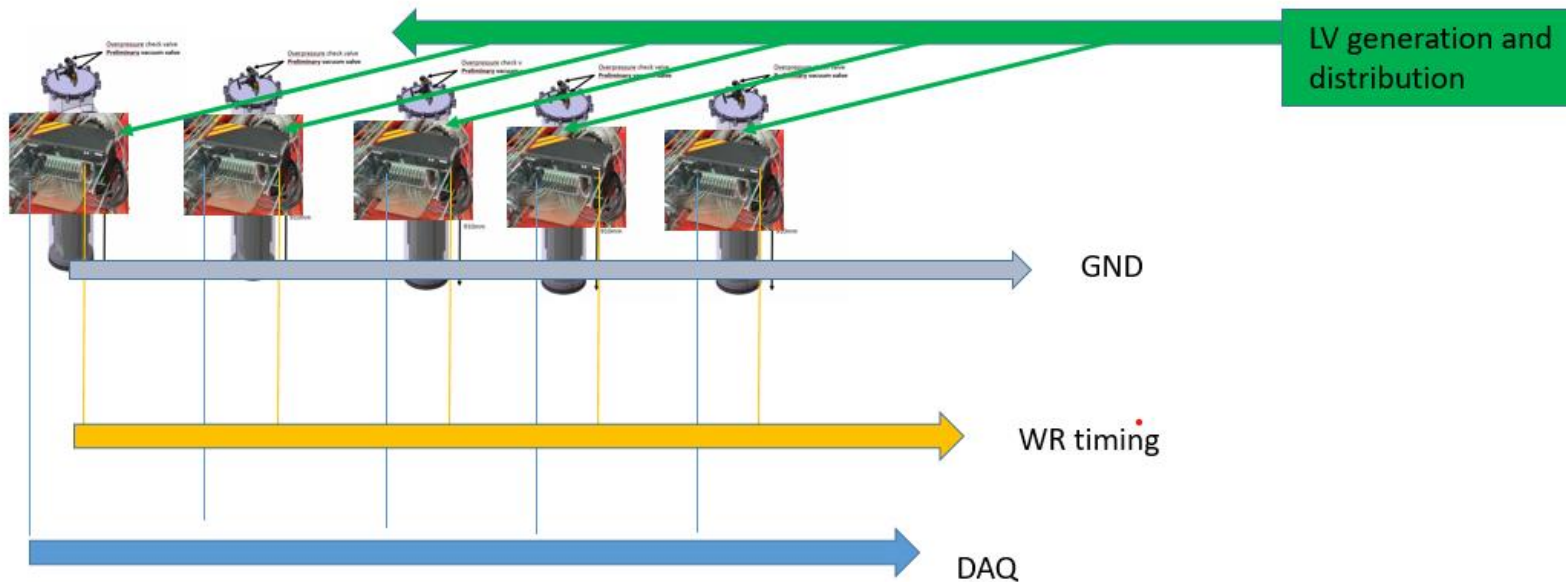
**10Gbit links:** backup solution, that can be easily put in place in case of issues (change MCH with NP02-like ones, unplugging of 40Gb cables and plugging of 10Gb fibers)

**Finalizing offers for 40Gb and 10Gb cables/patch panels under procurement**



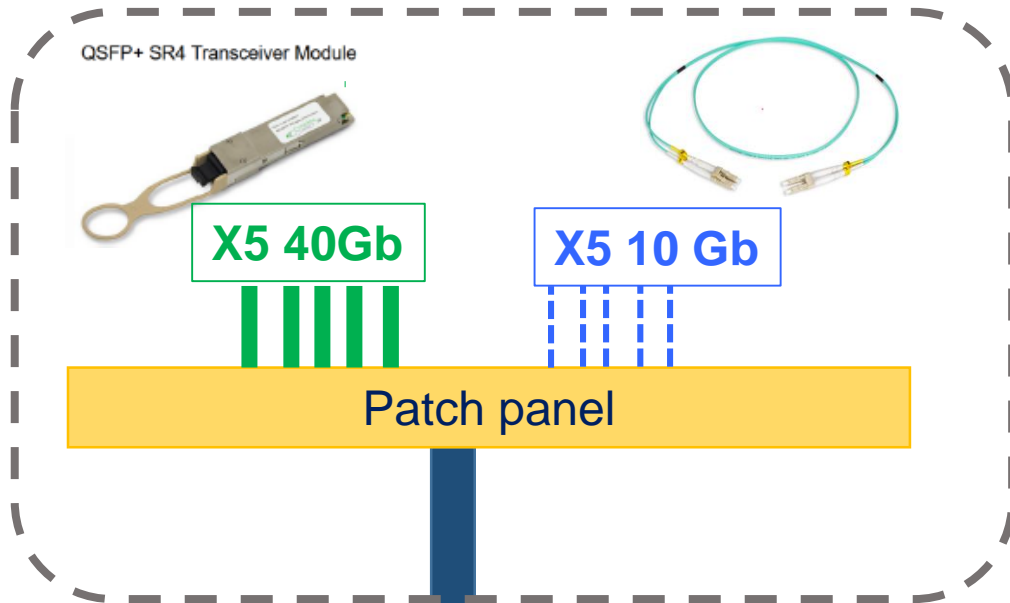
## Top drift electronics integration

- July-September Integration and full commissioning test in NP02 as parallel system in a place nearby the cold-box
- Chimneys put on some temporary stands; all blades and FE cards inserted in chimneys which are connected to the LV distribution system and cabled to the uTCA crates connected to the timing system and DAQ → take noise data

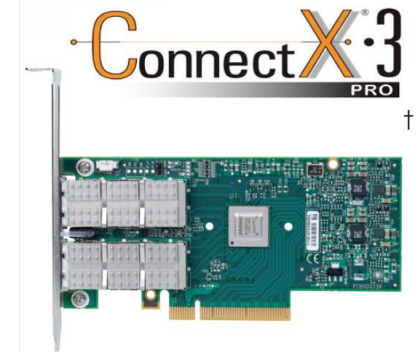


- When cold-box integration starts (beginning of September): un-cabling of chimneys from crates + plugging of chimneys in cold-box cover (2 days)
- When cold-box cover closed: Installation of uTCA crates on cold-box roof and re-cabling (1 day)

# Integration of Optical Fiber infrastructure

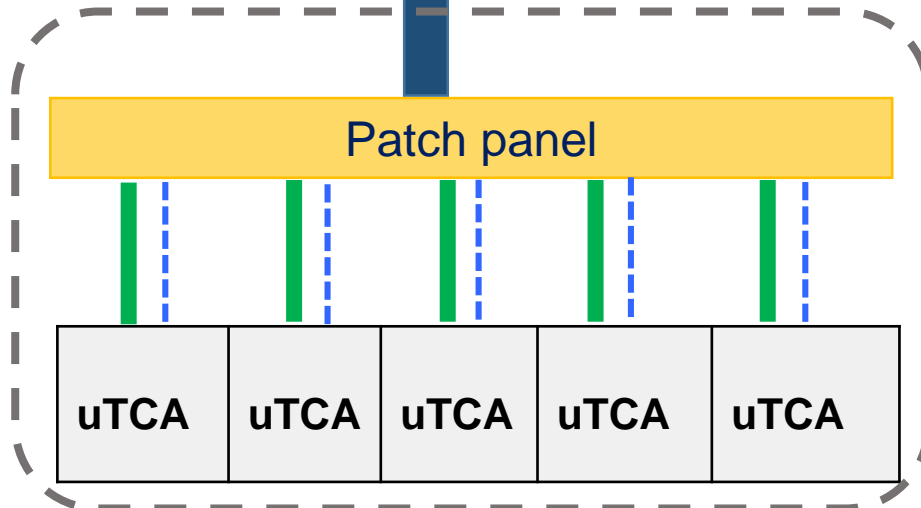


## DAQ ROOM



Mellanox cards x2 QSFP  
40 Gbit routinely used for far for 40Gb connectivity

Backbone fibers bundle: this cable will stay rolled up in Summer, then further pulled to the final cold-box position in September (30m assumed)



## 2 steps:

1. Summer 2021: installed in proximity of the cold-box or in a nearby place at EHN1 for the integration test.
2. September 2021: moved to the cold-box roof, in their final position

## Cold-box data availability

- Data taken with the cold-box will be available on CERNOES, and then copied on tape at CERN and FERMILAB. They will follow the same path as NP02/NP04 raw data.
- This is also important to allow interested people to access them
- Discussion with data management group have already started
- Software used to transfer cold-box data to EOS already available in NP02 environment.

# Conclusions

- We have been/are intensively working in view of the tests campaign in 2021 with:
  - Procurement and tests of additional material until June (practically completed)
  - Integration and preliminary tests June-August
  - Commissioning and operation + NP02 support from September
- Most of the material is procured and being cross-checked and calibrated
- Optical Fiber infrastructure for maximal flexibility in the different staged and very high bandwidth (x5 40 Gbit crates in continuous streaming) has been defined, and offers under finalization
- The test campaign will start with first tests in 2021 and then extend to 2022 with full CRP tests in order to prepare for the module 0 campaign in 2023