FD2 CE CDR Summary and FY22 R&D

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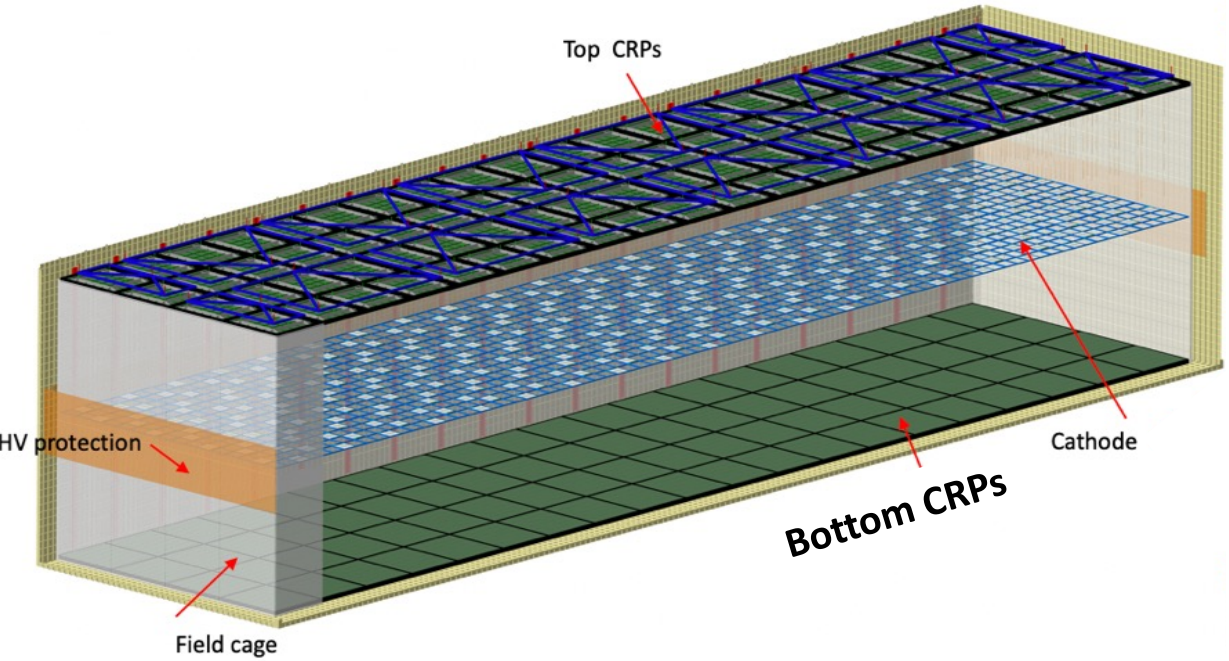
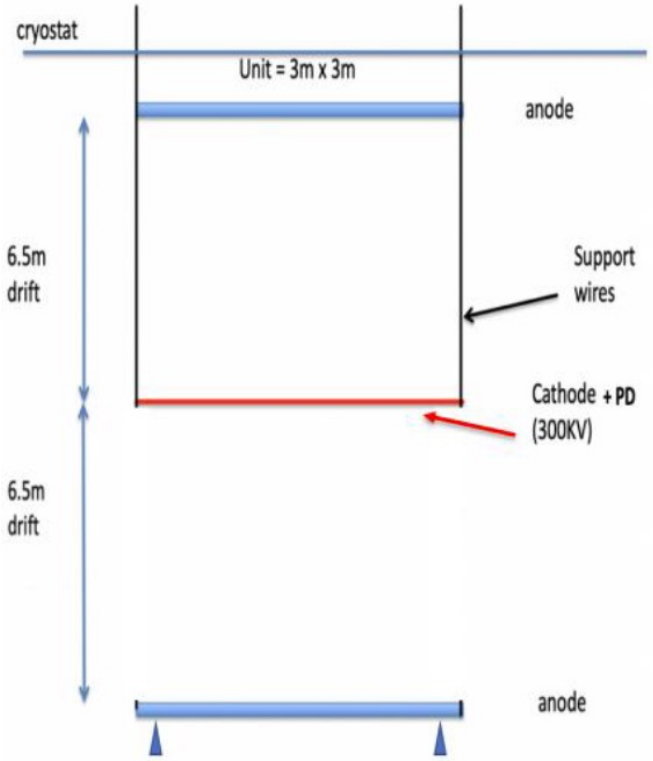
CE Consortium
26 July 2021

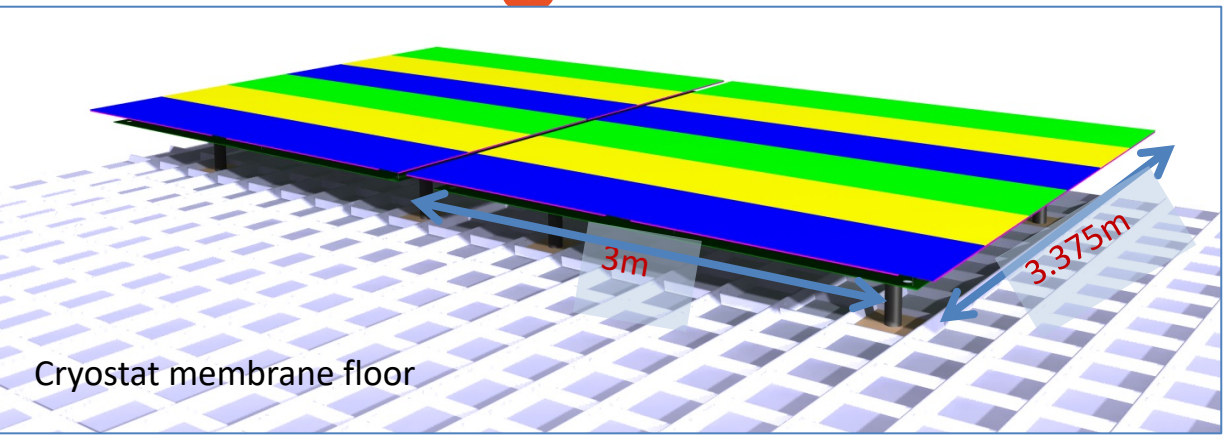
Bottom Cold Electronics

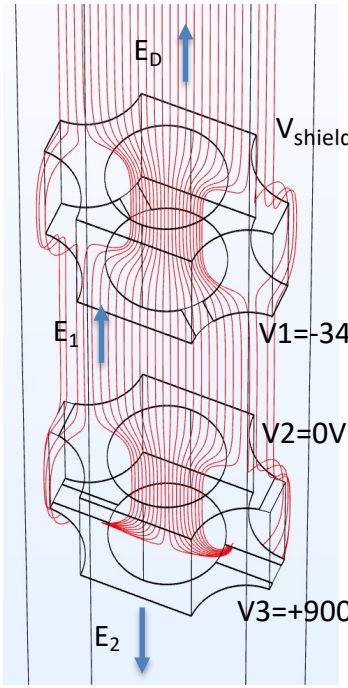




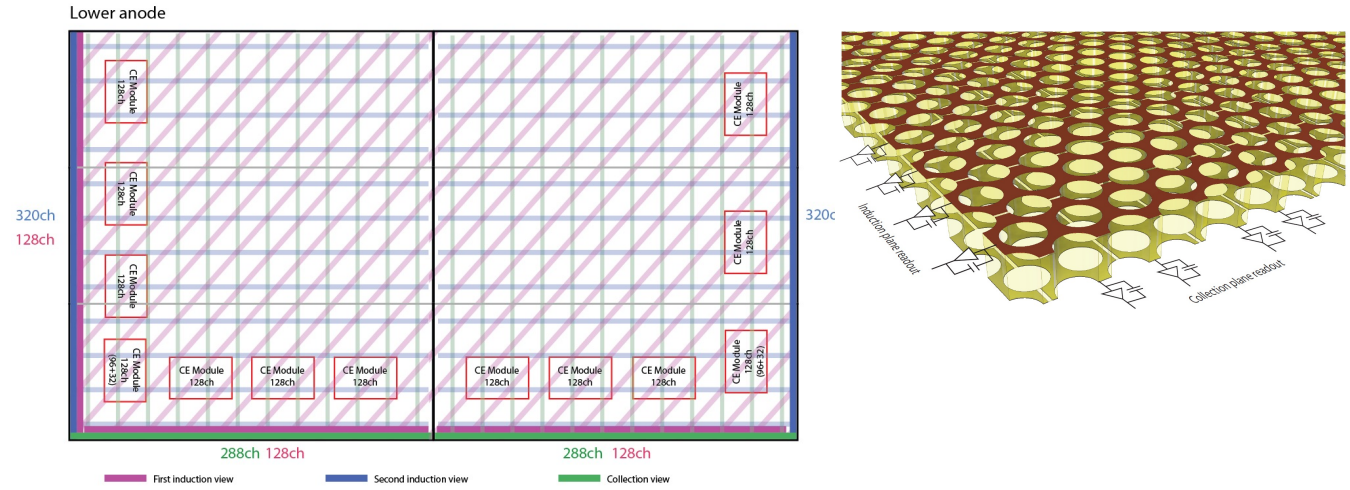
Scope: CE Consortium responsible for the electronics to read out 80 CRPs at the bottom of the cryostat

Charge Readout Plane (CRP)





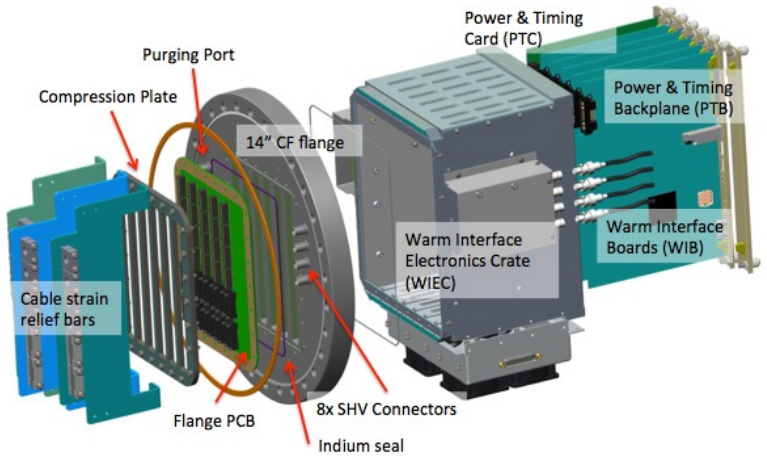
Electron paths in a 3-view configuration with a shield plane facing the cathode.



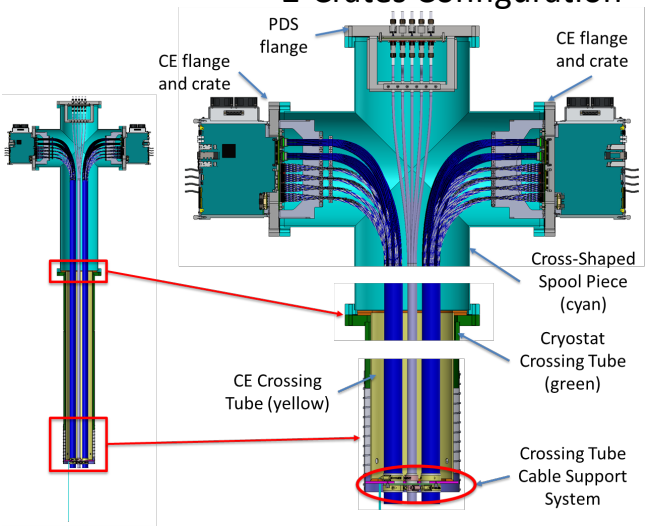
- Induced signal on CRP strips similar to APA wires
- Strip capacitance similar to APA wires
- FD1 CE can be used with minimal changes (e.g. connectors)

TPC Warm Electronics

Warm Electronics Assembly

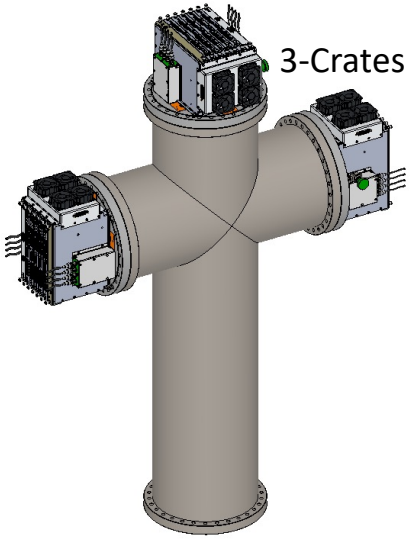


2-Crates Configuration



	DUNE SP LArTPC (half drift)	Vertical Drift 3-view config
LV supplies	25/2	17
Bias voltage crates	5	1 or 2
Bias voltage channels	450 (+208 FC)	160
DDSS panels	30	18
Cryostat penetrations	75/2	40
WIECs	75	100
WIBs	375	520
PTCs	75	100

3-Crates Configuration



FD2 Bottom CE Conceptaul Design Review

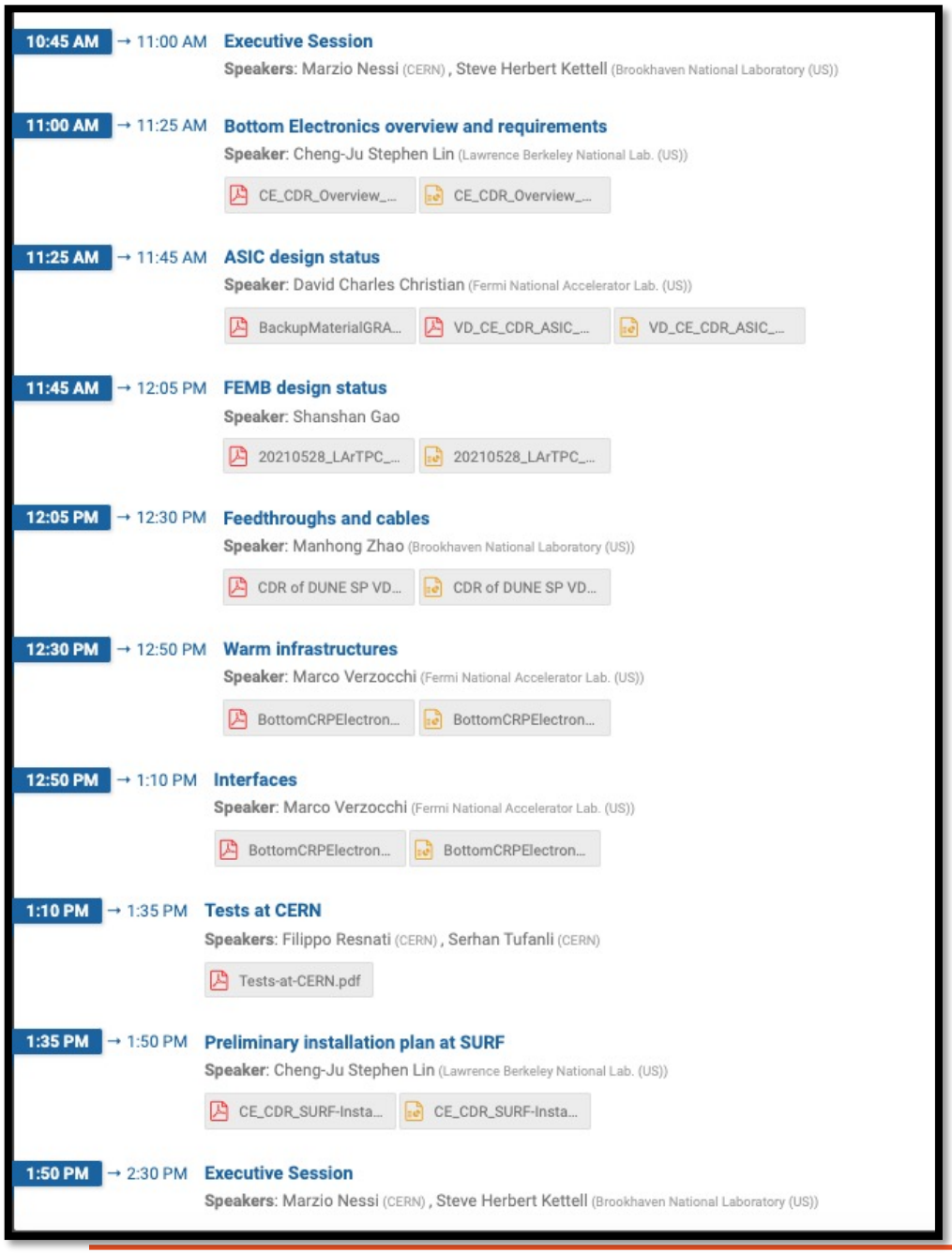
- CDR took place May 28, 2021

- Received final report from review committee about a week ago
  https://edms.cern.ch/document/2580461

- Main charge questions:
  1) Are the requirements documented? Are they reasonable?
  2) Is the scope understood?
  3) Is there a reasonable Plan for R&D and prototyping?
  4) Is the design concept reasonable and feasible?

- Received favorable findings from the committee

- Will discuss some of the recommendations from the committee



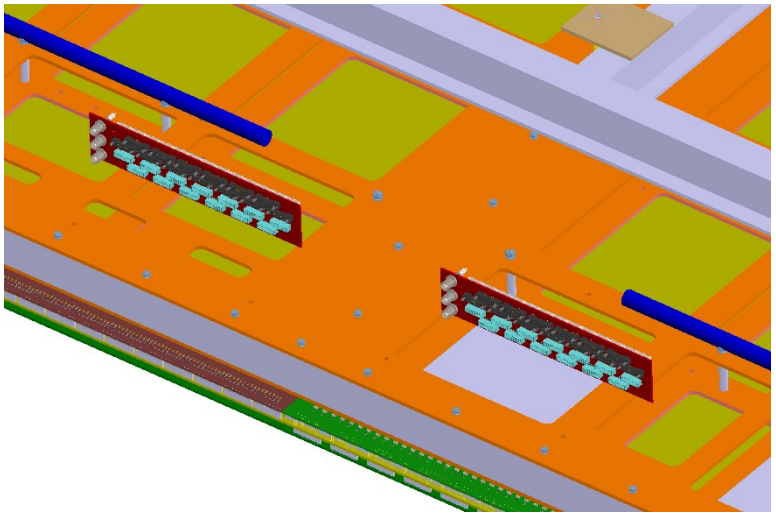
CDR presentations on Indico:
https://indico.cern.ch/event/1038739/

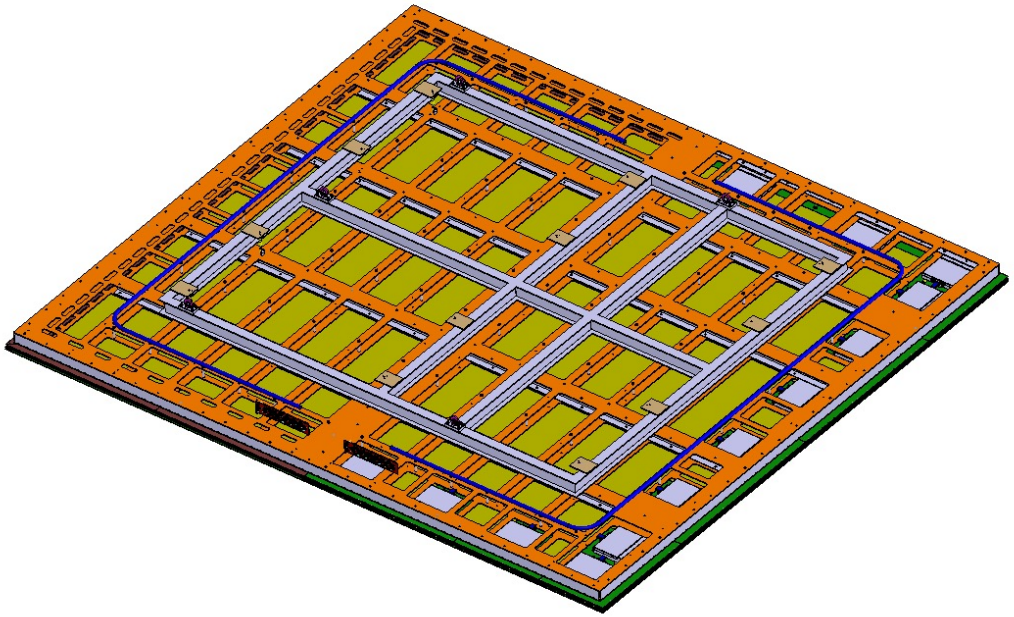
8 presentations covering the design and also R&D plans

CDR Recommendations

Verify signal performance and reliability in warm and cold of the patch panel for validation in FD2-VD cold-box tests

- To simply FD2 Bottom CRP installation, one option understudy is to install FEMBs on CRP and also run short cables from FEMBs to a patch panel on the side of the CRP at the CRP factories
- At SURF, connect the long 25m cables from roof top to patch panel on the side of CRP





CDR Recommendations

Work with DAQ, TDE and PDS to understand the implications of the choices of the timing system before preliminary

- Top CRP CE uses White Rabbit for timing
- FD1 CE uses “Bristol” Timing System
- For FD2 Bottom CE to switch to White Rabbit would require modifying Warm-Interface Boards and timing distribution scheme
- Timing Group is exploring supporting both timing systems for FD2

Work with CRP, HV, TDE, and DAQ to develop interface documents before preliminary design

- At the moment, no formal interface documents exist for FD2
- Need to work with other subsystems to clearly define the interfaces and responsibilities

CDR Recommendations

Continue to explore optimization of the channel count for each CRU for FD2-VD cold-box testing

- 1600 channels per CRU is not optimal for bottom CE
  - Some CRPs have cables that go to two different flanges and some even different penetrations
  - Awkward mapping for FELIX fibers
  - Not a preferred grounding scheme
  - Half of penetrations have 3 WIECs and half have 2 WIECs → not enough extra flanges for PDS fibers
- Proposing to reduce channel count by 64 → 1536 channels/CRU
- Would solve all above issues, but has implication for top CE. Ongoing discussion with top CE Consortium

CDR Recommendations

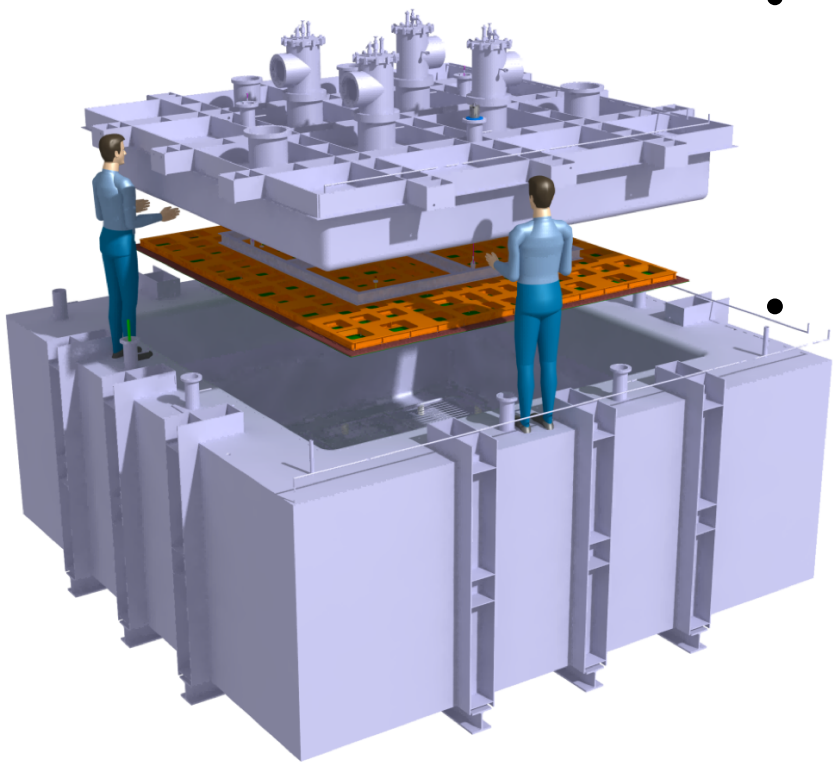
Have the Grounding & Shielding committee review and sign off on the FD2-VD grounding plan before preliminary design

Continue to advance ASIC/FEMB production and validation for ProtoDUNE-II-HD and FD2-VD cold-box tests

Many activities are planned at CERN this year, please provide a list of needed personnel resources by early summer 2021

FY21 and FY22 R&D

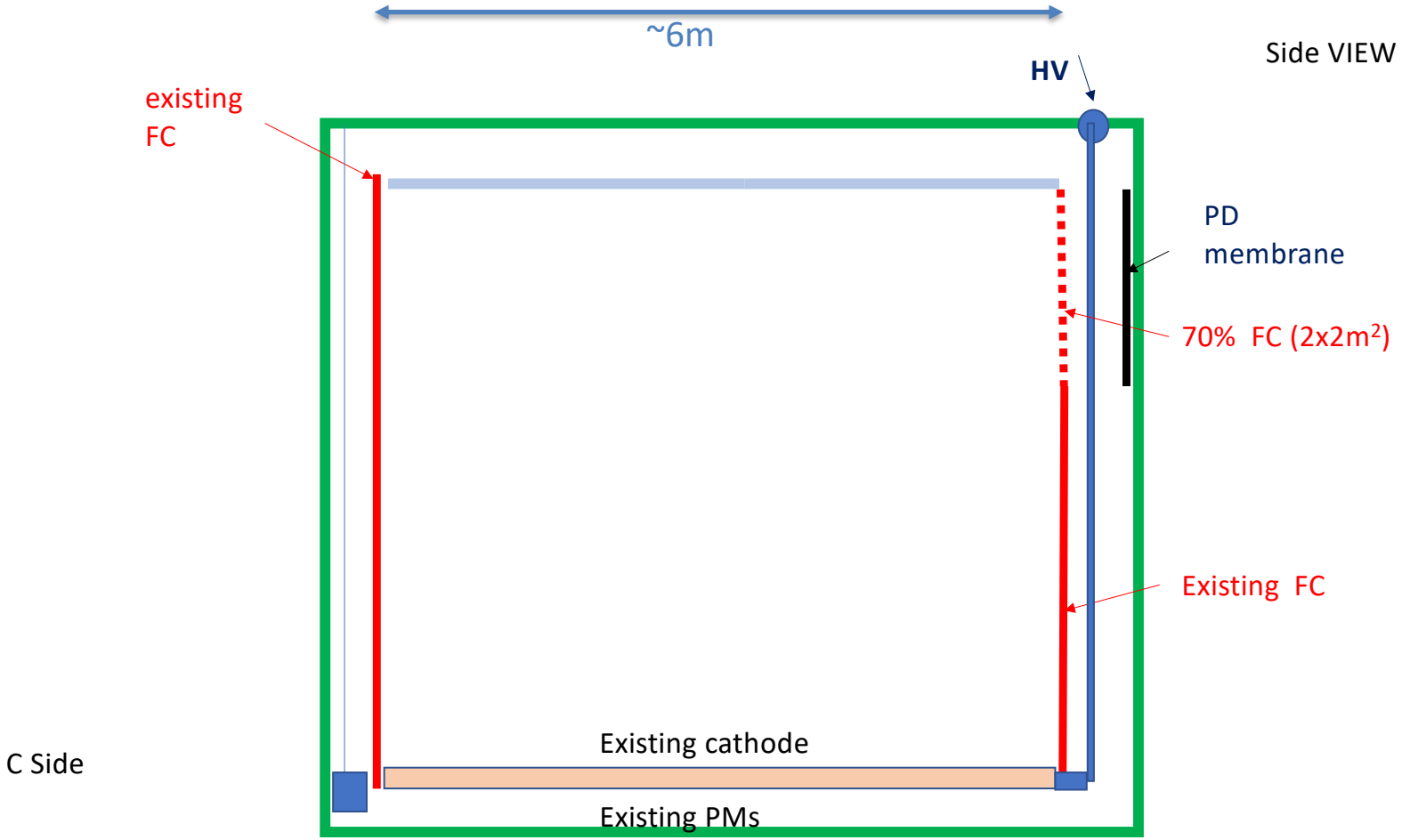
- NP02 Cold-box (TPC in LAr) being modified to test full size CRP
- First test this fall: half instrumented with top CE and half instrumented with bottom CE
- Data taking expect to start in October



- Two more Cold-box run early next year:
  1) ”Optimized” CRP with top CE
  2) “Optimized” CRP with bottom CE
- Testing configuration for Module-0 in NP02

NP02 HV Test

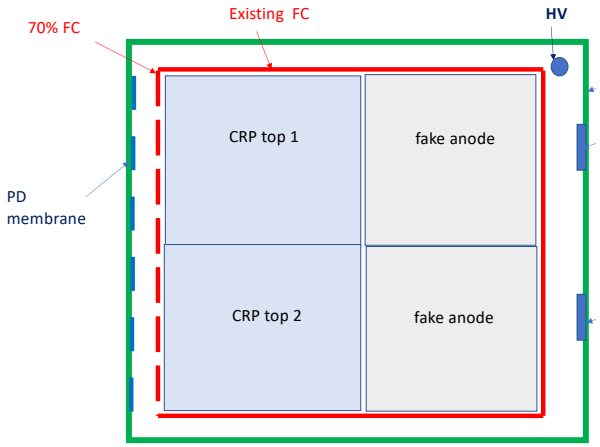
- Installation is ongoing now. Modifying Dual-Phase FC.
- Testing new HV feedthrough at 300 kV and PD prototype
- Results should be available by early fall



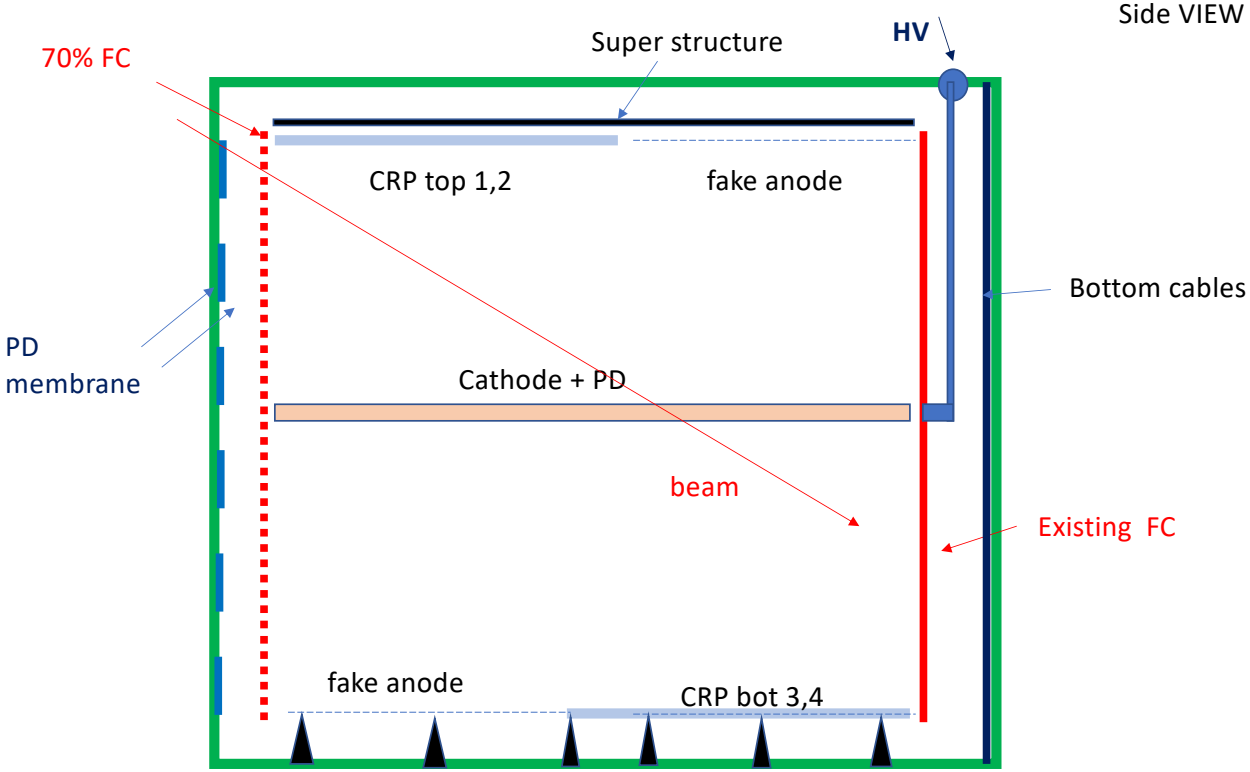
Module-0 in NP02

- Still optimizing the configuration
- Testing various aspects of FD2
- Planned for 2023
- Instrument two full bottom CE CRPs
- Test ~25m long cold cable

Top VIEW



Side VIEW



Summary

- Had a productive CDR for FD2 Bottom CE
- Will start addressing all the recommendations from the committee
- Very active R&D at CERN (NP02/04 Cold-boxes and Module-0s) in the next few years
- Short on people from the U.S. to participate in the CERN Cold-boxes and Module-0 runs. Let Marco and I know if you are interested in spending some time at CERN to help out
- Also need people to work on the offline data analysis from the CERN tests