

Naming convention for APA positions inside the cryostat (and other considerations)

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Outline

- A few weeks ago Jack contacted Alberto and me and asked whether we had a naming convention for the position of the APAs
- I prepared some of these slides that were circulated between a few people (including Kyle)
- No real comment, other than “it’s more or less what we all think”
- Then I started to investigate how to expand this to FEMBs (goal would be to expand also to cables, and Dave Wagner wants to expand this to photon detectors)
- Slides 3-6 should really be a no-brainer
- Starting from slide 7 “hic sunt leones”



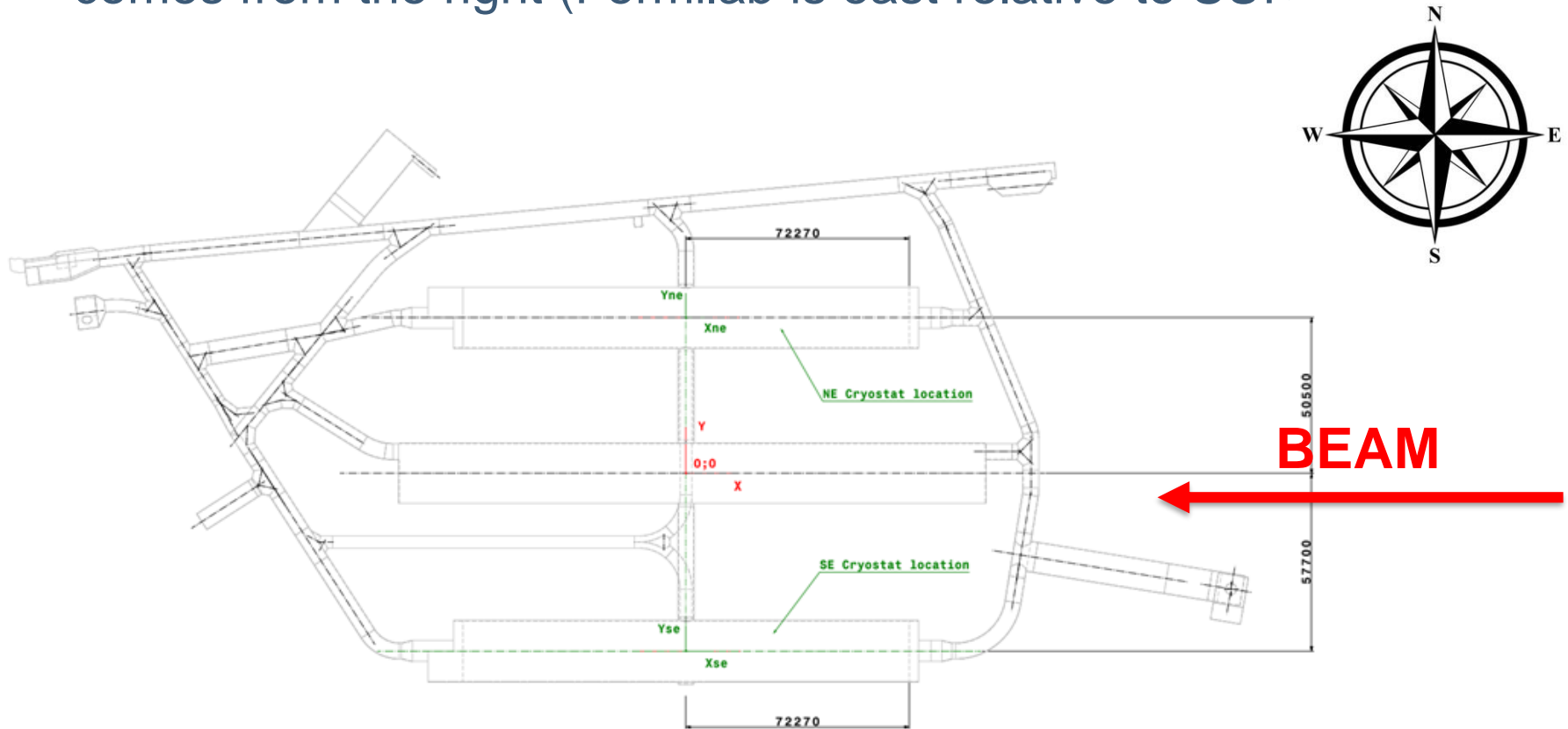
Naming Proposal

- We are not deciding the naming of APAs, we are discussing the naming of the APAs positions in the cryostat
 - APAs are inserted in the cryostat from the end-wall opposite to the TCO opening (west side of cryostat)
 - There are 3 arrays of APAs (north, center, south)
 - There are 2 vertical positions (upper, lower)
 - Use a 5 character string to identify the position of an APA:
- Where:
 - **M**=1, 2 is the single phase detector module number (1 in the north cavern, 2 in the south cavern)
 - **RR**=01,, 25 is the row number (01 is on the east side of the cryostat, 25 on the west side, closest to the TCO)
 - **A** is one of N, C, or S (north, central, south)
 - **B** is one of U or L (upper or lower)

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SURF Caverns and Cryostats

- Please note that compared to ProtoDUNE, in DUNE the beam comes from the right (Fermilab is east relative to SURF)



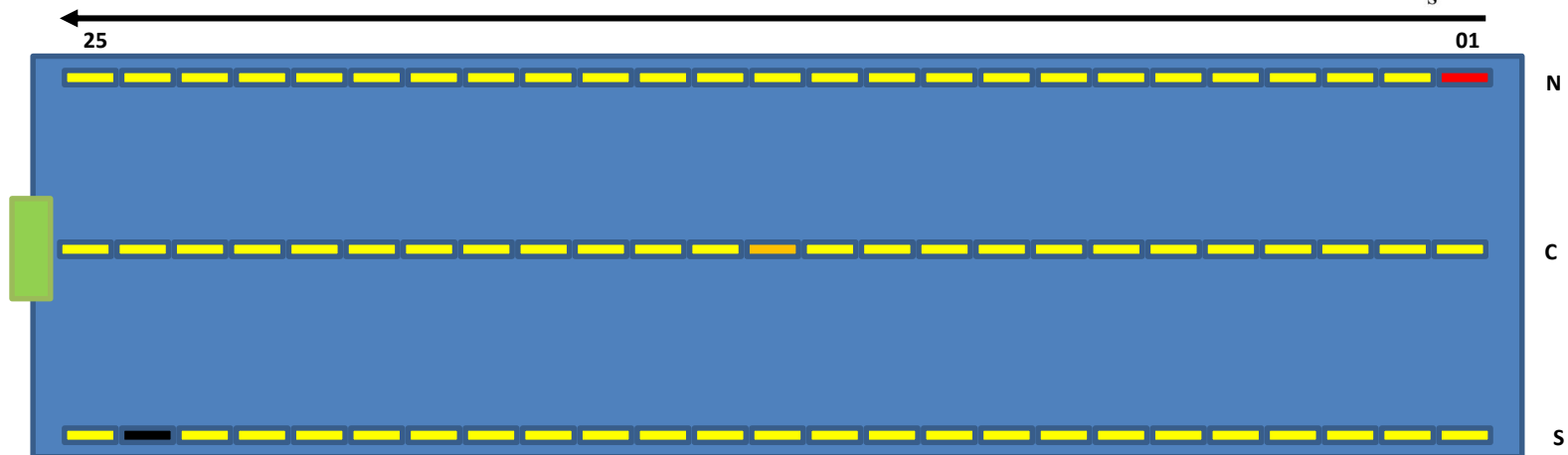
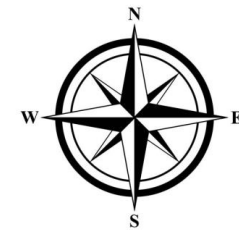
Detector Module 1

Red APAs are in position 101Nx (x=U or L)

Orange APAs are in position 113Cx (x=U or L)

Black APAs are in position 124Sx (x=U or L)

Green box represents the TCO



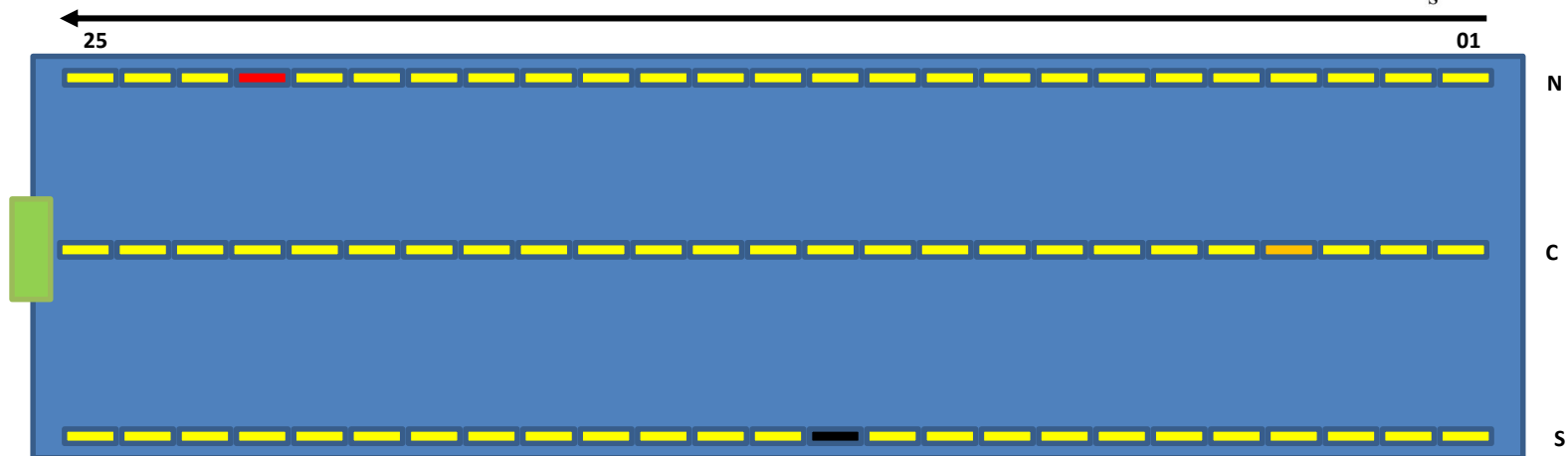
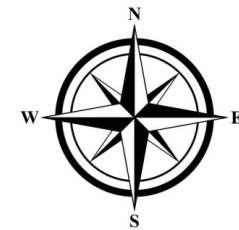
Detector Module 2

Red APAs are in position 222Nx (x=U or L)

Orange APAs are in position 204Cx (x=U or L)

Black APAs are in position 212Sx (x=U or L)

Green box represents the TCO

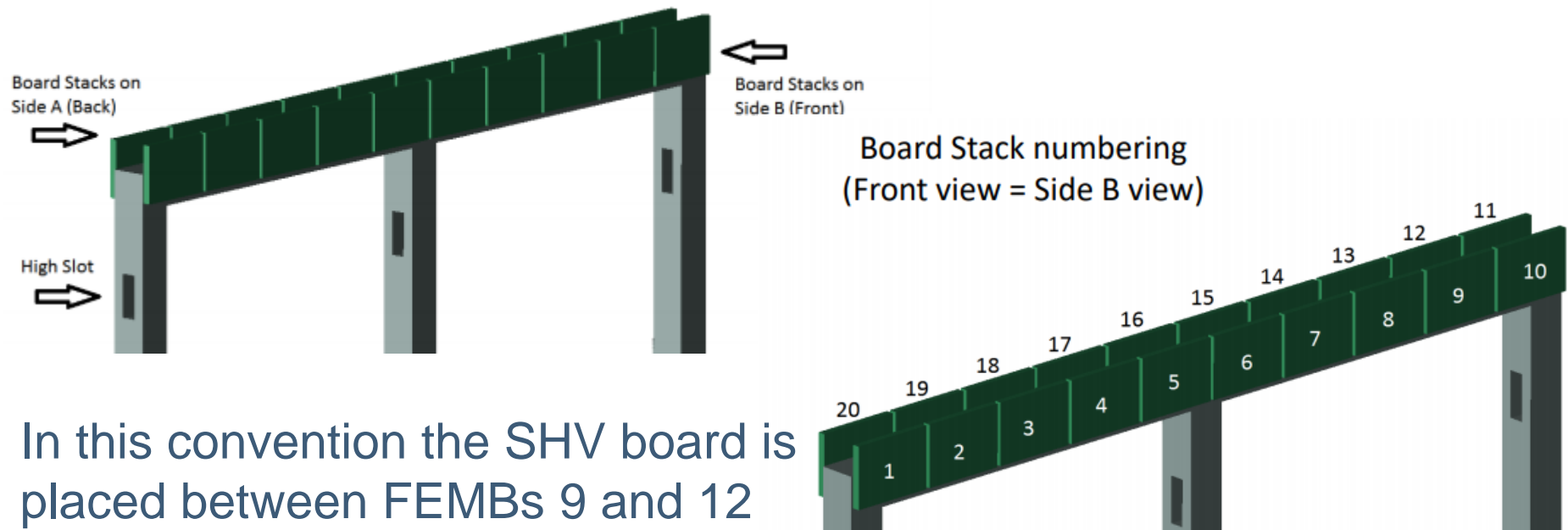


Extending this to the FEMBs

- This should be simple
- Decide which FEMB position is 01, which one is 10, which one is 11, which one is 20 (do we start counting at 1 or at 0 ?)
- It turns out that in ProtoDUNE two conventions have been used
 - The APA uses one convention, TPC electronics and offline use another
 - This is not going to be fun when we extract the ProtoDUNE APAs from the cryostat and we try to match the dead channels offline with the wires on the APA and try to investigate....
- Are we going to be stuck with this for DUNE ?

The APA Convention

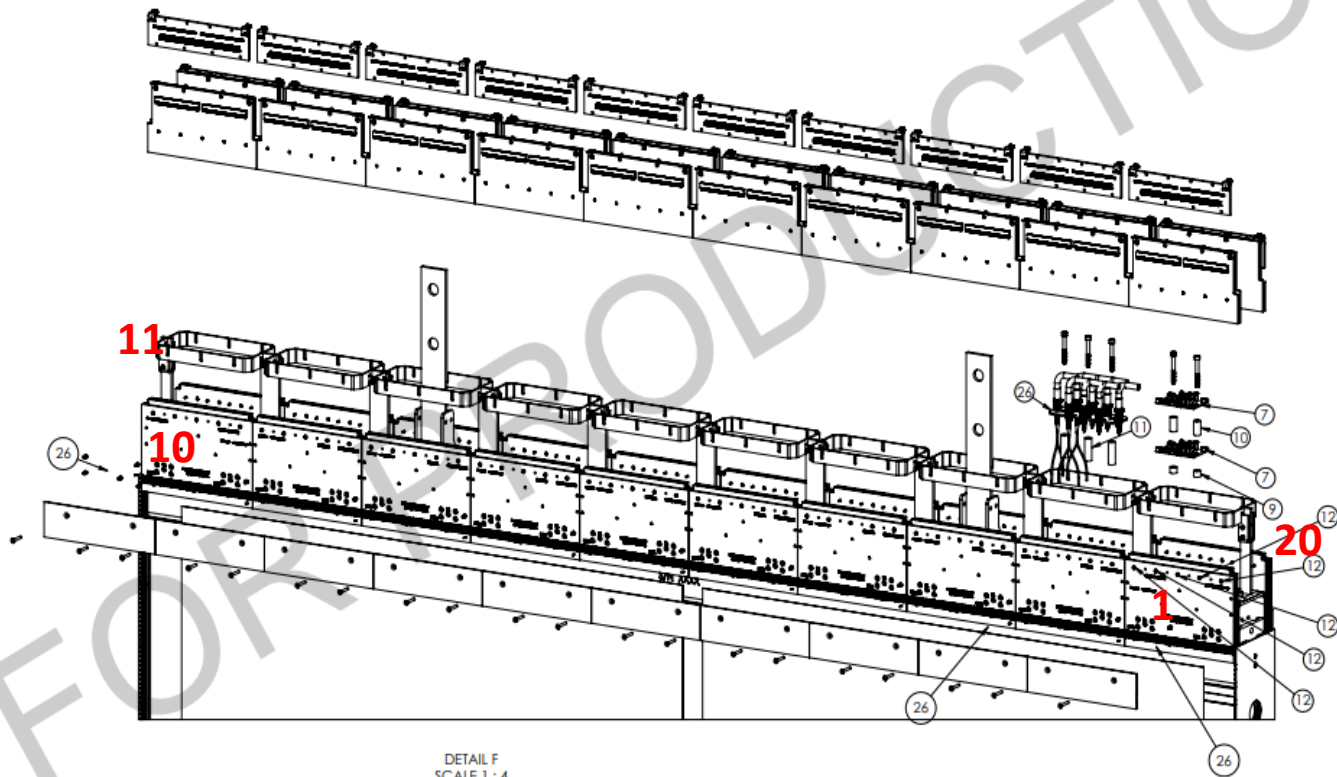
- The APA consortium breaks the symmetry of the APA (assign sides A&B) by using the position of the highest photon detector insertion slot



In this convention the SHV board is placed between FEMBs 9 and 12
The FEMB ordering (looking from the top of the APA) is counter-clockwise

The TPC Electronics / SW Convention

- In ProtoDUNE the numbering scheme used for the TPC electronics and the offline has the FEMBs ordered clock-wise and the SHV board sits between FEMBs 2 and 19

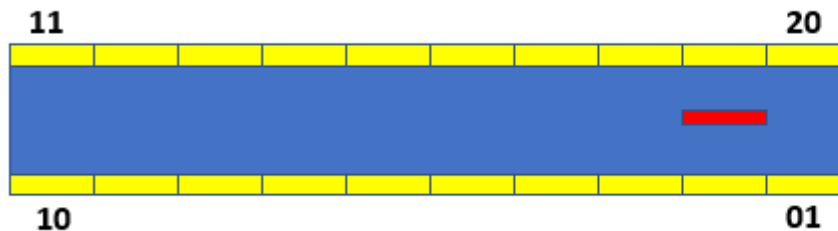


Consequences

- Whenever we take out the ProtoDUNE APAs from the cryostat and we try to investigate the non-responsive channels we need to take into account the different numbering schemes
- If we do not fix this difference for DUNE, we will always need a map between the measurements done by the APA consortium (ex. wire tension measurements) and measurements done based on electronic readout
- I am not going to argue for one or the other
- In the rest I will make some considerations based on the TPC electronics numbering scheme
 - These remain valid even if DUNE uses the other numbering scheme

Numbering scheme for FEMBs

- Essentially using the location of the SHV board to break the symmetry (works because the SHV board is installed by the time we install the FEMBs)
- Use the same scheme for all APAs independent from their position in the cryostat, concentrate on FEMBs for upper APA for the moment
- This means that for the north array FEMBs 11/20 are close to the cryostat wall (see little charge) and that the same happens for FEMBs 01/10 for the south array



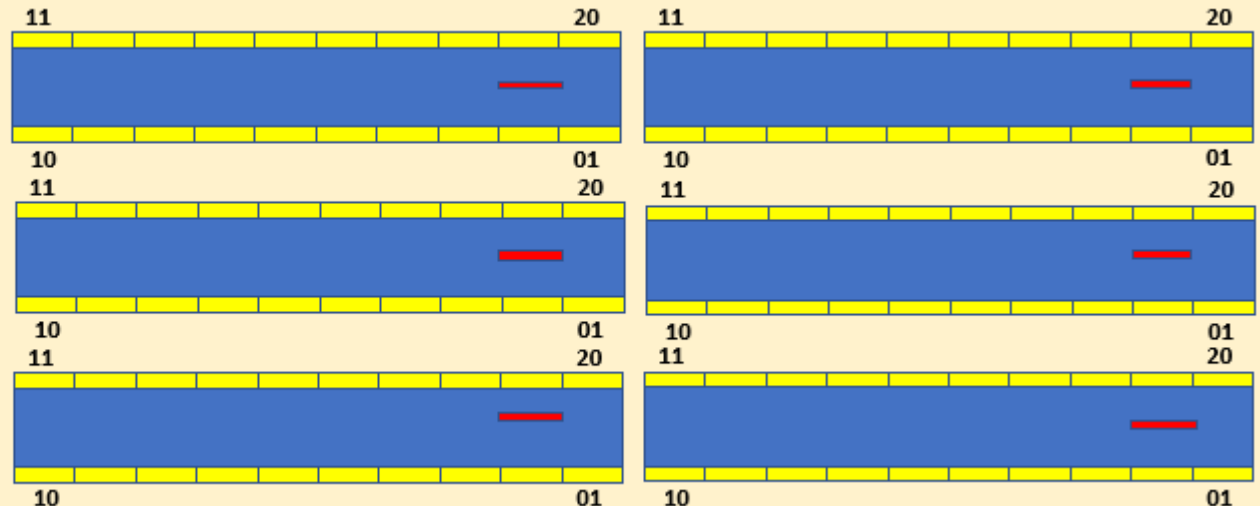
VIEW FROM ABOVE
THE HEAD TUBE OF
AN APA

Upper APAs in the cryostat

- All APAs inserted in the cryostat with the same orientation
- Use same numbering scheme
- Cryostat in pink below, with TCO opening on the left side



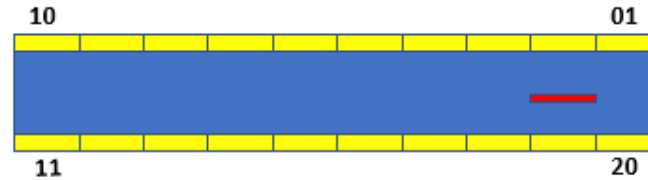
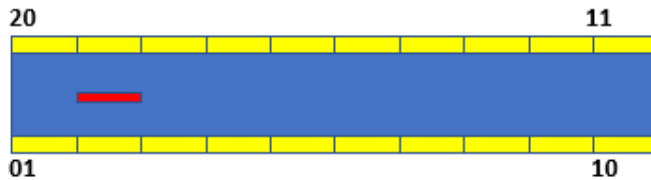
VIEW FROM TOP
OF THE CRYOSTAT



Lower APAs

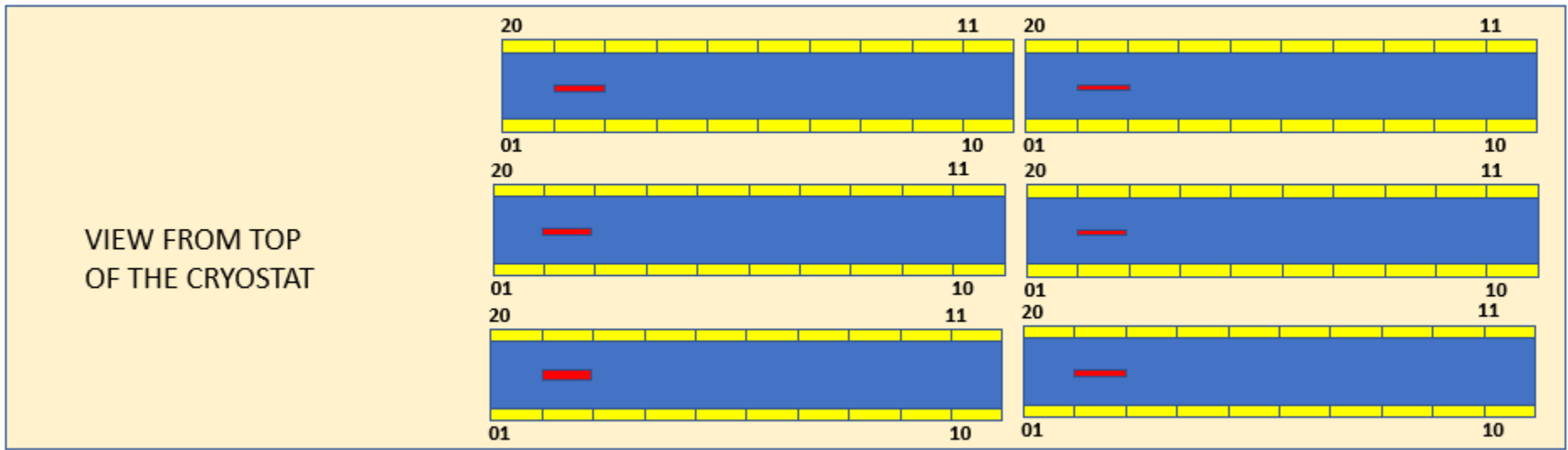
- Two choices, depending on how the lower APA is rotated relative to the upper APA
- Maintain clock-wise ordering when viewing the APA from above the head tube (i.e. clock-wise ordering in the local reference frame of the APA)
- Two choices correspond to having the SHV boards of the upper and lower APAs on opposite sides or vertically aligned

THESE ARE THE VIEWS FROM THE TOP OF THE CRYOSTAT, IN THE LOCAL REFERENCE FRAME OF AN APA THE FEMBS ARE STILL NUMBERED IN A CLOCKWISE WAY



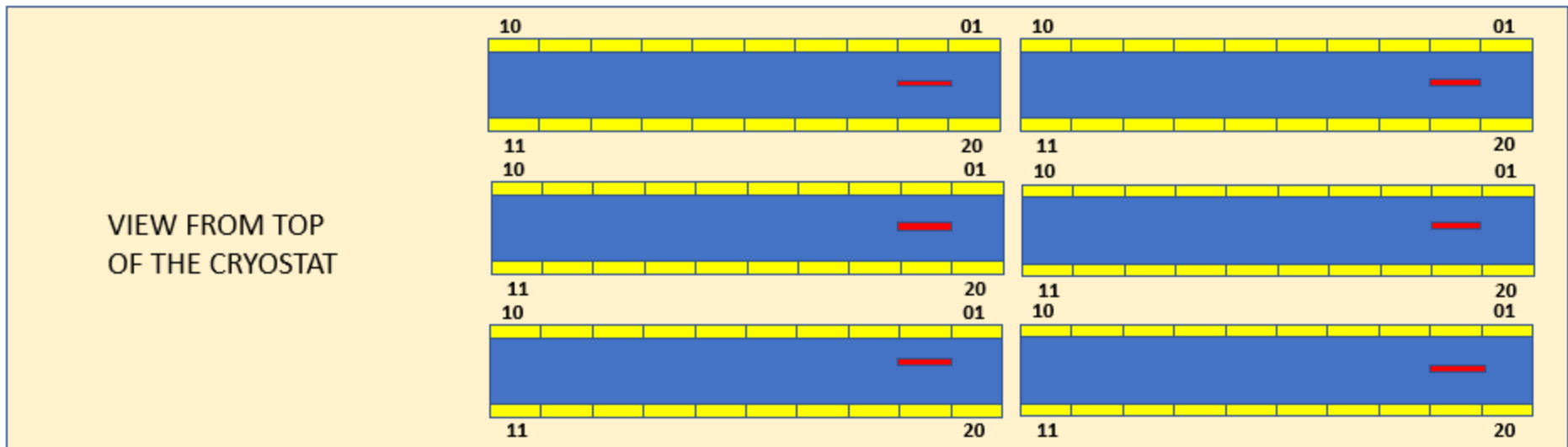
Lower APAs choice 1

- This is the solution with the SHV boards on the opposite side



Lower APAs choice 2

- This is the solution with the SHV boards on the opposite side

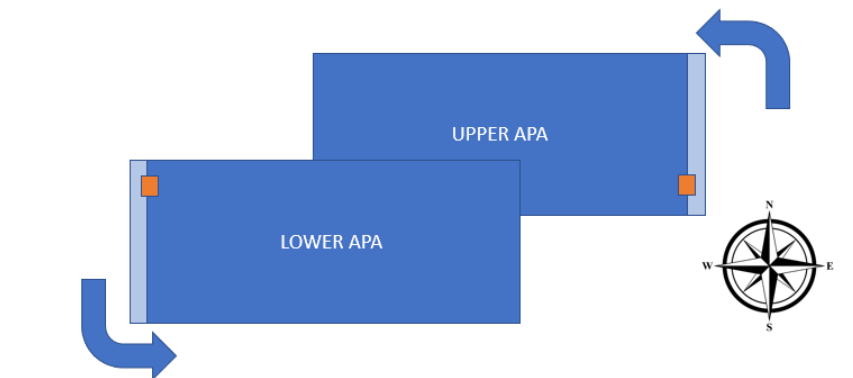
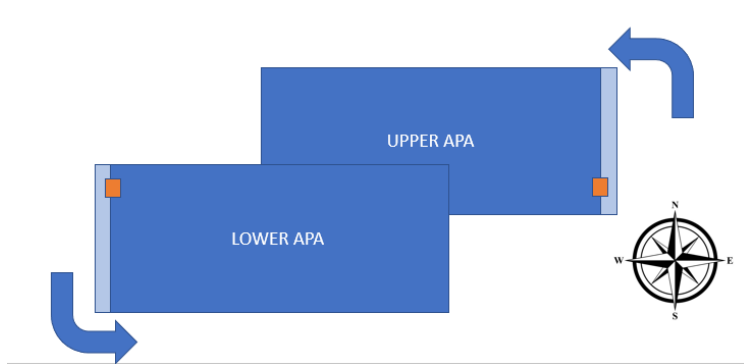


Differences ? Consequences ?

- There is really no difference (as far as I can say) between the two solutions (I cannot see any advantage to one or the other)
- May want to consider photon detector cabling / numbering as well to decide between the two

Rotating APAs in the clean room ?

- There is no easy mechanism to rotate the APAs around their vertical axis in the clean room
- The APAs need to be inserted in the support frame, the support frame needs to be inserted in the transport box, the transport box needs to arrive in the clean room **ALWAYS IN A CONSISTENT WAY**
- This needs to be part of the APA QC procedures



Conclusions

- DUNE needs to take a decision about the difference in numbering scheme between APA on one side and TPC electronics/offline on the other side
- Proper documentation is absolutely necessary
 - ProtoDUNE documentation for TPC electronics / offline is sort of fine, but beware of the Wiki page....
- For offline monitoring purposes it may be interesting to have wire addresses that use the range 1-384,000 (1st detector)
- **MRRAB**www
- Need to decide the mapping between **RRAB** and range 0-149