

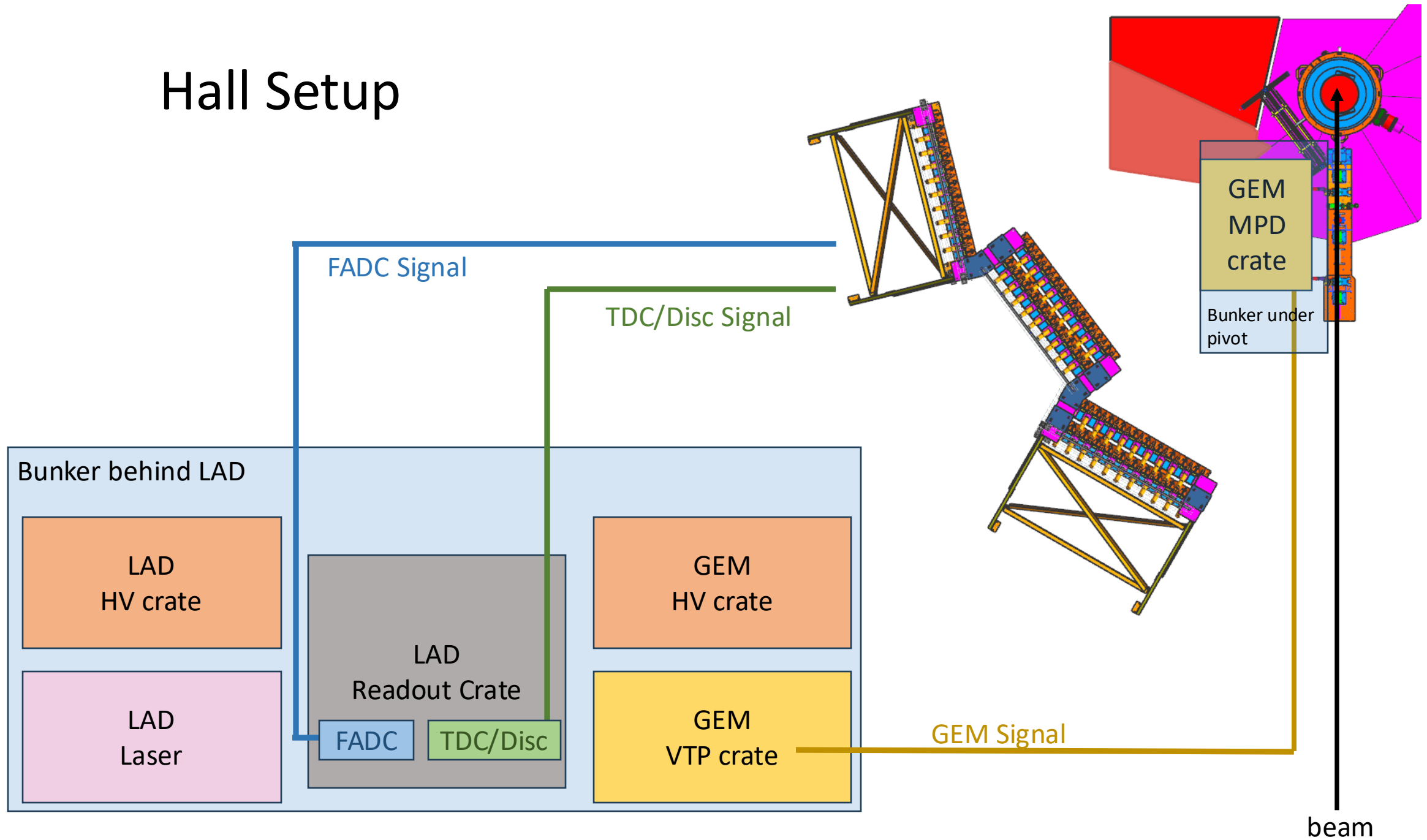
LAD

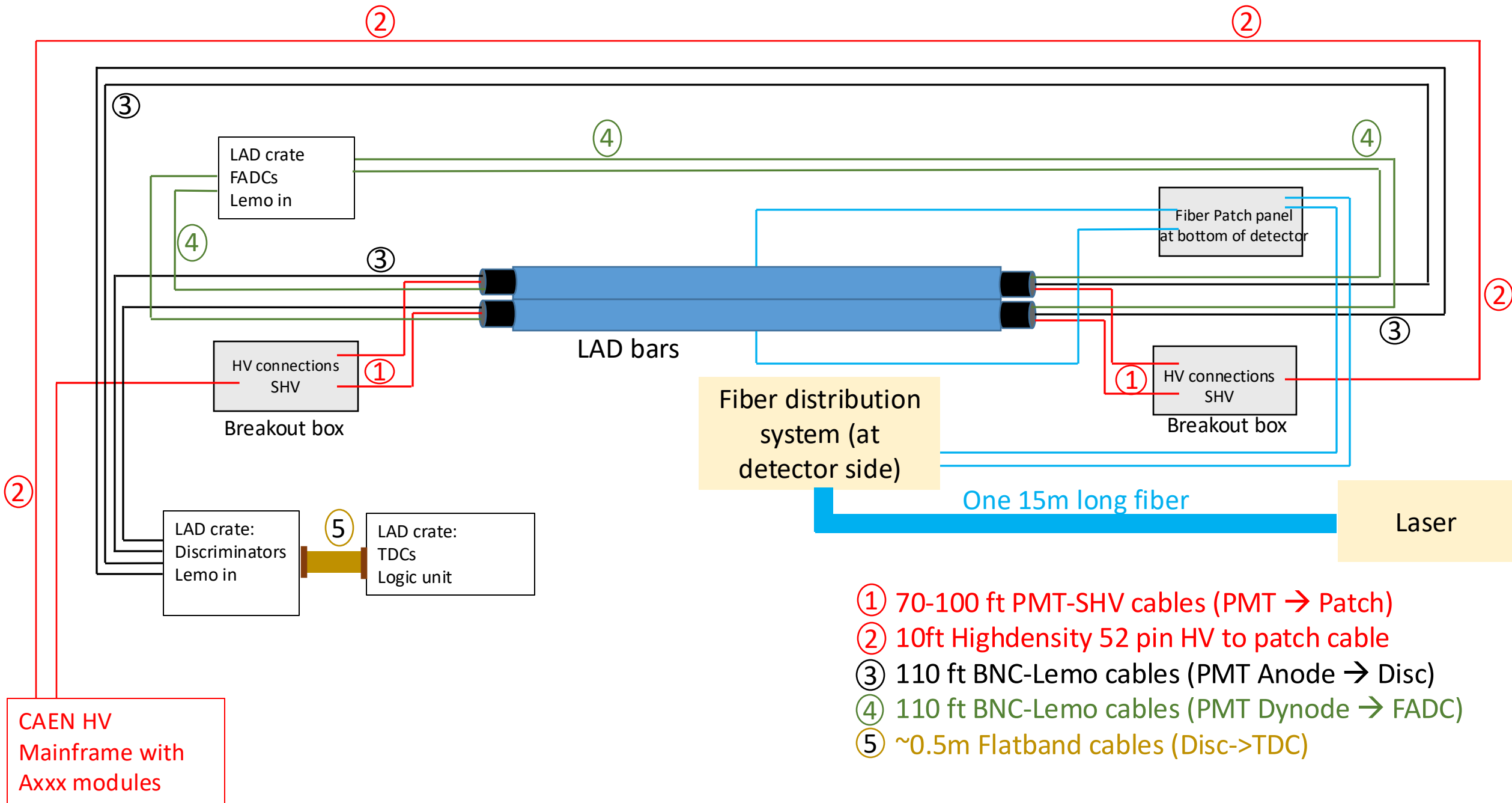
Cable and Trigger Diagrams

v0.4

Florian Hauenstein
01/15/2025

Hall Setup



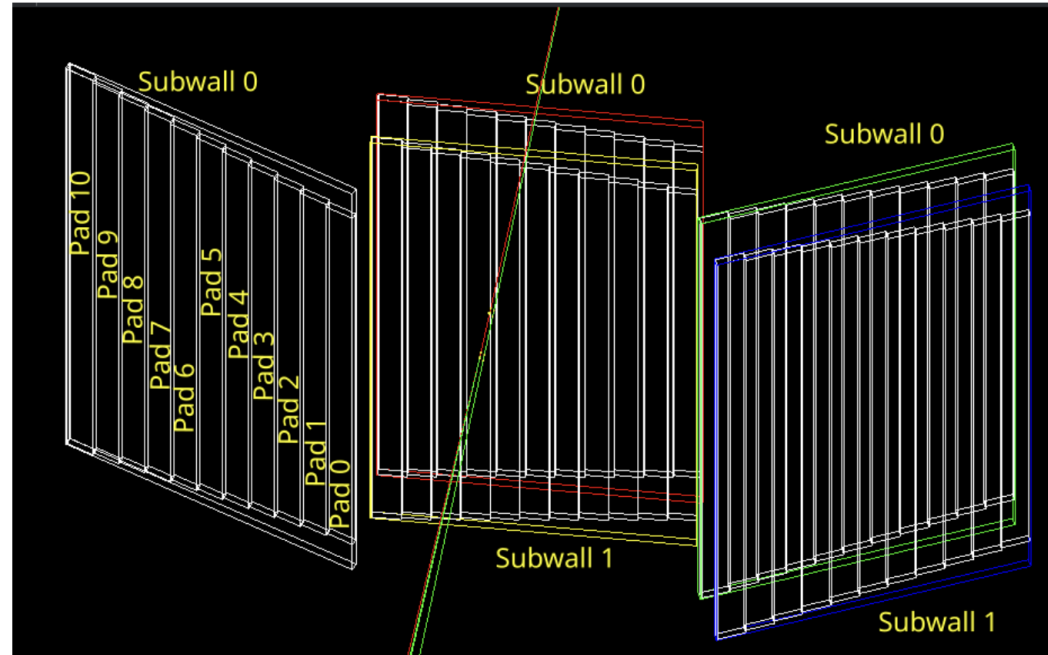
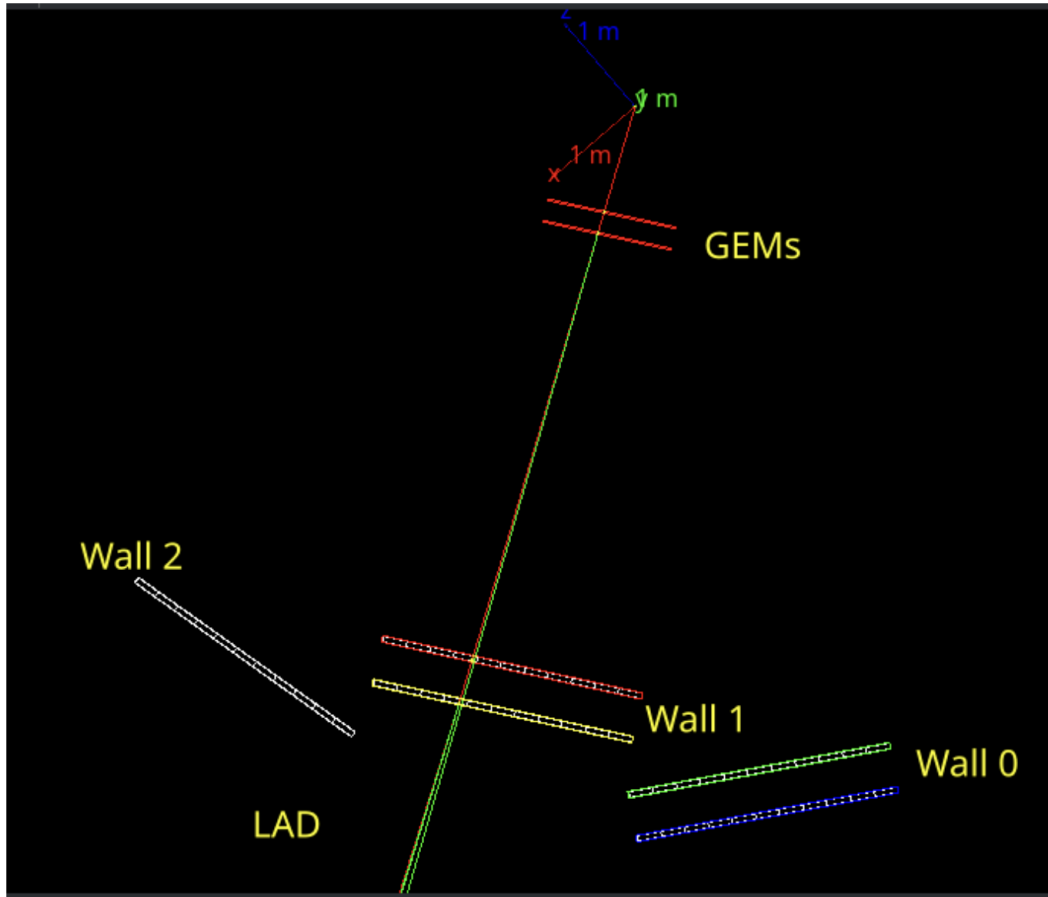


LAD Readout Crate: Crate Name lad-vme1

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
CPU Board: LAD		Trigger Logic Board V1495		Disc G1	Disc G2	Disc G3	Disc G4	Disc G5	Disc G6	Disc G7	TDC 1190A or 1290	Signal Distribution Card	FADC G1 0x6800	FADC G2 0x7000	FADC G3 0x7800	FADC G4 0x8000	FADC G5 0x8800	FADC G6 0x9000	FADC G7 0x9800	Trigger Interface Card

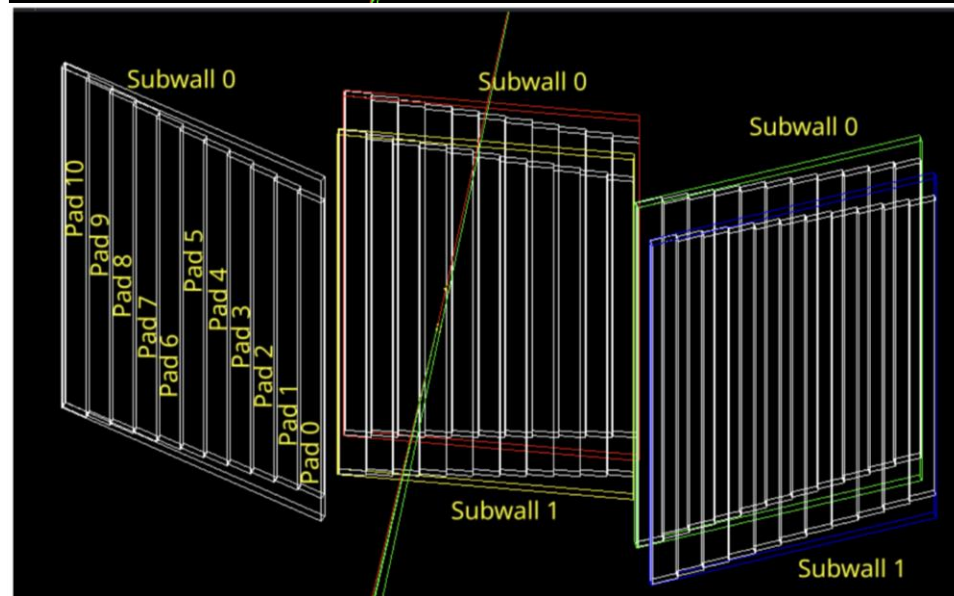
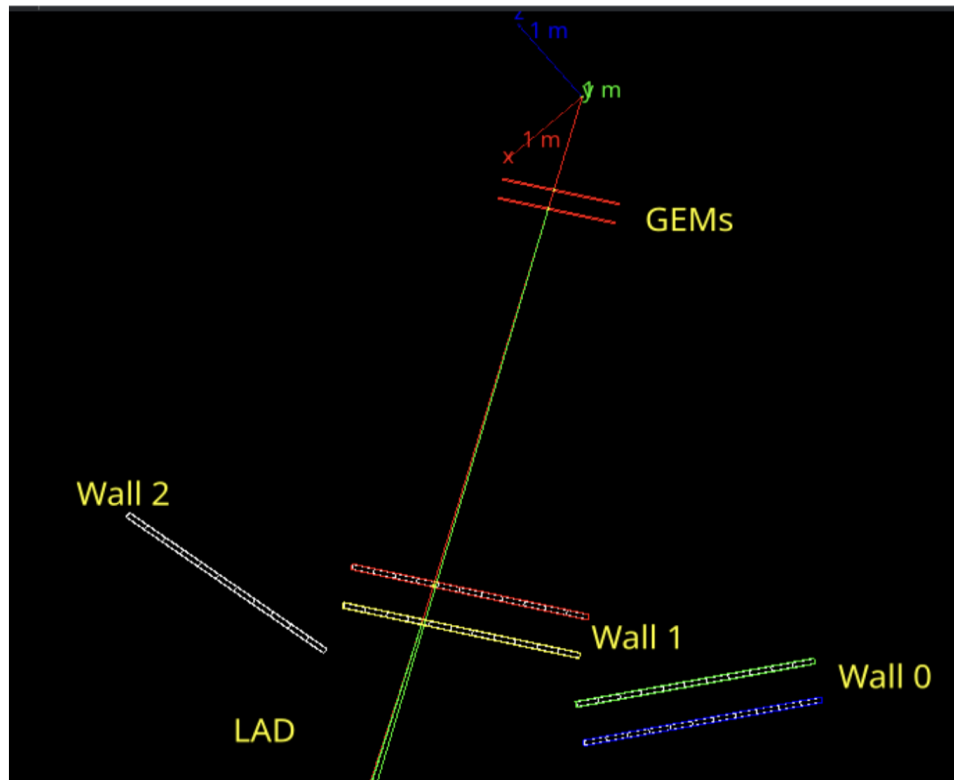
1V Jumper set on all FADCs

Plan for Cable Maps



- ADC and TDC channels from PMTs = 110, 7 FADCs and Discriminators = 112 channels
 - 2 spare channels, one will be used for laser reference photo diode
 - Plan: Use top part of FADCs (channels 8-15) for top PMTs and lower part (channel 0-7) for bottom PMTs
- HV:
 - 4 boards each 36 channels = 144 → a lot of spares since 110 required
 - Plan: Wall 2 gets standalone breakout box, skip 12th channel on each breakbox

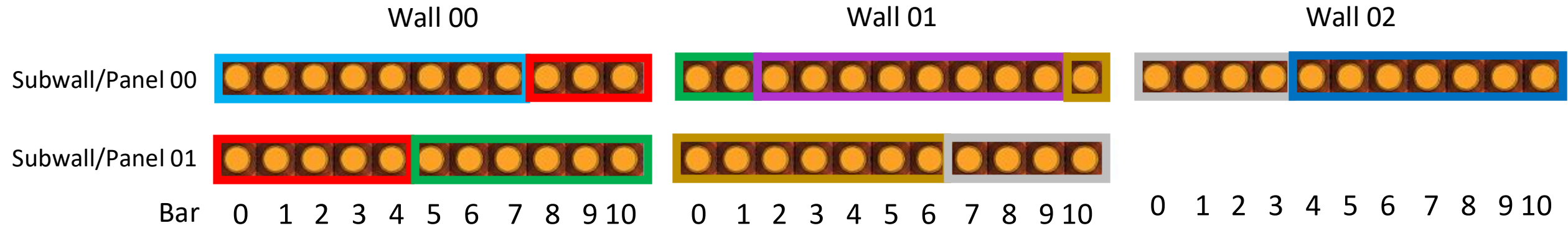
LAD Labeling



- Six digit numbers for each bar
 - First Number = Wall (00,01,02)
 - Second Number = Layer (00,01)
 - Third and Fourth number = Bar in layer (00-10)
- For every PMT the label is extended by U and D corresponding to top or bottom PMT

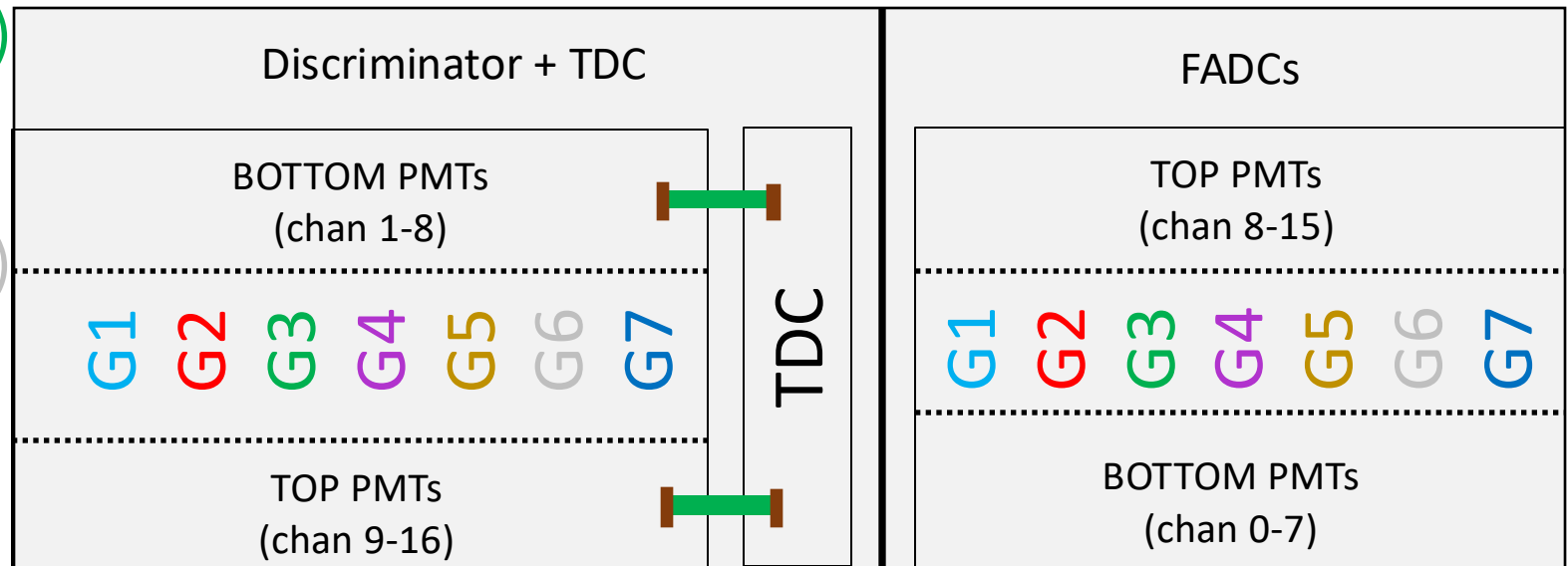
Label = WW LL BB U/D

Signal Mapping (FADCs and Discriminators/TDC)



- G1: 0000(00-07)
- G2: 0000(08-10) + 0001(00-04)
- G3: 0001(05-10) + 0100(00-01)
- G4: 0100(02-09)
- G5: 010010 + 0101(00-06)
- G6: 0101(07-10) + 0200(00-03)
- G7: 0200(04-10)

- Bottom PMTs: Channels 0-7 on FADC and 1-8 on Disc
- Top PMTs: Channels 8-15 on FADC and 9-16 on Disc



HV Mapping

Wall 00

Wall 01

Wall 02

Subwall/Panel 00



Subwall/Panel 01



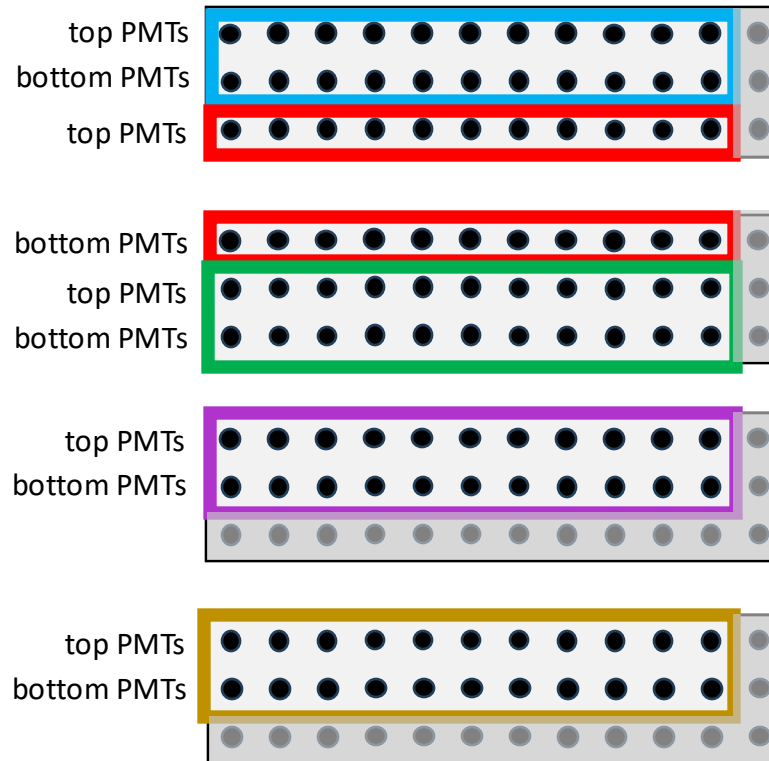
Bar

0 1 2 3 4 5 6 7 8 9 10

0 1 2 3 4 5 6 7 8 9 10

0 1 2 3 4 5 6 7 8 9 10

HV Break out boxes



LAD HV Mainframe

Slot 0

Slot 2

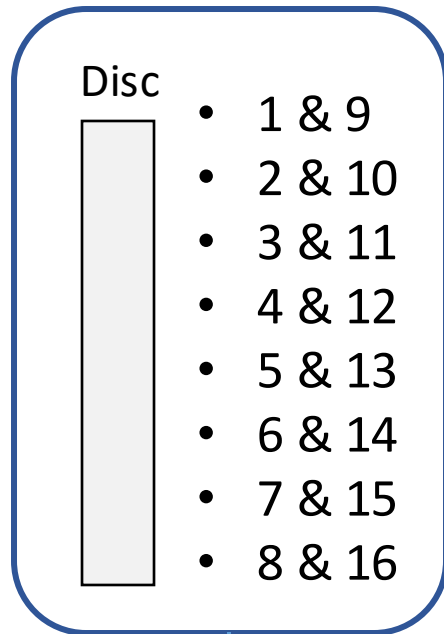
Slot 4

Slot 6

- HVG1: 0000(00-10)
- HVG2: 0001(00-10)
- HVG3: 0100(00-10)
- HVG4: 0101(00-10)
- HVG5: 0200(00-10)

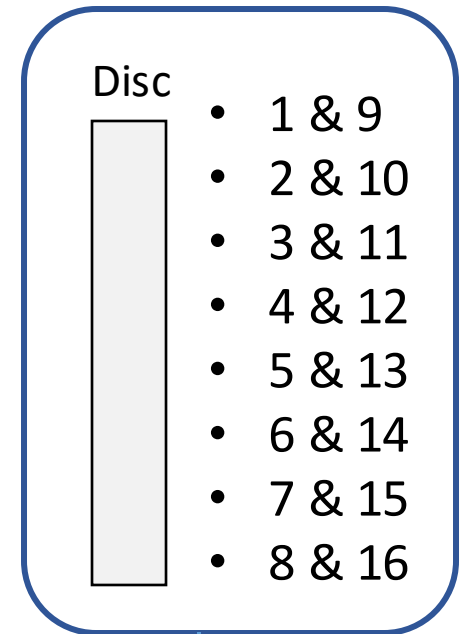
LAD Trigger Logic within v1495

Step 1:
Coincidence on
each bar

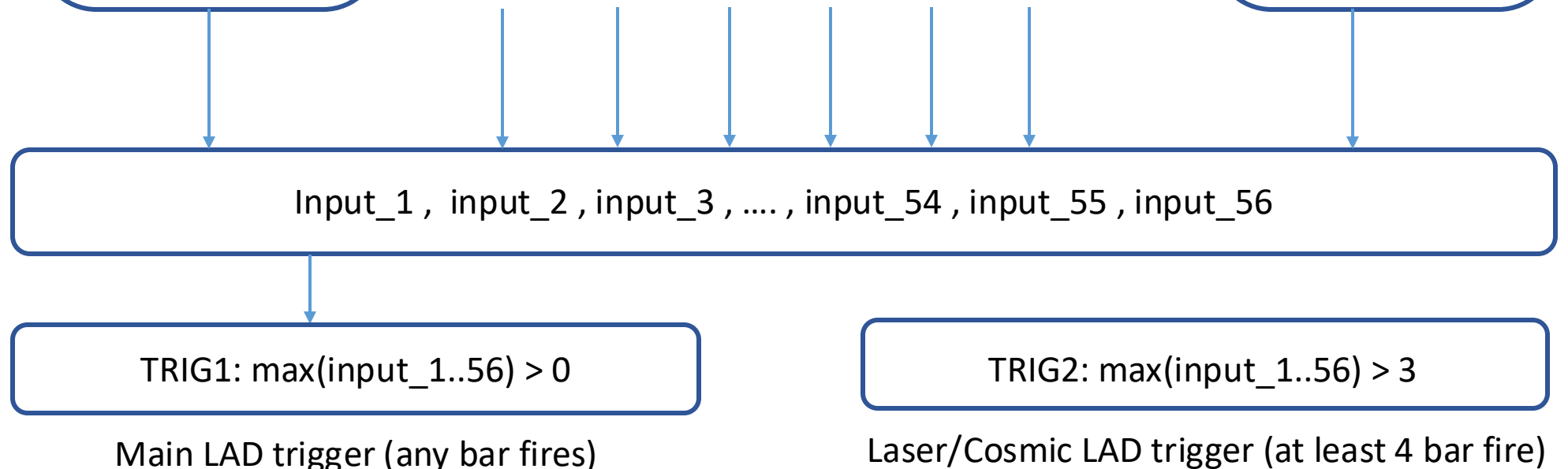


... for channels on each discriminator (7 total)...

Note: G7 discriminator will have channels
8 & 16 empty to technically only 55 inputs with signal below



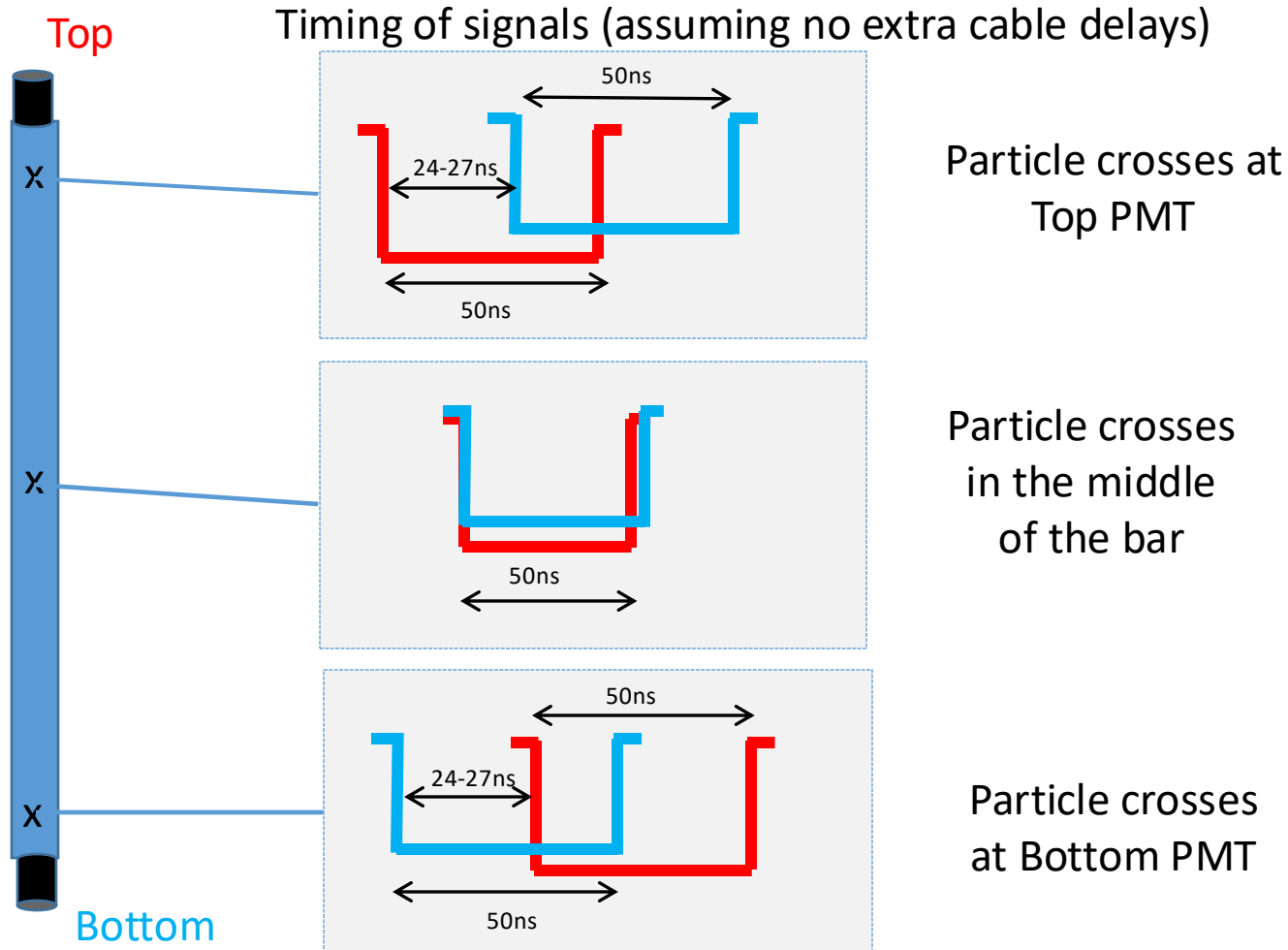
Step 2:
Combine bar
info for trigger



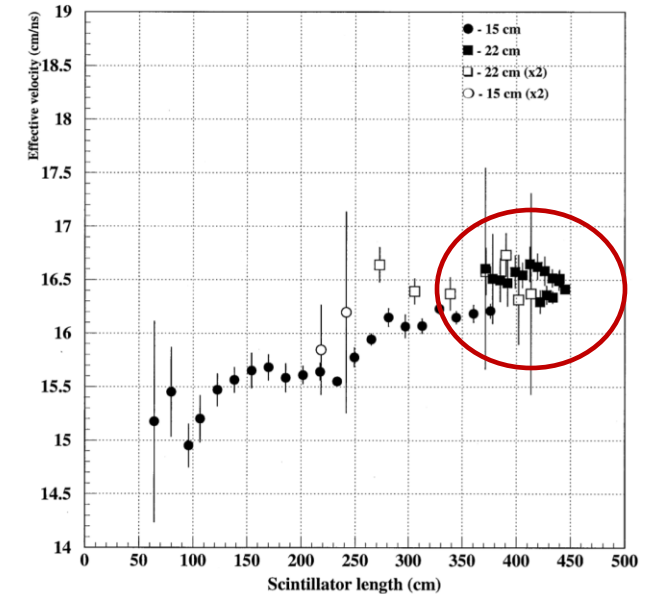
LAD Trigger Timings

Bar Coincidence Timing

- Length of bars between 387.5cm and 445.1cm in each panel
- Assuming effective velocity of 16.5 cm/ns \rightarrow 24ns to 27ns difference between signals at PMTs



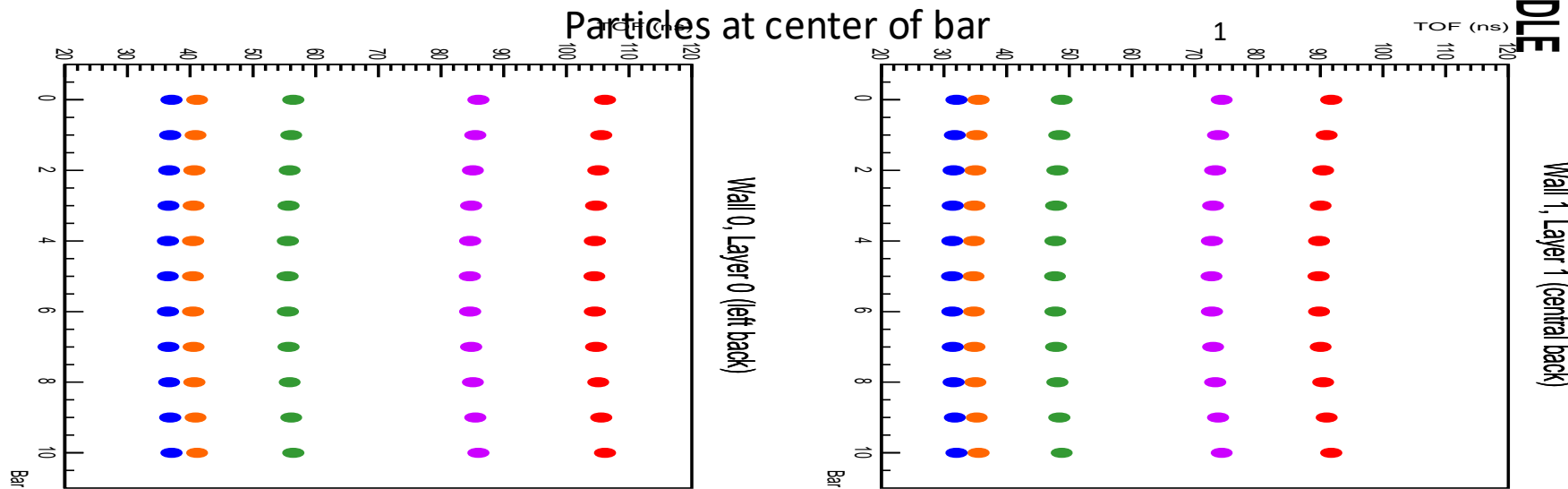
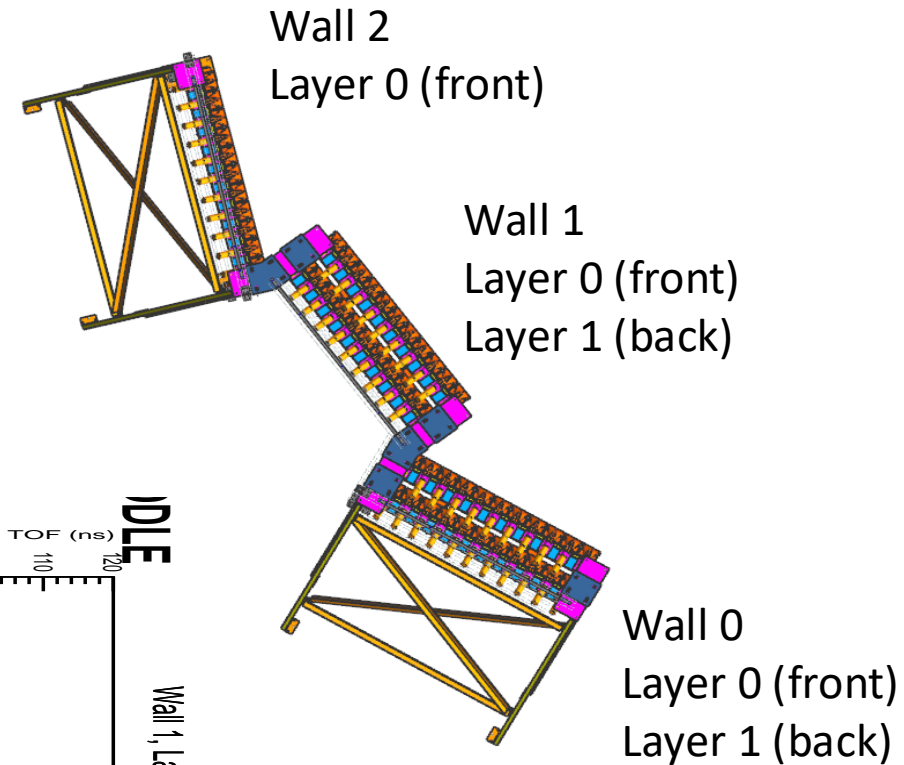
E.S. Smith, NIM A432, 265 (1999)



- Conclusion: Bar coincidence signal within a 30ns window

Time of Flight for Particles from Target (1)

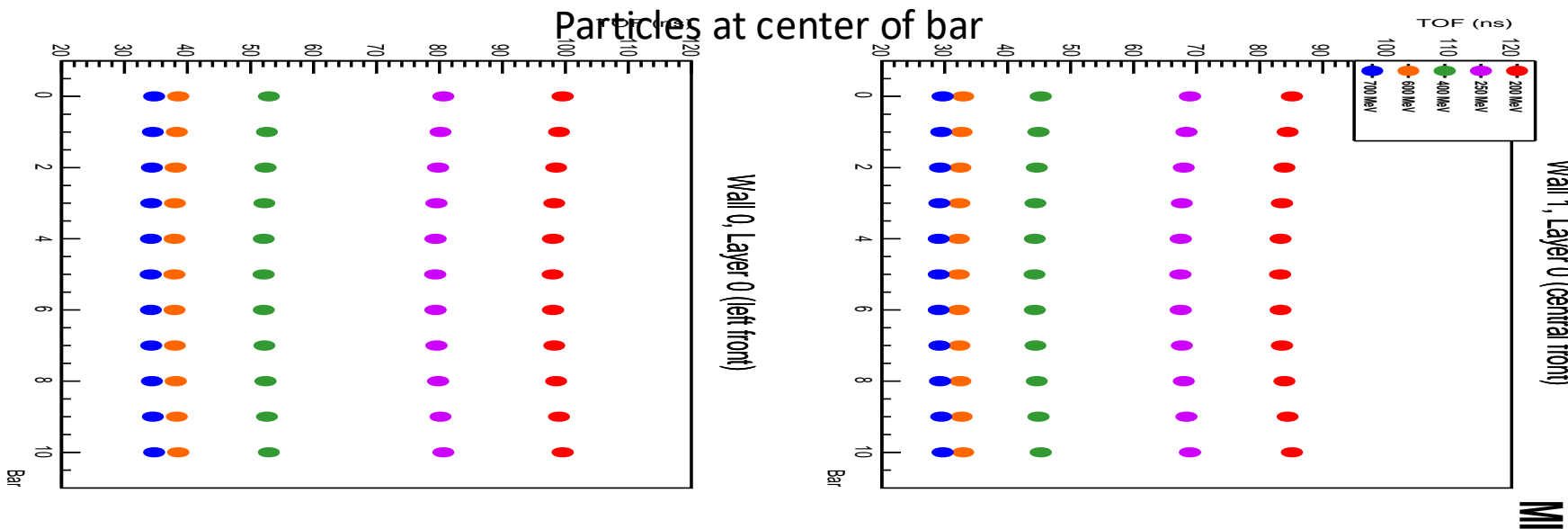
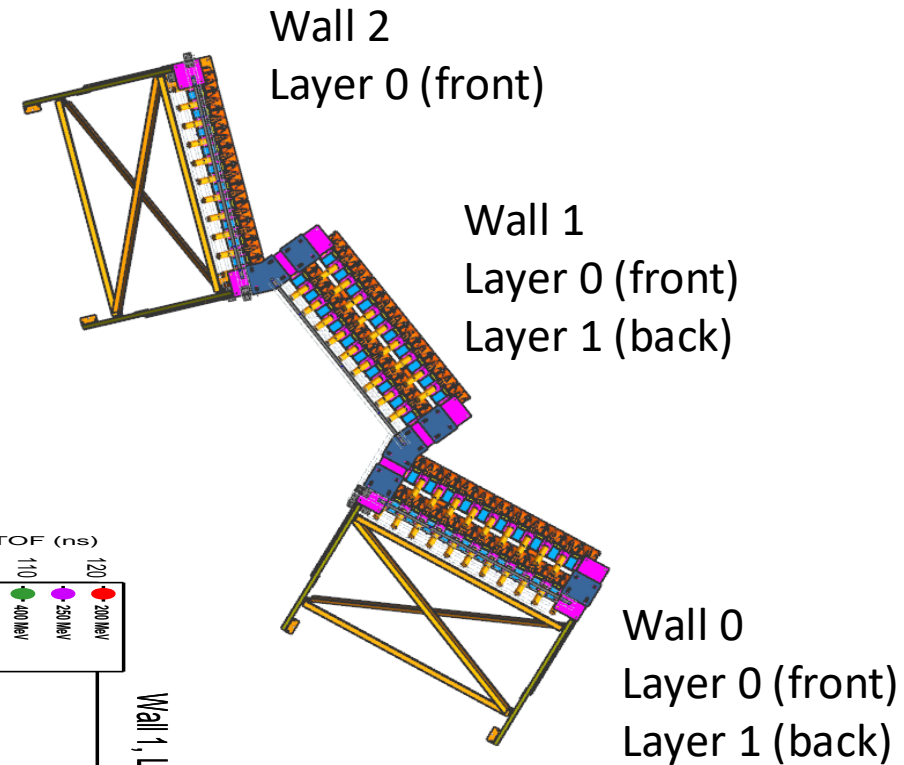
- Wall 2 Layer 0 is symmetric to Wall 0 Layer 0 → same ToF from target
- Assume protons from 200MeV/c to 700 MeV/c to be conservative (Note: We expect a higher minimum momentum)



- ToF range from 30ns to 110ns

Time of Flight for Particles from Target (2)

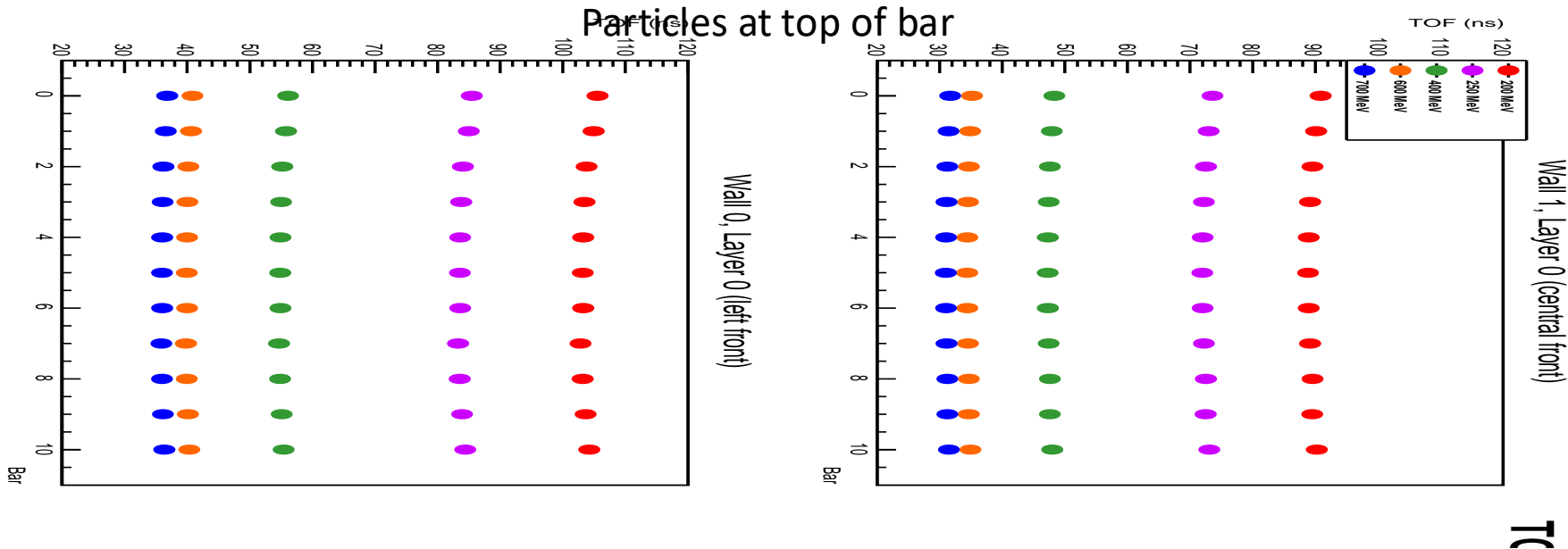
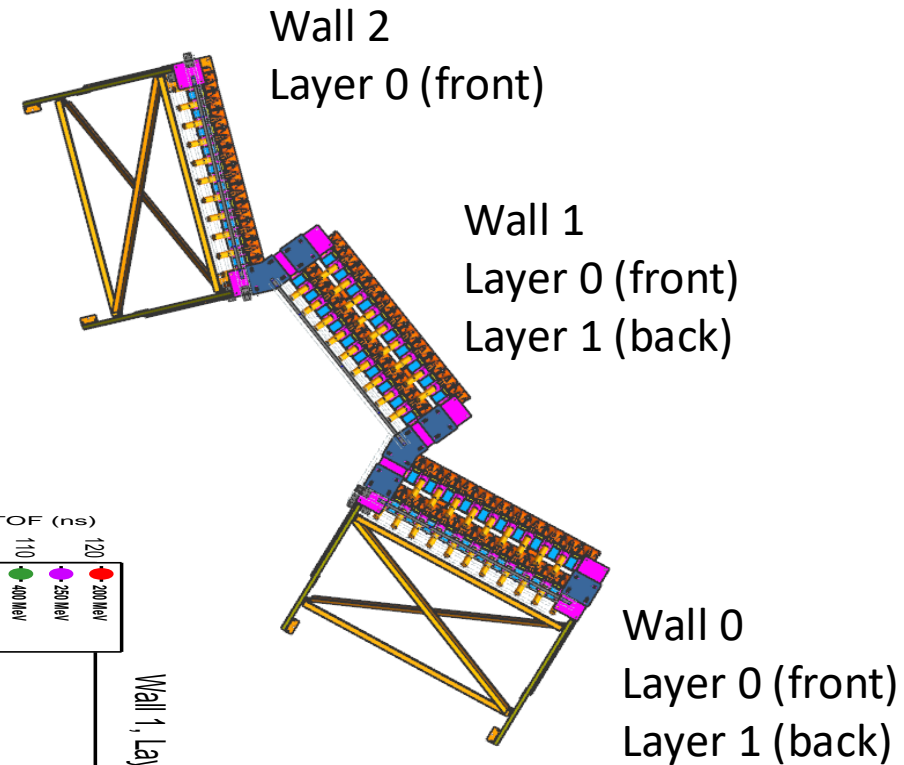
- Wall 2 Layer 0 is symmetric to Wall 0 Layer 0 → same ToF from target
- Assume protons from 200MeV/c to 700 MeV/c to be conservative (Note: We expect a higher minimum momentum)



- ToF range from 26ns to 95ns

Time of Flight for Particles from Target (3)

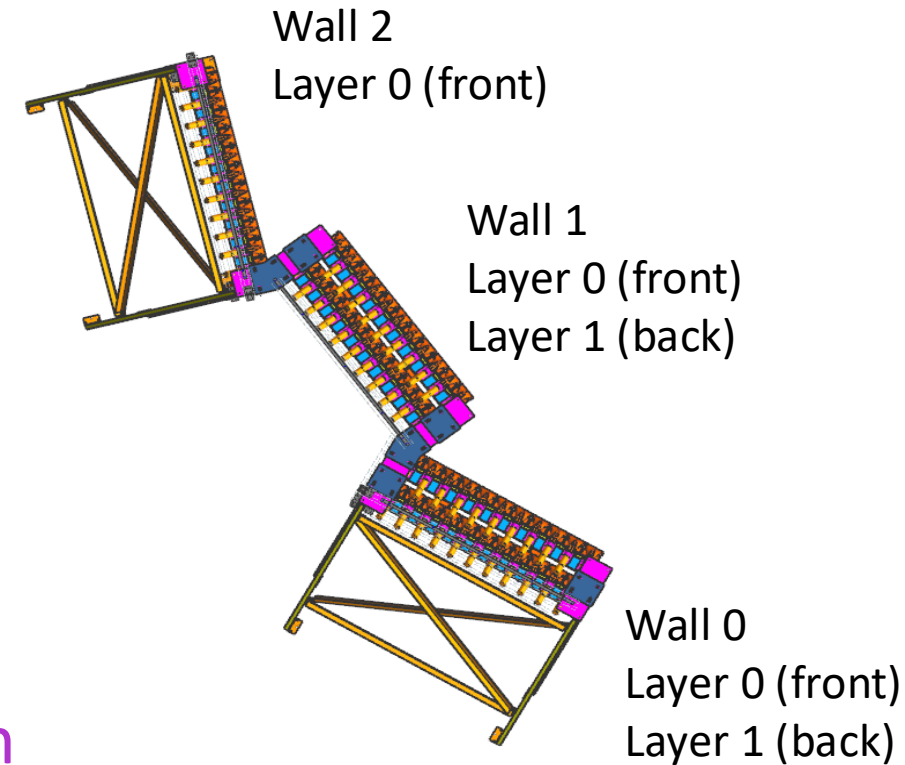
- Wall 2 Layer 0 is symmetric to Wall 0 Layer 0 → same ToF from target
- Assume protons from 200MeV/c to 700 MeV/c to be conservative (Note: We expect a higher minimum momentum)



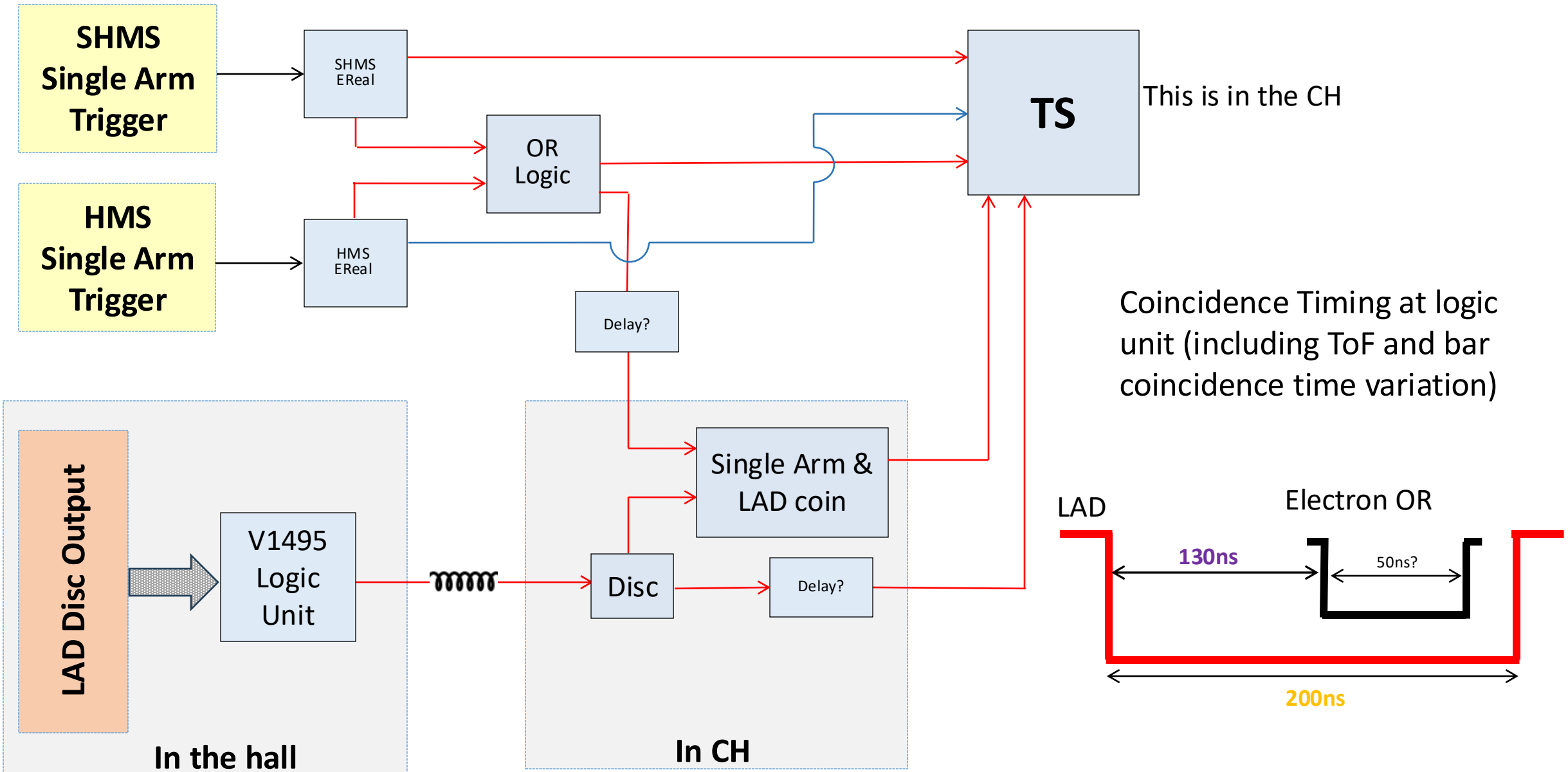
- ToF between 30ns to 100ns
- Not much effect from where it hits (~5ns) since pathlength dominated by distance from target

Time of Flight for Particles from Target (4)

- Wall 2 Layer 0 is symmetric to Wall 0 Layer 0 → same ToF from target
 - Assume protons from 200MeV/c to 700 MeV/c to be conservative (Note: We expect a higher minimum momentum)
 - Minimum ToF of all bars: 25ns
 - Maximum ToF of all bars: 115ns
-
- Conclusion: Have conservative 100ns window from ToF (20 to 120ns)
 - Together with bar coincidence variation -> 130ns
-
- Might need to check also pion window

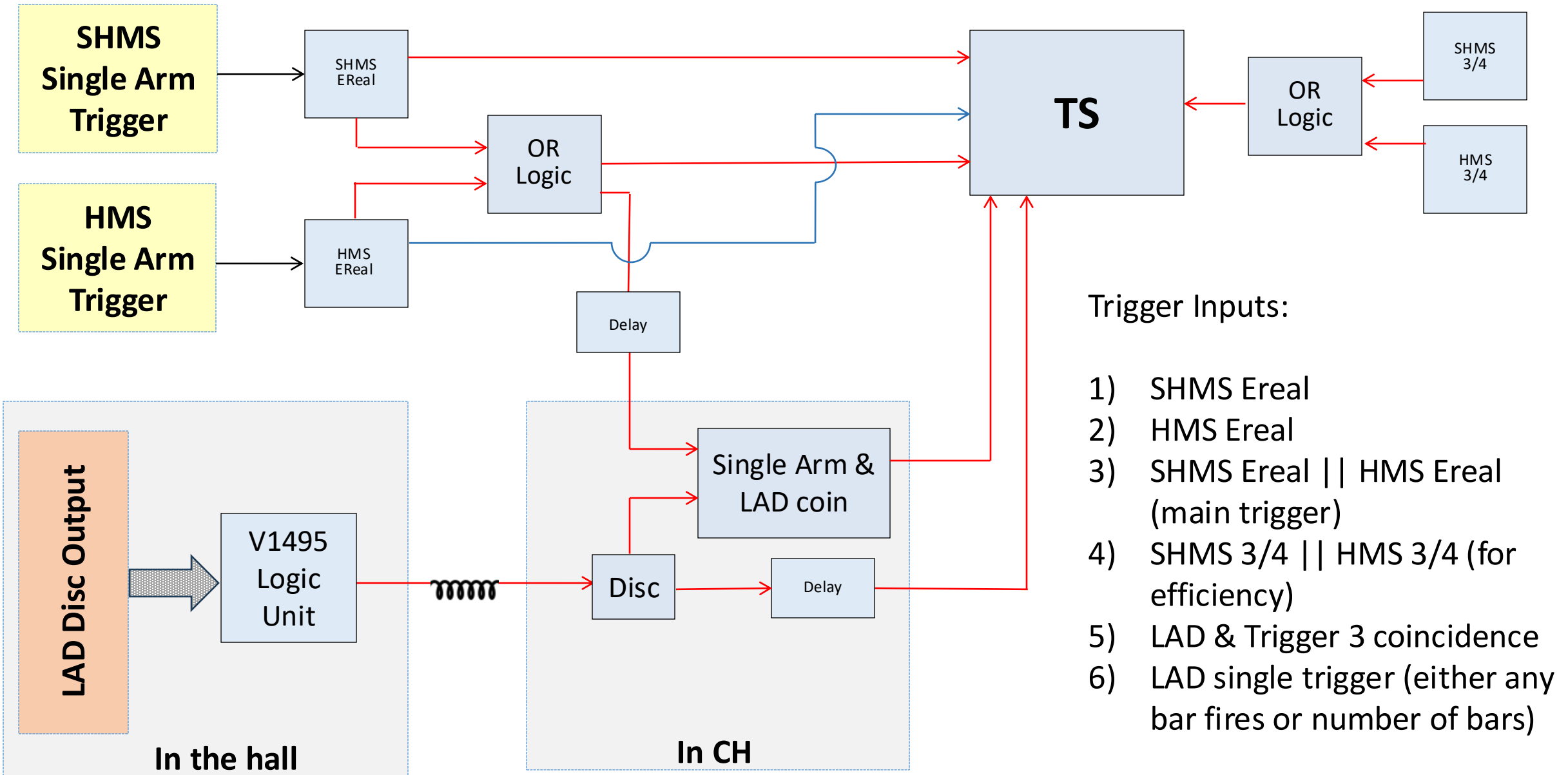


Trigger Setup for coincidence and single arm triggers



Need to finalize other numbers and cable delays

Trigger Setup for coincidence and single arm triggers



Trigger Inputs:

- 1) SHMS Ereal
- 2) HMS Ereal
- 3) SHMS Ereal || HMS Ereal (main trigger)
- 4) SHMS 3/4 || HMS 3/4 (for efficiency)
- 5) LAD & Trigger 3 coincidence
- 6) LAD single trigger (either any bar fires or number of bars)

Old Stuff

Trigger Info and Notes

- Main trigger: OR from both electron single arm triggers
- Supplemental trigger
 - LAD single arm for commissioning, detector checkout
 - Coincidence OR+LAD → might be necessary for absolute timing calibration, diagnostics during experiment if signal is in TDC/Scaler (PS = -1)
- Logic signal from LAD needs to go to counting house to feed TS and coincidence
- Questions:
 - Set timings with EDTM for everything? → Answer yes!
 - Currently, coincidence is timed on electron OR. Is that reasonable? → Answer yes!
 - What are retiming concerns? How does this work with the feedback of the trigger signals into ADCs?
Answer: Each crate has some reference signal so a subtraction can be made in software via settings file