

Hall C Winter Collaboration Meeting

January 22-23, 2018

Commissioning Experiment: Deuteron Electro-Disintegration (E12-10-003)

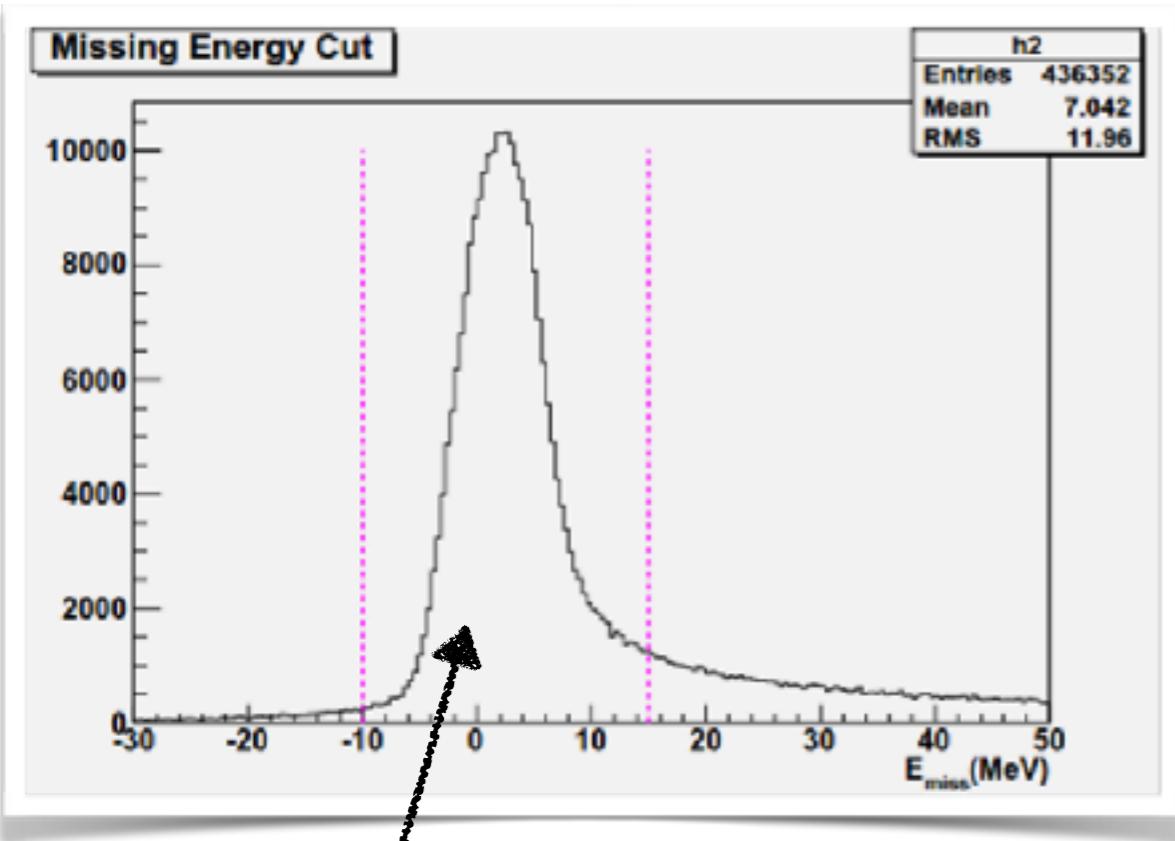
and

Update on Hall C DAQ/Electronics

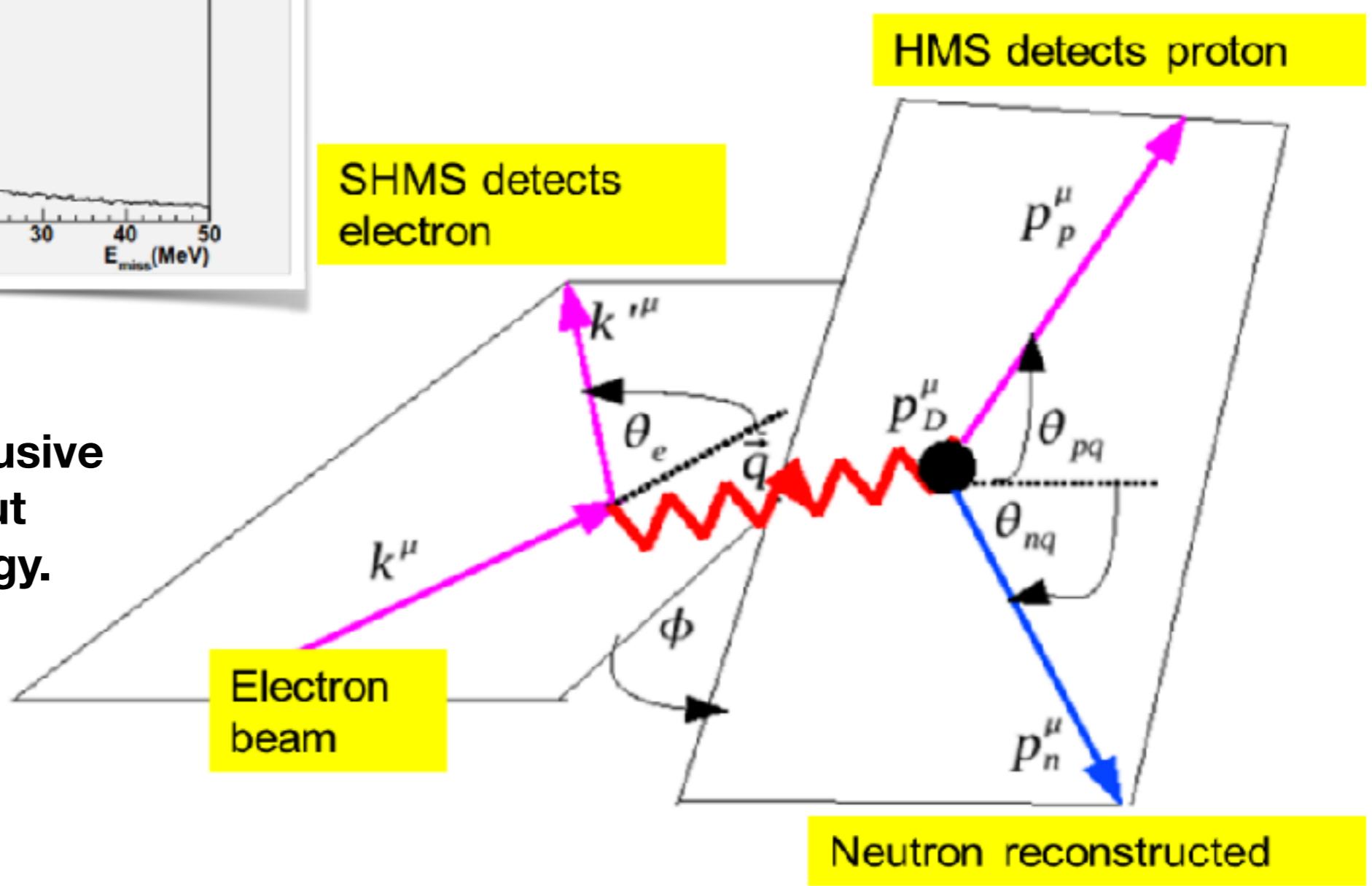
Carlos Yero



E12-10-003 Kinematics

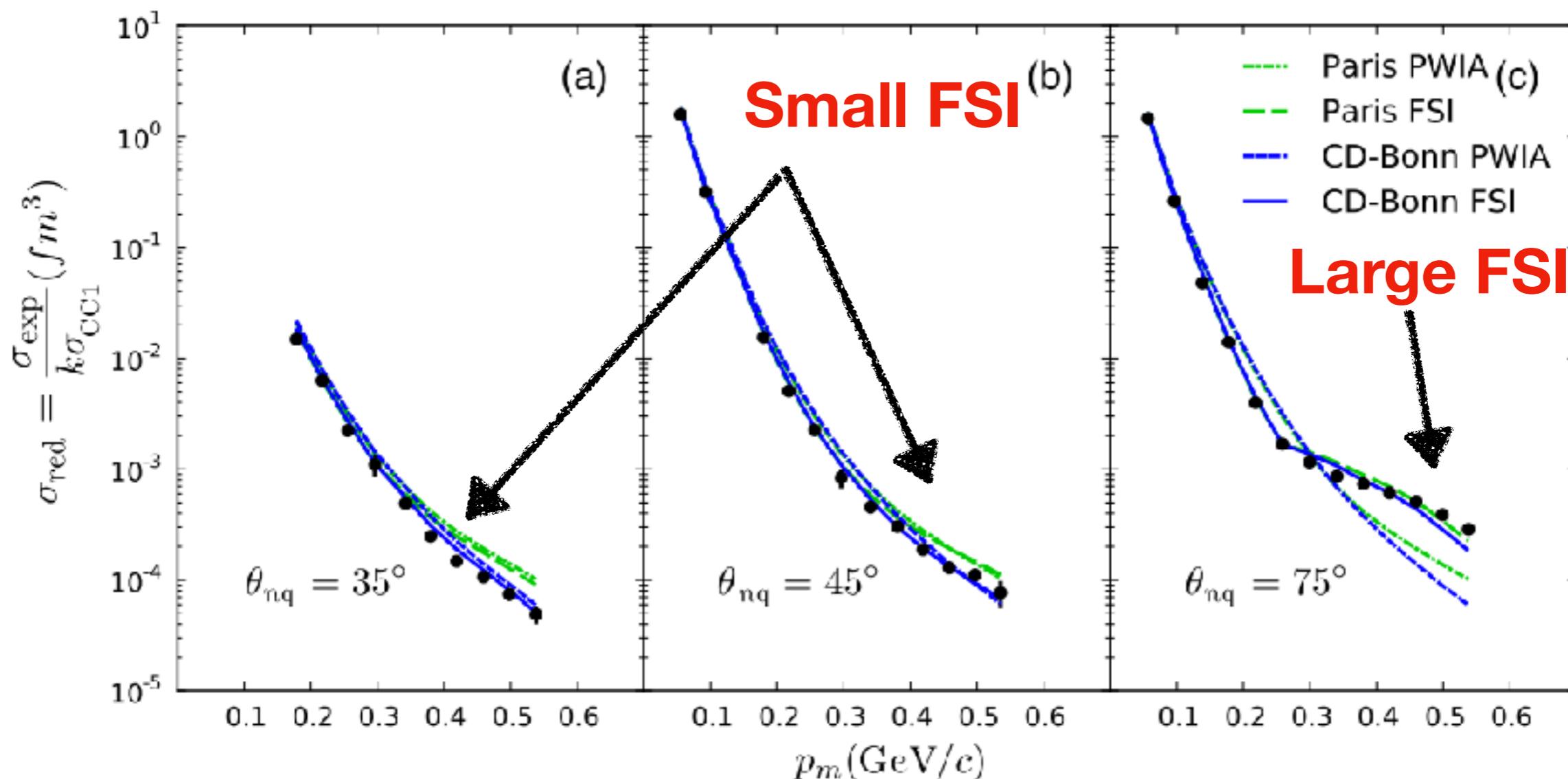


Study the $D(e,e'p)n$, exclusive reaction by making a cut around the missing energy.



Previous Hall A Experiment:

- E12-10-003 in Hall C will explore the deuteron momentum distribution at unexplored kinematics, where FSI have been shown to be small
- Study the short-range structure of Deuteron via momentum distributions with reduced FSI
- Check the validity of the theoretical models for missing momenta >500 MeV/c



E12-10-003 Run Plan

Expected Time: 3 PAC days (6 days total)

$$E_{Beam} = 10.6 \text{ GeV}$$

$$I_{Beam} = 70 \mu\text{A}$$

I. Hydrogen Elastics, H(e,e'p)

Electron kinematics

Target: LH₂(10 cm)

$$Q^2 = 4.026 \text{ GeV}^2$$

$$P'_e = 8.454 \text{ GeV/c}$$

$$\theta_e = 12.169^\circ$$

Proton kinematics

$$P_p = 2.938 \text{ GeV/c}$$

$$\theta_p = 37.339^\circ$$

Deuteron, D(e,e'p)n

Electron kinematics

Target: LD₂(10 cm)

$$Q^2 = 4.25 \text{ GeV}^2$$

$$P'_e = 8.922 \text{ GeV/c}$$

$$\theta_e = 12.169^\circ$$

Proton kinematics

II. @ Pmiss = 80 MeV

$$P_p = 2.435 \text{ GeV/c}$$

$$\theta_p = 40.061^\circ$$

III. @ Pmiss = 500 MeV

$$P_p = 2.305 \text{ GeV/c}$$

$$\theta_p = 53.252$$

IV. @ Pmiss = 650 MeV

$$P_p = 2.220 \text{ GeV/c}$$

$$\theta_p = 56.401$$

V. @ Pmiss = 800 MeV

$$P_p = 2.120 \text{ GeV/c}$$

$$\theta_p = 59.388$$

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Magnet cycling procedure is time consuming, so a common central momentum setting was determined.

Deuteron, D(e,e'p)n

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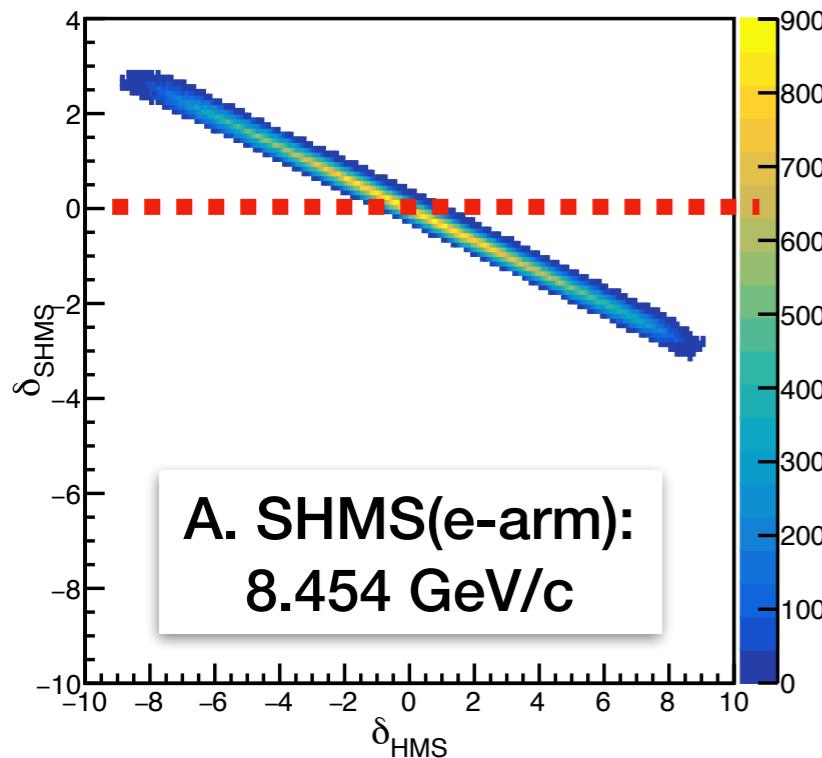
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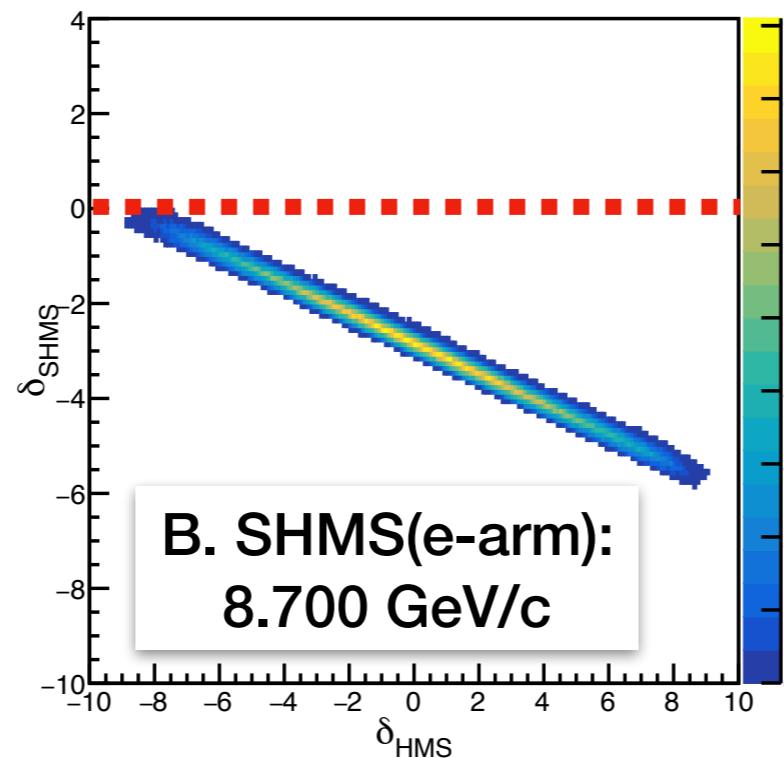
$$\theta_p = 59.388$$

Simulation of SHMS Momentum Acceptance

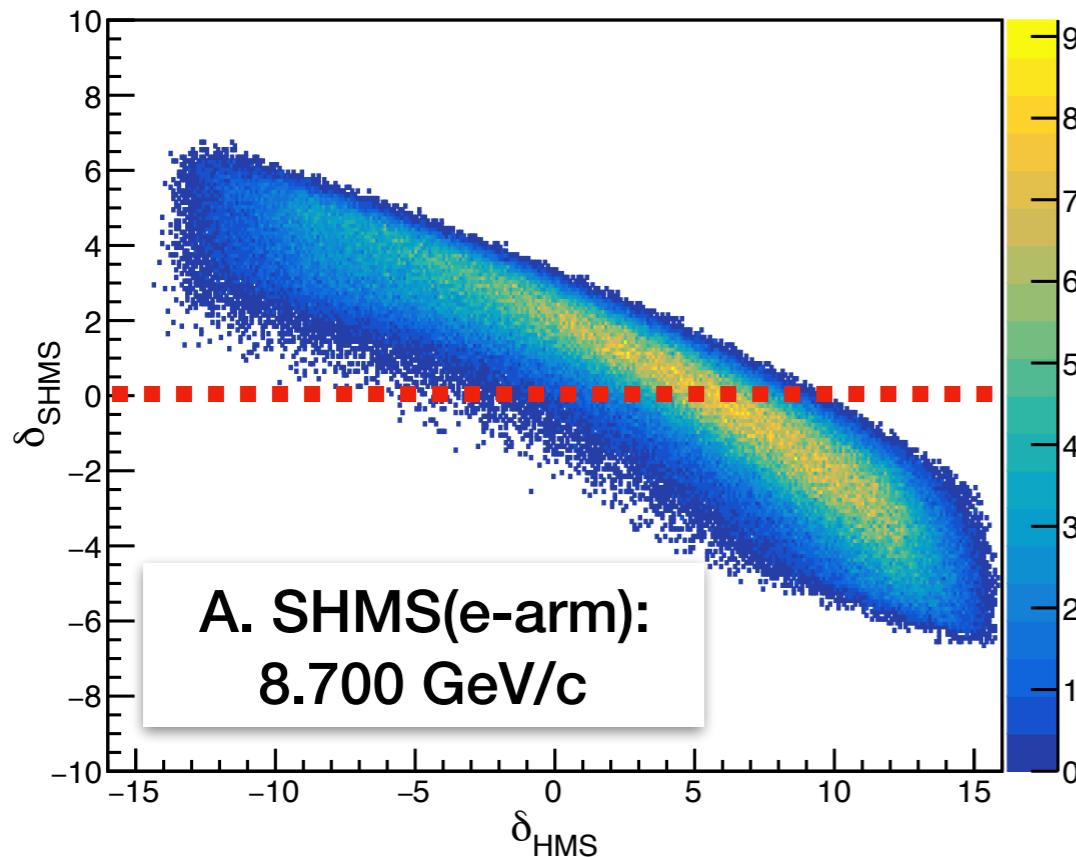
Hydrogen Elastics δ Acceptance



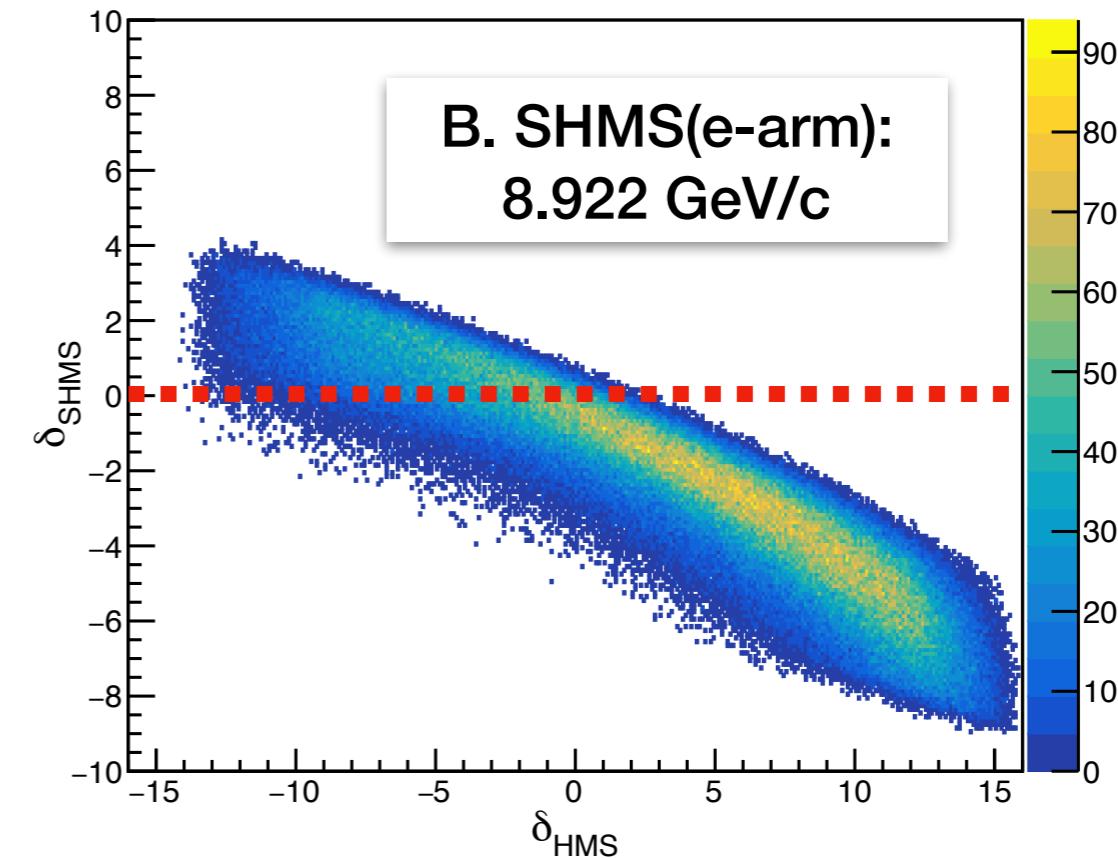
Hydrogen Elastics δ Acceptance



$D(e,e'p)n @ P_{\text{miss}} = 500 \text{ MeV}$, δ Acceptance

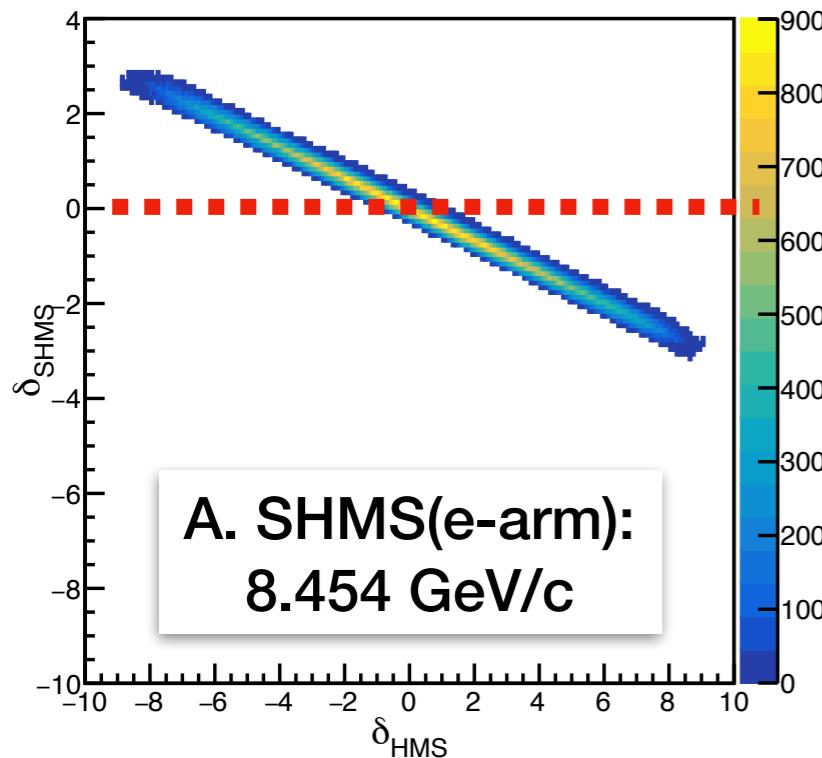


$D(e,e'p)n @ P_{\text{miss}} = 500 \text{ MeV}$, δ Acceptance

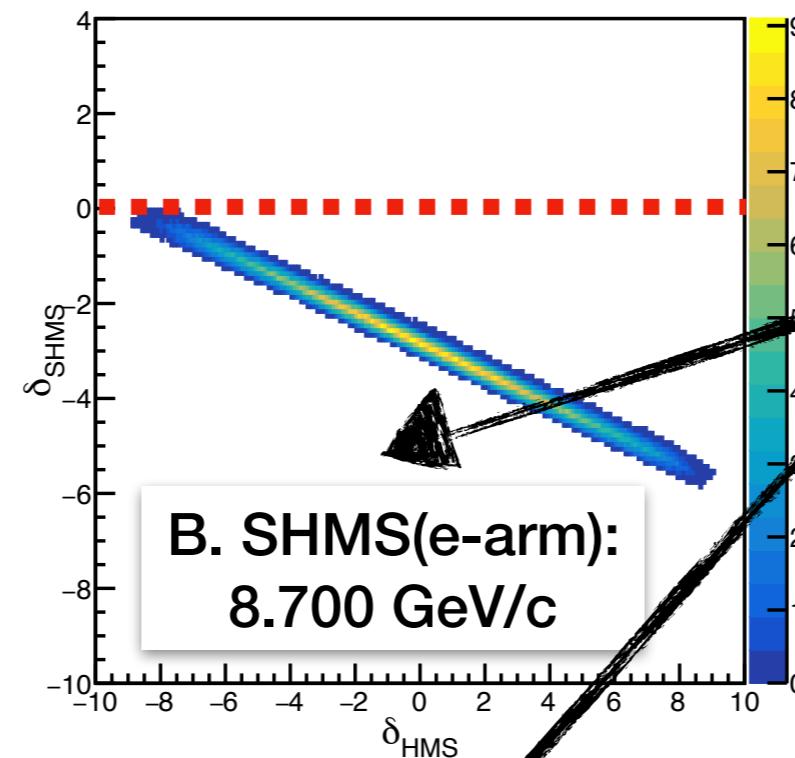


Simulation of SHMS Momentum Acceptance

Hydrogen Elastics δ Acceptance

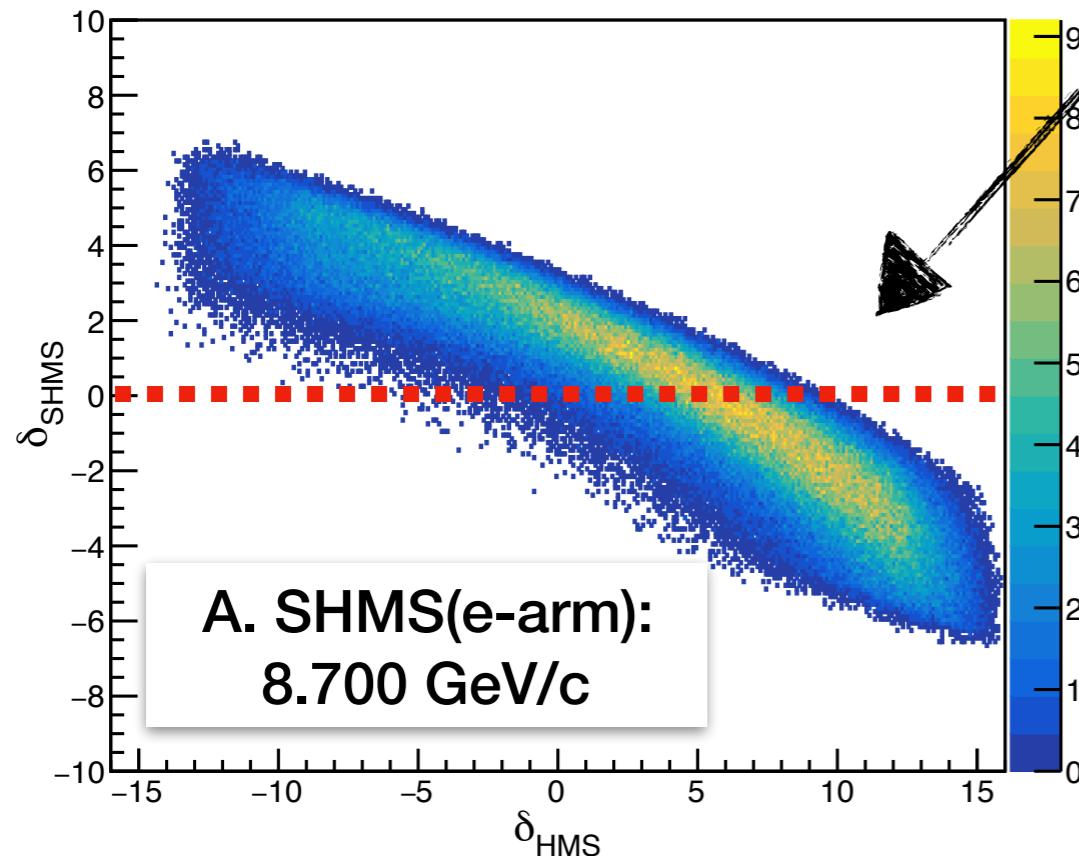


Hydrogen Elastics δ Acceptance

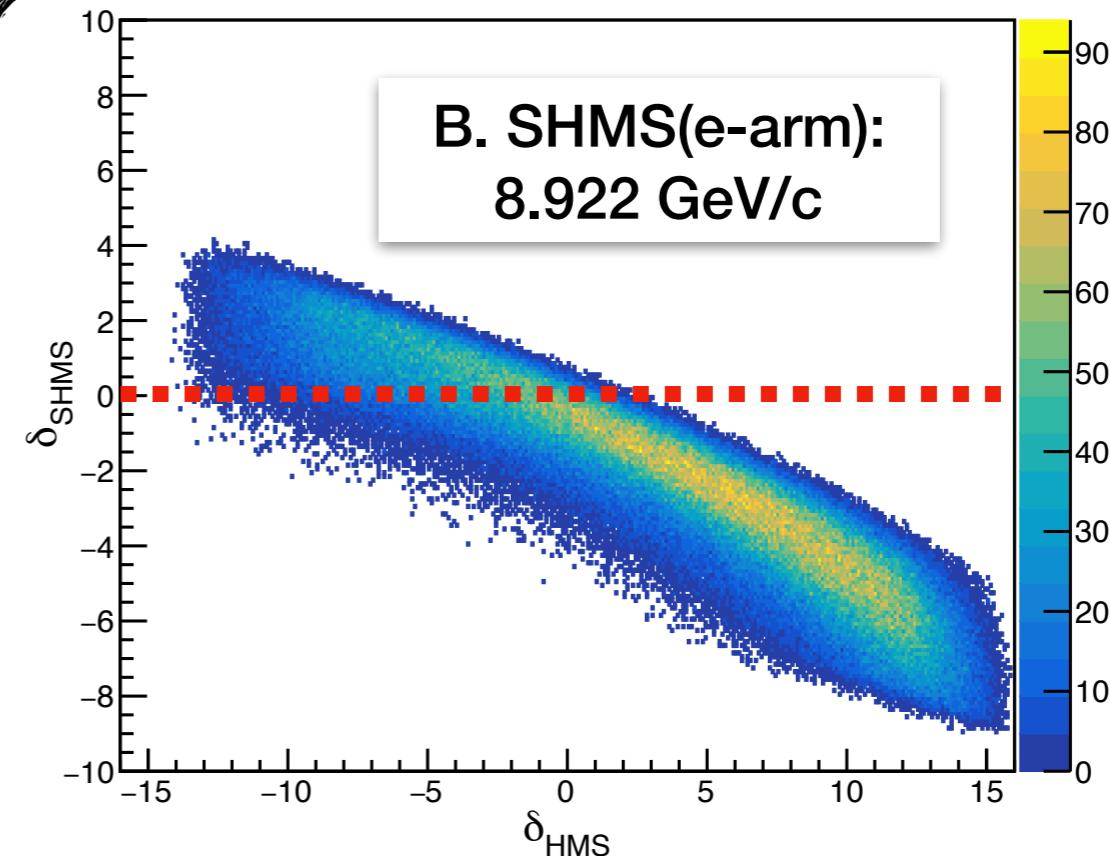


COMMON SHMS
Central Momentum:
8.7 GeV/c

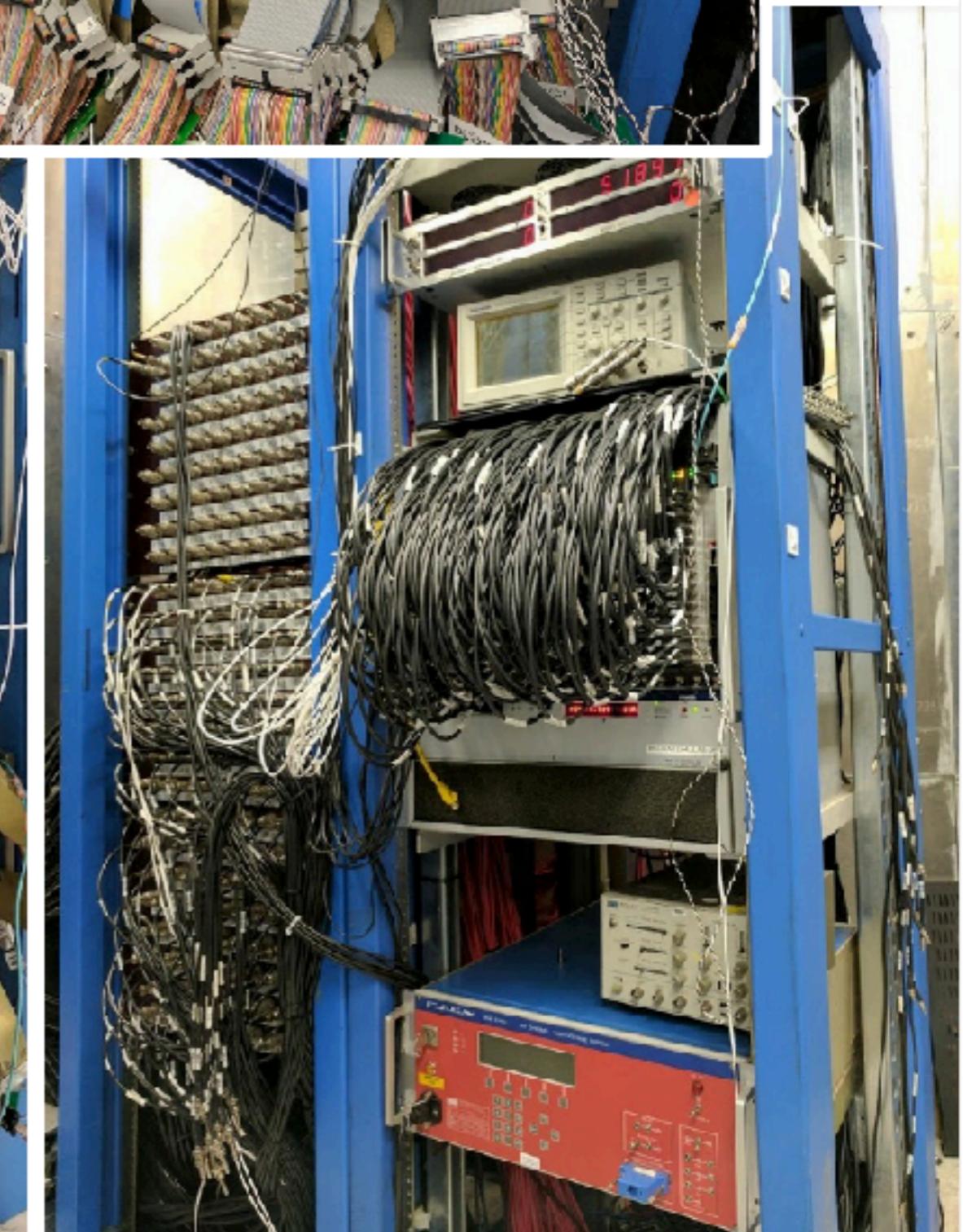
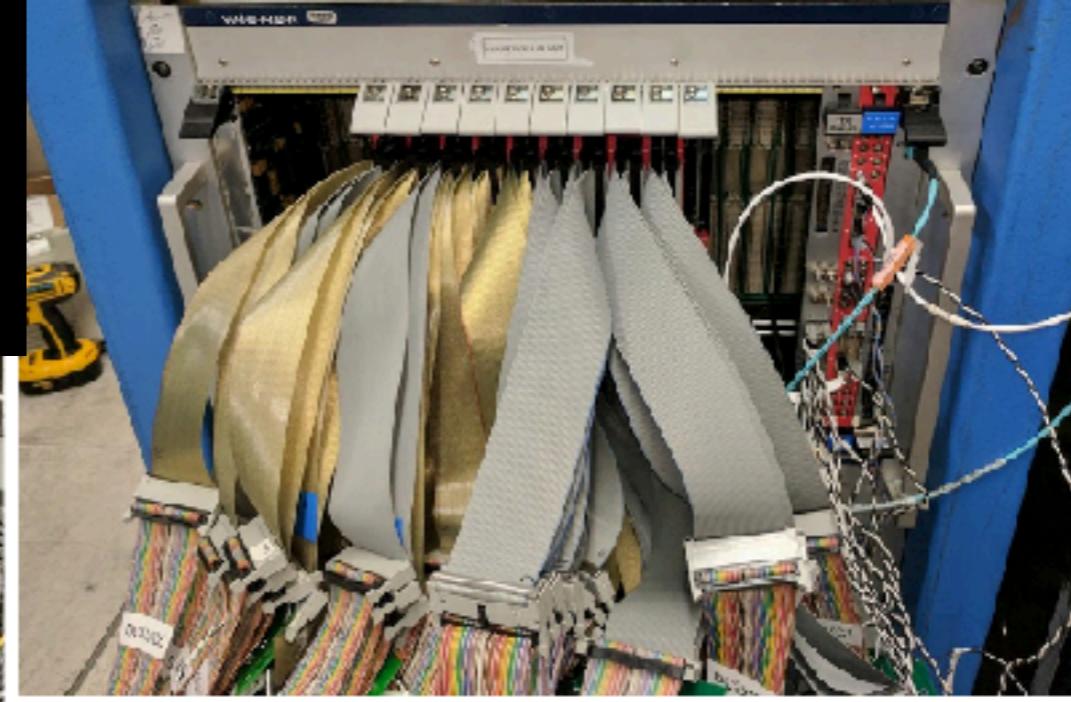
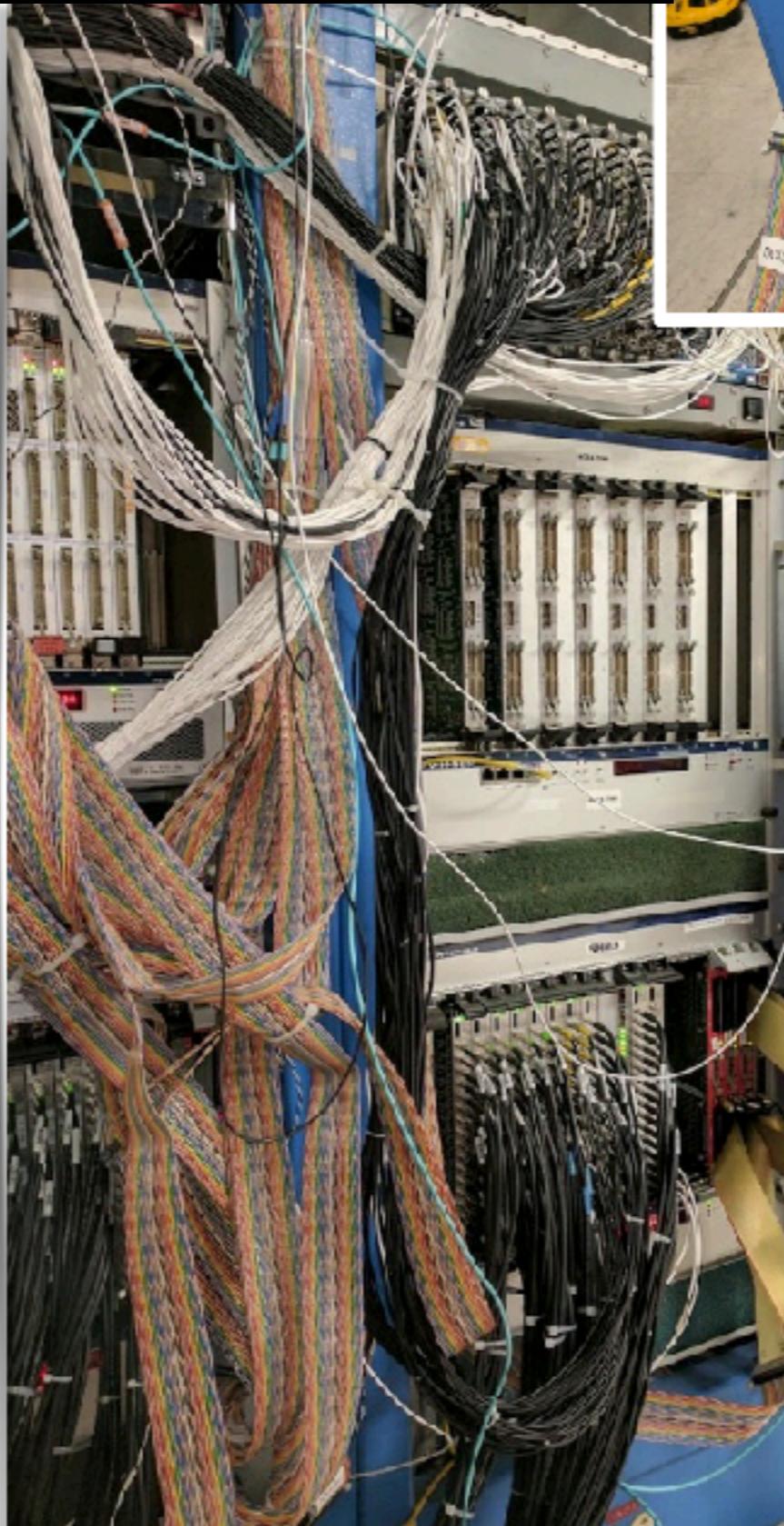
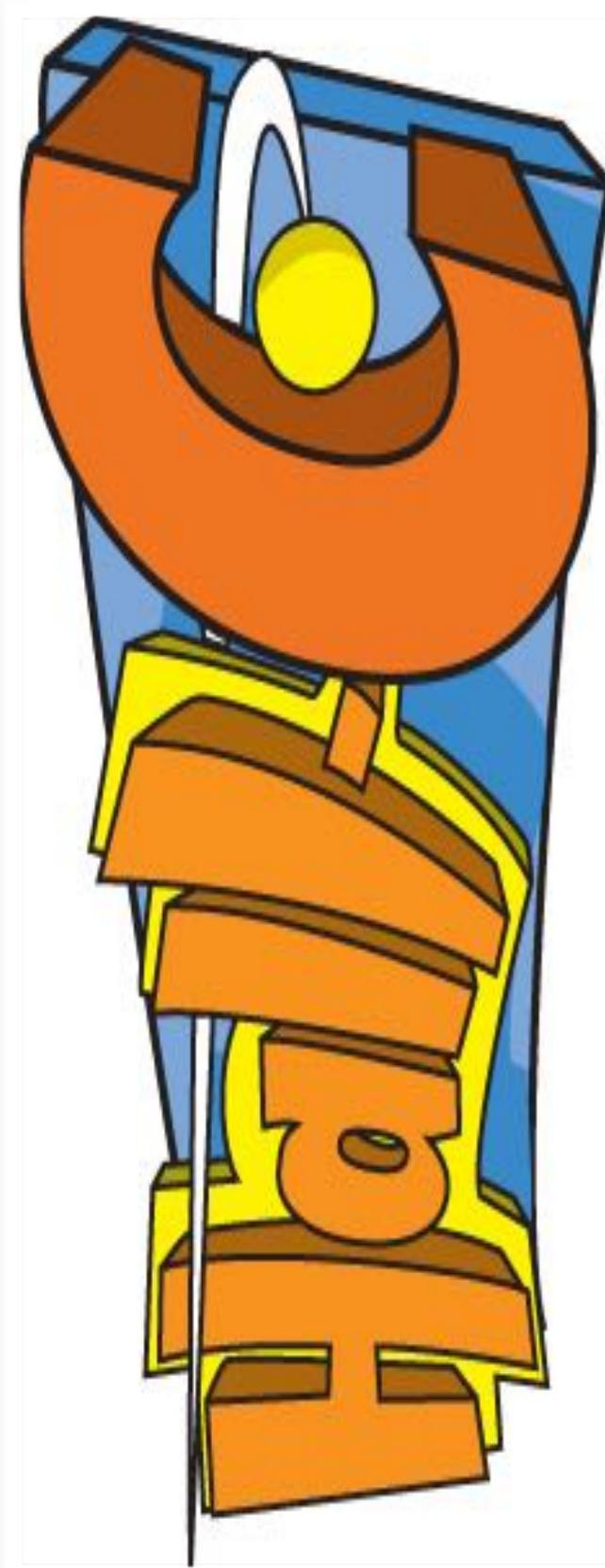
$D(e,e'p)n @ P_{miss} = 500 \text{ MeV}$, δ Acceptance



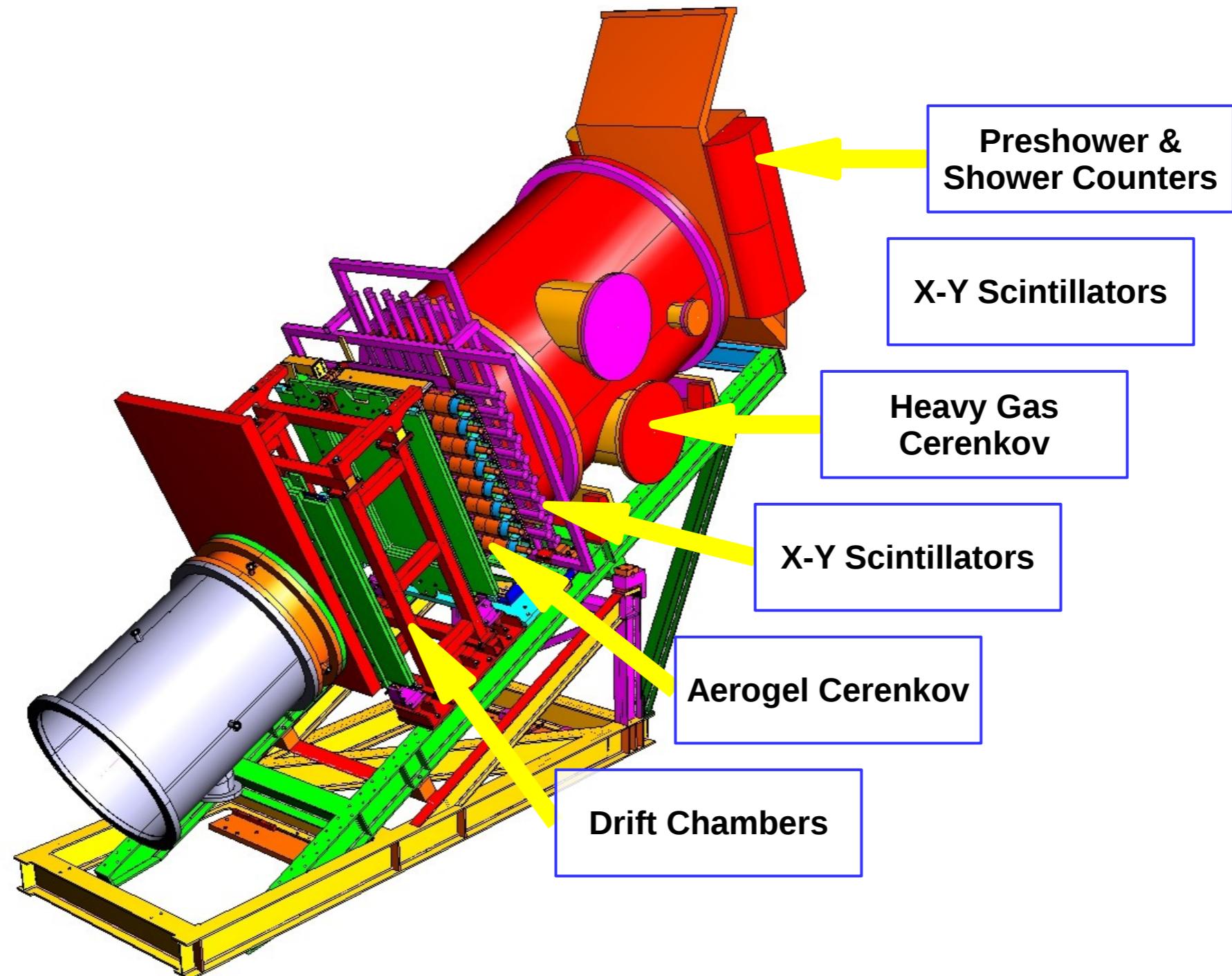
$D(e,e'p)n @ P_{miss} = 500 \text{ MeV}$, δ Acceptance



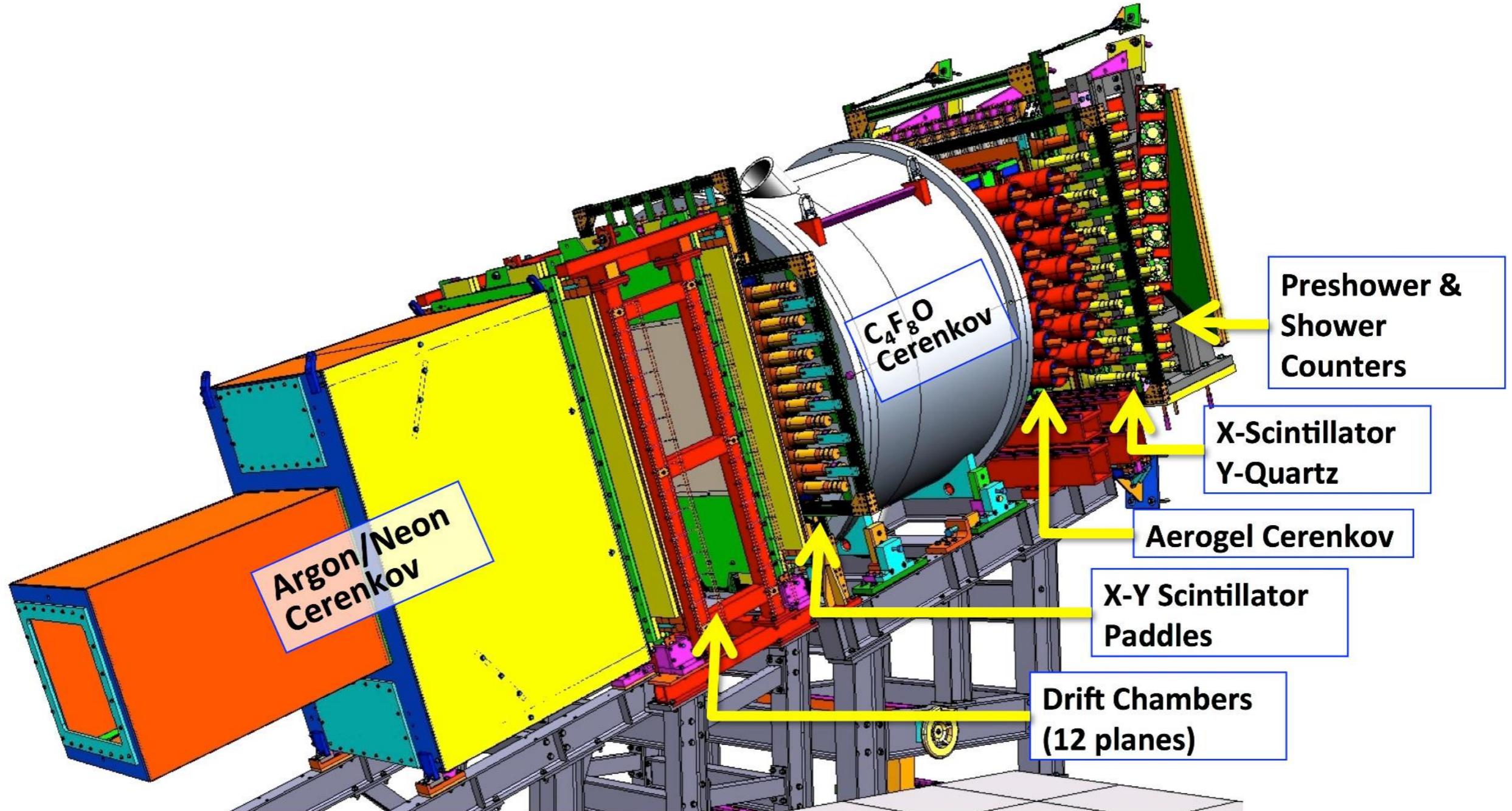
Hall C DAQ/ Electronics



Particle Detectors inside the HMS



Particle Detectors inside the SHMS



ReadOut Controllers (ROCs) Distribution

Counting Room

ROC01: (HMS)

- Hodoscopes (fADC/TDC)
- Calorimeter (fADC/TDC)
- Gas Cherenkov(fADC/TDC)

ROC02: (sHMS)

- Hodoscopes (fADC/TDC)
- Noble/Heavy Gas
- Cherenkov.(fADC/TDC)
- preShower (fADC/TDC)

ROC05: (HMS)

- SCALERS/BCMs

ROC08: (sHMS)

- SCALERS/BCMs

HMS Hut

ROC03: (HMS)

- Drift Chambers (TDCs)

SHMS Hut

ROC04: (sHMS)

- Shower Calorimeter (fADC)
- PreShower (fADC)

ROC06: (sHMS)

- Drift Chambers (TDCs)

ROC012: (sHMS)

- Gas Electron Multiplier (GEM)

ReadOut Crates (ROCs) Distribution

Counting Roc



- Hodoscopes
- Calorimeter
- Gas Chamber

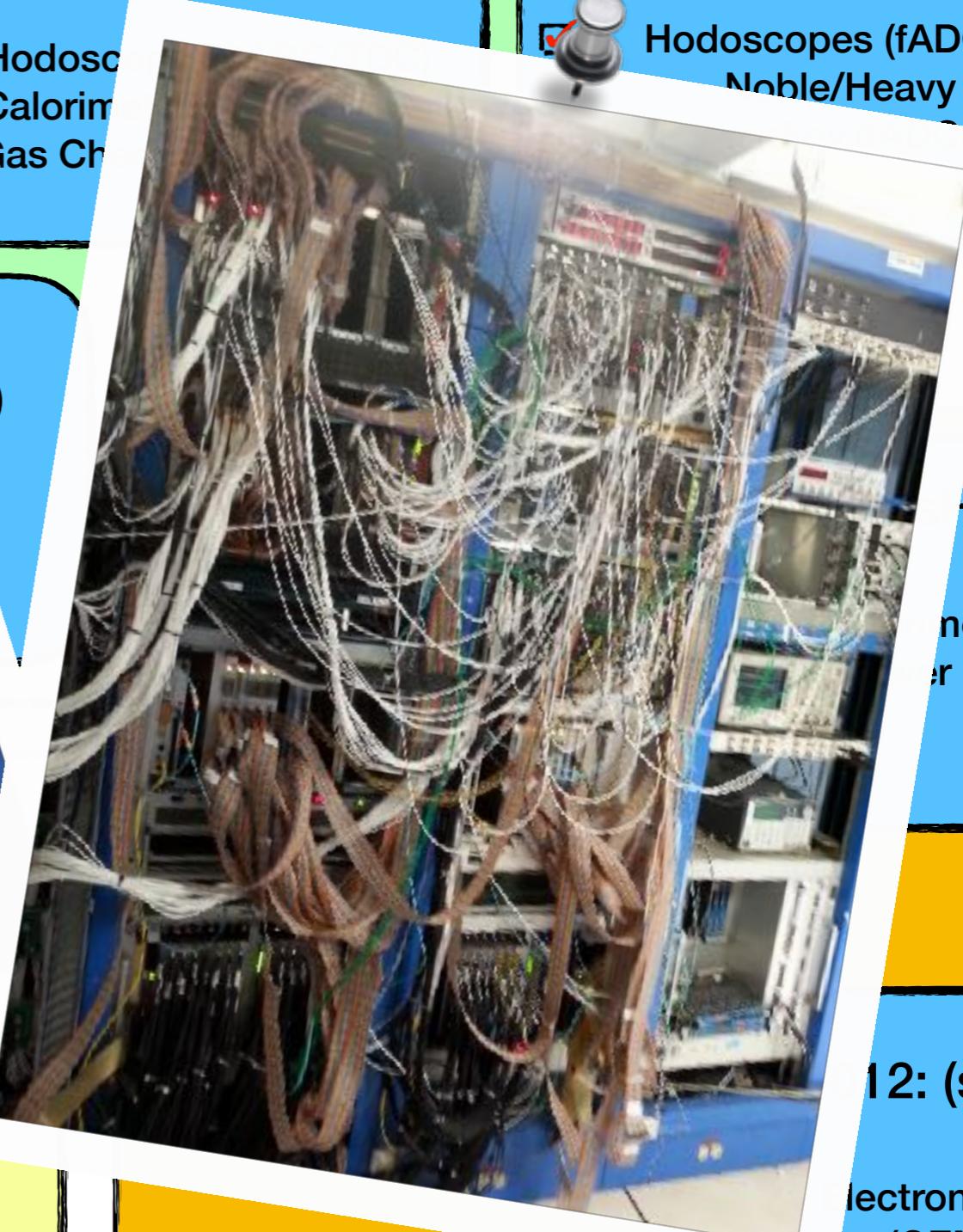
HMS)
1s

- Hodoscopes (fADC/TDC)
- Noble/Heavy Gas
- Counter (fADC)
- Counter (fADC)

sHMS)

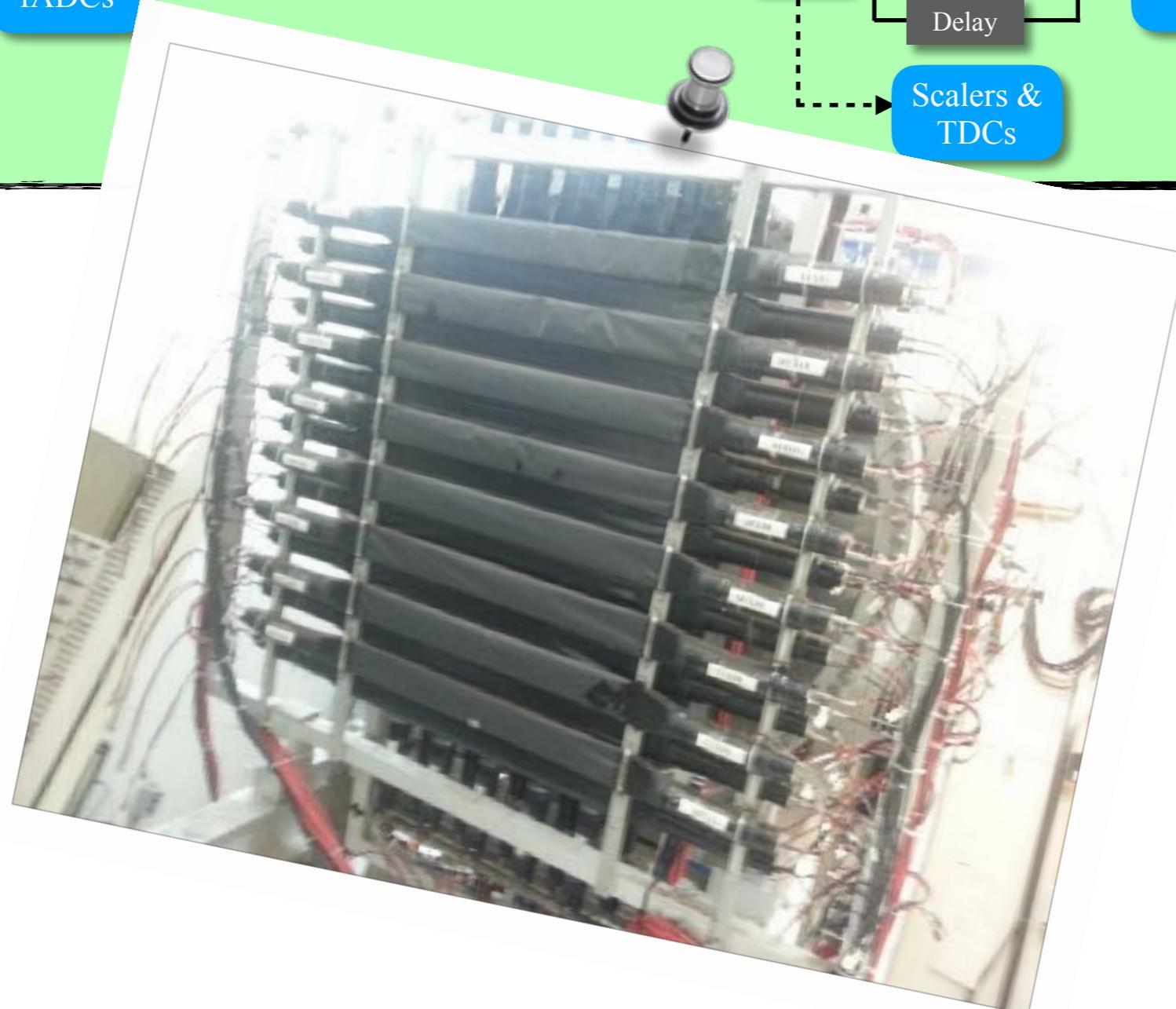
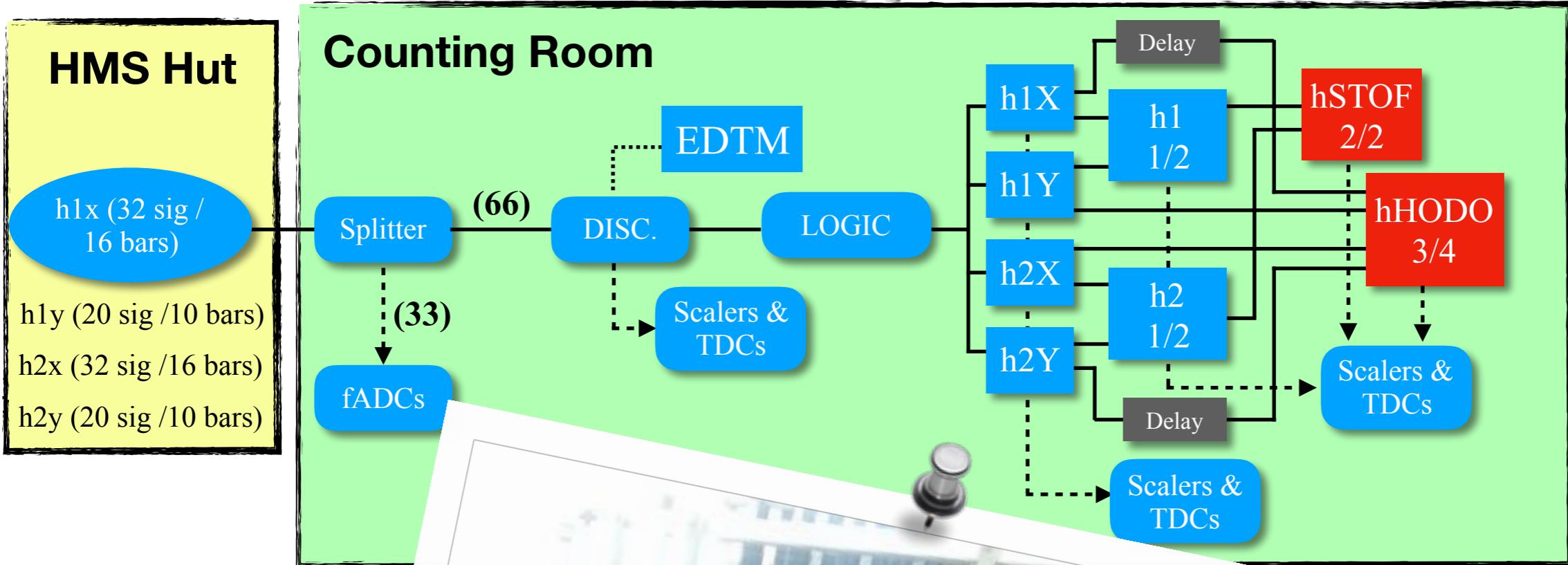
ROC02: (sHMS)

- Hodoscopes (fADC/TDC)
- Noble/Heavy Gas
- Counter (fADC)
- Counter (fADC)

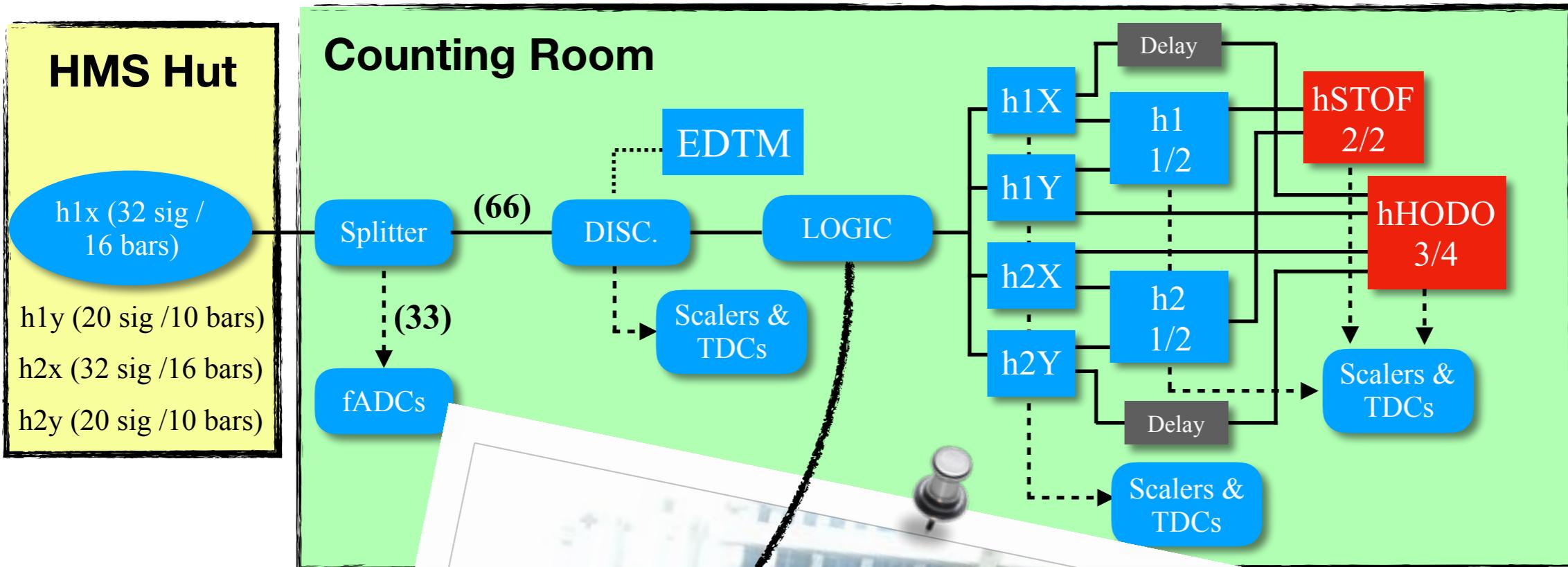


- 12: (sHMS)
- Electron Multiplier (GEM)

HMS Hodoscopes



HMS Hodoscopes

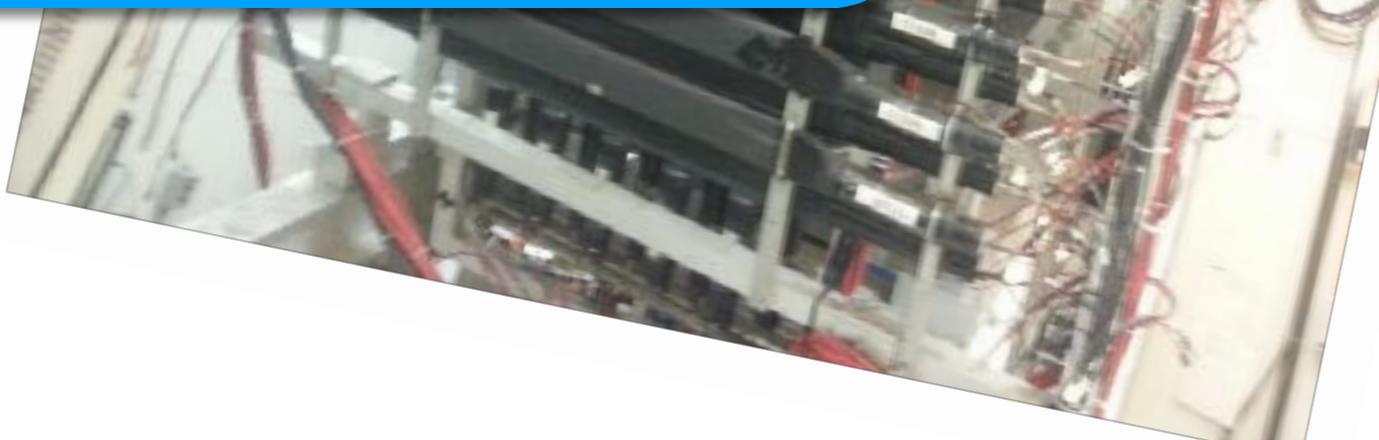


$$h1X = h1X+ \text{ (16-fold OR)} \text{ AND } h1X- \text{ (16-fold OR)}$$

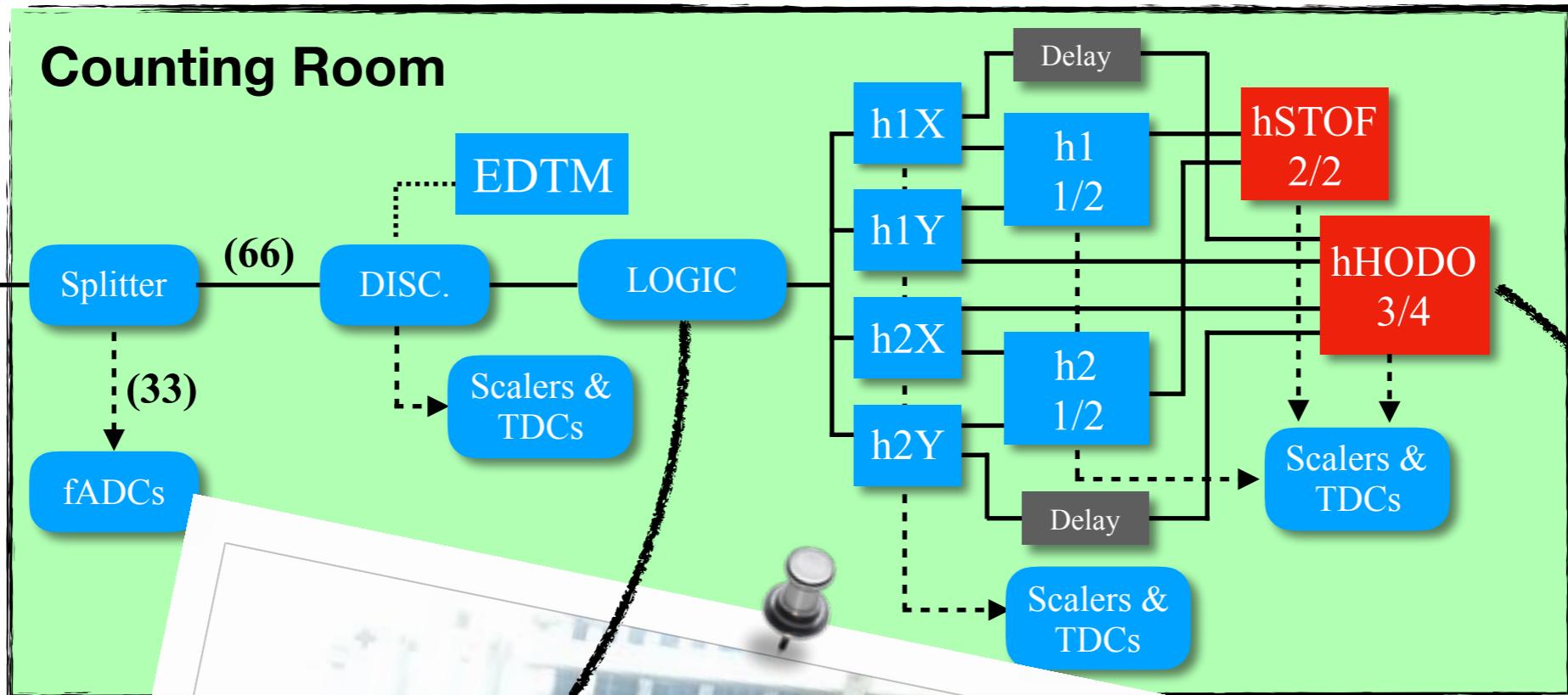
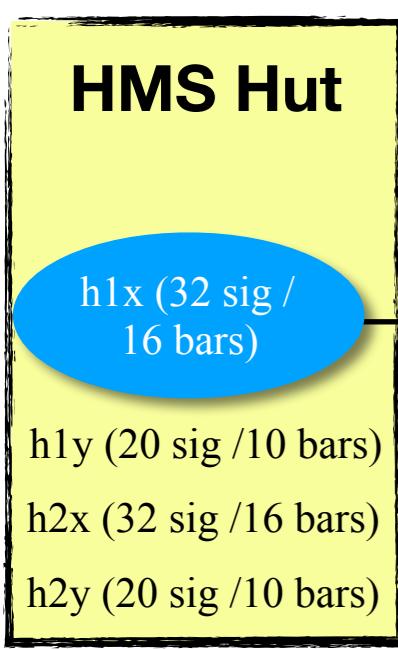
$$h1Y = h1Y+ \text{ (10-fold OR)} \text{ AND } h1Y- \text{ (10-fold OR)}$$

$$h2X = h2X+ \text{ (16-fold OR)} \text{ AND } h2X- \text{ (16-fold OR)}$$

$$h2Y = h2Y+ \text{ (10-fold OR)} \text{ AND } h2Y- \text{ (10-fold OR)}$$



HMS Hodoscopes

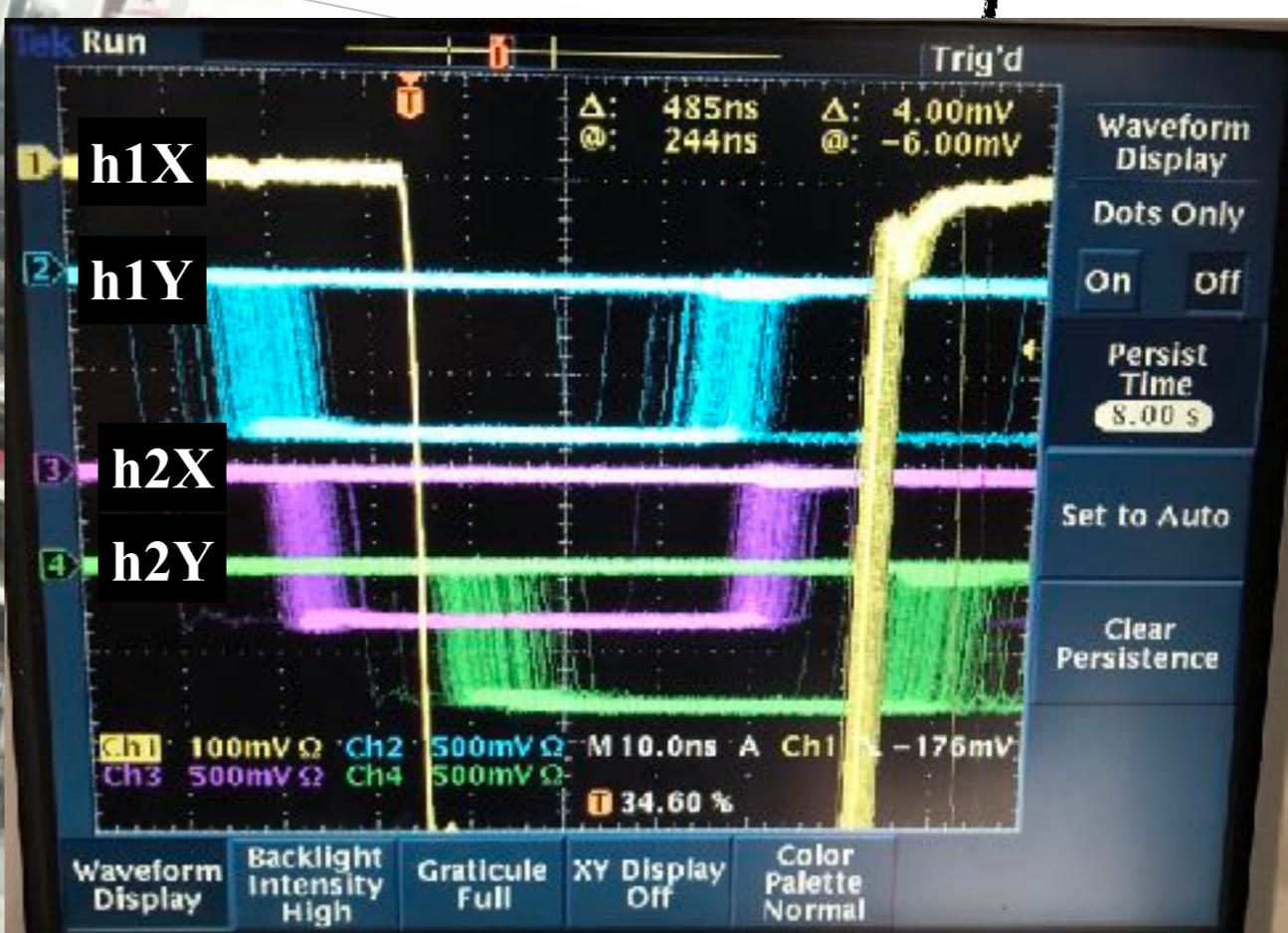
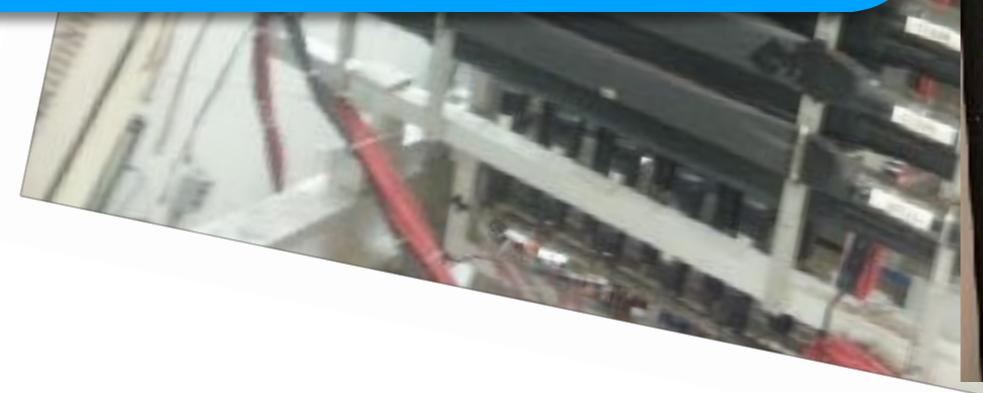


$$h1X = h1X+ \text{ (16-fold OR)} \text{ AND } h1X- \text{ (16-fold OR)}$$

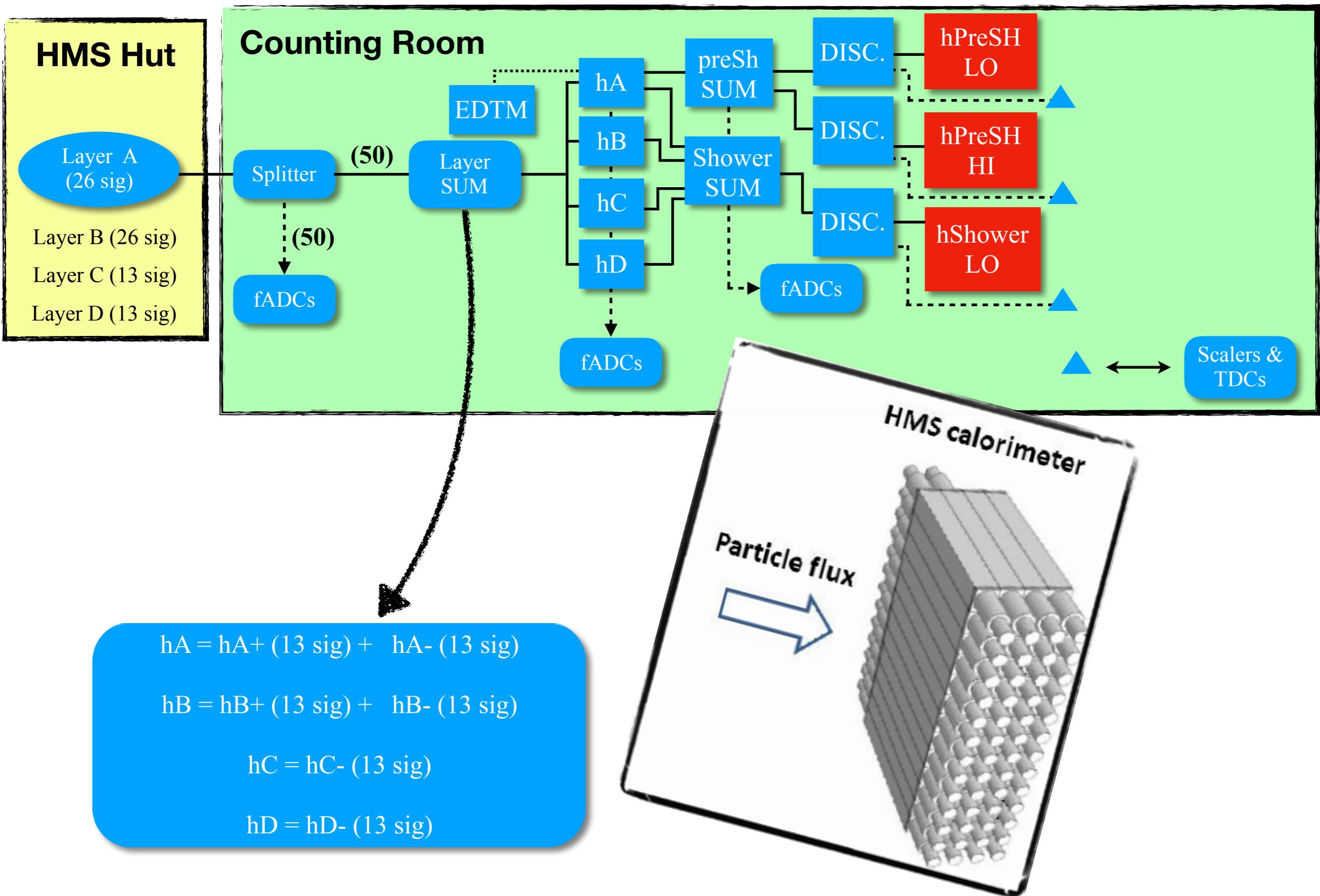
$$h1Y = h1Y+ \text{ (10-fold OR)} \text{ AND } h1Y- \text{ (10-fold OR)}$$

$$h2X = h2X+ \text{ (16-fold OR)} \text{ AND } h2X- \text{ (16-fold OR)}$$

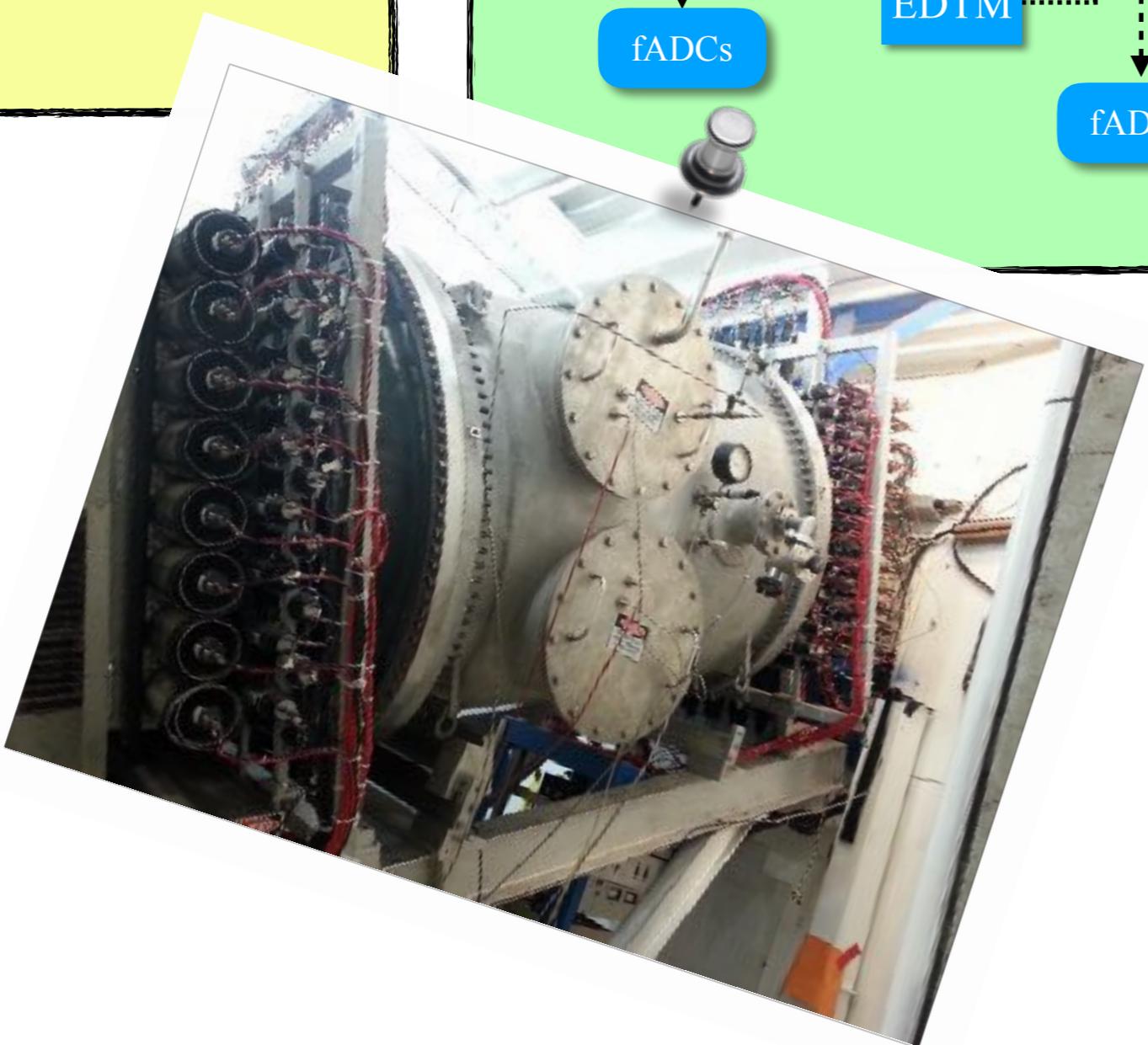
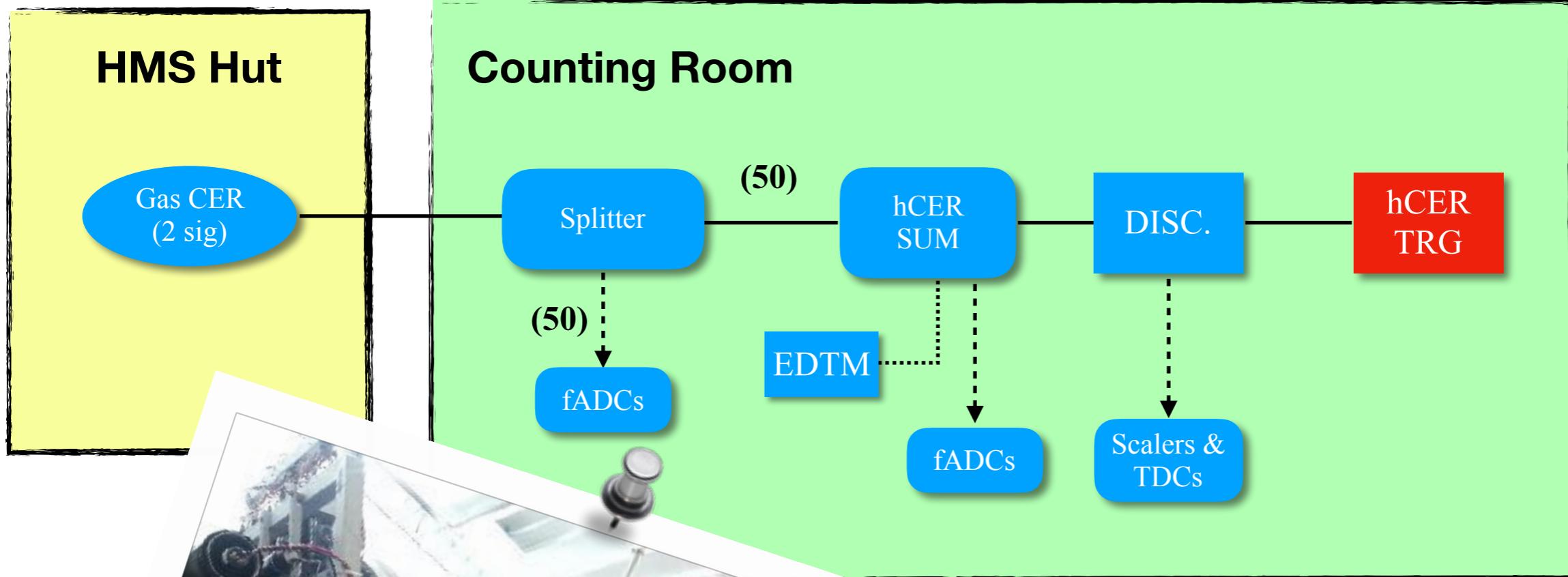
$$h2Y = h2Y+ \text{ (10-fold OR)} \text{ AND } h2Y- \text{ (10-fold OR)}$$



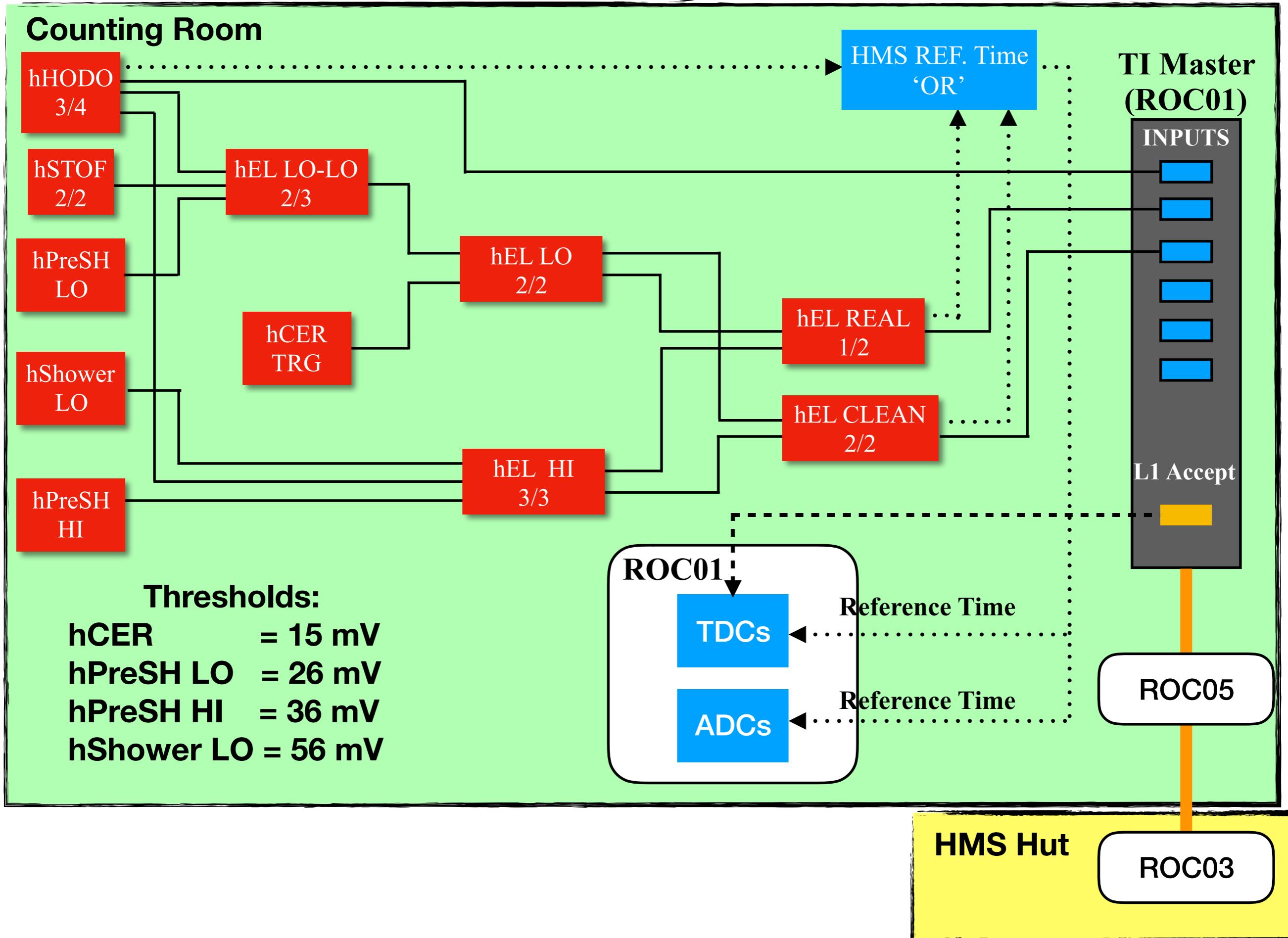
HMS Calorimeter



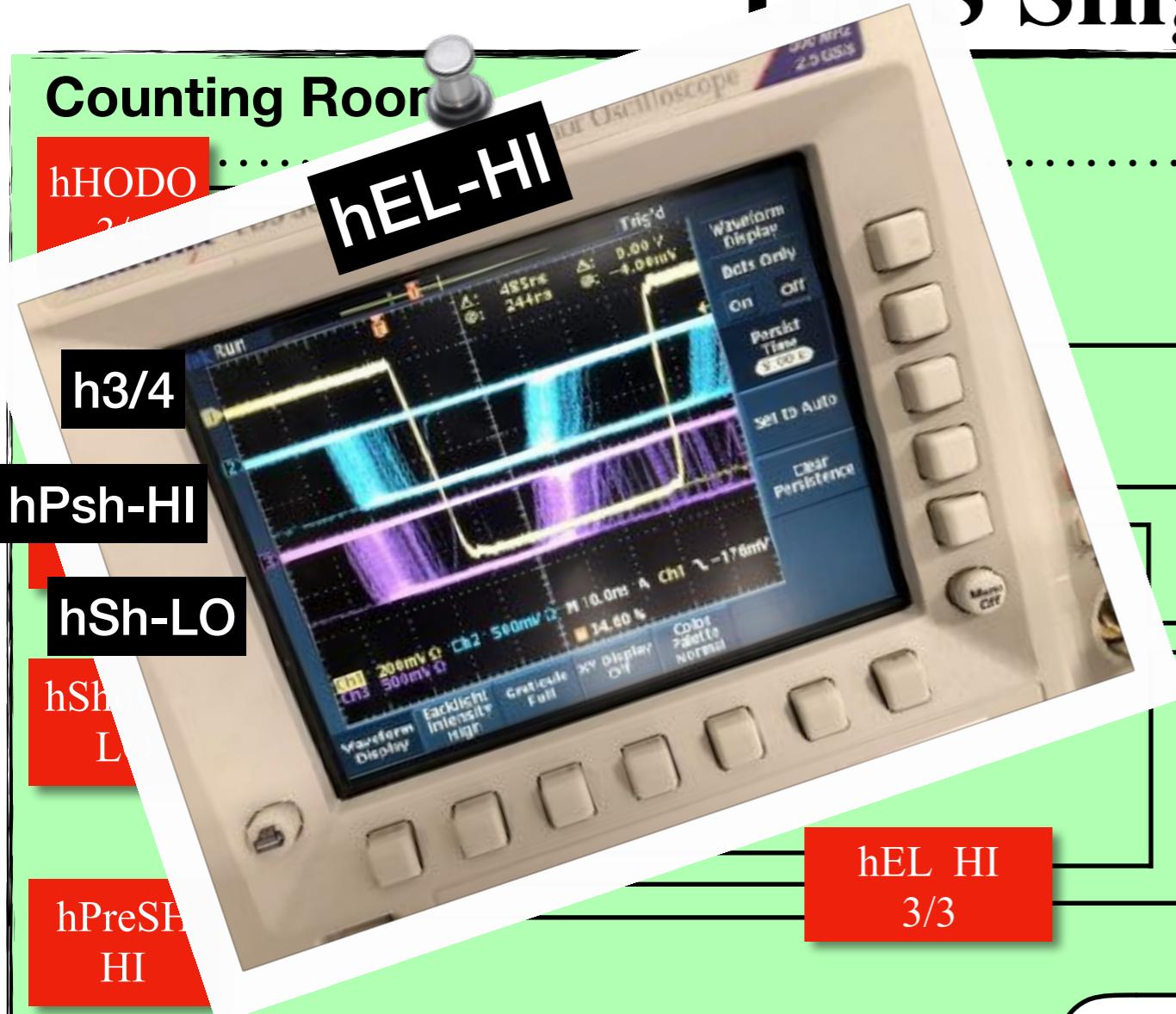
HMS Gas Cherenkov



HMS Single Arm

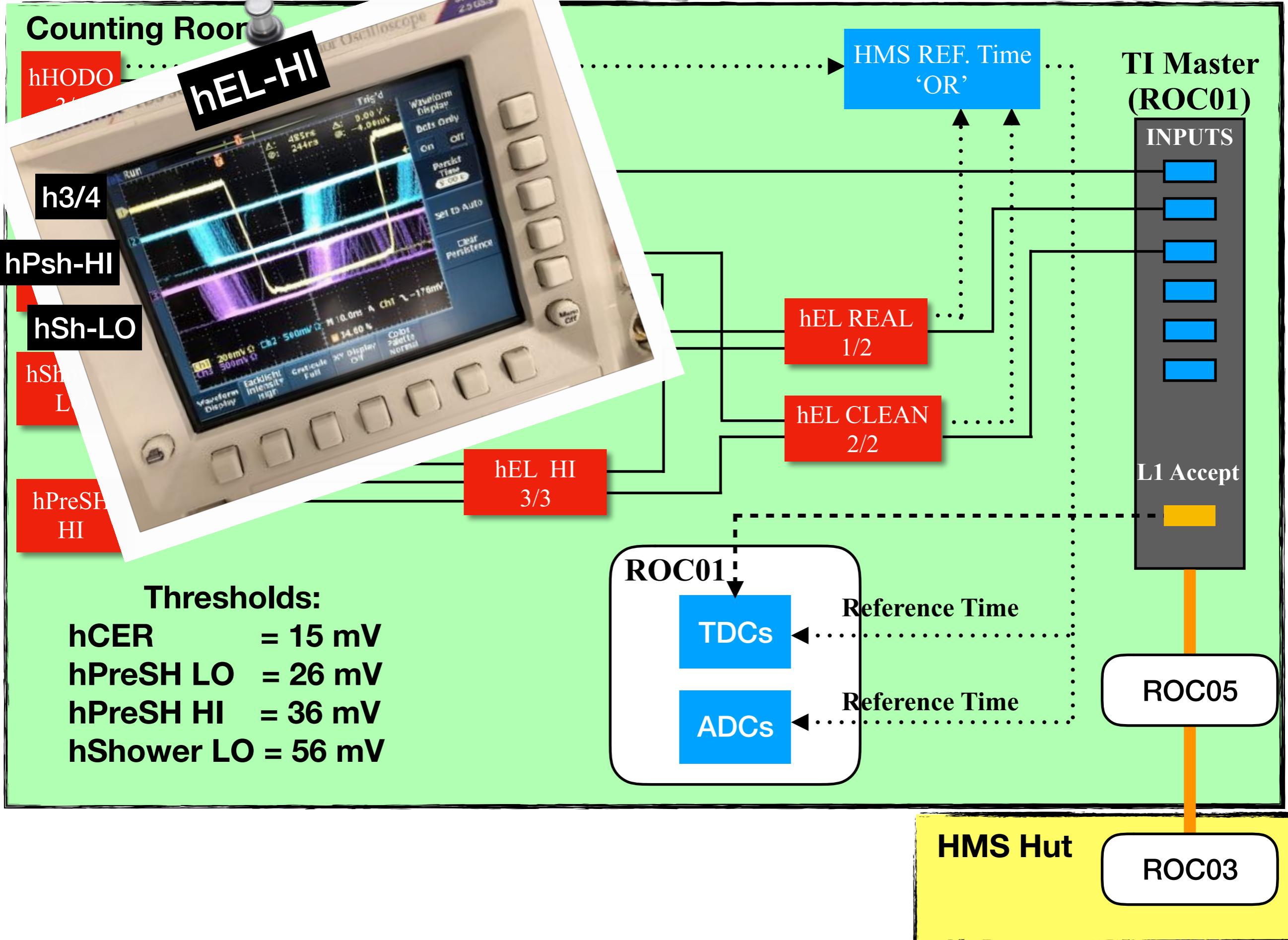


HMS Single Arm



Thresholds:

hCER	= 15 mV
hPreSH LO	= 26 mV
hPreSH HI	= 36 mV
hShower LO	= 56 mV



HMS Single Arm

Counting Room

hHODO

2/2

hEL-HI

h3/4

hPsh-HI

hSh-LO

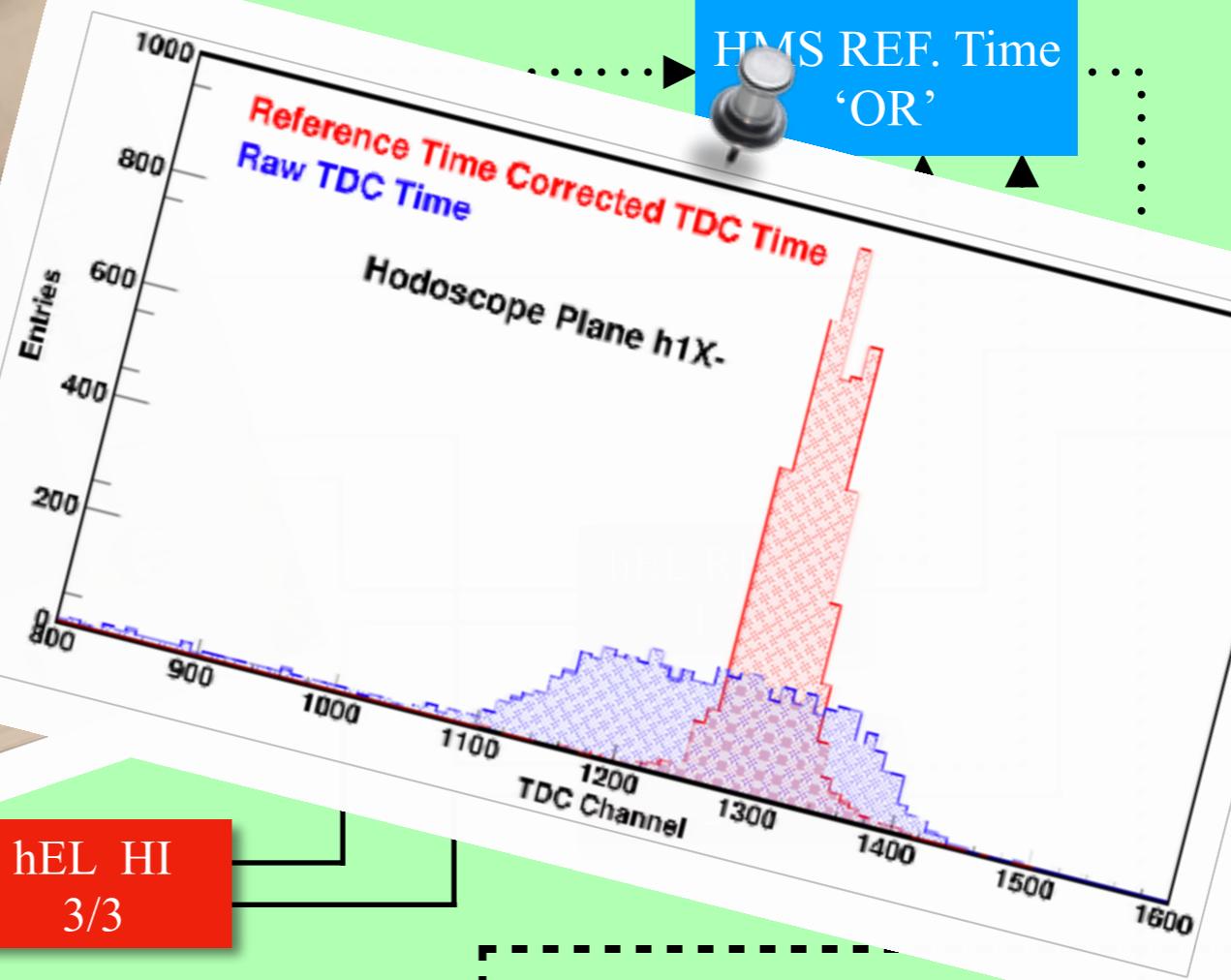
hSh
L

hPreSH
HI



Thresholds:

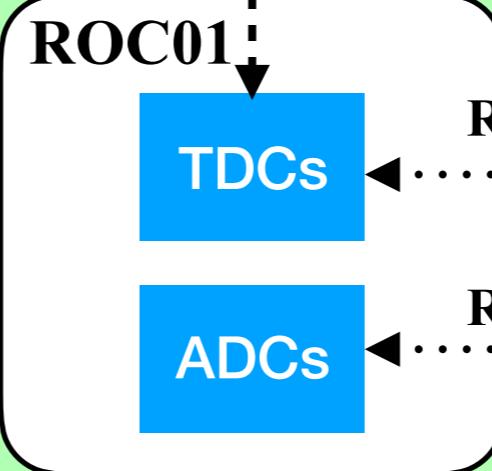
- hCER = 15 mV
- hPreSH LO = 26 mV
- hPreSH HI = 36 mV
- hShower LO = 56 mV



TI Master
(ROC01)

INPUTS

L1 Accept

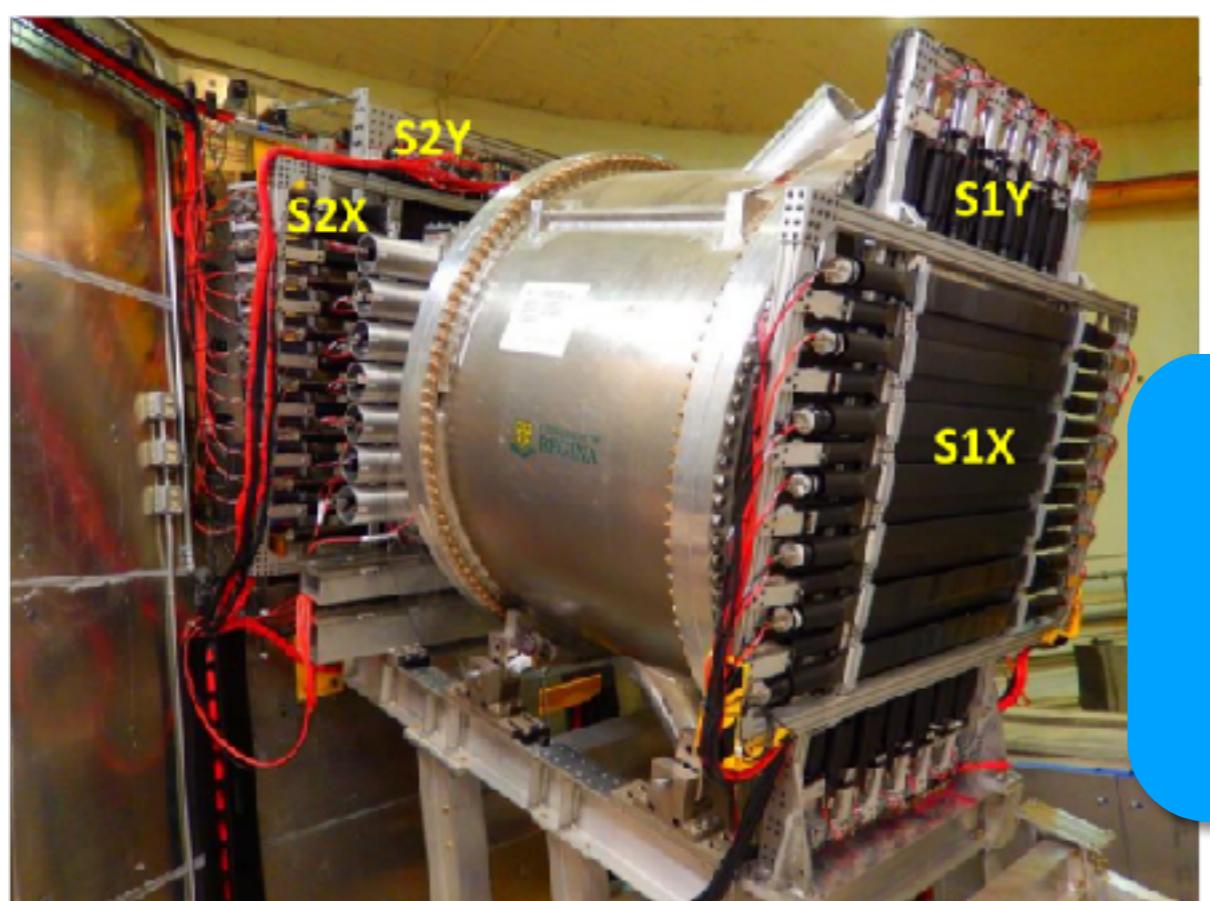
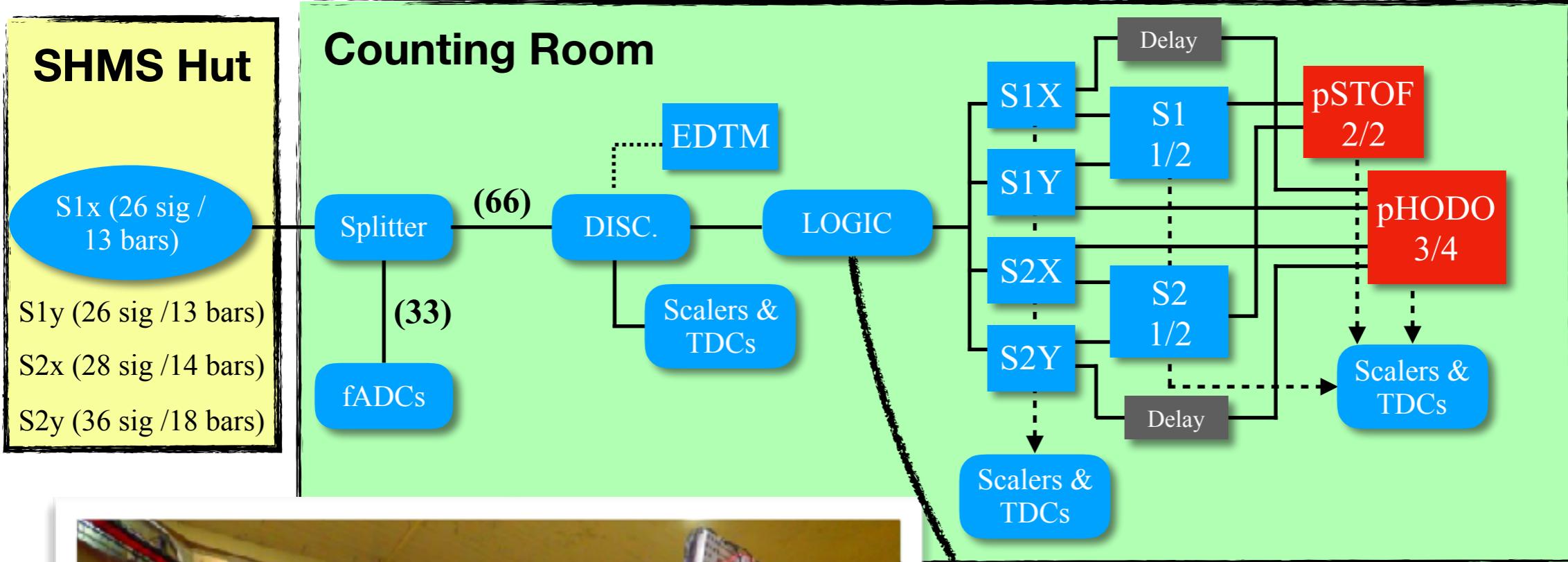


ROC05

HMS Hut

ROC03

SHMS Hodoscopes



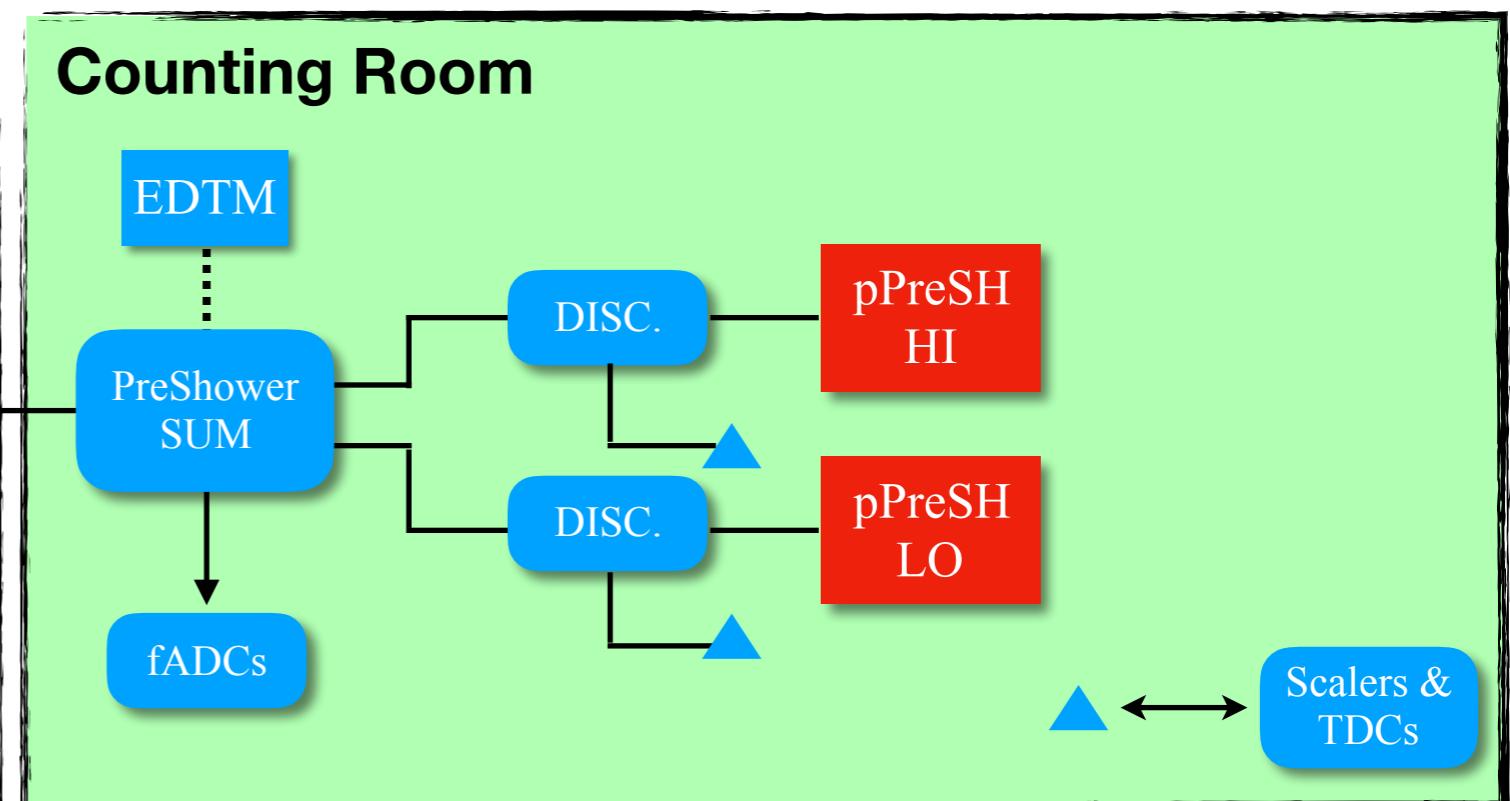
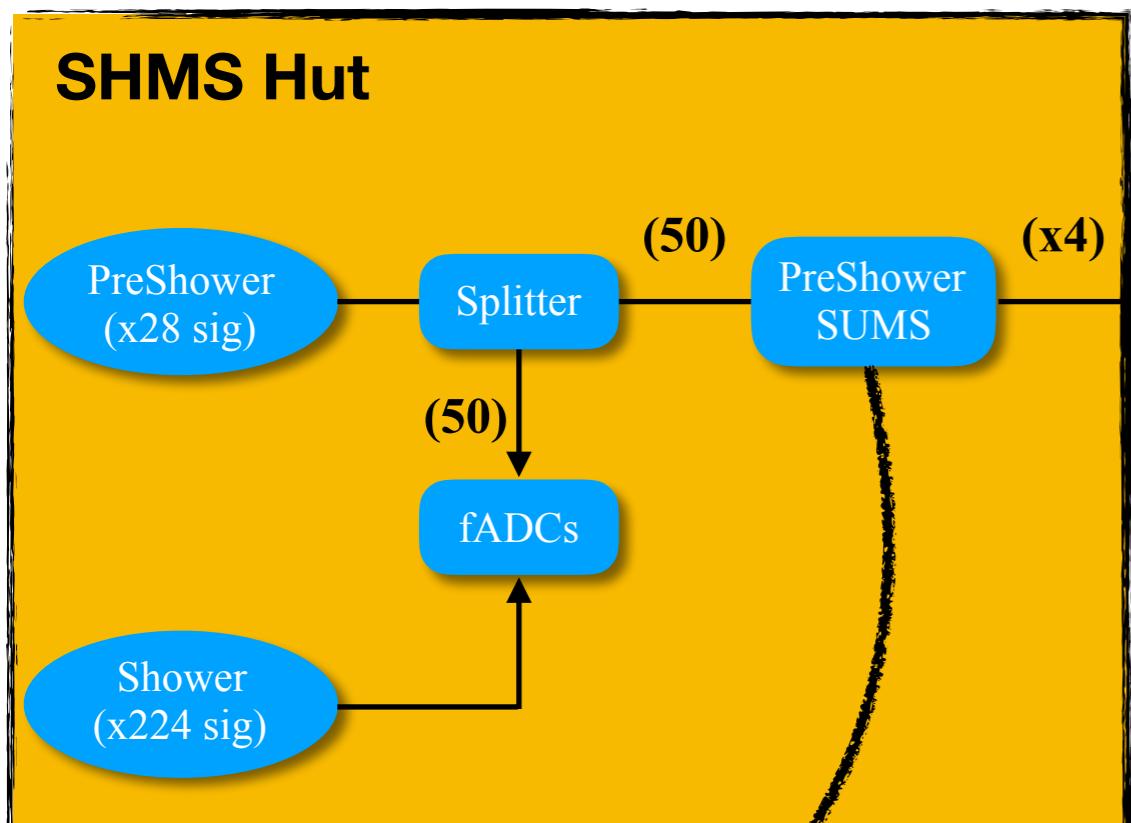
$$h1X = h1X+ \text{ (16-fold OR)} \text{ AND } h1X- \text{ (16-fold OR)}$$

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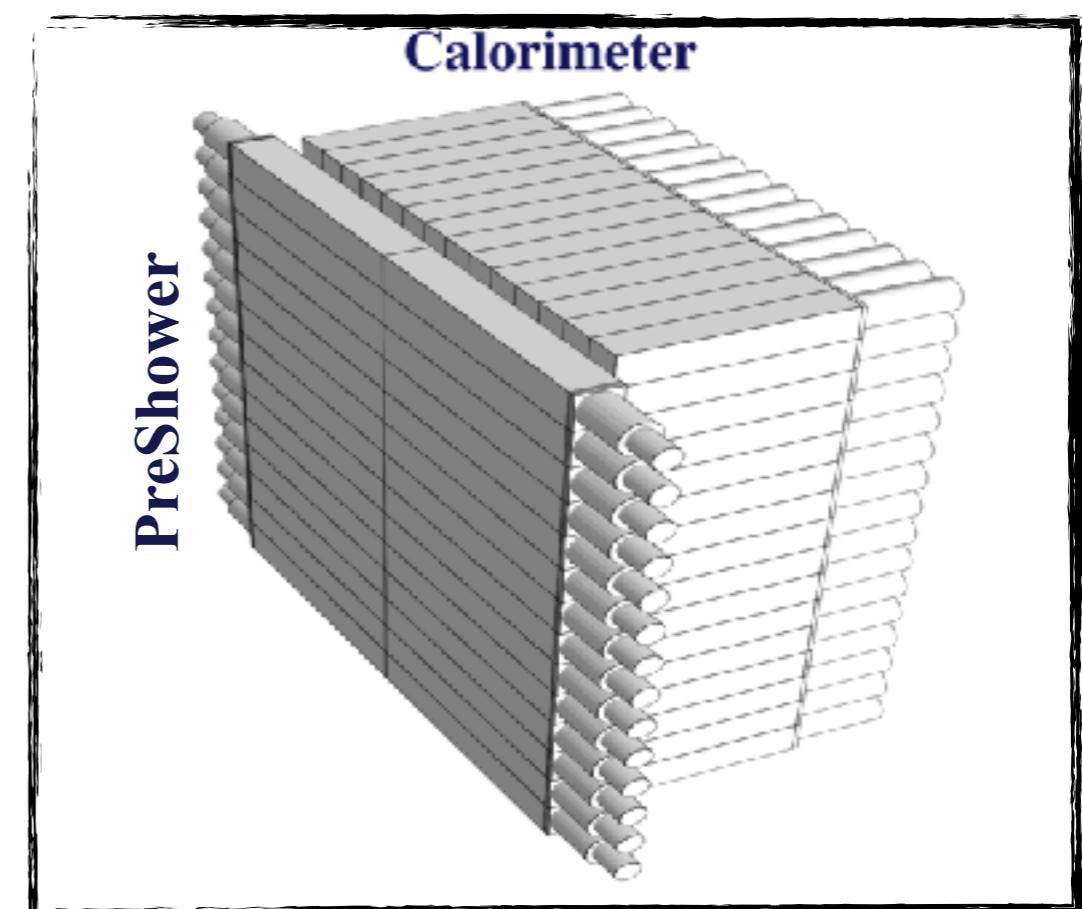
$$h2X = h2X+ \text{ (16-fold OR)} \text{ AND } h2X- \text{ (16-fold OR)}$$

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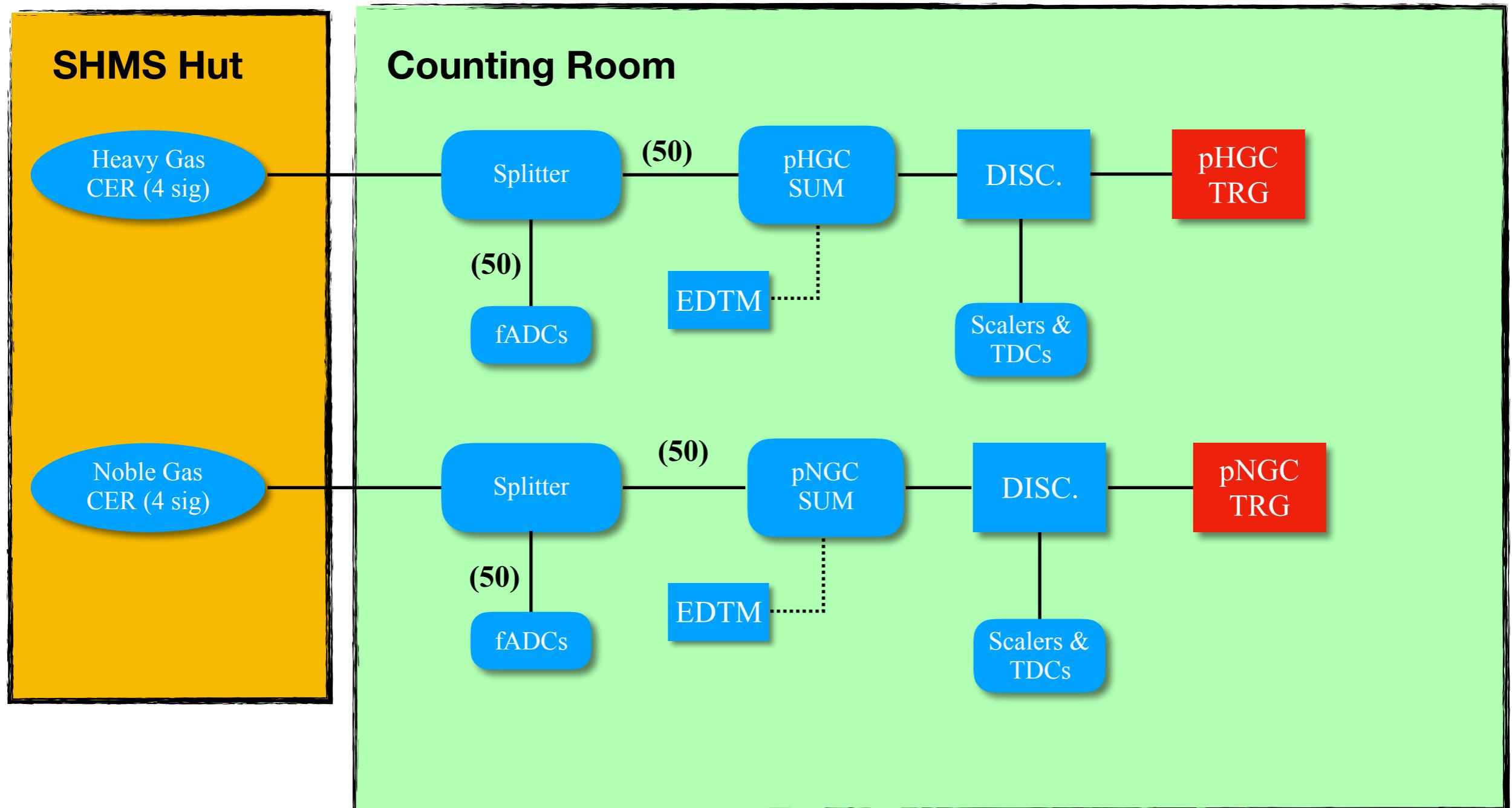
SHMS PreShower/Shower Calorimeter



Sig 1: [1-4] + (+) [1-4] -
Sig 2: [5-8] + (+) [5-8] -
Sig 3: [9-12] + (+) [9-12] -
Sig 4: [13-14] + (+) [13-14] -

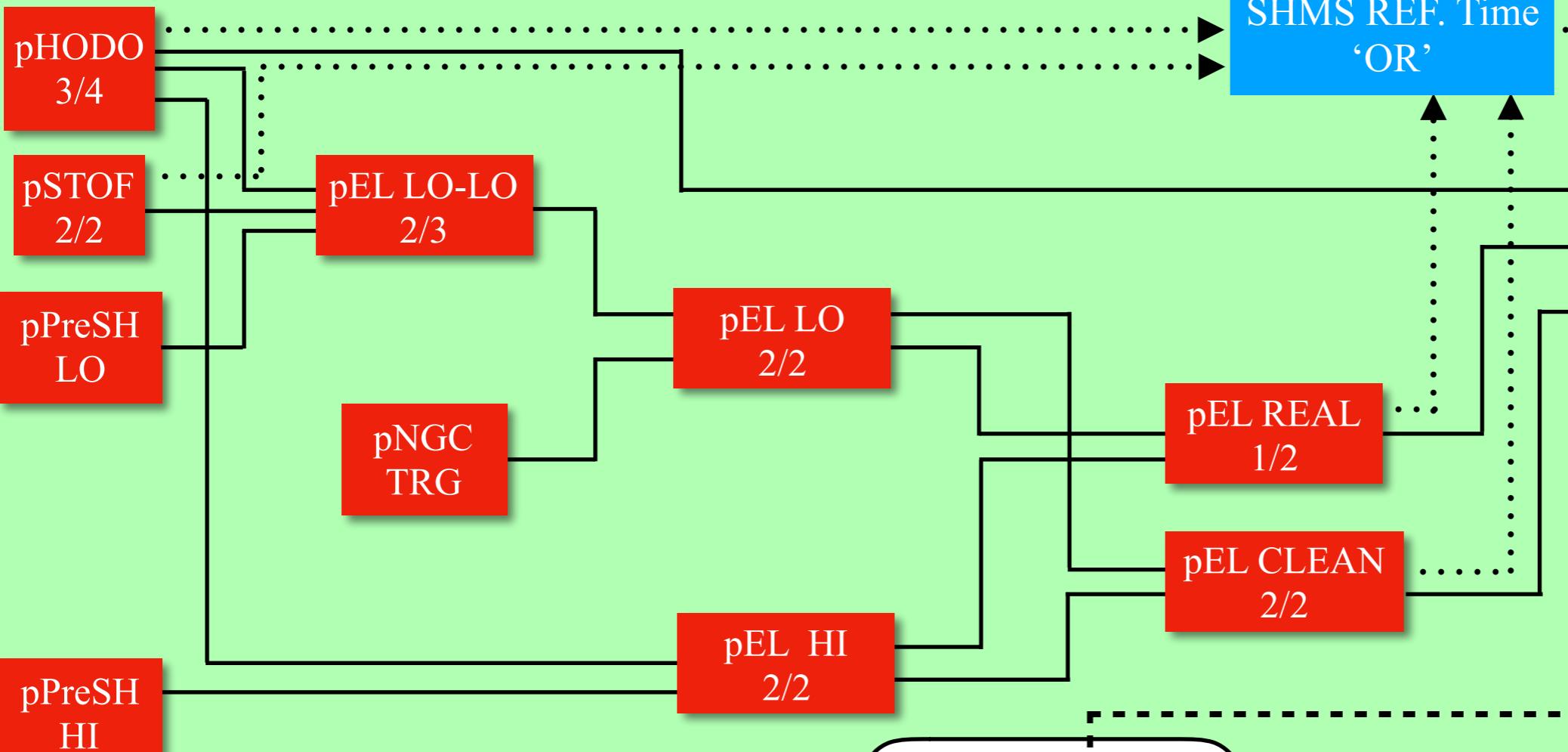


SHMS Heavy/Noble Gas Cherenkov

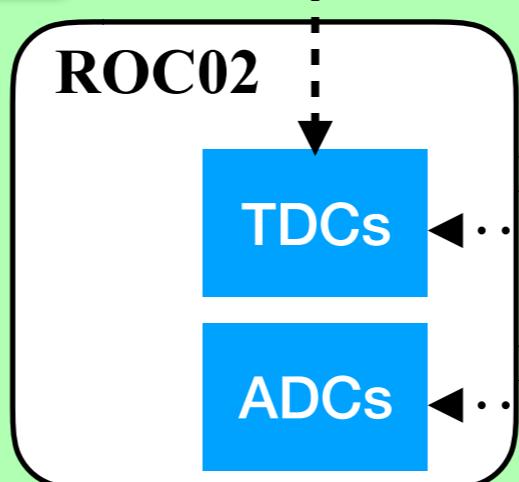
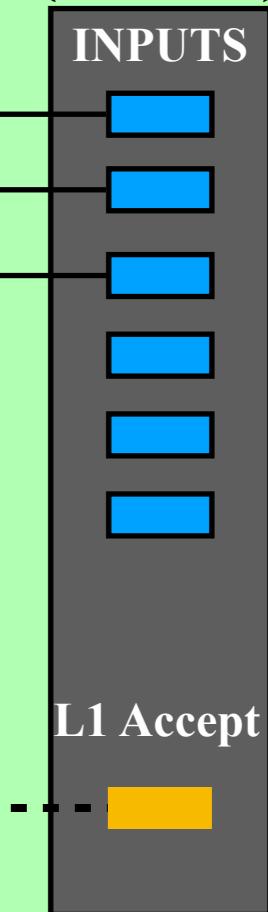


SHMS Single Arm

Counting Room



TI Master (ROC02)



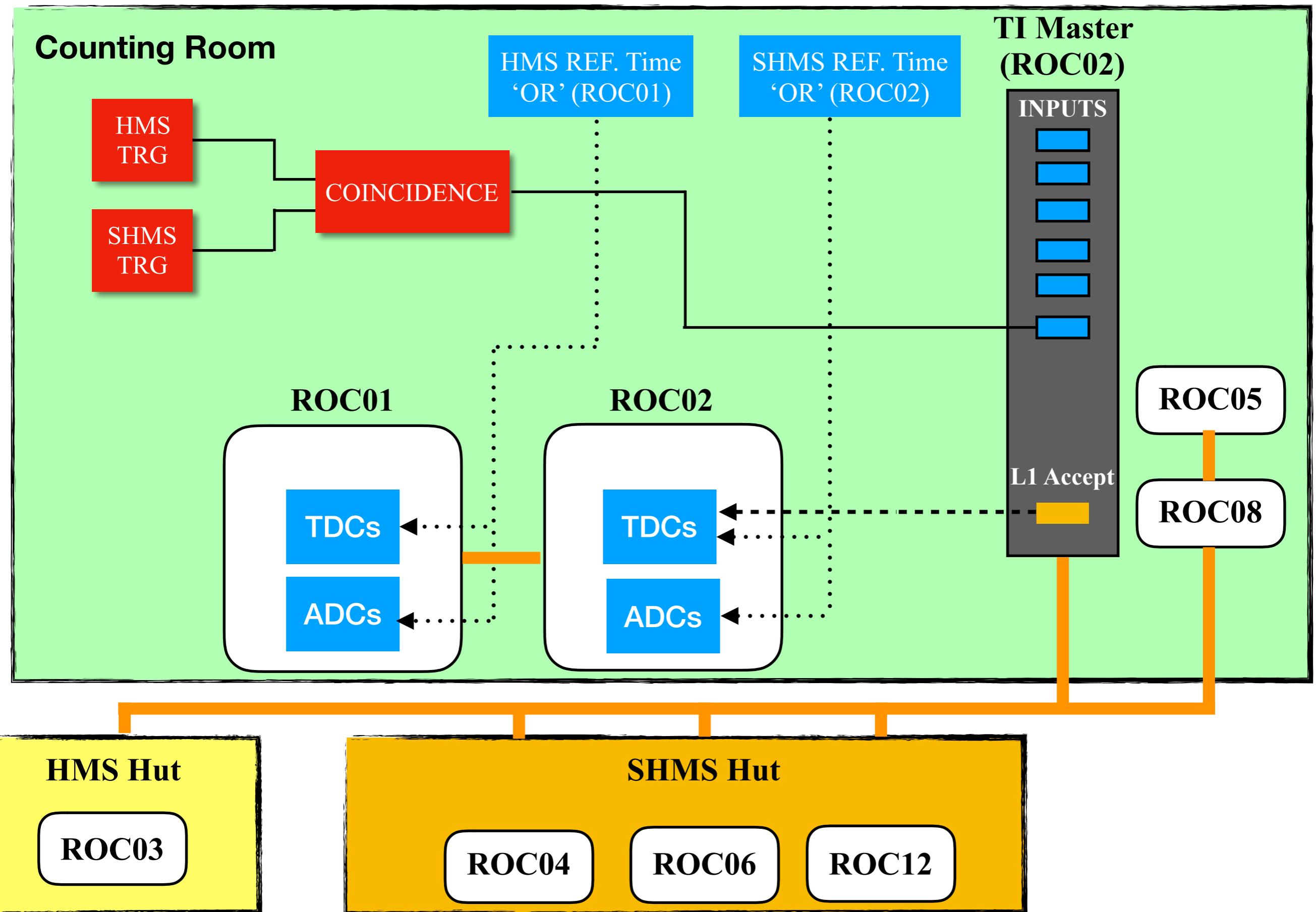
Thresholds:

pNGC	= 10 mV
pPreSH LO	= 10 mV
pPreSH HI	= 15 mV

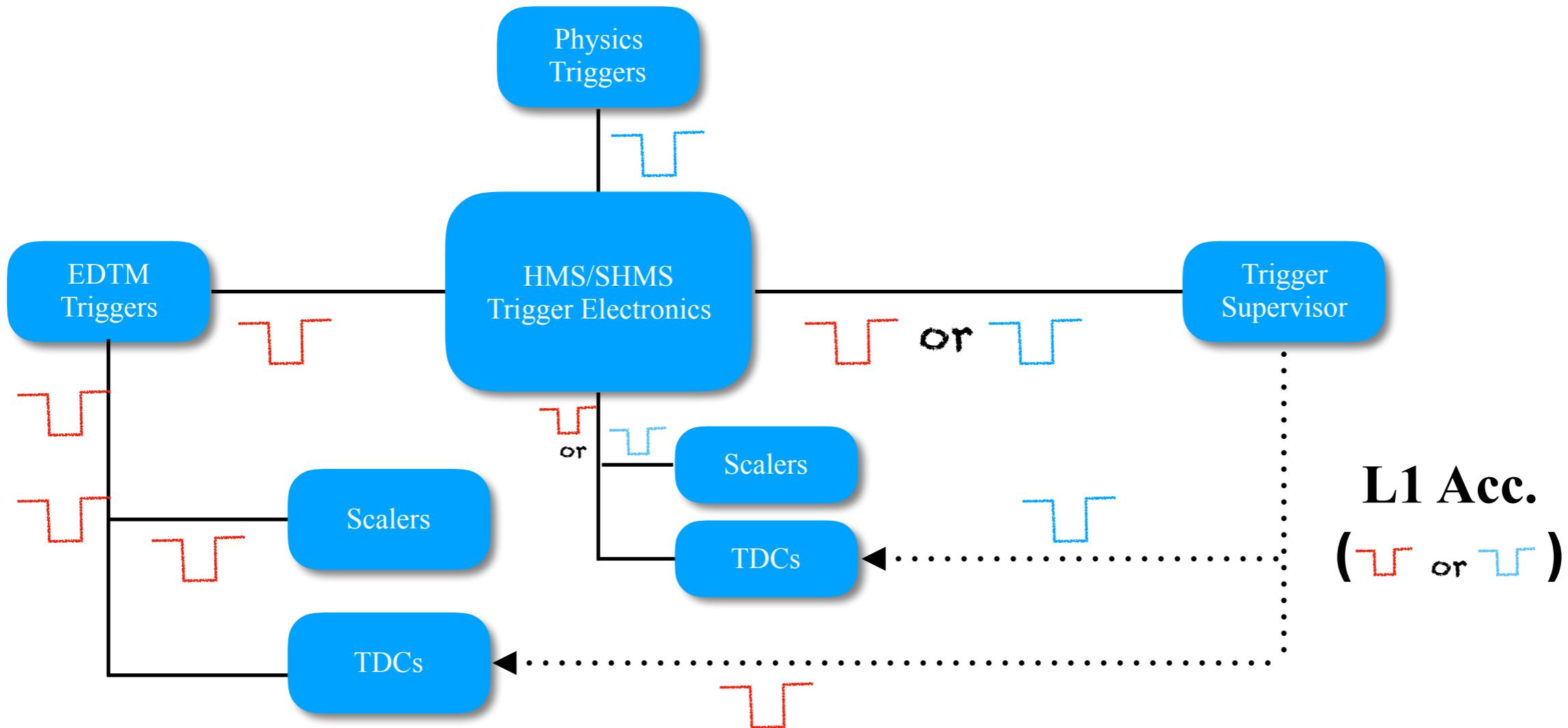
SHMS Hut



HMS/SHMS Coincidence



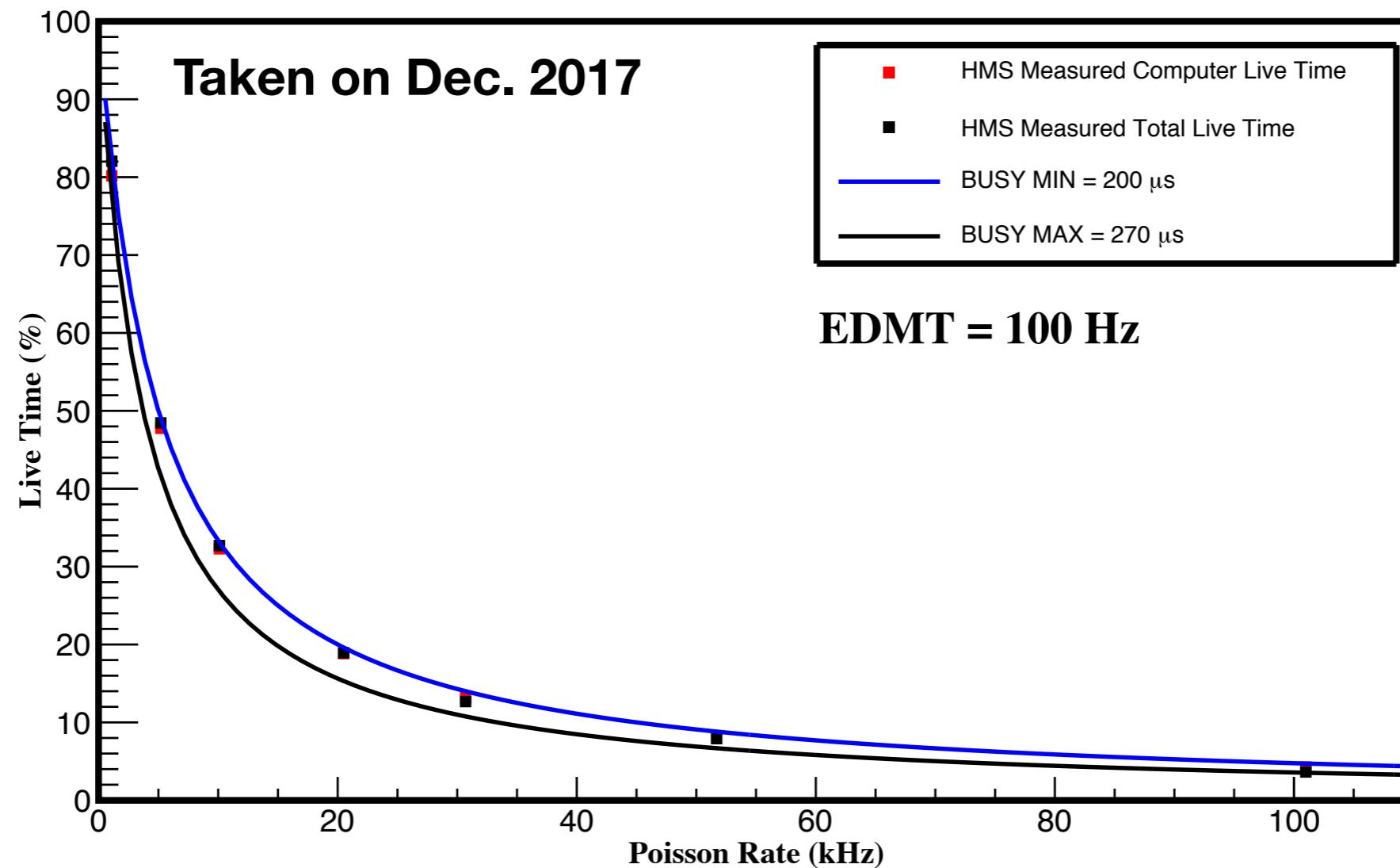
Electronic Dead Time Monitoring (EDTM)



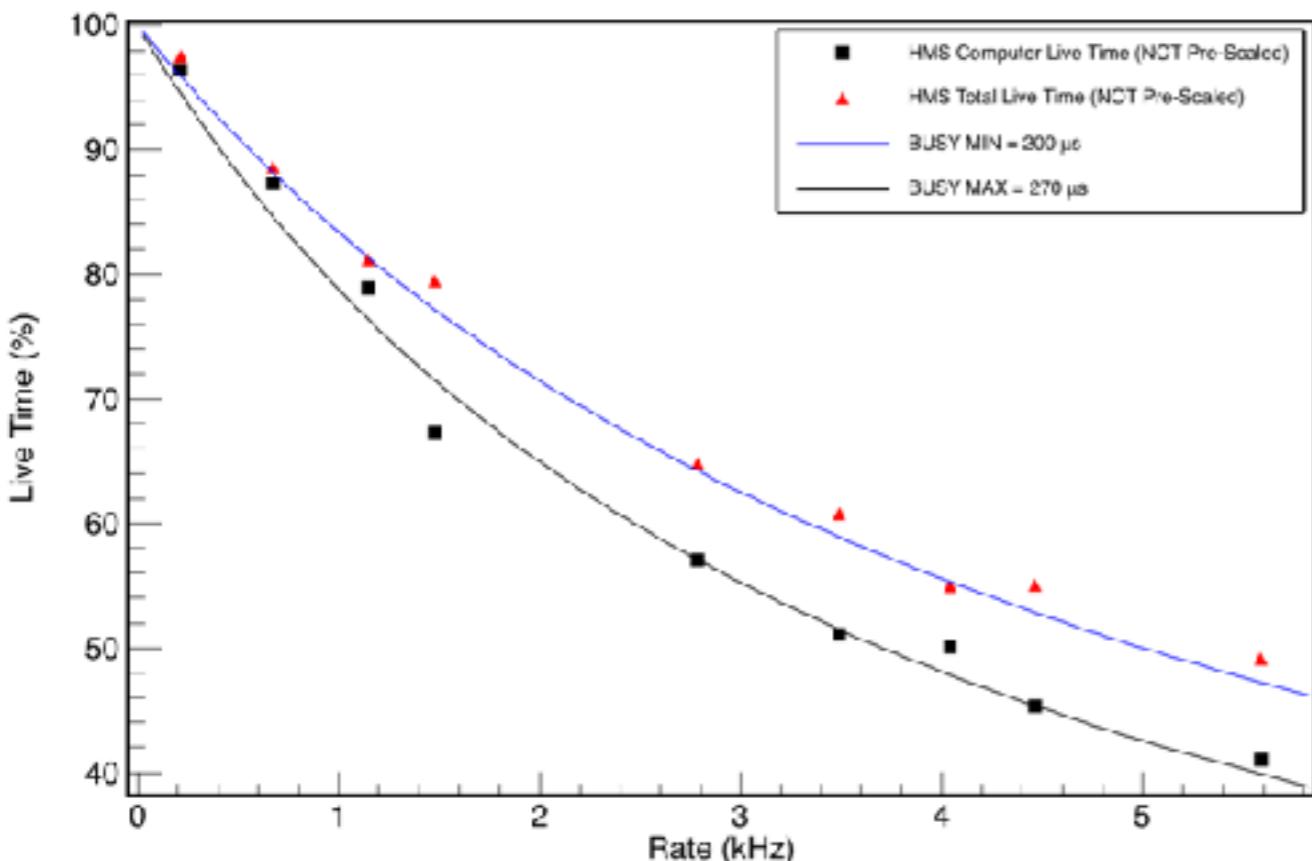
$$\text{Total Live Time} = \frac{\#\text{Accepted EDTM Triggers, TDC} \neq 0}{\#\text{EDTM Scaler Counts}}$$

$$\text{Computer Live Time} = \frac{\#\text{Accepted Triggers, TDC} \neq 0}{\#\text{pre-Trigger Scaler Counts}}$$

HMS Live Time Measurements (NO Scaler Reads)



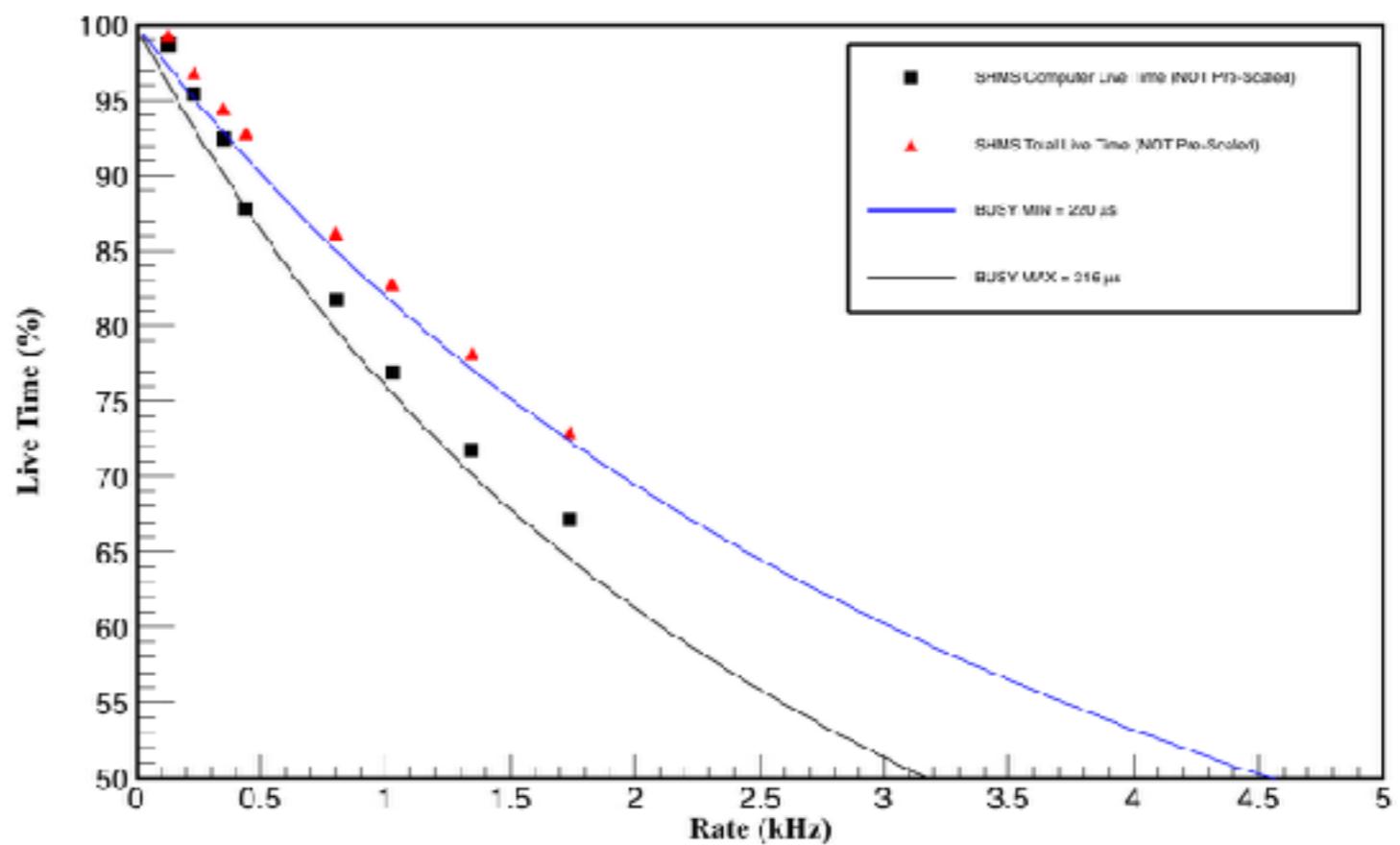
Data Taken with Beam on January, 2018



Computer Live Times agree with theory

Total Live times should be smaller than Computer Live Times

**Understanding EDTM is
A Work-in-Progress**



Thanks!

Questions?

