

Hall C Winter Collaboration Meeting

Hall C Analyzer Update

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On Behalf of the Software Working Group

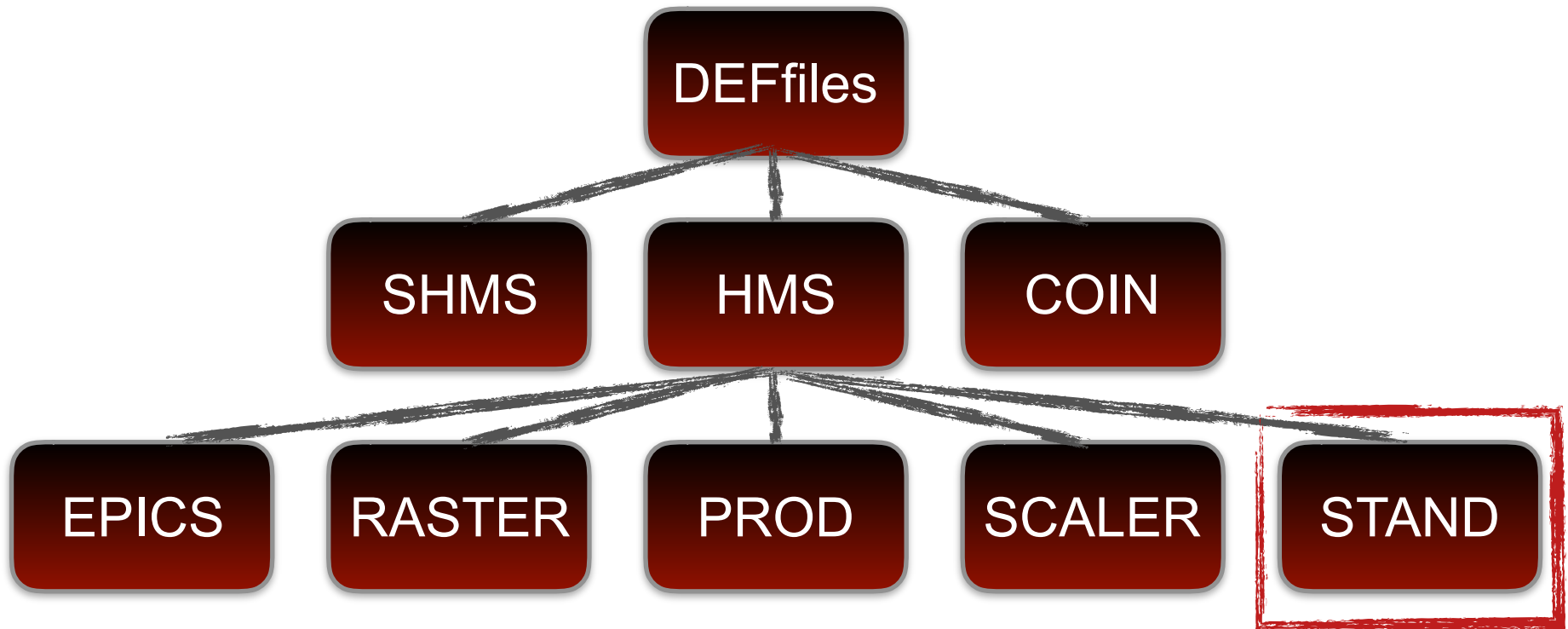
Hall A/C Software Analysis Workshop

- Hall A/C software analysis workshop took place June 26-27, 2017
 - [Wiki Page](#)
- Multiple topics pertinent to both Halls A & C were covered
 - Interactive sessions and take home exercises
 - Overviews of PODD, HCANA, Hall C Replay
 - ROOT and counting house tips and tricks
 - Examples of detector and optics calibrations
 - Interactive exercises involving SAMC, SIMC, G4MC, and radiative correction calculations were provided
- All sessions recorded on Blue Jeans and are available on the [wiki](#)
- Serves as valuable resource for collaborators who are not familiar with the halls A & C software packages

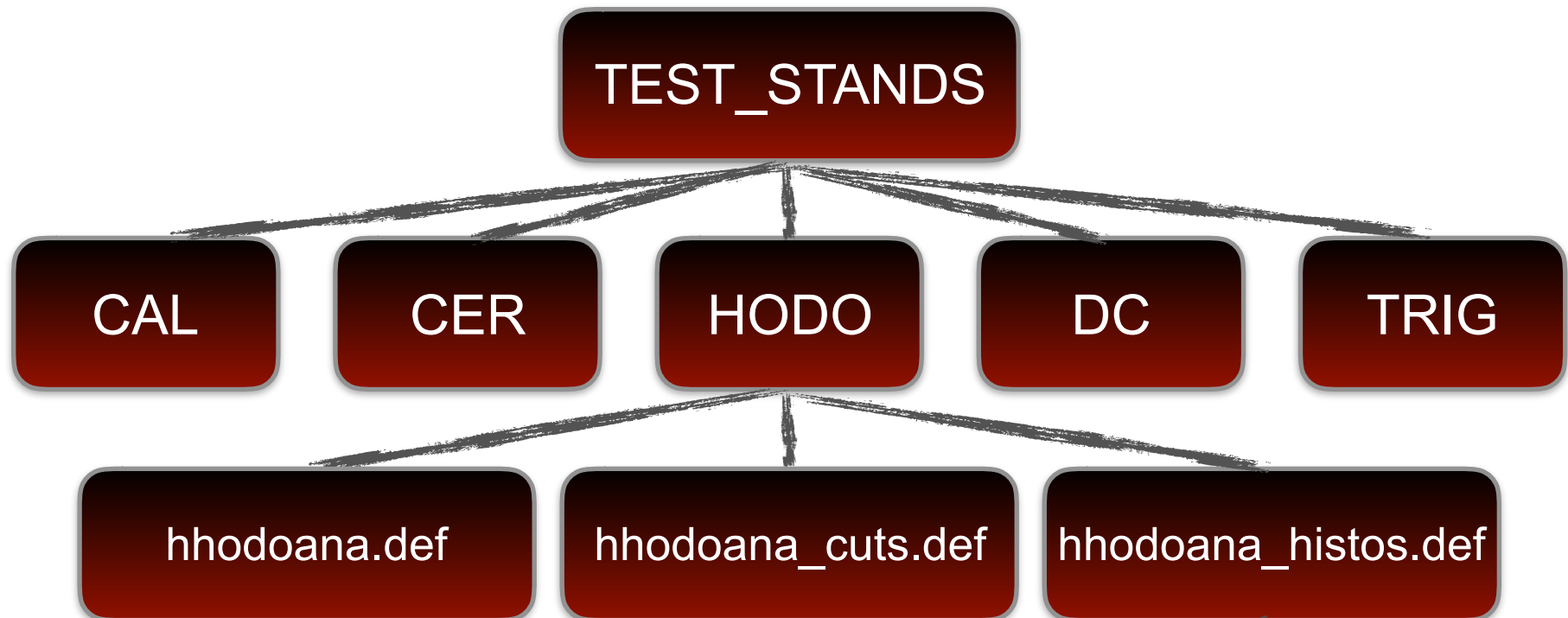


Recent Updates to Hall C Replay

- **#include** directives are now supported in both **definition** and **cuts** files
- The definition files interface has been restructured in order to facilitate online monitoring in a production setting while preserving the ability to debug detectors with the TEST_STAND replays



Recent Updates to Hall C Replay



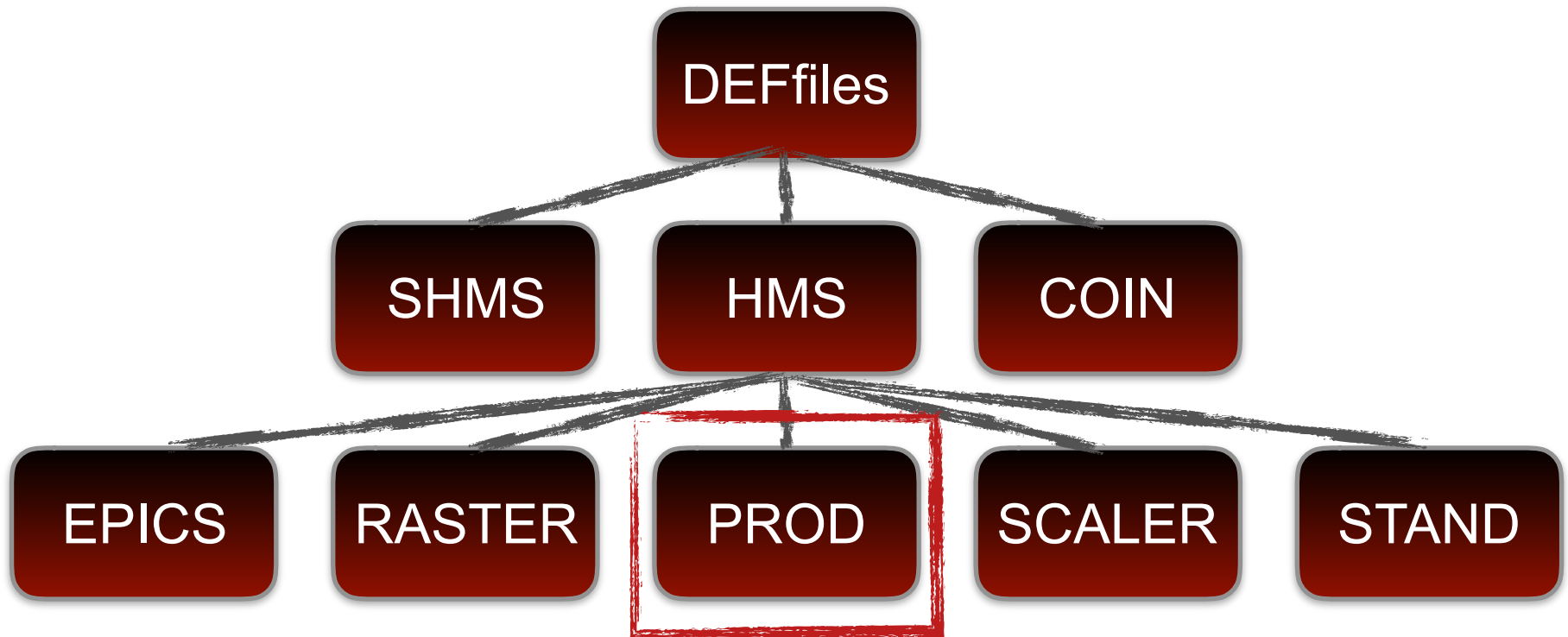
```
block T.hms.*  
block H.hod.*  
  
#include "DEF-files/HMS/TEST_STANDS/HODO/hhodoana_histos.def"  
#include "DEF-files/HMS/PRODUCTION/HODO/hhodo_histos.def"
```

- Data objects that are not utilized in online monitoring
 - Raw ADC & TDC objects
 - Raw ADC/TDC occupancies & multiplicities
 - Good ADC & TDC objects
 - Corrected ADC & TDC objects



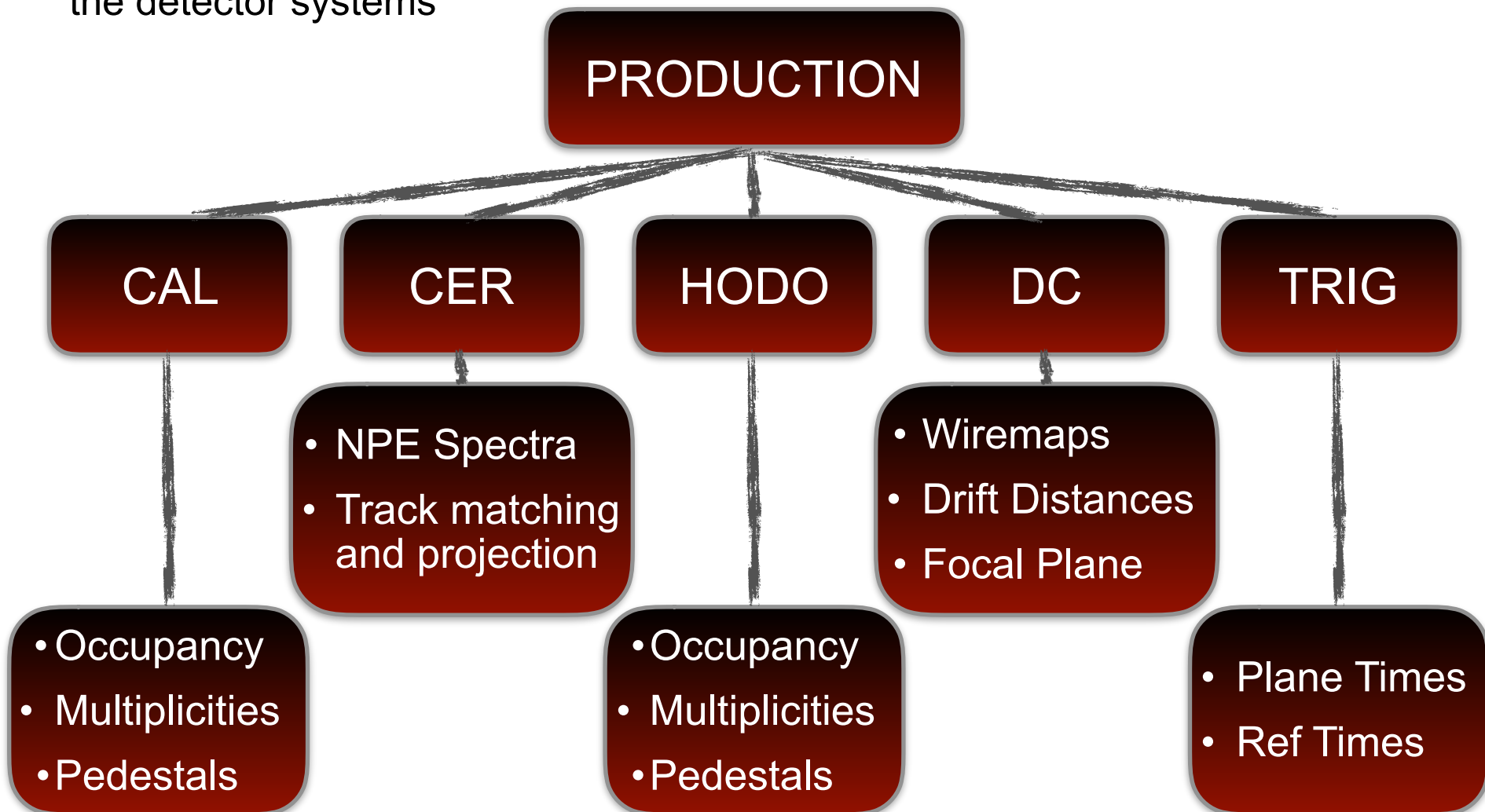
Recent Updates to Hall C Replay

- The **PRODUCTION** directories contain **DEFfiles** which are utilized in the online monitoring



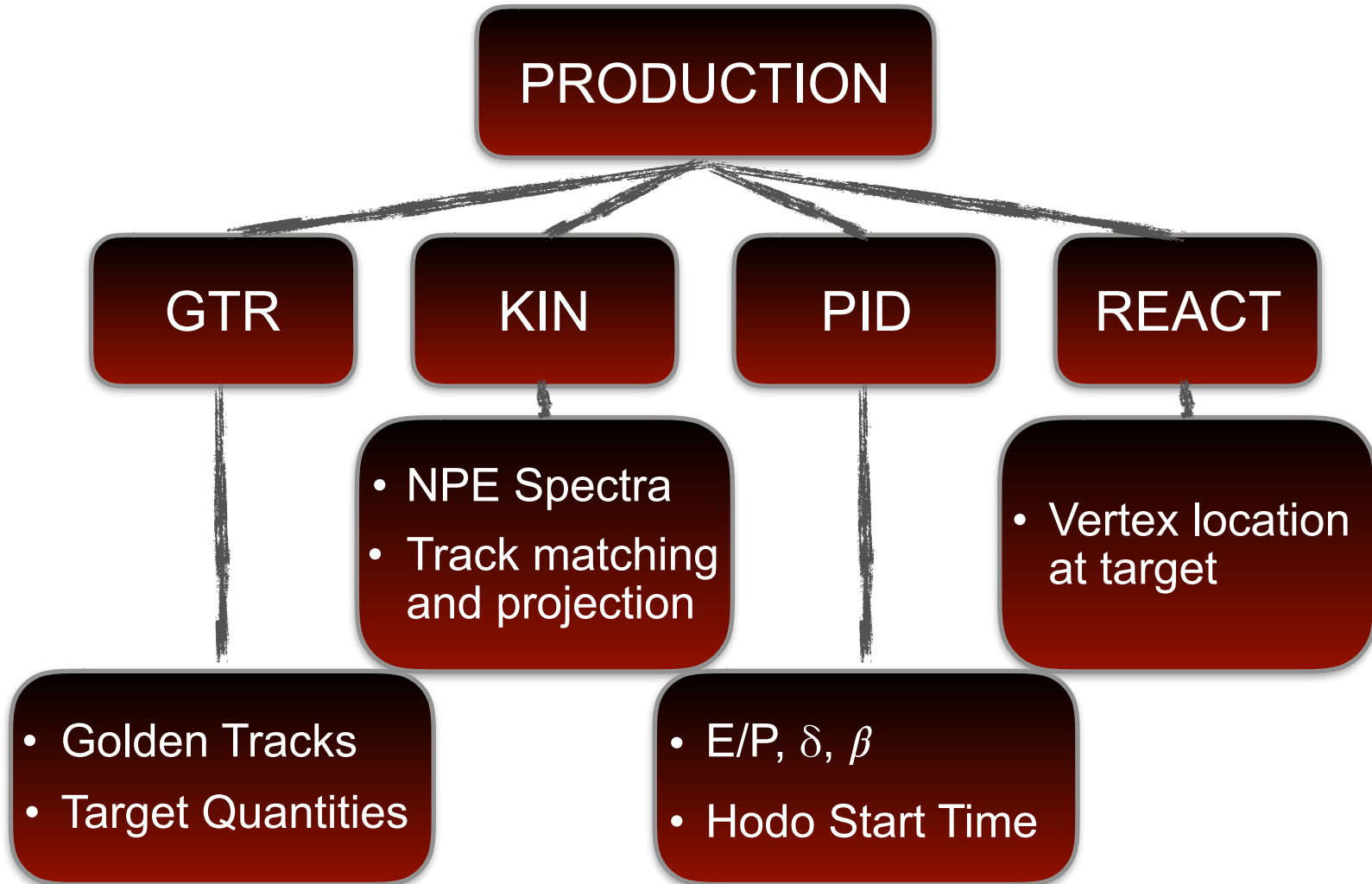
Recent Updates to Hall C Replay

- Detector PRODUCTION **DEFfiles** provide information regarding the health of the detector systems



Recent Updates to Hall C Replay

- Physics **DEFfiles** provide reconstructed quantities



Recent Updates to Hall C Replay

hstackana_production.def

```
#include "DEF-files/HMS/PRODUCTION/CAL/hcal_histos.def"
#include "DEF-files/HMS/PRODUCTION/CER/hcer_histos.def"
#include "DEF-files/HMS/PRODUCTION/DC/hdc_histos.def"
#include "DEF-files/HMS/PRODUCTION/HODO/hhodo_histos.def"
#include "DEF-files/HMS/PRODUCTION/KIN/hkin_histos.def"
#include "DEF-files/HMS/PRODUCTION/GTR/hgtr_histos.def"
#include "DEF-files/HMS/PRODUCTION/RASTER/hraster_histos.def"
#include "DEF-files/HMS/PRODUCTION/TRIG/htrig_histos.def"
#include "DEF-files/HMS/PRODUCTION/EPICS/hepics_vars.def"
#include "DEF-files/HMS/PRODUCTION/REACT/hreact_histos.def"
#include "DEF-files/HMS/PRODUCTION/PID/hpid_histos.def"
```

hstackana_production_all.def

```
#include "DEF-files/HMS/PRODUCTION/BLOCK/hblock_vars.def"

#include "DEF-files/HMS/TEST_STANDS/CER/hcerana_histos.def"
#include "DEF-files/HMS/TEST_STANDS/DC/hdcana_histos.def"
#include "DEF-files/HMS/TEST_STANDS/HODO/hhodoana_histos.def"
#include "DEF-files/HMS/TEST_STANDS/CAL/hcalana_histos.def"
#include "DEF-files/HMS/TEST_STANDS/TRIG/htrigana_histos.def"

#include "DEF-files/HMS/PRODUCTION/CAL/hcal_histos.def"
#include "DEF-files/HMS/PRODUCTION/BLOCK/hblock_vars.def"
#include "DEF-files/HMS/PRODUCTION/CER/hcer_histos.def"
#include "DEF-files/HMS/PRODUCTION/DC/hdc_histos.def"
#include "DEF-files/HMS/PRODUCTION/HODO/hhodo_histos.def"
#include "DEF-files/HMS/PRODUCTION/KIN/hkin_histos.def"
#include "DEF-files/HMS/PRODUCTION/GTR/hgtr_histos.def"
#include "DEF-files/HMS/PRODUCTION/RASTER/hraster_histos.def"
#include "DEF-files/HMS/PRODUCTION/TRIG/htrig_histos.def"
#include "DEF-files/HMS/PRODUCTION/EPICS/hepics_vars.def"
#include "DEF-files/HMS/PRODUCTION/REACT/hreact_histos.def"
#include "DEF-files/HMS/PRODUCTION/PID/hpid_histos.def"
```



Recent Updates to Hall C Replay

- Report files stored in **TEMPLATES** directories for single arm and coincidence replays are in place and are a work in progress
 - **SCALERS** reports on rates and dead times
 - **PRODUCTION** reports on tracking/PID efficiencies and everything that is reported in **SCALERS**
- Replays and online monitoring for coincidence running have been added to **SCRIPTS/COIN/PRODUCTION/**
 - **replay_production_coin_hElec_pProt.C**
 - **replay_production_coin_hProt_pElec.C**
- Single arm replays over coincidence data provide online monitoring of the detector systems, PID, tracking and physics quantities in **SCRIPTS/(S)HMS/PRODUCTION/**
 - **replay_production_(s)hms_coin.C**
 - Missing data objects from other arm are ignored



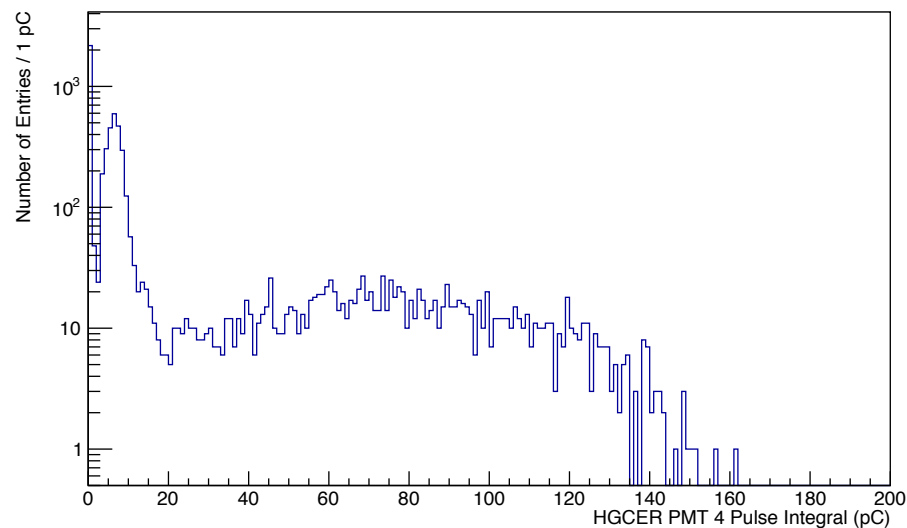
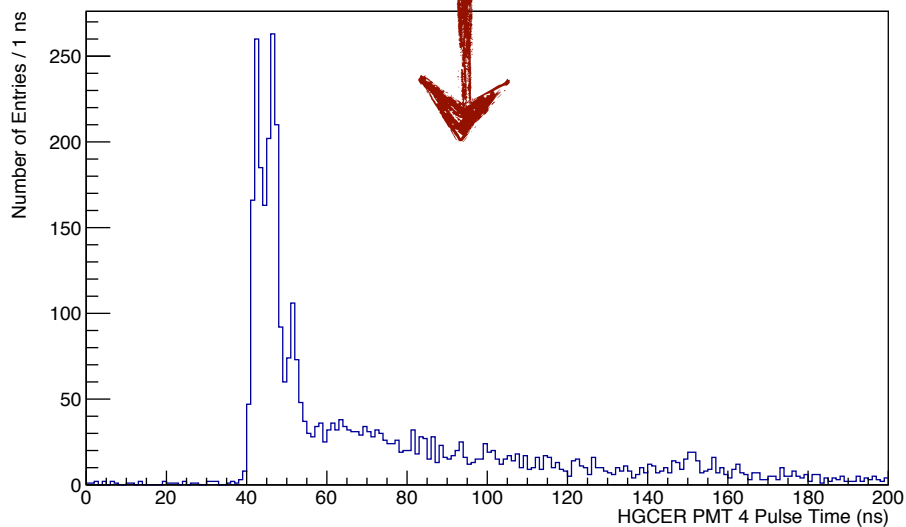
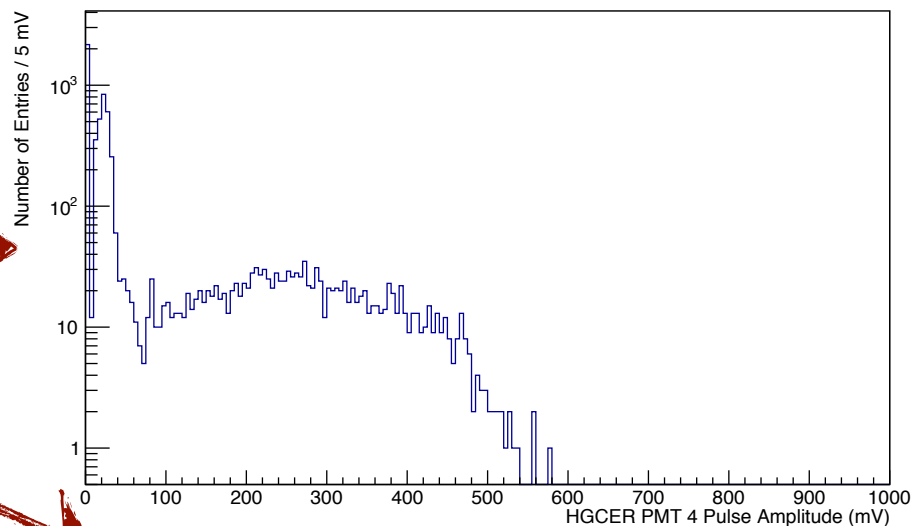
Recent Updates to HCANA

- FADC data objects are now reported in derived SI units instead of FADC channels

- Amplitude \rightarrow mV

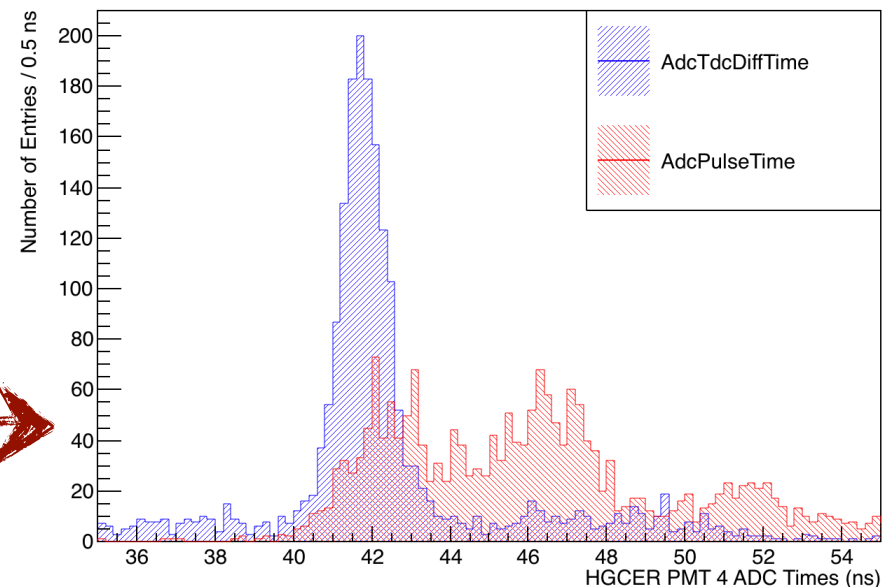
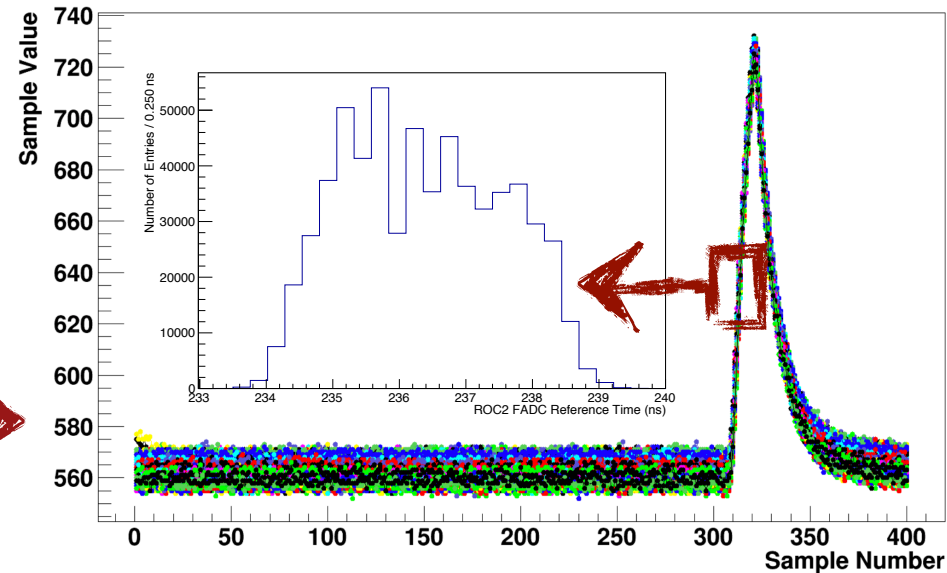
- Integral \rightarrow pC

- Time \rightarrow ns



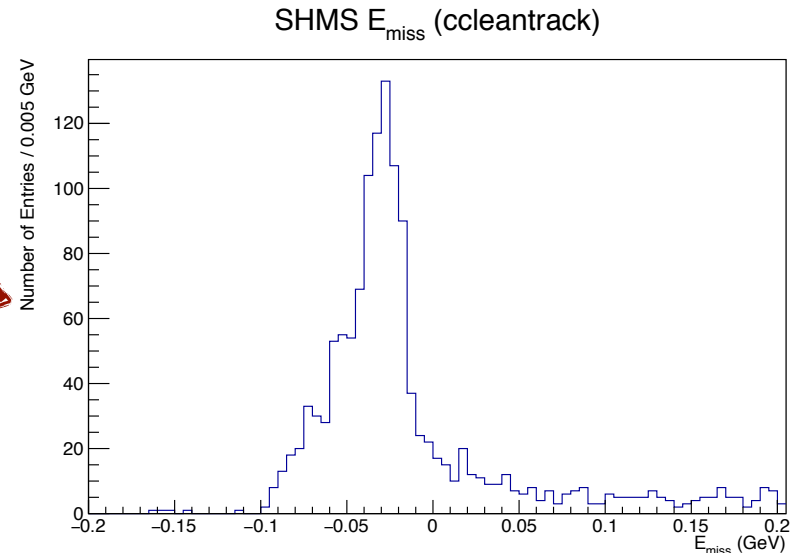
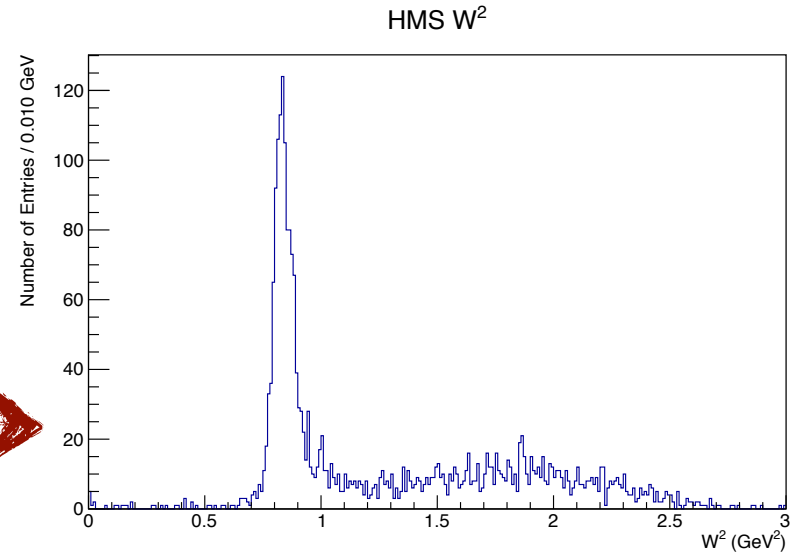
Recent Updates to HCANA

- An FADC reference time is now present in ROC's 1 & 2
- A copy of the pre-existing TDC reference time is fed into an RC circuit in order to smear out the NIM logic signal
- **AdcPulseTimeRaw** objects contain the raw FADC times
- **AdcPulseTime** objects are now reference time subtracted via **THcRawAdcHit** class
- **AdcTdcDiffTime** objects are reference time subtracted FADC times minus the hodoscope start time



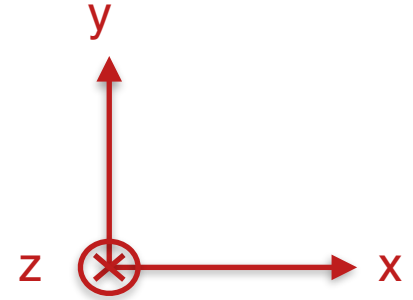
Recent Updates to HCANA

- New physics modules have been added which calculate various physics quantities
- **THcPrimaryKine**
 - Primary kinematics
 - Q^2 , ω , W^2 , x_{Bj} , ...
- **THcSecondaryKine**
 - Secondary kinematics
 - P_{miss} , E_{miss} , M_{recoil} , ...
- **THcExtTarCor**
 - Extended target corrections
 - δ_p , δ_δ , $\delta_{x'_{tar}}$

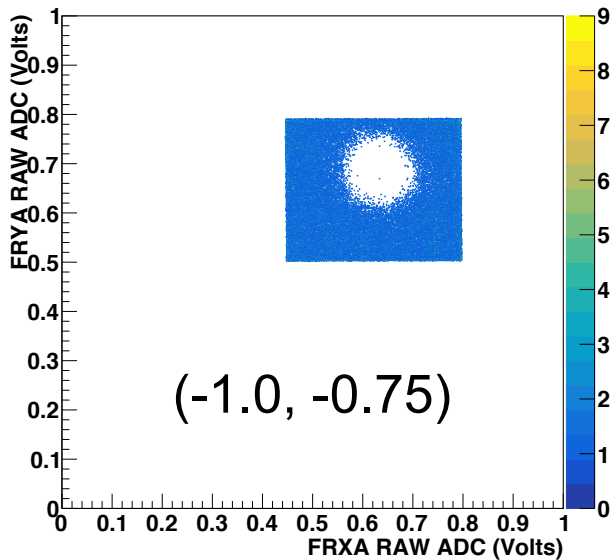


Recent Updates to HCANA

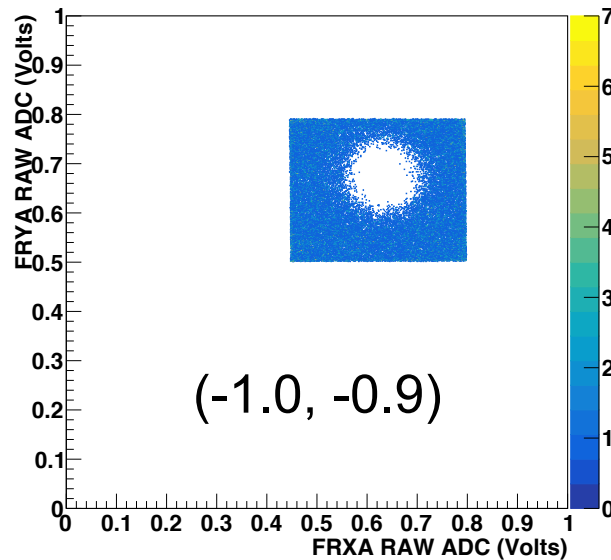
- **THcRaster** has been updated to be consistent with accelerators EPICS left handed coordinate system
- Carbon hole runs/coordinates are now more easily understood



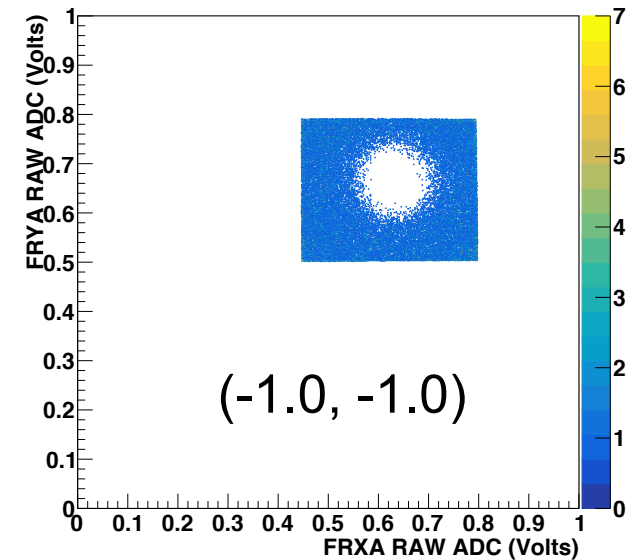
SHMS FRA X vs Y



SHMS FRA X vs Y

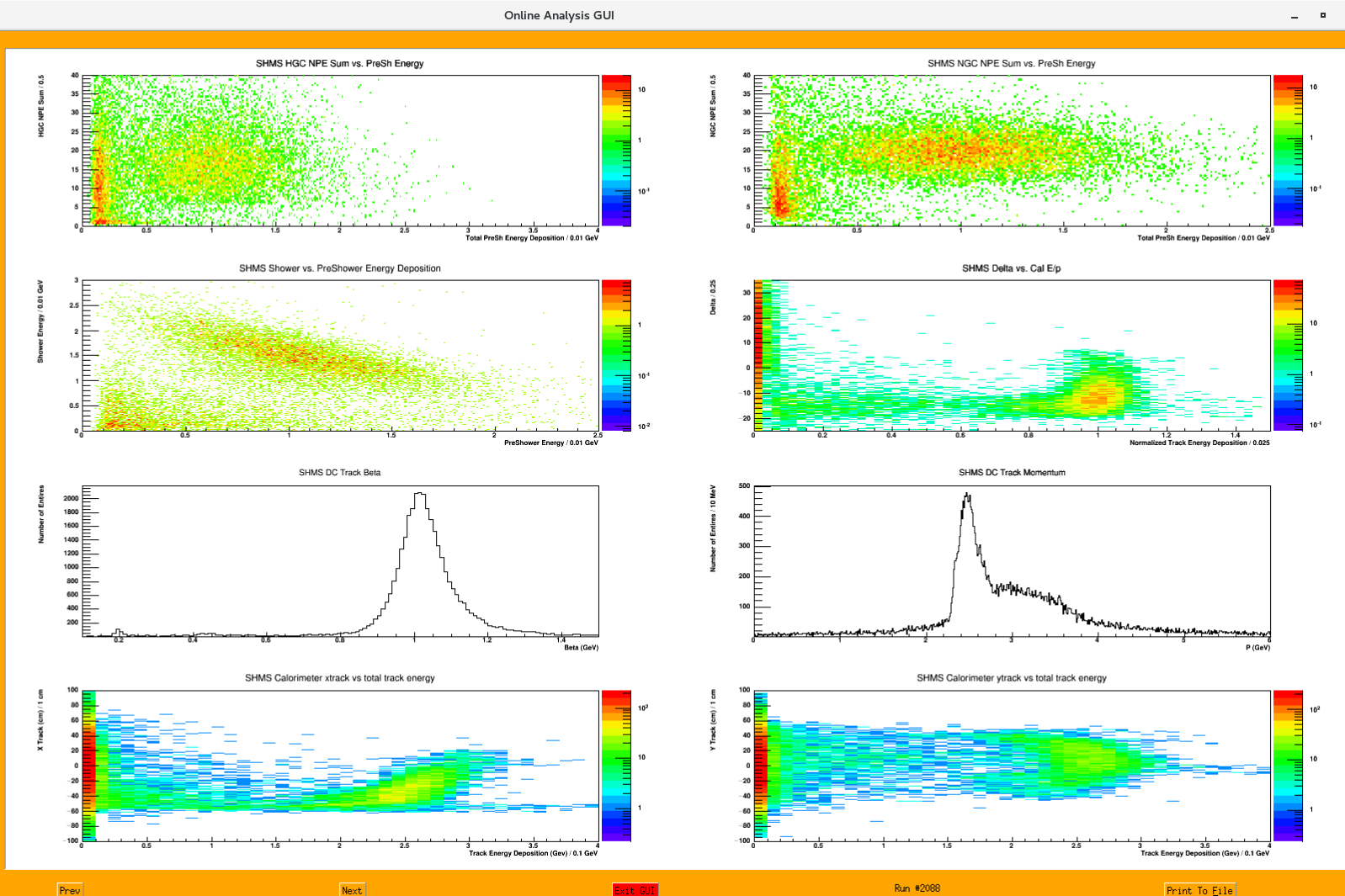


SHMS FRA X vs Y



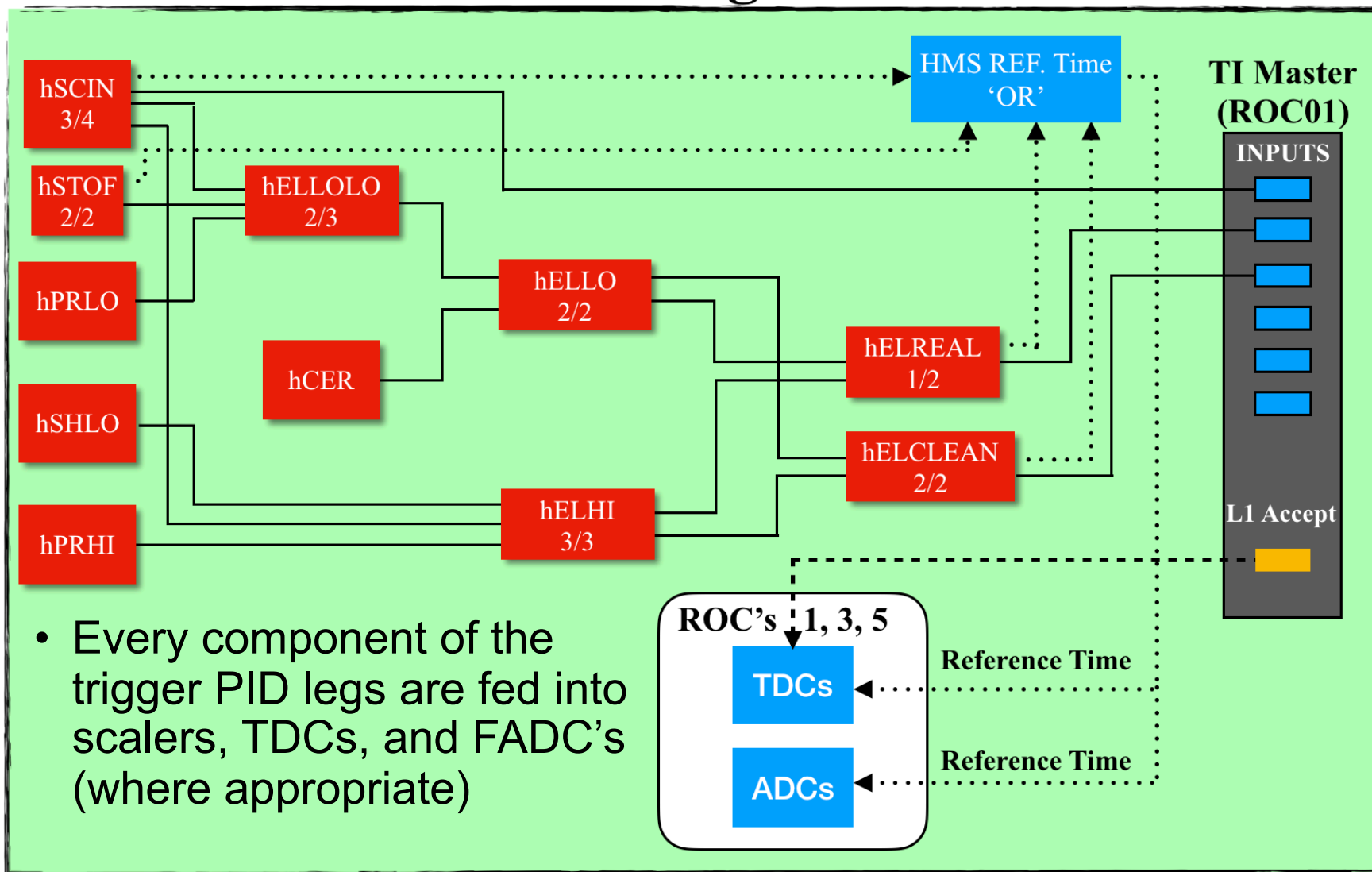
Hall C Online GUI: Making Plots Great Again!

- ☐ SHMS Hodoscope ADC Occ/Mult
- ☐ SHMS Hodoscope TDC Occ/Mult
- ☐ SHMS Hodoscope Pedestals
- ☐ SHMS DC Wire Maps
- ☐ SHMS DC Drift Distance
- ☐ SHMS DC Drift Time
- ☐ SHMS Focal Plane
- ☐ SHMS Target
- ☐ SHMS Cherenkov Occ/Mult
- ☐ SHMS Cherenkov Pedestals
- ☐ SHMS Cherenkov NPE
- ☐ SHMS Calorimeter Occ/Mult
- ☐ SHMS Calorimeter Pedestals
- ☐ SHMS DC Reference Times
- ☐ SHMS Trigger Reference Times
- ☐ SHMS Fast Raster
- ☐ SHMS Kinematics
- ☐ SHMS Tracked Variables
- ☒ SHMS PID
- ☐ SHMS PID (electrons)
- ☐ SHMS PID (pions)
- ☐ EPICS





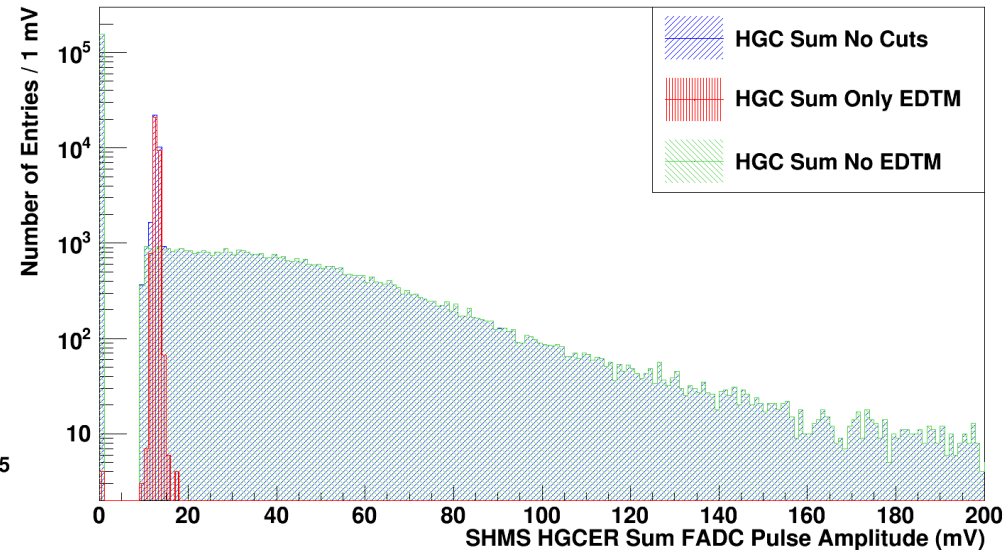
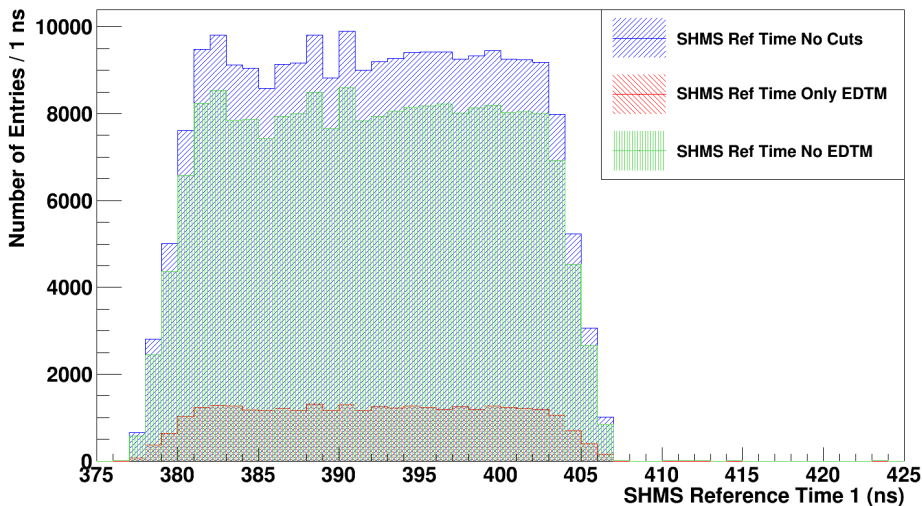
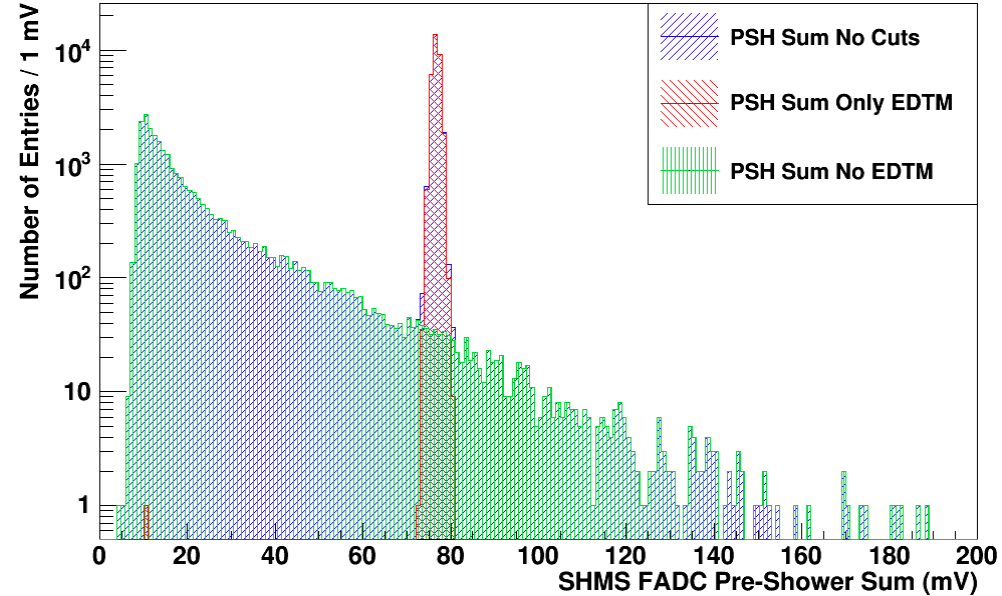
Trigger PID Legs & EDTM



Slide Courtesy of Carlos Yero

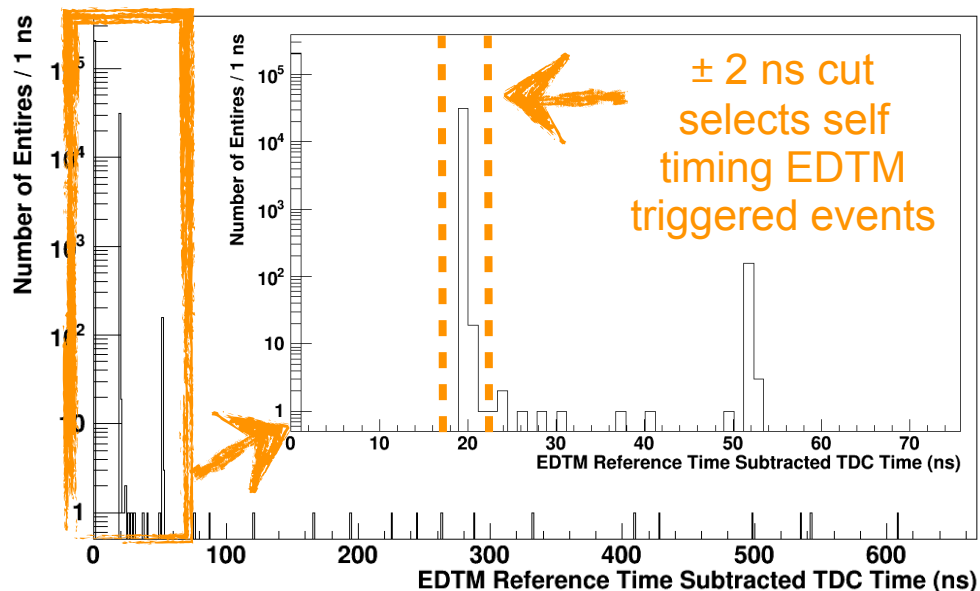
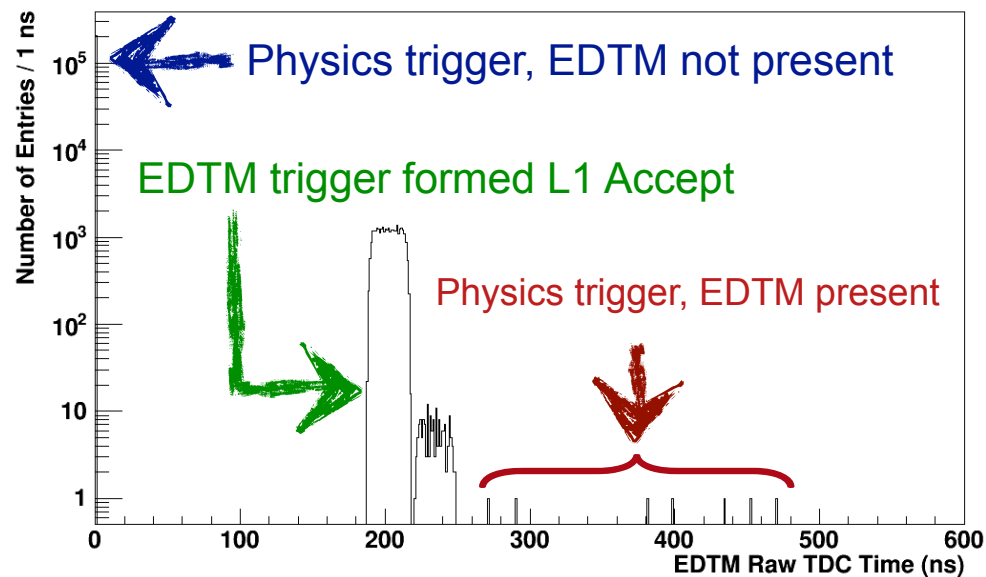
Trigger PID Legs & EDTM Signals

- By design, the EDTM is a real trigger as observed by the electronics and readout system
- It is deployed into the circuit as close to the detectors for all components which are involved in the trigger PID legs



EDTM Cuts: Select EDTM Events

- SHMS Run 2014
 - EDTM Rate = 100 Hz
- T.shms.pEDTM_tdcTimeRaw
 - EDTM TDC = 0
 - Physics trigger
 - EDTM $\neq 0$
 - Accidental EDTM
 - EDTM generated trigger
- T.shms.pEDTM_tdcTime
 - Reference time subtracted
 - Select **real EDTM events**



EDTM Cuts: Remove EDTM Events

- EDTM events can easily be removed from the data via cuts files

```
# Report file for SHMS stack

Block: RawDecode

Pedestal_event      g.evtyp == 99
SHMS_event          g.evtyp == 1
HMS_event           g.evtyp == 2
BOTH_SINGLES_event  g.evtyp == 3
COIN_ONLY_event     g.evtyp == 4
SHMS_COIN_event     g.evtyp == 5
HMS_COIN_event      g.evtyp == 6
COIN_ALL_event      g.evtyp == 7
ALL_events          SHMS_event || HMS_event || BOTH_SINGLES_event || COIN_ONLY_event || COIN_ALL_event

RawDecode_master 1

Block: Decode

pcut_TRIG1          T.shms.pTRIG1_tdcTimeRaw > 0
pcut_TRIG2          T.shms.pTRIG2_tdcTimeRaw > 0
pcut_TRIG3          T.shms.pTRIG3_tdcTimeRaw > 0
SHMS_Pretrig        pcut_TRIG1 || pcut_TRIG2 || pcut_TRIG3
shms_trigs          SHMS_event

pcut_edtm_accepted   T.shms.pEDTM_tdcTime != 0.0
pcut_edtm_accepted_tight T.shms.pEDTM_tdcTime >= 18.0 && T.shms.pEDTM_tdcTime <= 22.0
pcut_physics_accepted T.shms.pEDTM_tdcTime == 0.0

ALL_events_no_edtm   ALL_events && pcut_physics_accepted

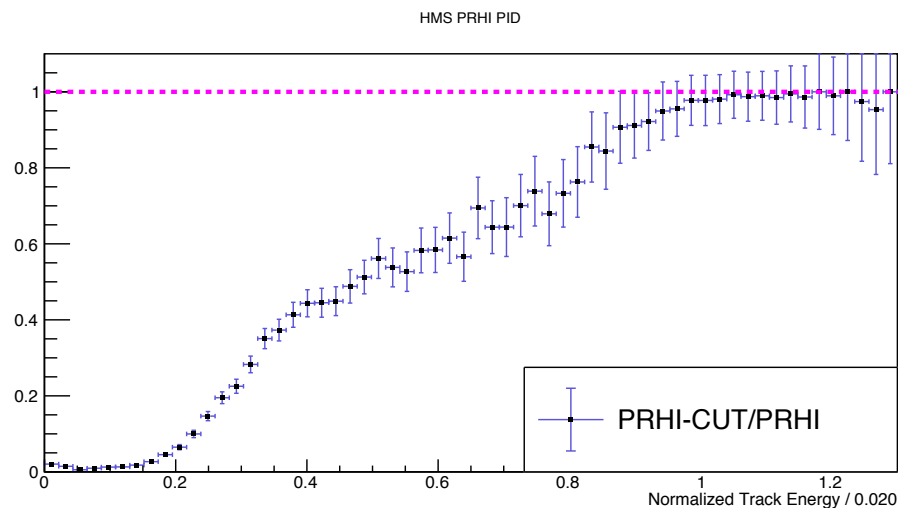
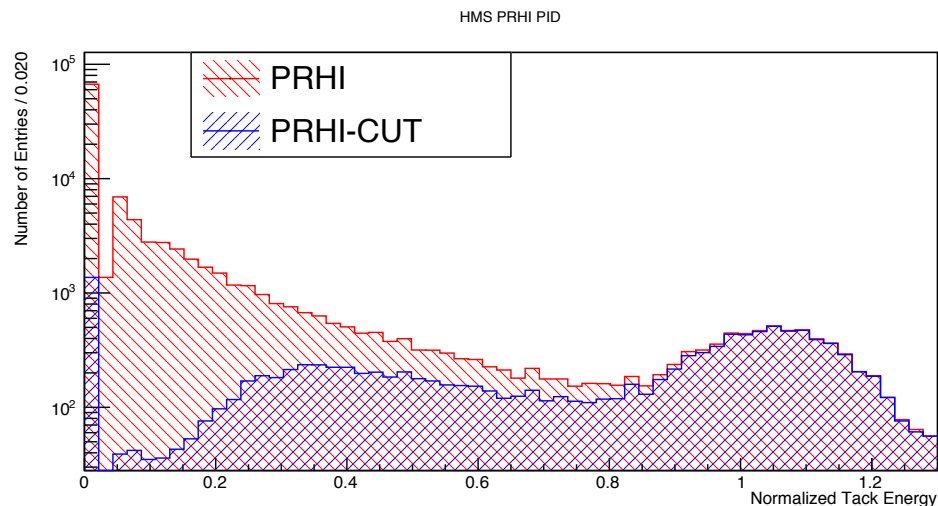
pcut_good_S1_time    T.shms.p1T_tdcTime > 241 && T.shms.p1T_tdcTime < 243
pcut_good_S2X_time   T.shms.p2X_tdcTime > 180 && T.shms.p2X_tdcTime < 220
pcut_good_S1_S2X_time pcut_good_S1_time && pcut_good_S2X_time

Decode_master        ALL_events_no_edtm
```



Trigger PID Legs

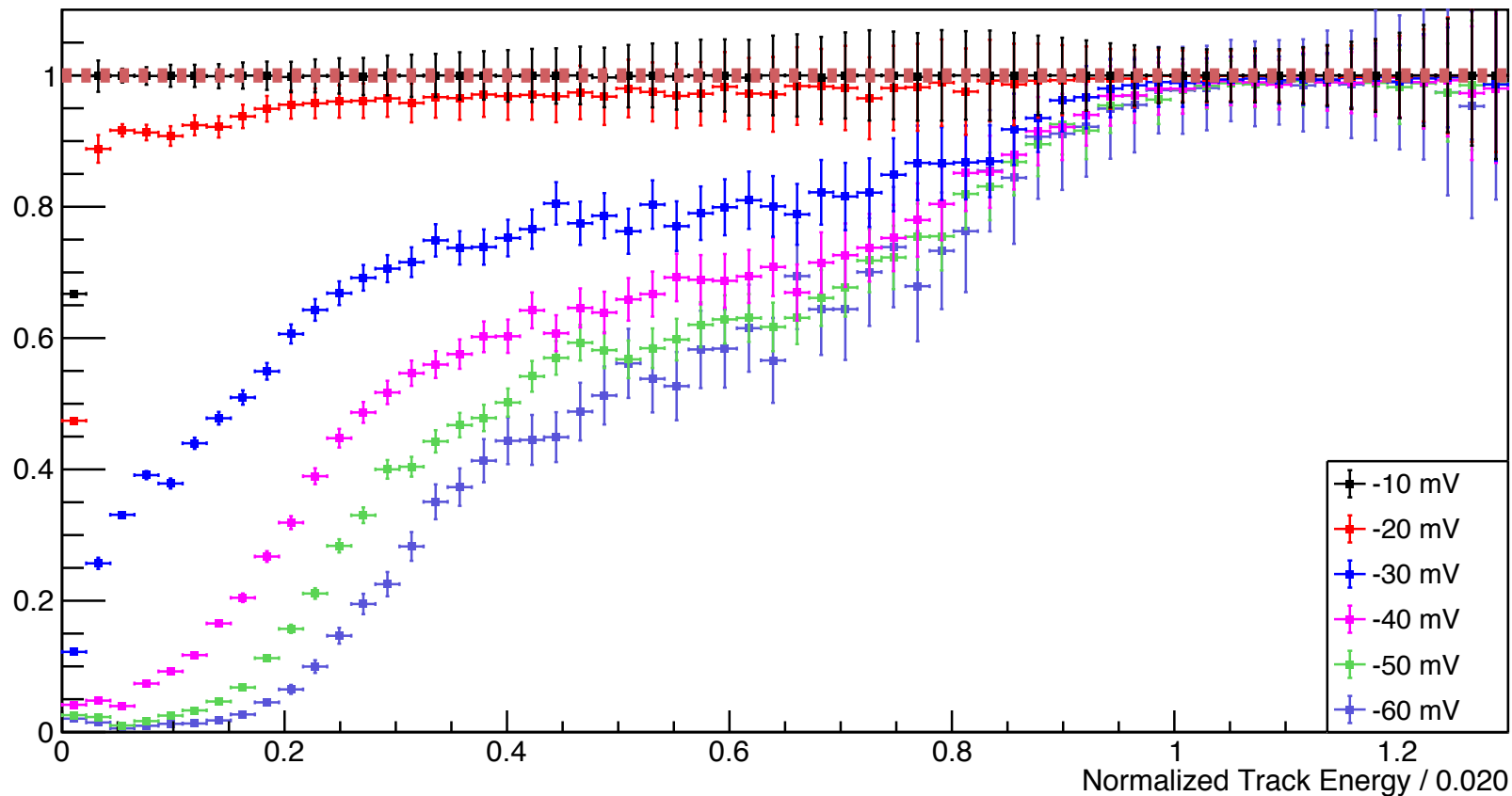
- All trigger PID components reside in scalers, TDC's, and FADC's (where appropriate)
- One can study off-line the effects of imposing hardware discriminator threshold cuts via software cuts
- Consider an example for HMS:
 - E/P in calorimeter
 - Select pions via Cherenkov
 - Cut on PRHI TDC channel
 - Calculate ratio to determine appropriate threshold for pion suppression



Trigger PID Legs

- Perform hardware threshold scan of PRHI leg

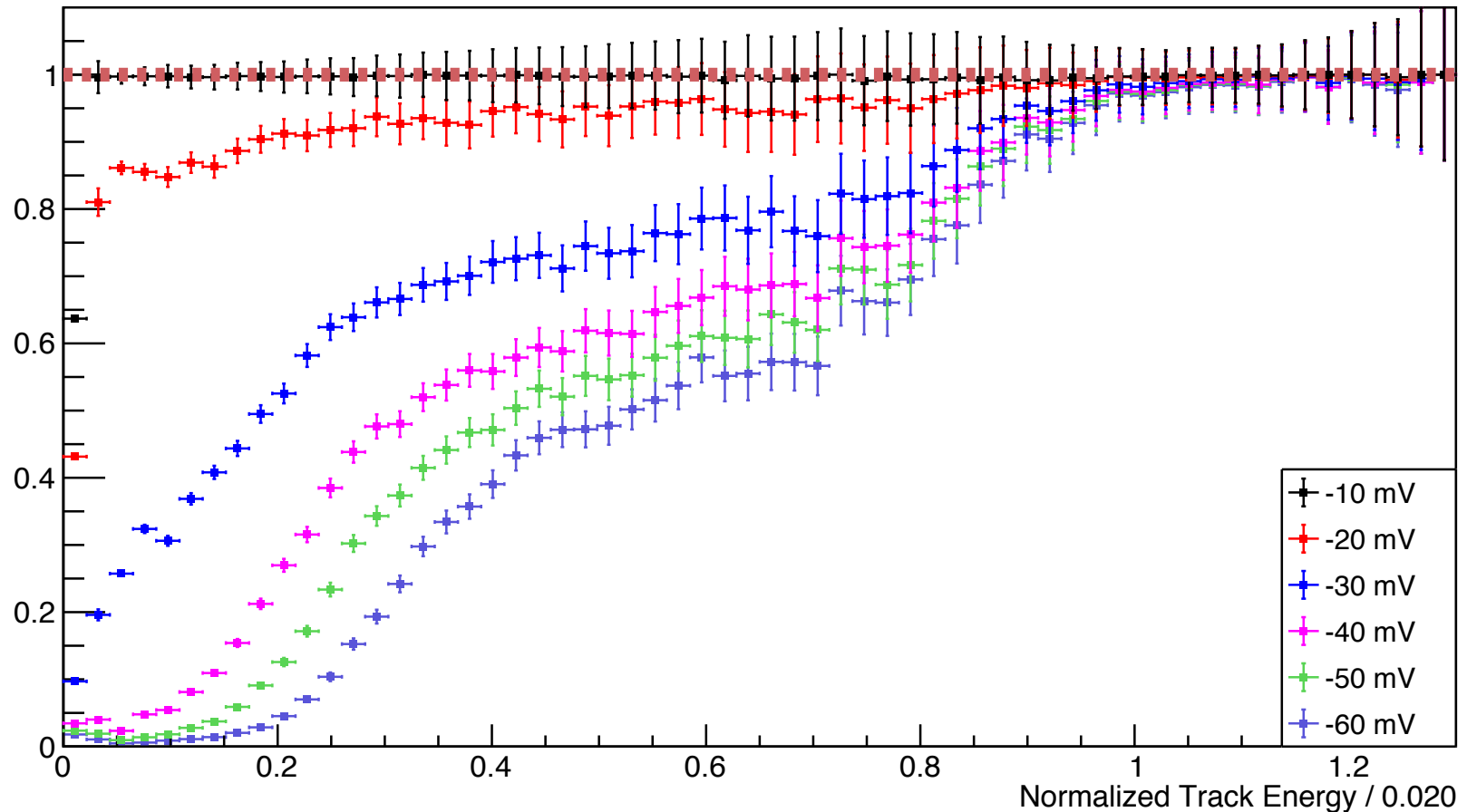
HMS PRHI PID (NPE SUM = 0.0)



Trigger PID Legs

- Perform software threshold scan of PRHI leg

HMS PRHI PID (NPE SUM = 0.0)



Hall C Winter Collaboration Meeting



Backup Slides



Slide Title

