12 GeV Software Review
engine/hcana comparisons

PM Session
Hall C

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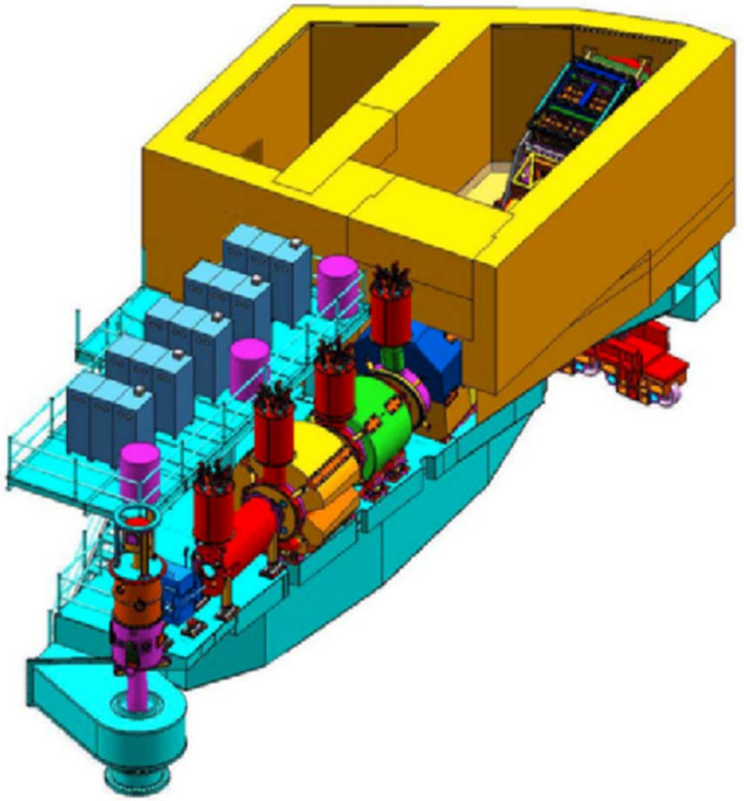


Reminder (from 06/05/2012 talk)

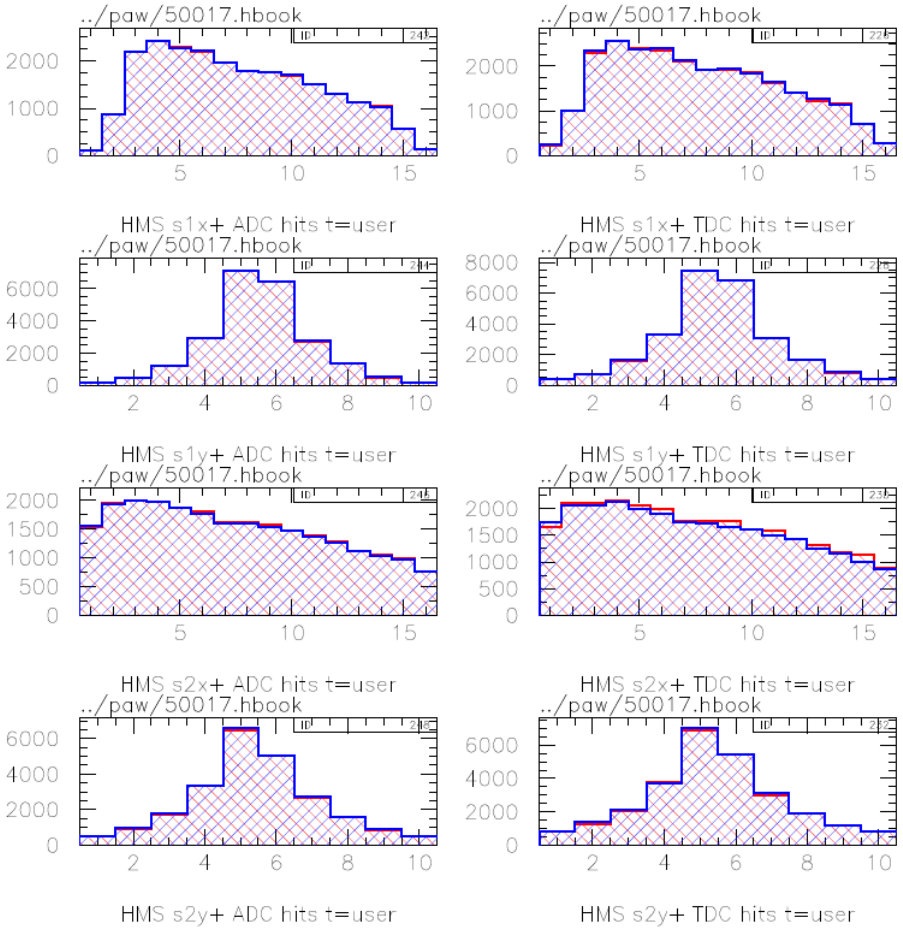
- Hall C Fortran/Cernlib analyzer (engine)
  - Used in the 6 GeV era
  - 100k+ LOC
- Hall C ROOT/C++ analyzer (hcana)
  - Moving into the 12 GeV era
  - Built on top of Hall A's PODD software
  - in publicly readable git repository (github)
  - Keep all analysis algorithms from engine
  - Document analysis algorithms

Current Status* (06/05/2013)

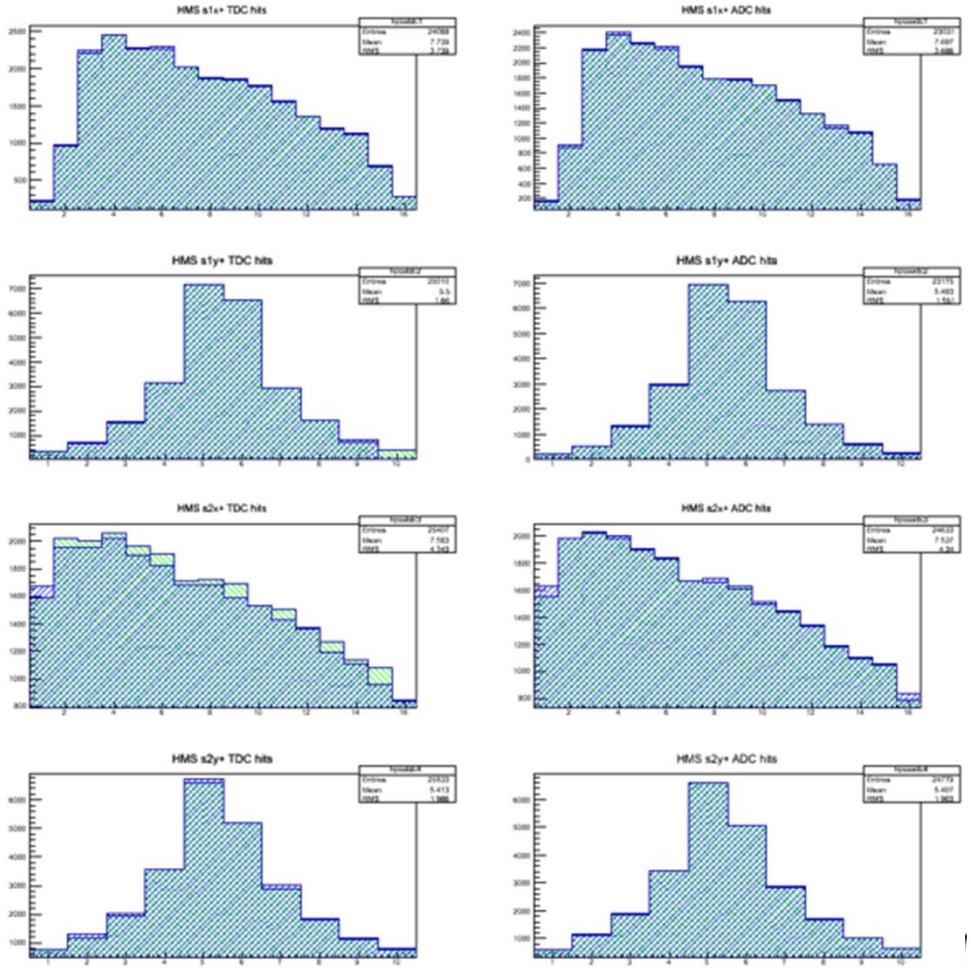
- Reads Hall C style parameter files
- Reads Hall C style hardware (detector mapping)
- Builds engine-style raw hit lists
- Extracts hodoscope and drift chamber hit lists from HMS CODA files
- Hodoscope reconstruction/rest of milestones to follow

Also from 06/05/2012

- HMS hodoscope ADCs & TDC
- In the engine



- Same HMS hodoscope raw ADC & TDC hits
- Done in hcana!



Reminder

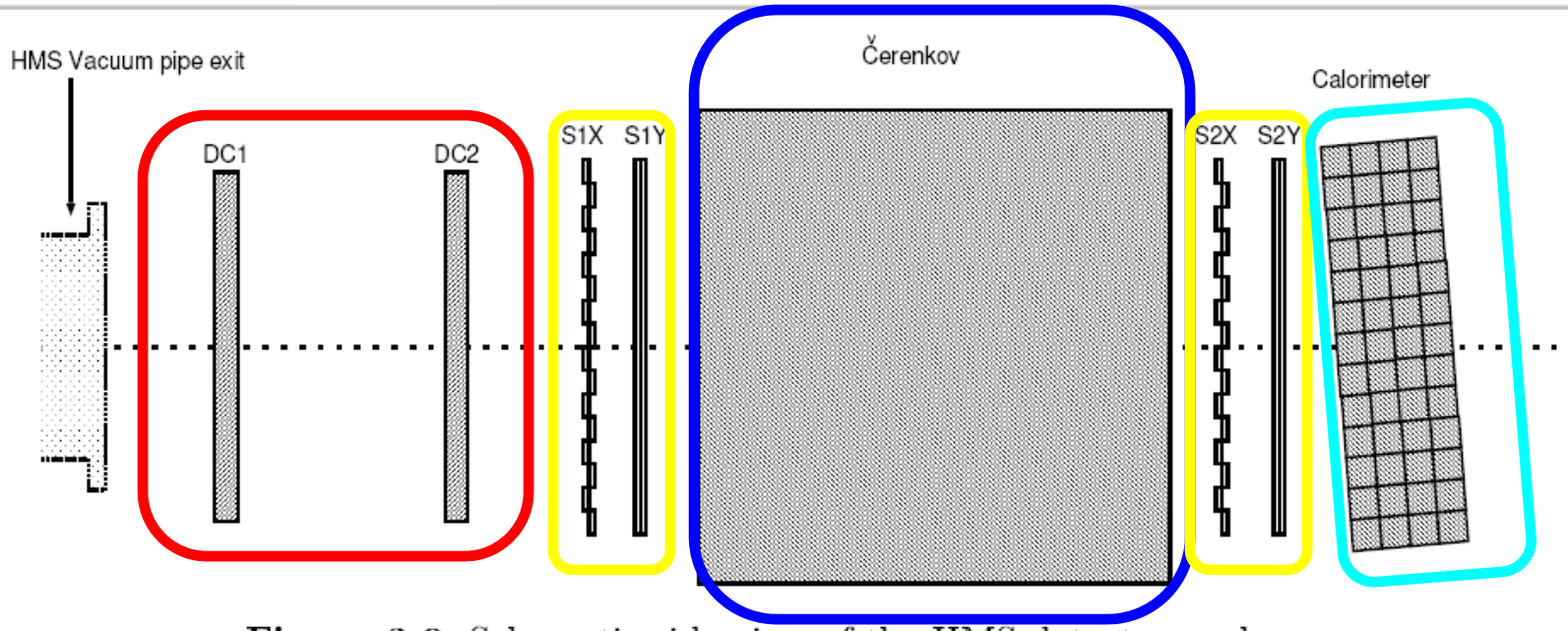


Figure 3.9: Schematic side view of the HMS detector package.

- ***HMS (and SHMS) spectrometers have 4 main detectors:***
  - ***Drift Chambers (tracking)***
  - ***Hodoscope (trigger, PID)***
  - ***Cerenkov (PID)***
  - ***Electromagnetic calorimeter (PID)***

Current Status (11/25/2013)

- Work has progressed in all four detector areas:
- DC/Tracking (Steve, Mark ~75% done*)
- Cerenkov (Ahmed ~80%)
- Calorimeter (Simon, Vardan ~80%)
- Hodoscope/Trigger (GN ~80%)

- * percentages are just my educated guess
- People working on these areas can give a better estimate
- See: https://github.com/JeffersonLab/hcana

- Also progress in the automated histogram allocation, filling, (meta)reporting

CEBAF Test Package

- *Hall C Fortran based analyzer relied on text file driven CTP (CEBAF Test Package), with four major components.*
  - *Parameters: Simple text based parameter database. Parameter values can be expressions.*
  - *Tests: Run time configurable cuts*
  - *Histograms: Run time 1d and 2d histogram definitions*
  - *Report Templates: Run time configurable analysis summary sheets.*
- *User desire to replicate CTP functionality in C++ analyzer.*
- *Existing Hall A analyzer code either provides similar features as CTP or makes it easy to code CTP features.*
  - *Use existing Hall A analyzer cut and histogram packages*
  - *Wrote replacements for CTP parameters and report components (SW)*

Report Templates

Template

```
htrig       = {htrig.scaler:%8d} ( {htrig.scaler/g_run_time:%7.1f} )
hms adcgates= {gscaler(176):%8d} [ {gscaler(176)/g_run_time:%7.1f} ]
sos adcgates= {gscaler(336):%8d} [ {gscaler(336)/g_run_time:%7.1f} ]
all adcgates= {gscaler(175):%8d} [ {gscaler(175)/g_run_time:%7.1f} ]

* RAW SOFTWARE EFFICIENCIES *
"raw"  means one or more hits per dc plane.
"Good" means one or two  hits per dc plane.

rawhdc1x1   = {hdc_events(1):%7d}   eff = {hdc_plane_eff(1):%5.3f}  BAD = .95
rawhdc1y1   = {hdc_events(2):%7d}   eff = {hdc_plane_eff(2):%5.3f}  BAD = .95
…
```

"test scaler" (# of times Cut passed)

hardware scaler

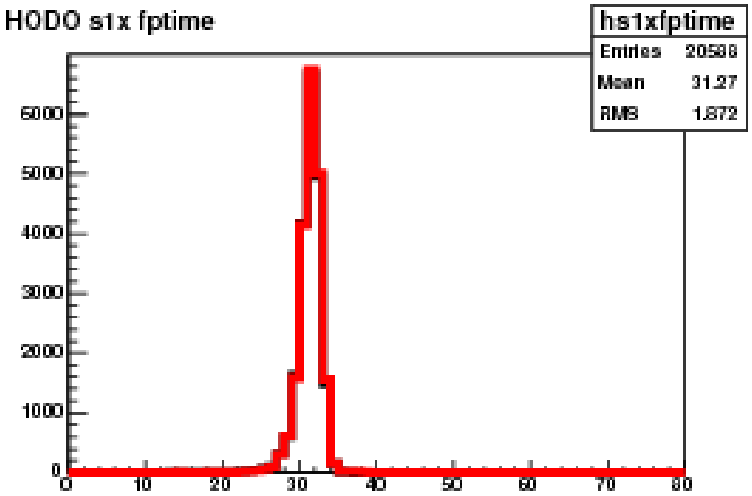
Sample Output

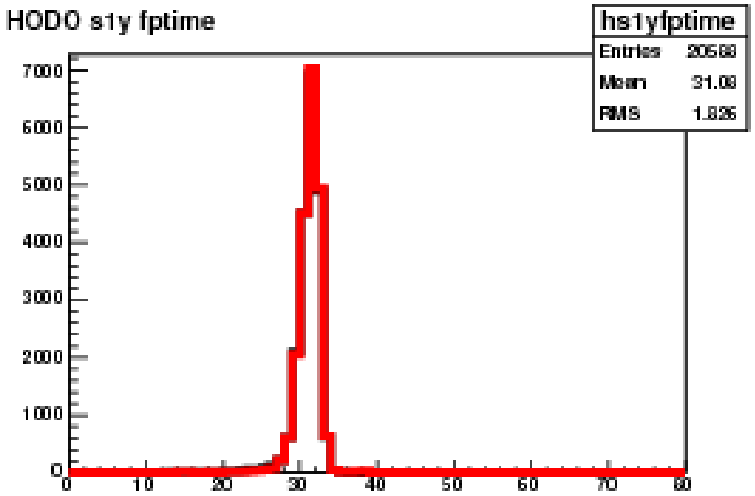
```
htrig       =    98576 ( 13857.27 )
hms adcgates=    98188 [ 13802.7 ]
sos adcgates=        0 [     0.0 ]
all adcgates=    99612 [ 14002.9 ]

* RAW SOFTWARE EFFICIENCIES *
"raw"  means one or more hits per dc plane.
"Good" means one or two  hits per dc plane.

rawhdc1x1   =   83772   eff = 0.935  BAD = .95
rawhdc1y1   =   84639   eff = 0.945  BAD = .95
…
```

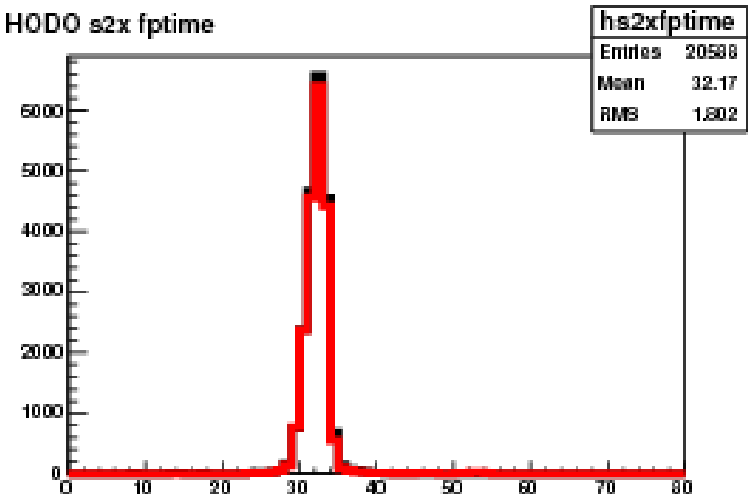
calculated in analyzer

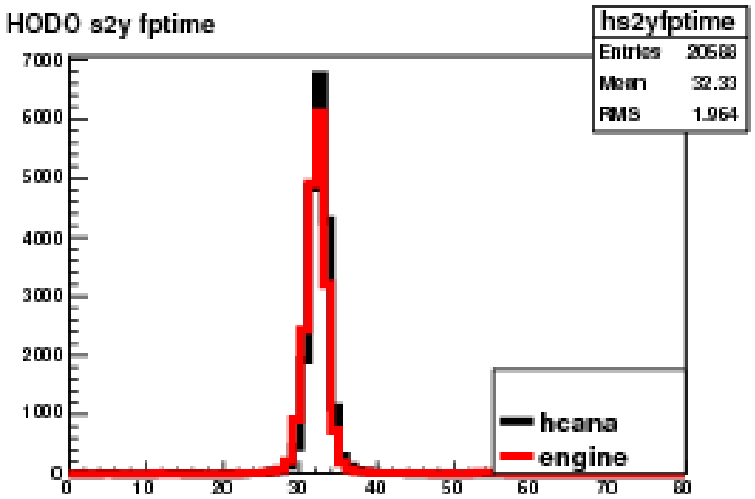
Hodoscope

- **Focal plane time for all scintillator planes**



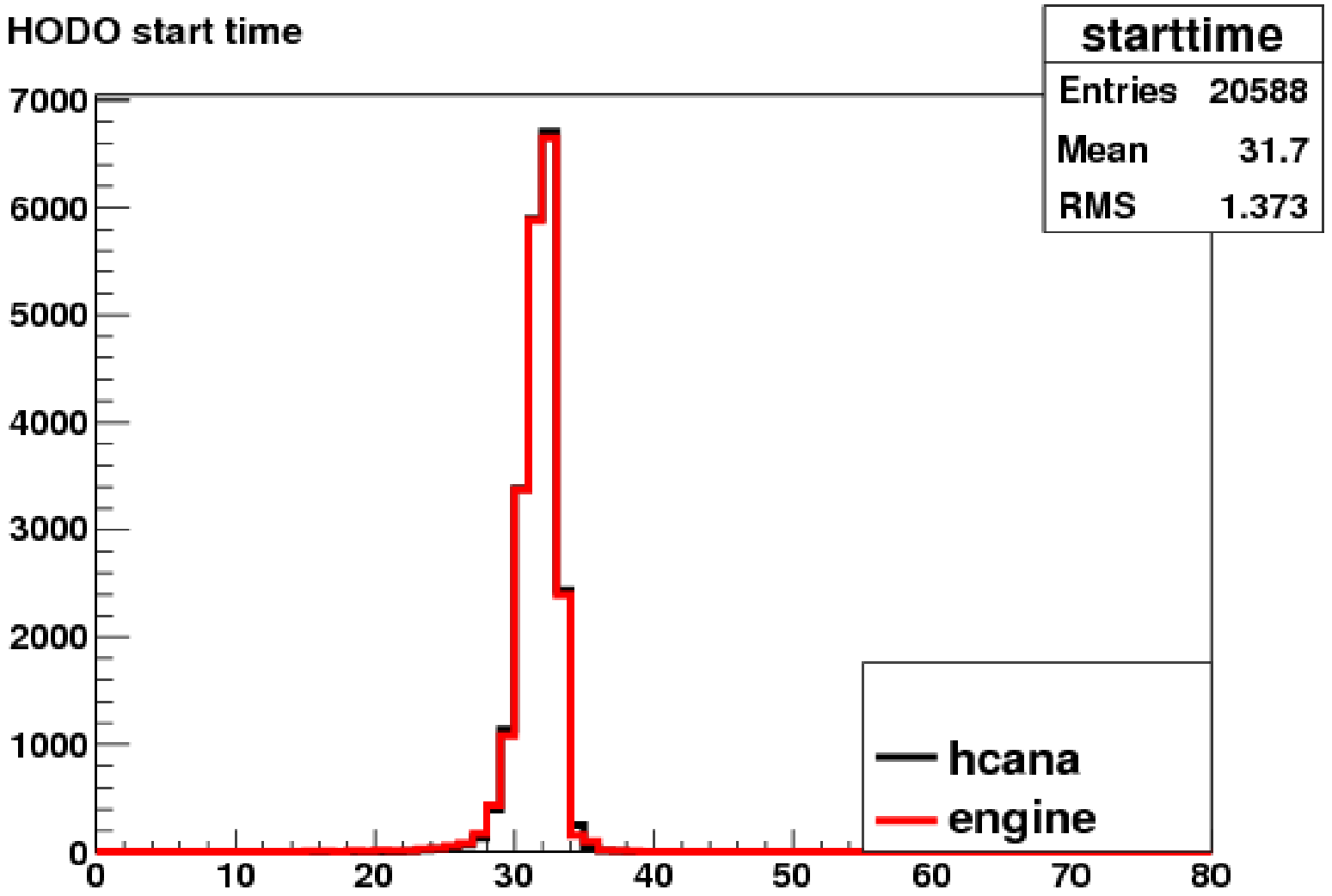






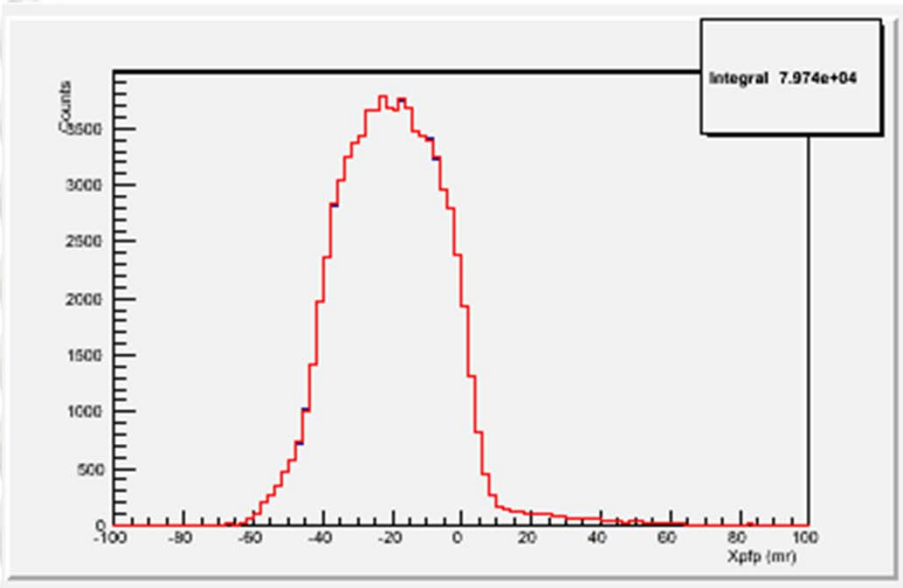
Hodoscope

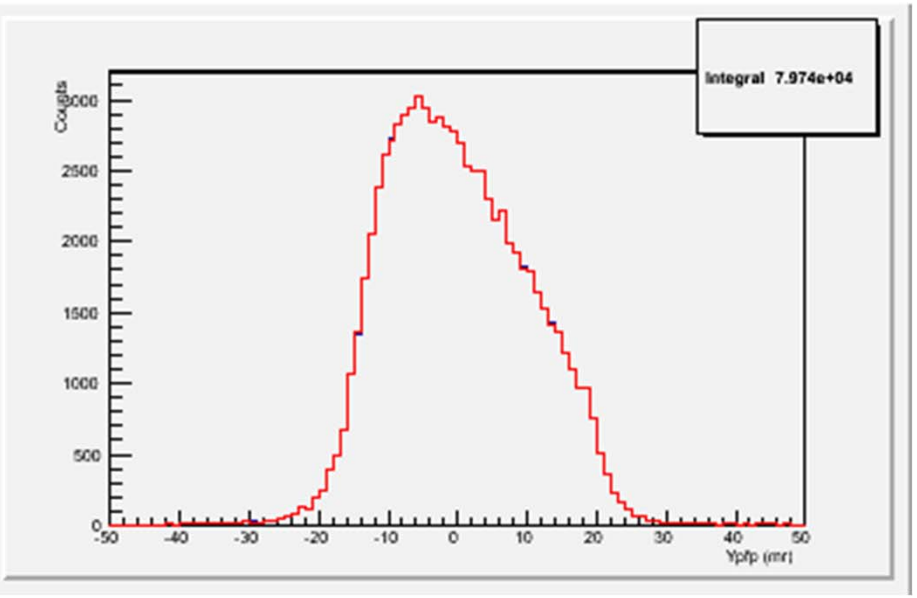
- Hodoscope start time



DC/Tracking

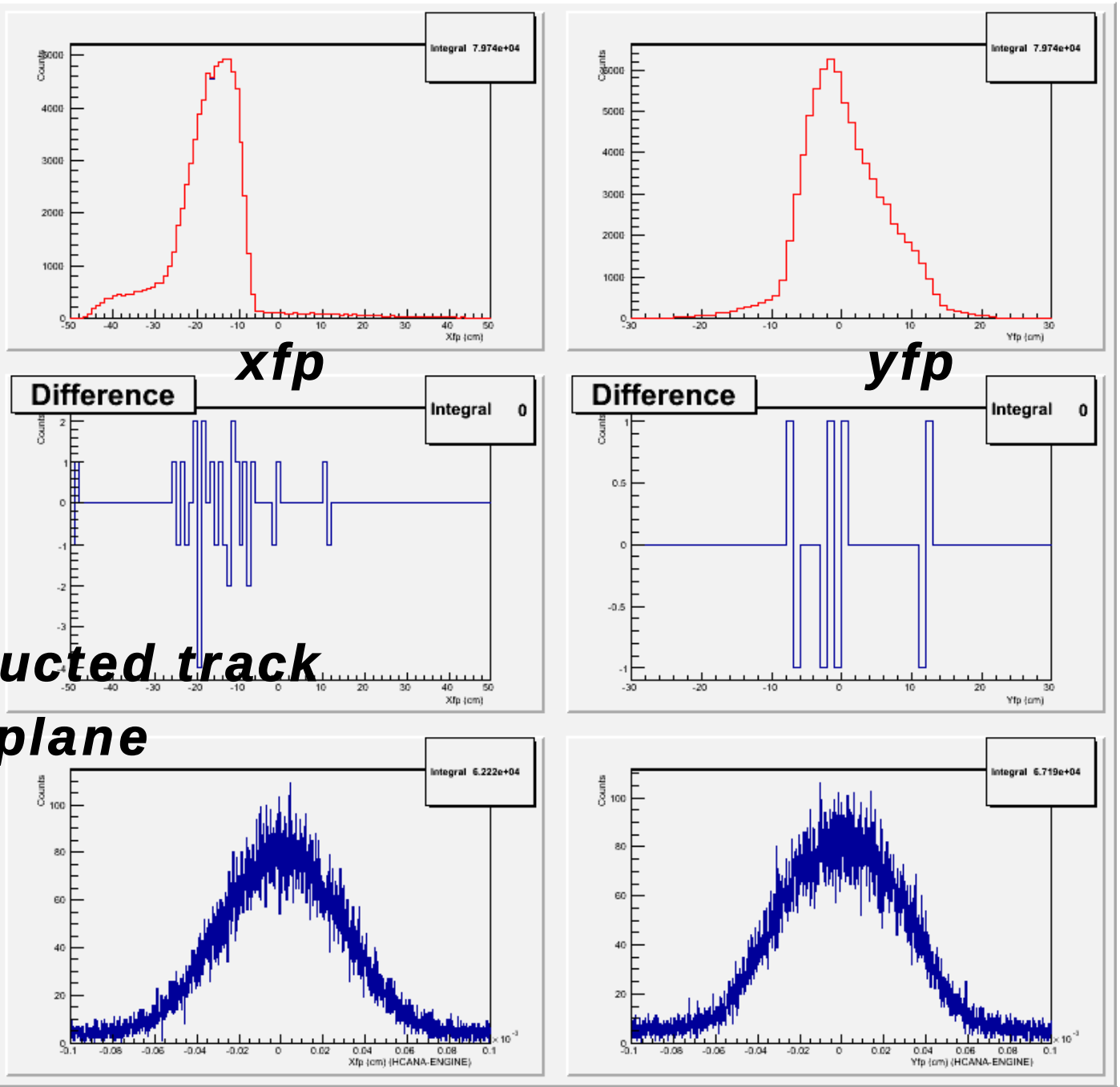
- **Steve Wood, Mark Jones**
- **Reconstructed focal plane quantities (xfp, yfp, xpfp, ypfp)**



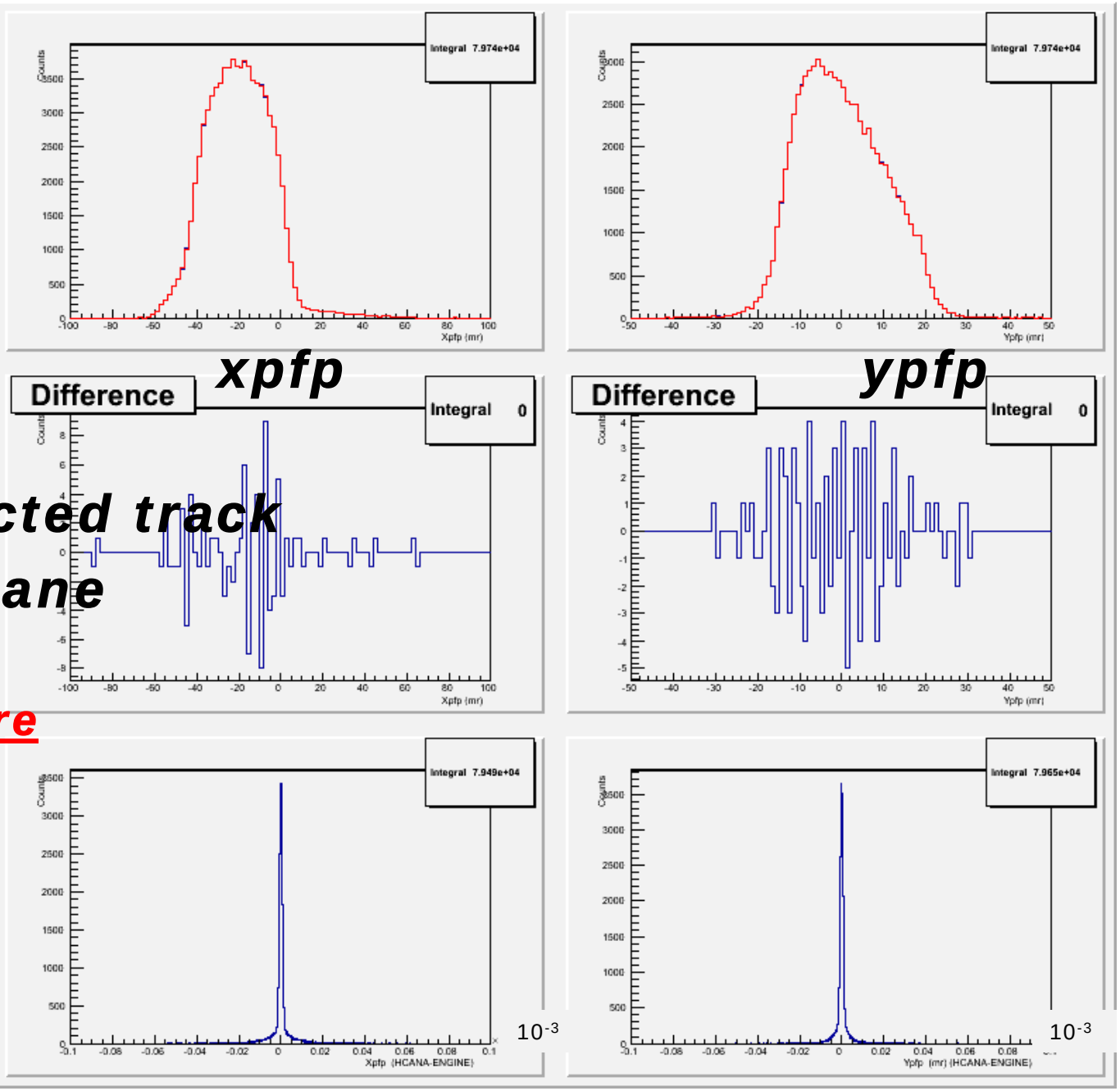


xpfp ***ypfp***

- 1st reconstructed track
- X & y focal plane position

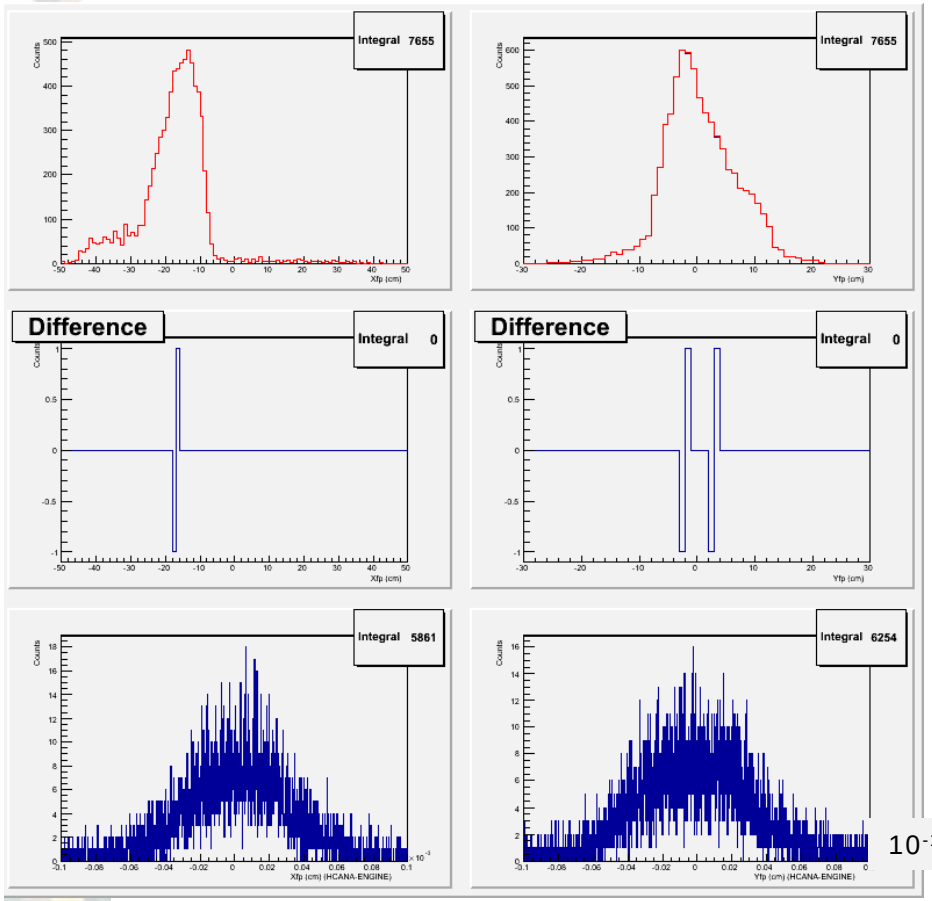


- 1st reconstructed track
- X & y focal plane angles
- More details here

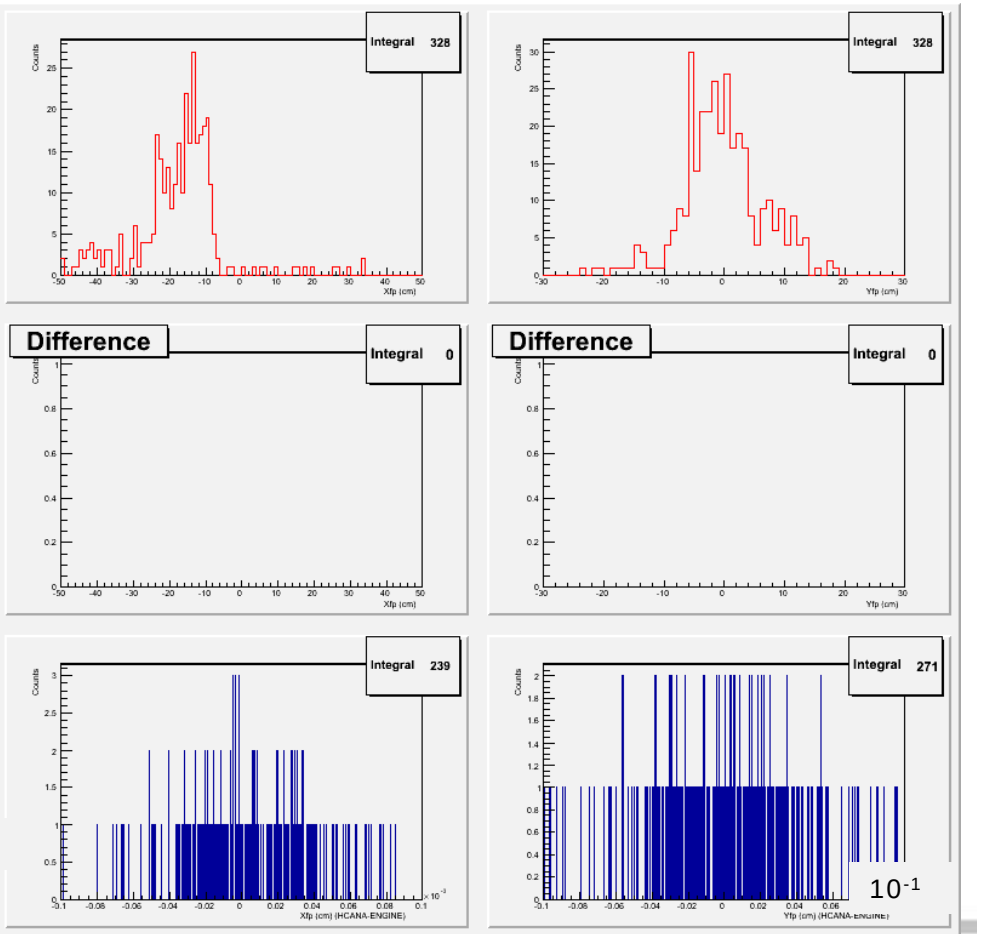


2nd and 3rd track*

X & y focal plane positions (cm)



10^{-1}



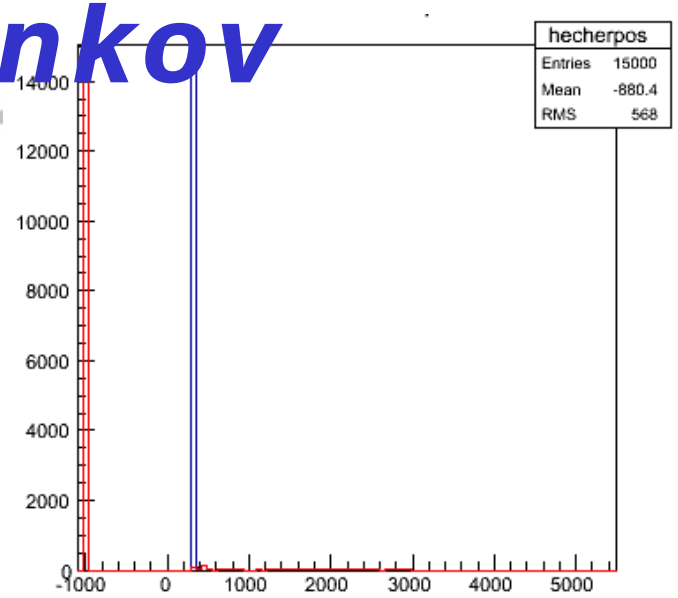
10^{-1}

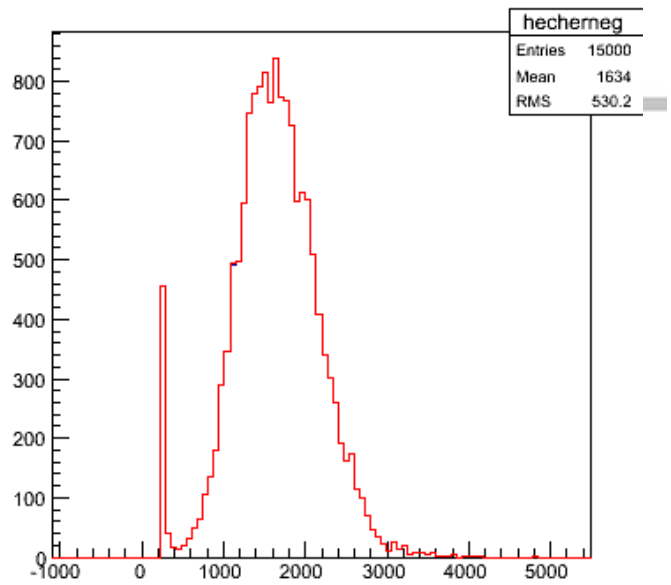
Cerenkov

- **Ahmed Zahed (Regina)**
- **"Started from ThcAerogel class and converted the logic of engine/HTRACKING/h_trans_cer.f to ThcCherenkov.cxx"**
- **hcana in blue, engine in red**

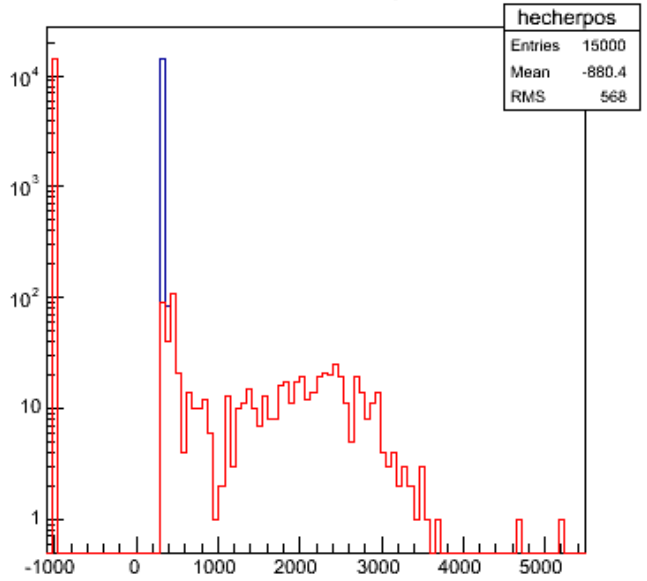
Cerenkov

- **Cerenkov ADCs & TDCs**

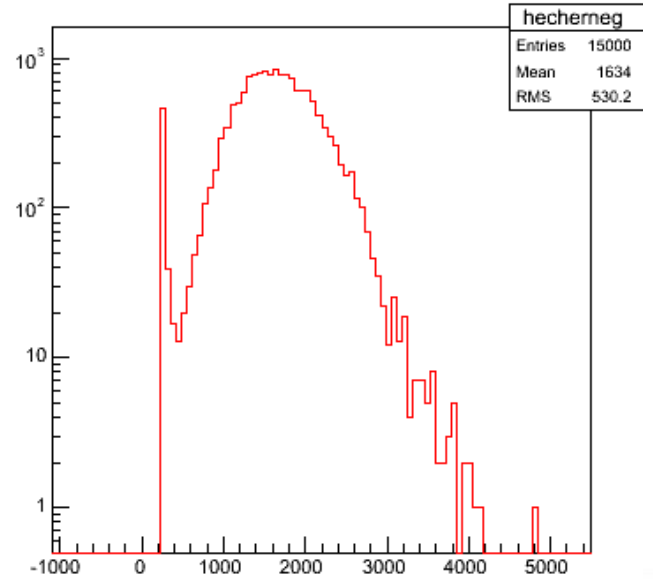




hcana adc top

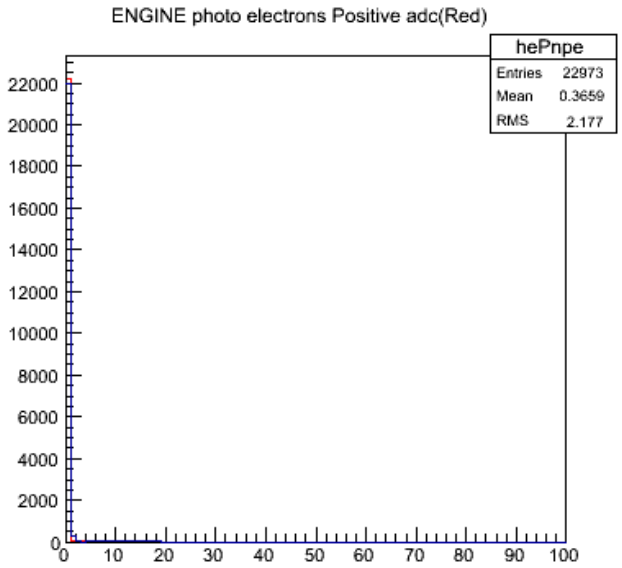


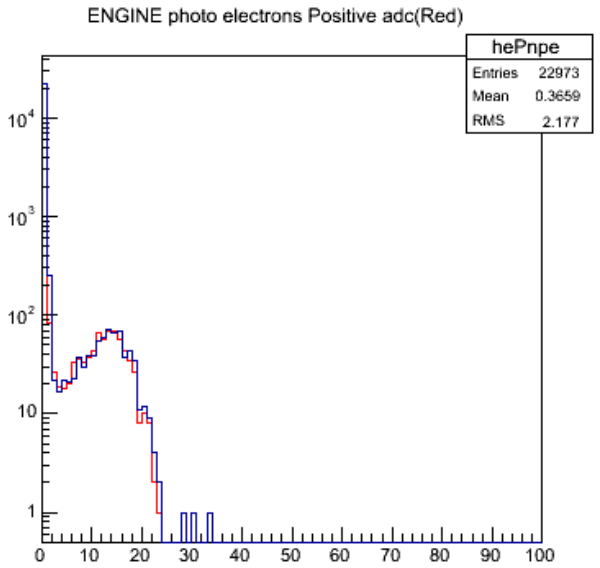
hcana adc bottom

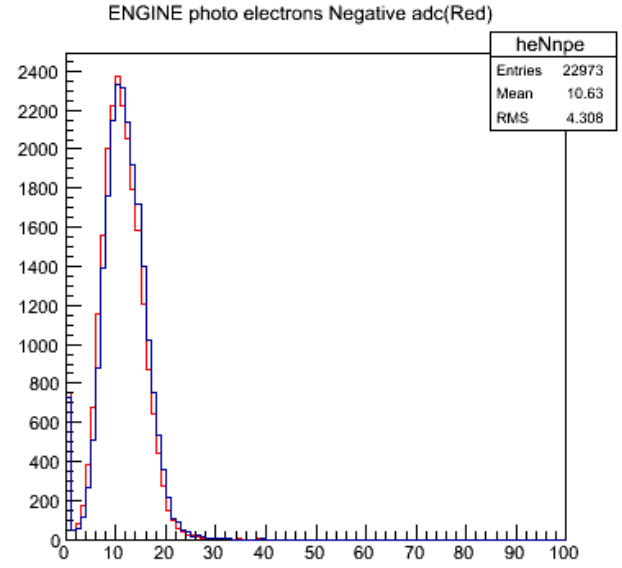


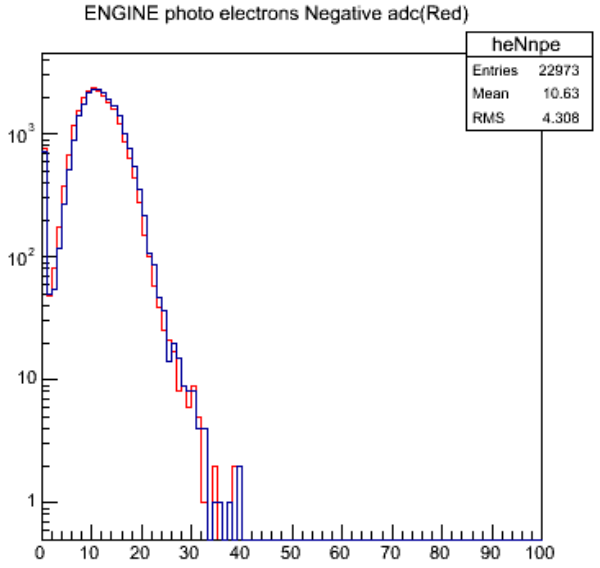
Cerenkov

- **Cerenkov number of photoelectrons**
- **Most of the disparity comes from the fact that at some point in the algorithm engine truncates the npe to an integer…**





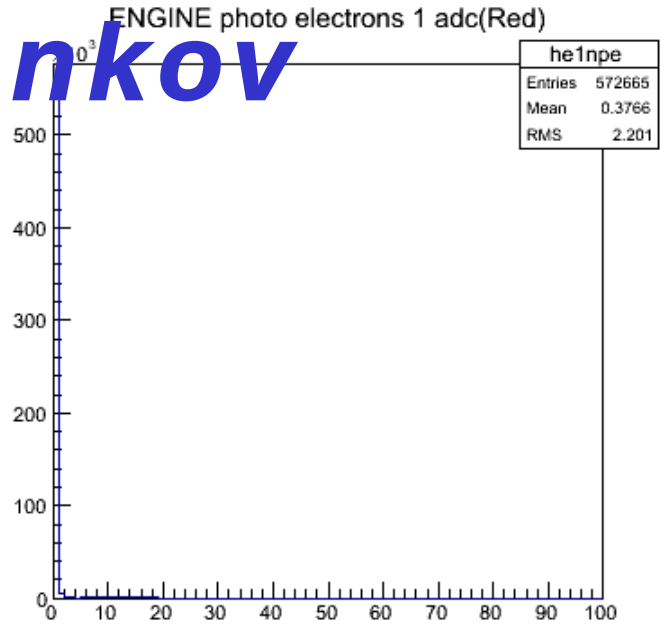


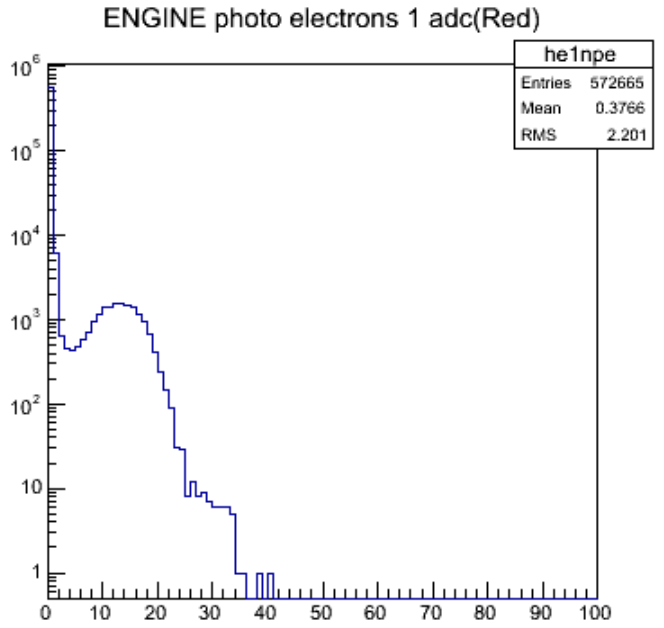


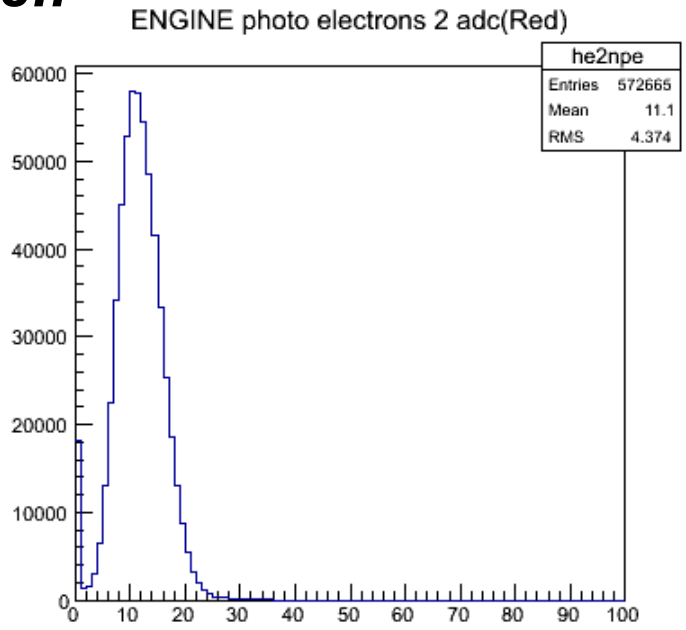
Jefferson Lab

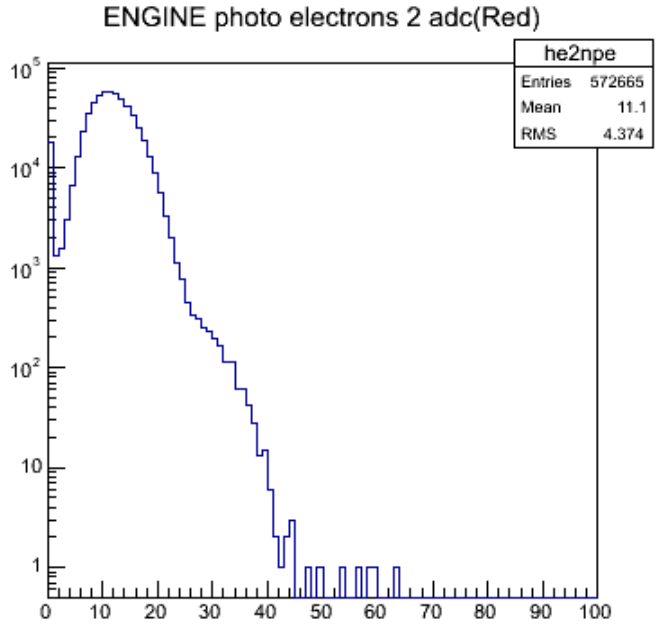
Cerenkov

- ***...After fixing the int/float discrepancy***
- ***There are two distributions plotted on each panel!***



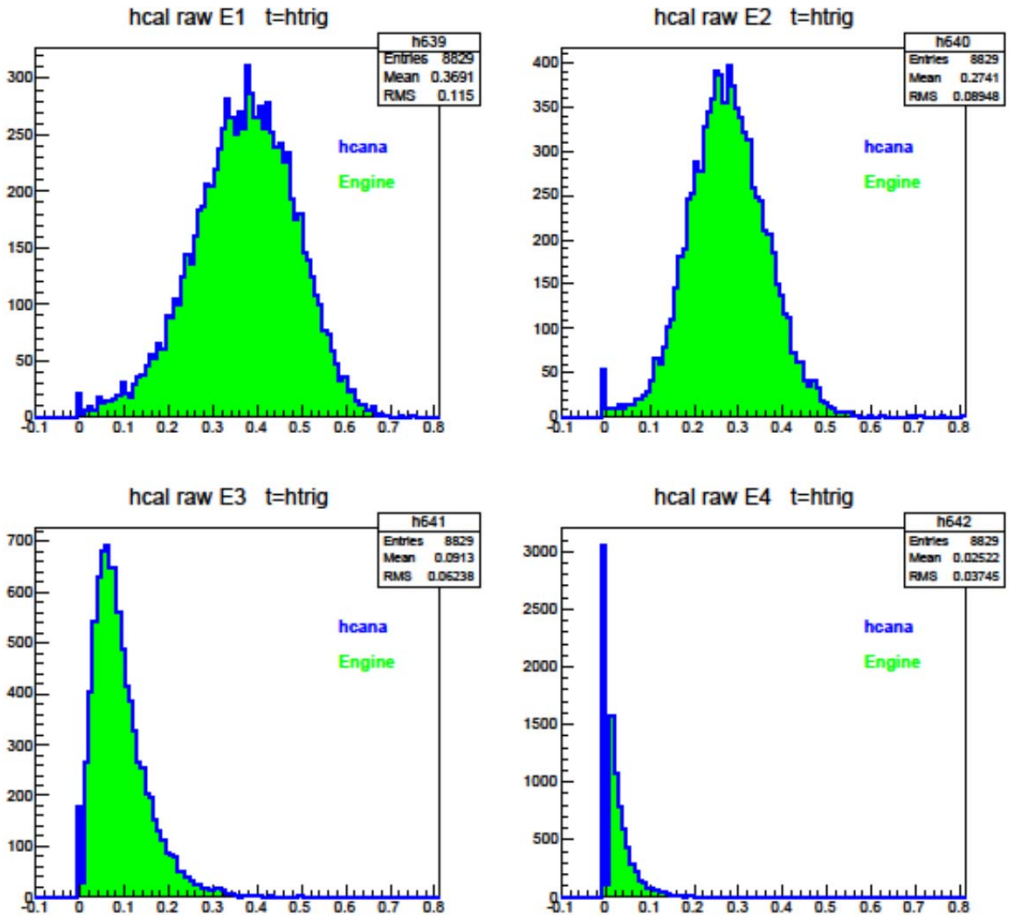




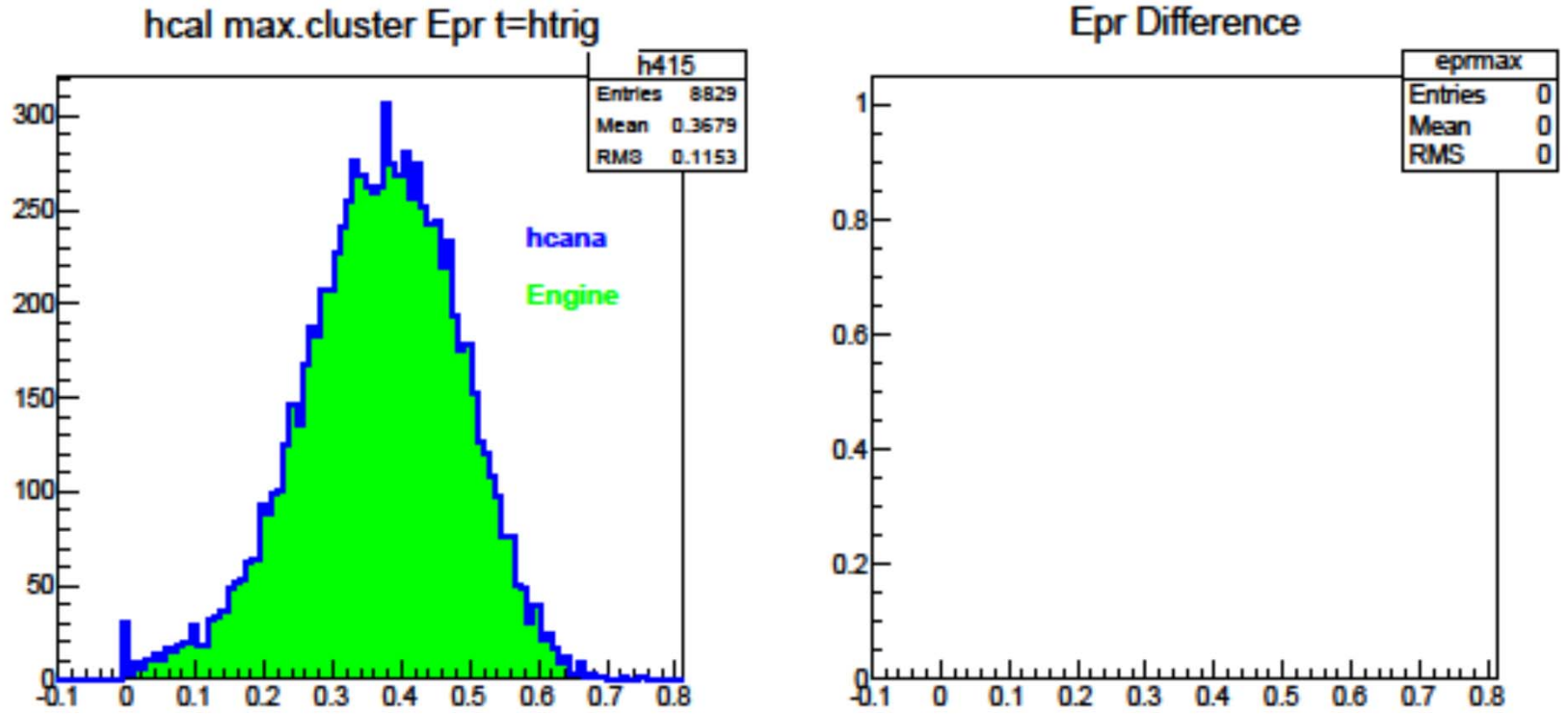


Calorimeter

- Yerevan group (Simon, Vardan…)
- Well documented algorithm
- Raw distributions



Calorimeter



Energy deposition in the Preshower (1-st layer) for the cluster with largest energy deposition (left) and the difference between hcana and engine (right)

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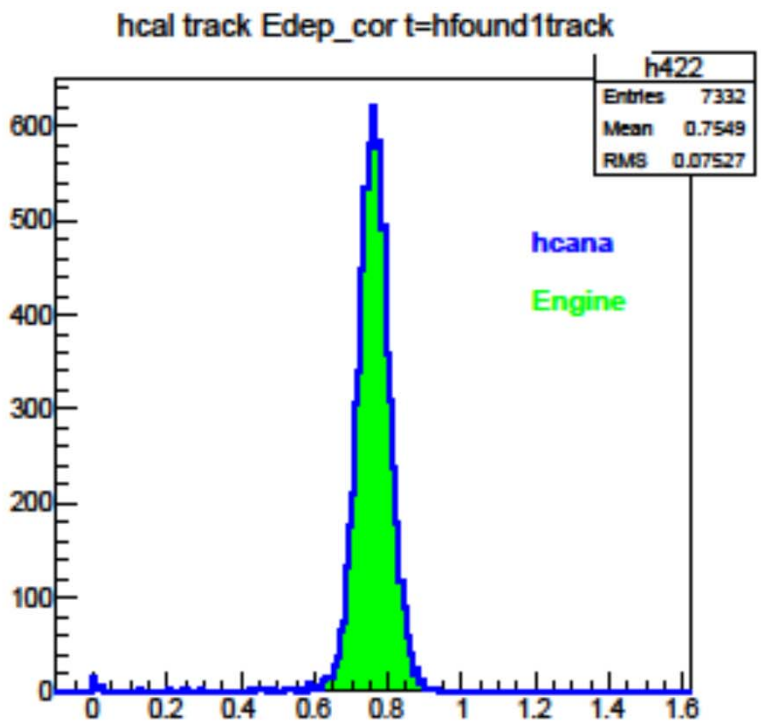
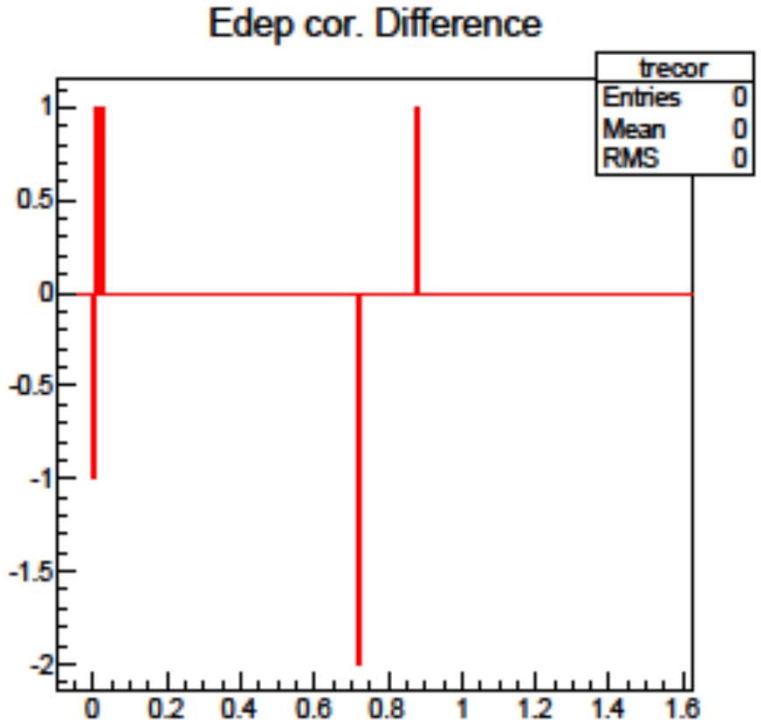
Calorimeter





Energy deposition in the cluster associated to the track for single track events (left), and difference between hcana and engine (right).

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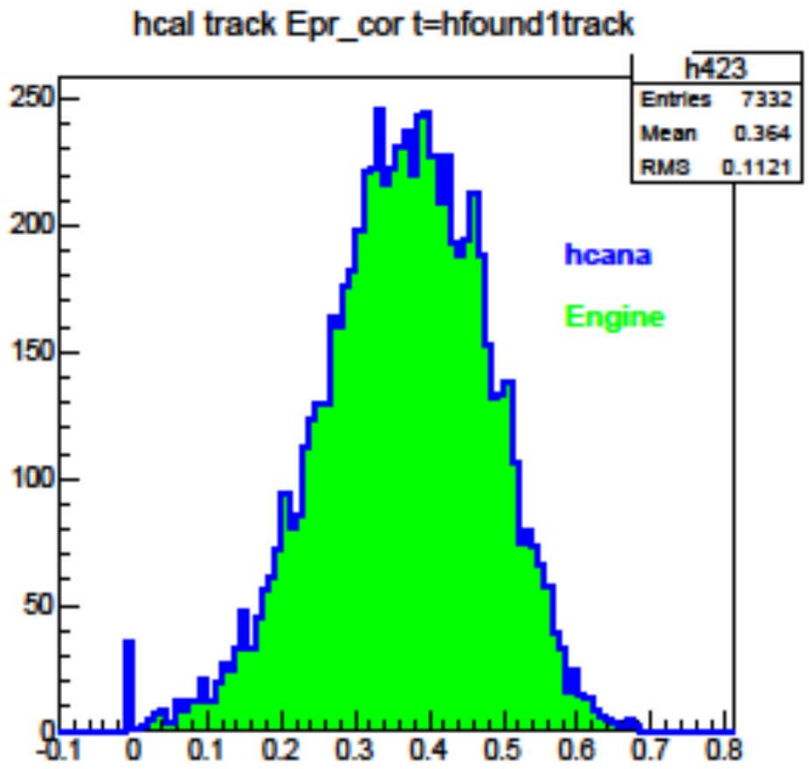
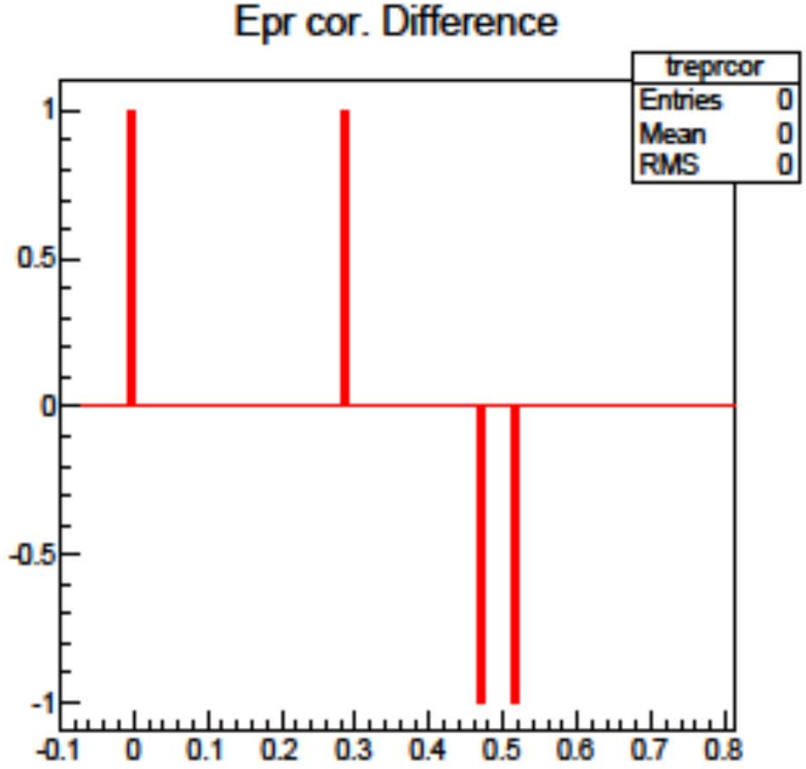
Calorimeter





Preshower energy deposition in the cluster associated to the track for single track events (left), and difference between hcana and engine (right)

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Summary

- ***Substantial, simultaneous, sustained progress in coding all Hall C detectors.***
- ***Good (almost perfect) engine-hcana agreement on the quantities reconstructed thus far***
- ***Finishing up code for individual detectors should allow (near future) to move on to full track reconstruction***

To Do List

- ***Handling of "special events" (Scalers, EPICS, etc.)***
- ***Beam raster***
- ***Computing physics quantities***
- ***Systematic review of local/global variables (so we can replicate online diagnostic histograms and fill root tree with same information as engine ntuples)***
- ***Calibration scripts***
- ***Setting up a viewer for online diagnostic histograms***

- ***Continue documenting algorithms***
- ***Enlist more testers/early adopters***
- ***Perform extensive "stress tests" (more/longer runs, different beam conditions)***