Hall C Analysis Status Report

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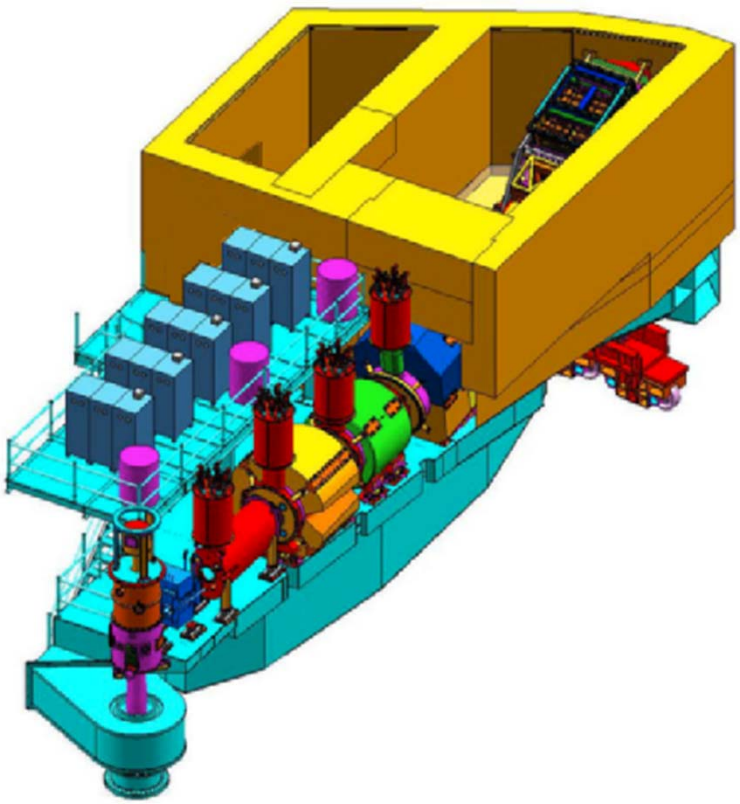
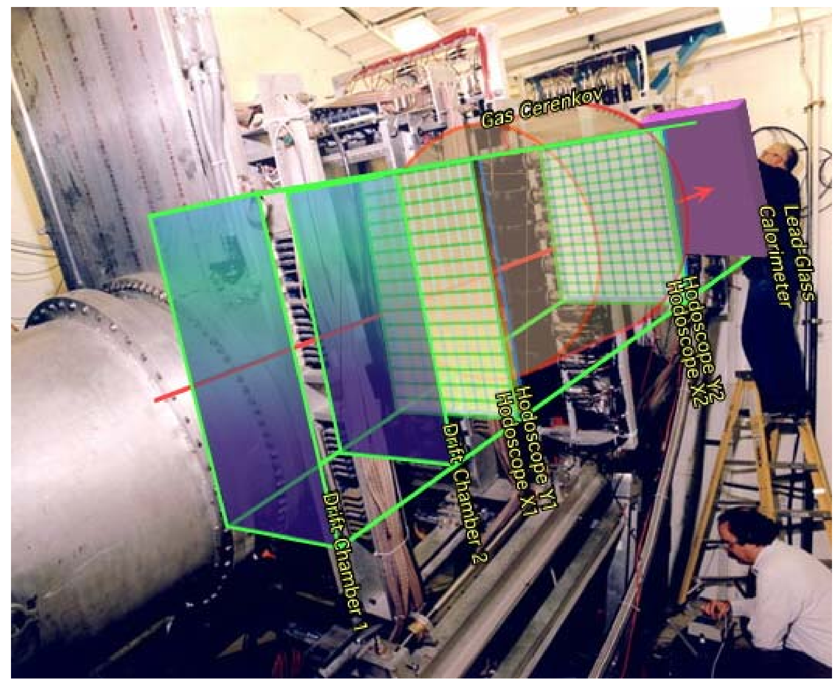




Hall C

Mark Jones , Hall C Staff

Overview

- In first 3 years of running, experiments will use the existing High Momentum Spectrometer (HMS) and the new Super High Momentum Spectrometer (SHMS). SHMS replaces the Short Orbit Spectrometer (SOS).
- HMS and SHMS have similar detector packages: Drift Chambers, Scintillator hodoscope, gas Cerenkov, Aerogel, Lead-glass calorimeter.
- After 2018, several experiments use new apparatus: neutron polarimeter, neutral meson spectrometer, backward angle hodoscope as 3rd arm.

Status and Timeline

- SHMS carriage is on the pivot and detector hut is being constructed.
- Magnets being built. Installed in late 2014 thru 2015.
- Beam commissioning in Feb 2016 (Shift from April 2015)

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***

HMS and SHMS comparison

HMS detector	SHMS detector	Comment
Front X-Y scintillator plane Rear X-Y scintillator plane	Front X-Y scintillator plane Rear X scintillator plane Rear Y quartz plane	Same code Same code New code
Drift Chamber	Drift Chamber	SHMS DC based on Hall C SOS DC design
Gas Cerenkov	Noble Gas Cerenkov Heavy Gas Cerenkov	Same code
Aerogel	Aerogel	Same code
Lead Glass Calorimeter 4 columns oriented perpendicular to central ray	Pre Shower Column “Fly’s Eye” Arrangement of Calorimeter	New code. SHMS is similar to Hall A Calorimeter

Test new HMS code against original Fortran code (ENGINE) using 6 GeV HMS data

Test new SHMS code against original Fortran code (ENGINE) using 6 GeV SOS data

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***

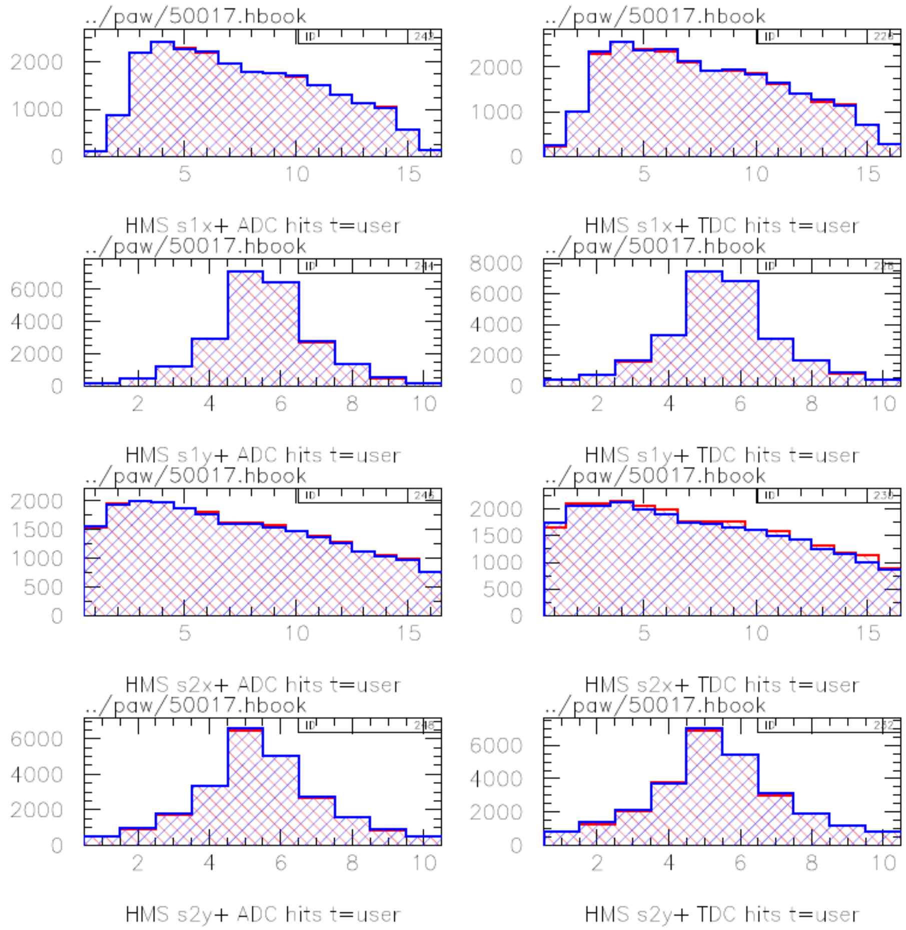
Management Structure

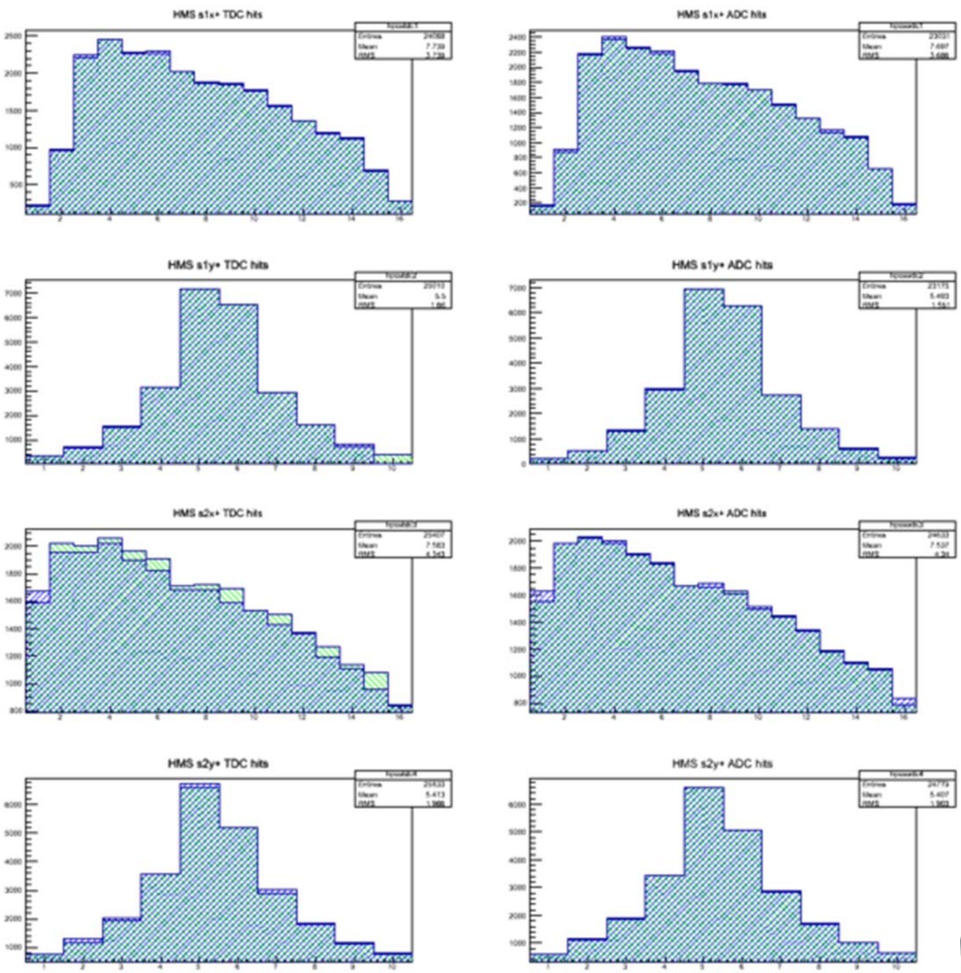
Activity	Person	Institute
Software Manager	Mark Jones	Jefferson Lab
C++/ROOT Analyzer	Gabriel Niculescu	James Madison University
Calibrations	John Arrington	Argonne National Lab
Online histogramming	Pete Markowitz	Florida International Univ.
Simulation (SIMC)	David Gaskell	Jefferson Lab

Also from 06/05/2012

- **HMS hodoscope ADCs & TDC**
- **In the engine**

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





Reminder

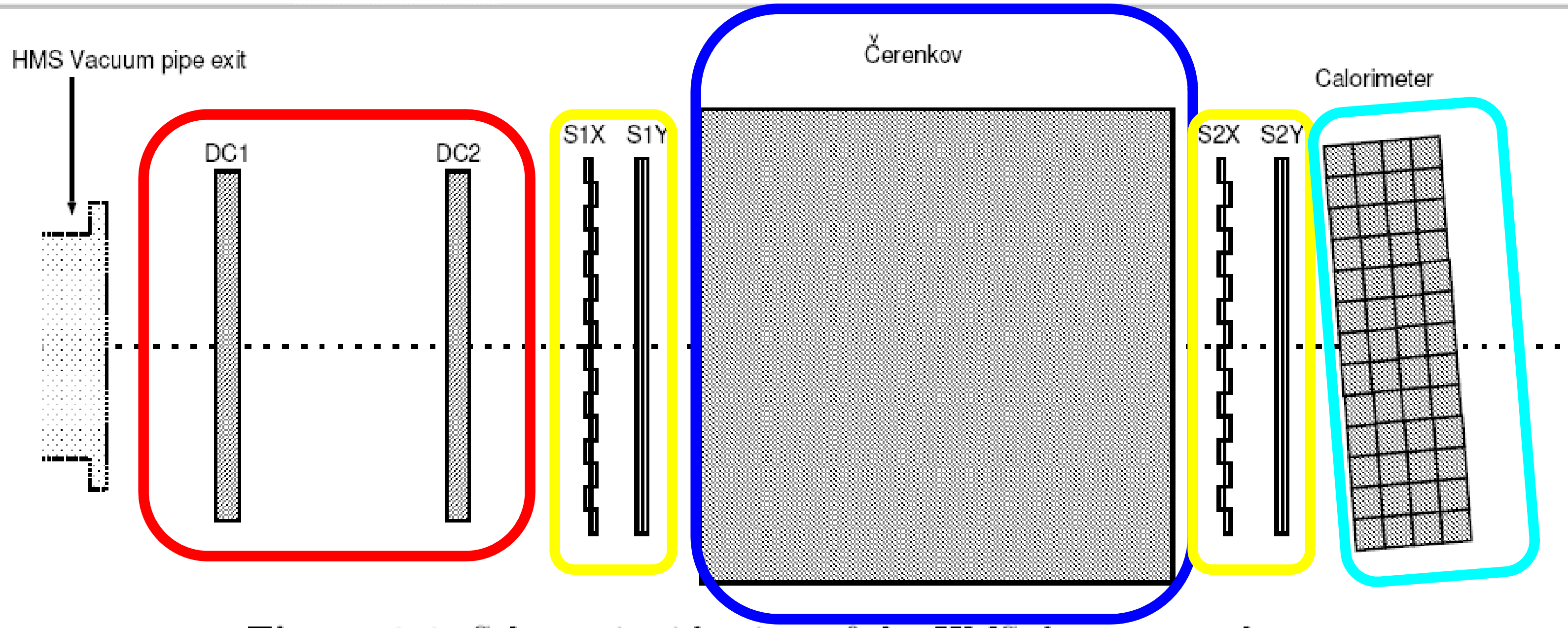


Figure 3.9: Schematic side view of the HMS detector package.

- ***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

calculated in analyzer

Sample Output

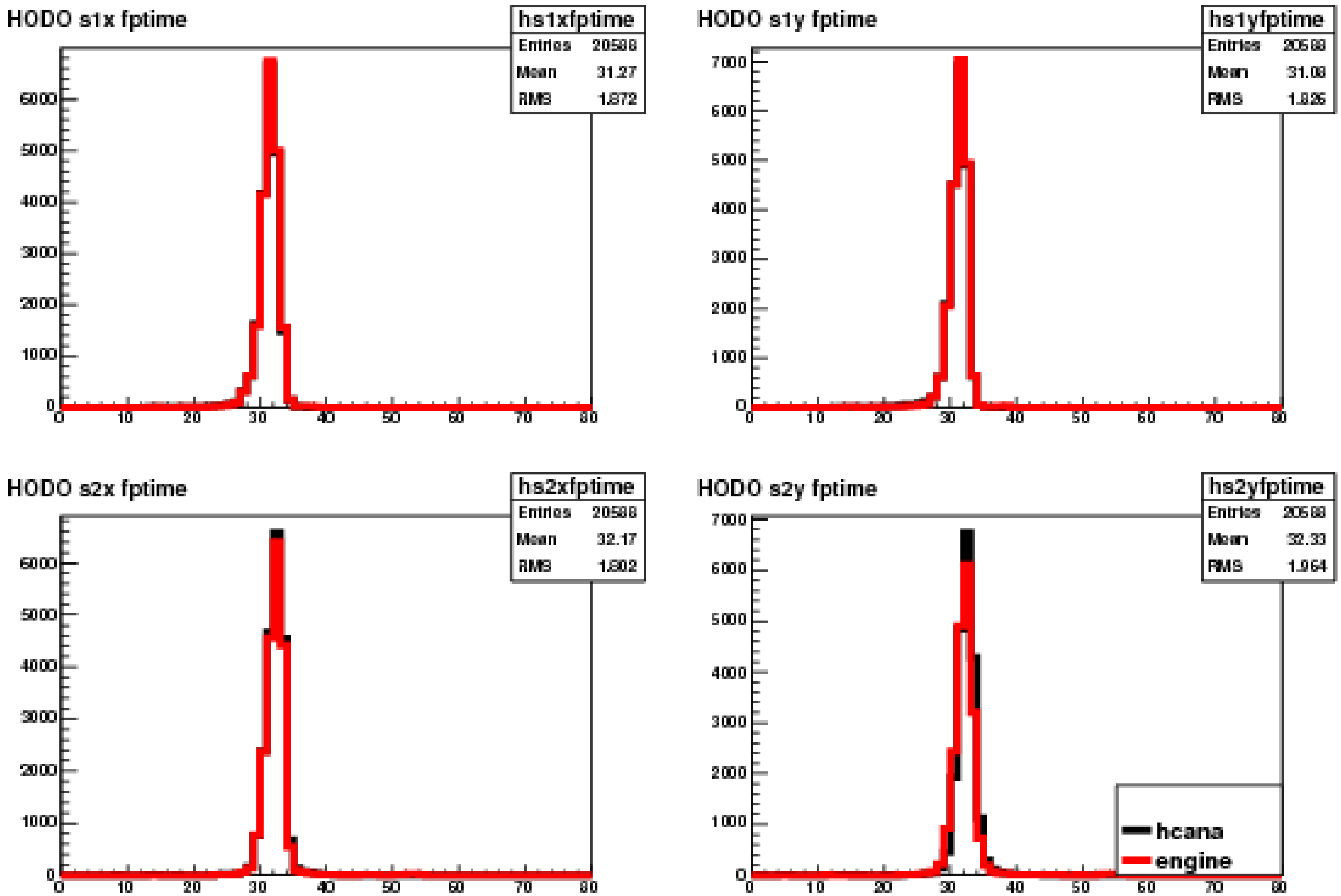
```
htrig       =    98576 ( 13857.27 )
hms adcgates=    98188 [ 13802.7 ]
sos adcgates=        0 [     0.0 ]
all adcgates=    99612 [ 14002.9 ]

* 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
…
```

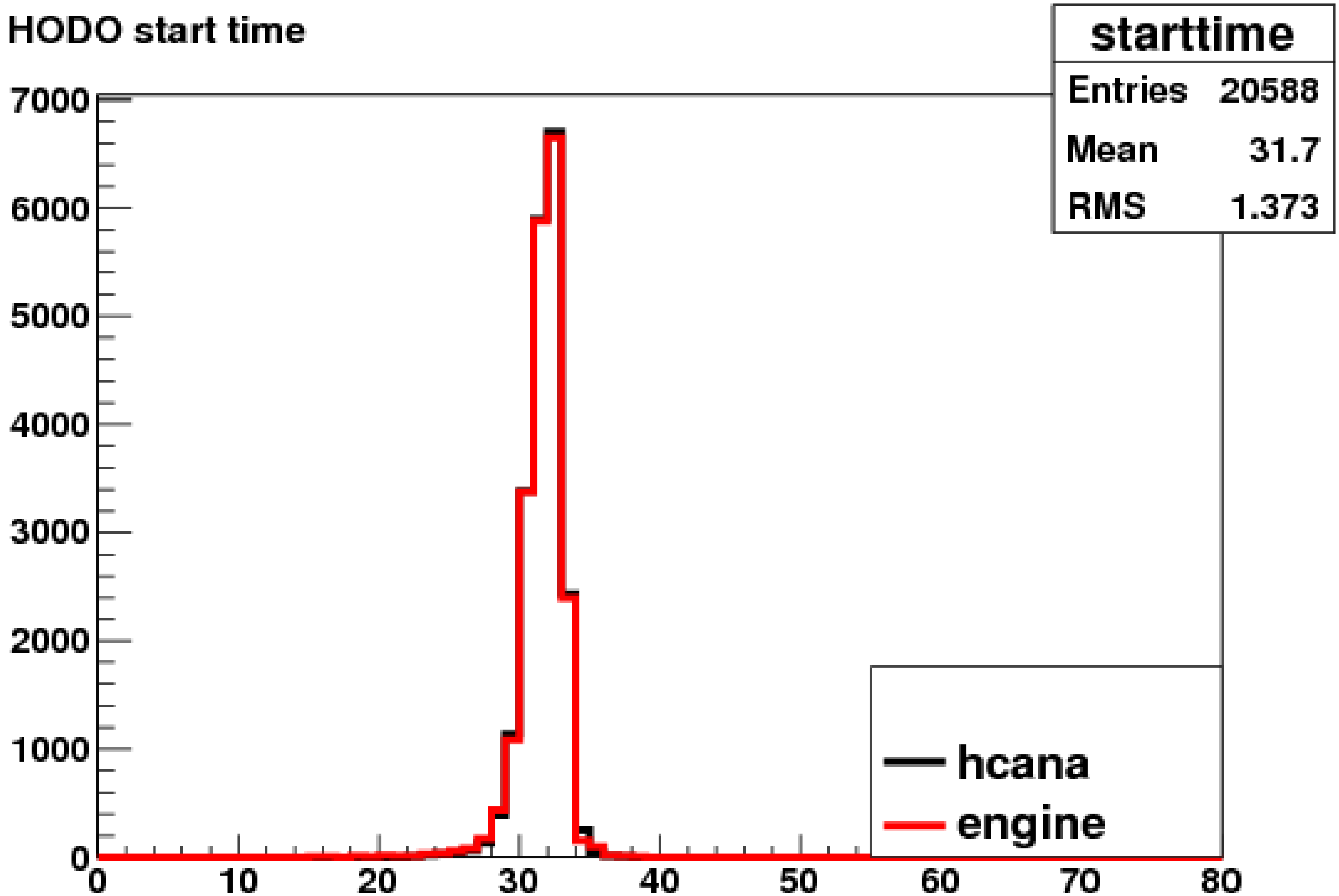
Hodoscope

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



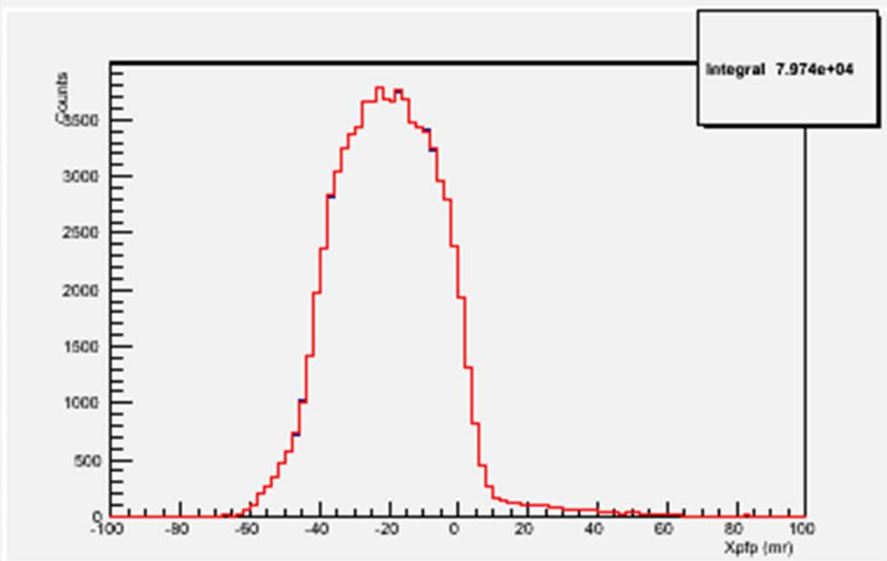
Hodoscope

- *Hodoscope start time*

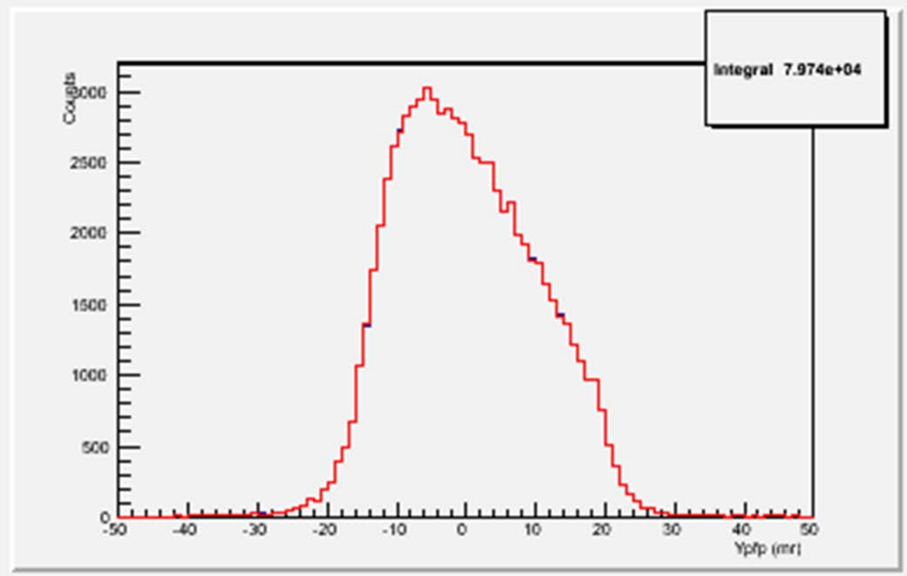


DC/Tracking

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

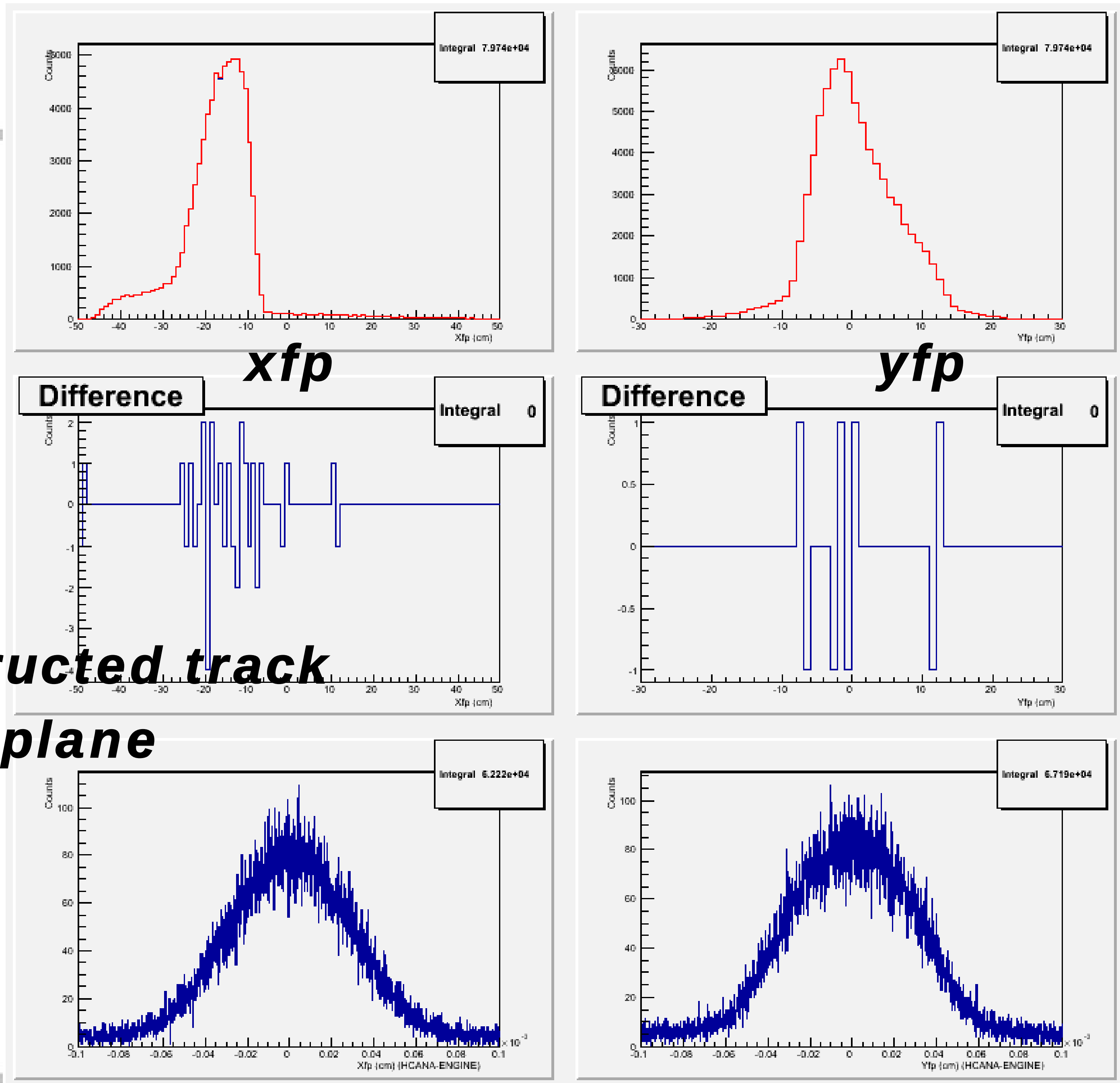


xpfp



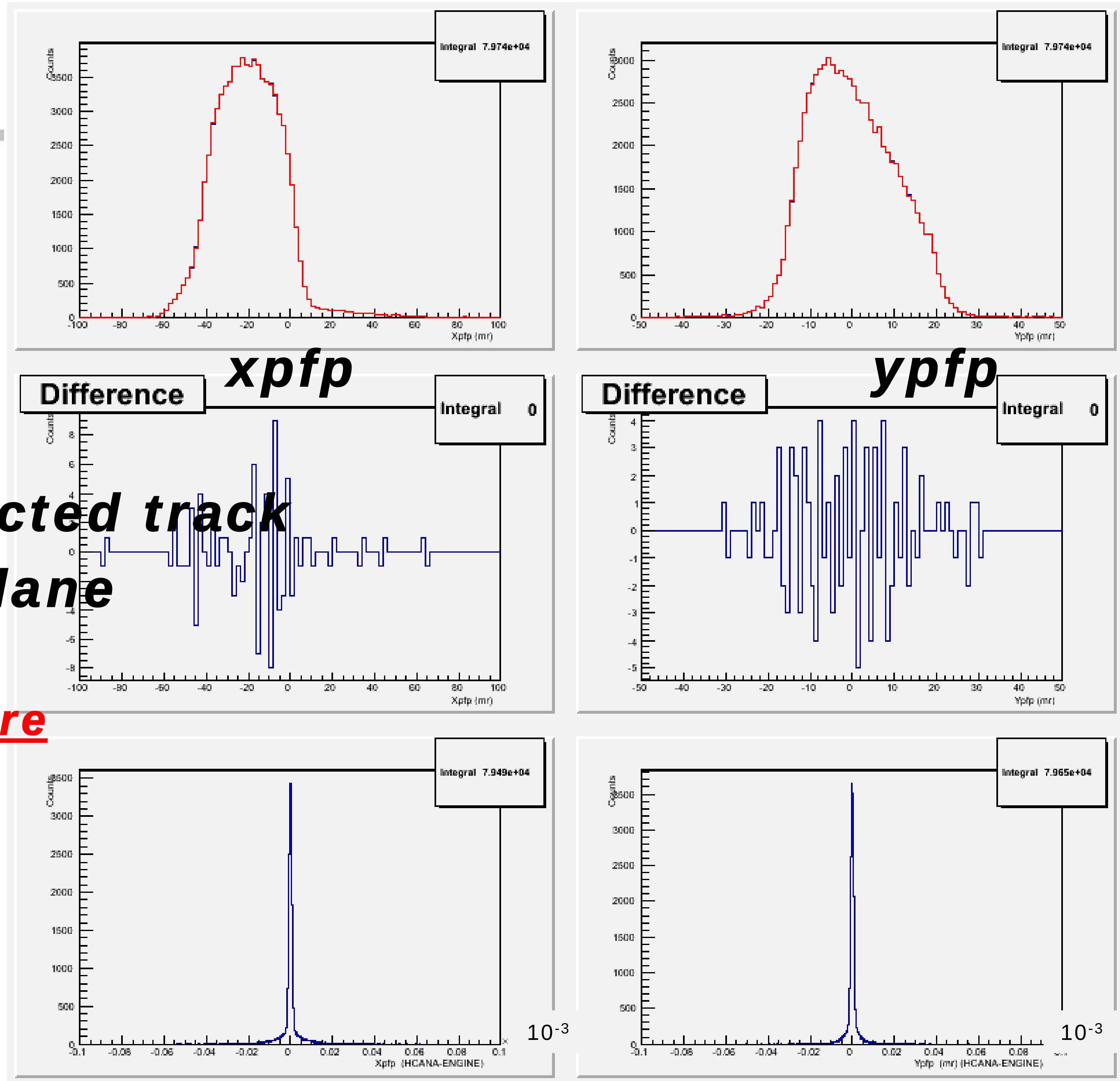
ypfp

DC/Tracking



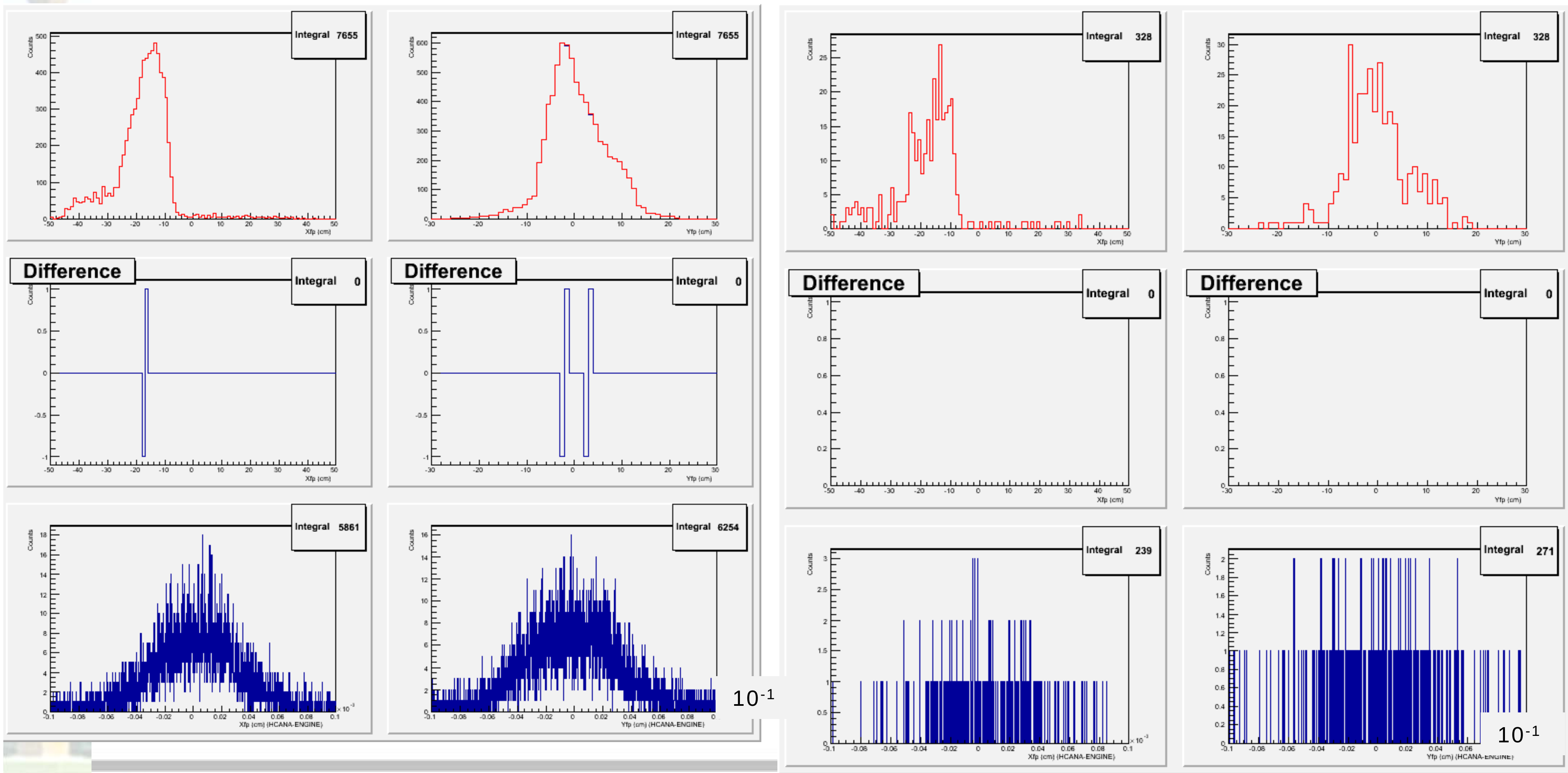
- ***1st reconstructed track***
- ***X & y focal plane position***

DC/Tracking



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

- **2nd and 3rd track***
- **X & y focal plane positions (cm)**

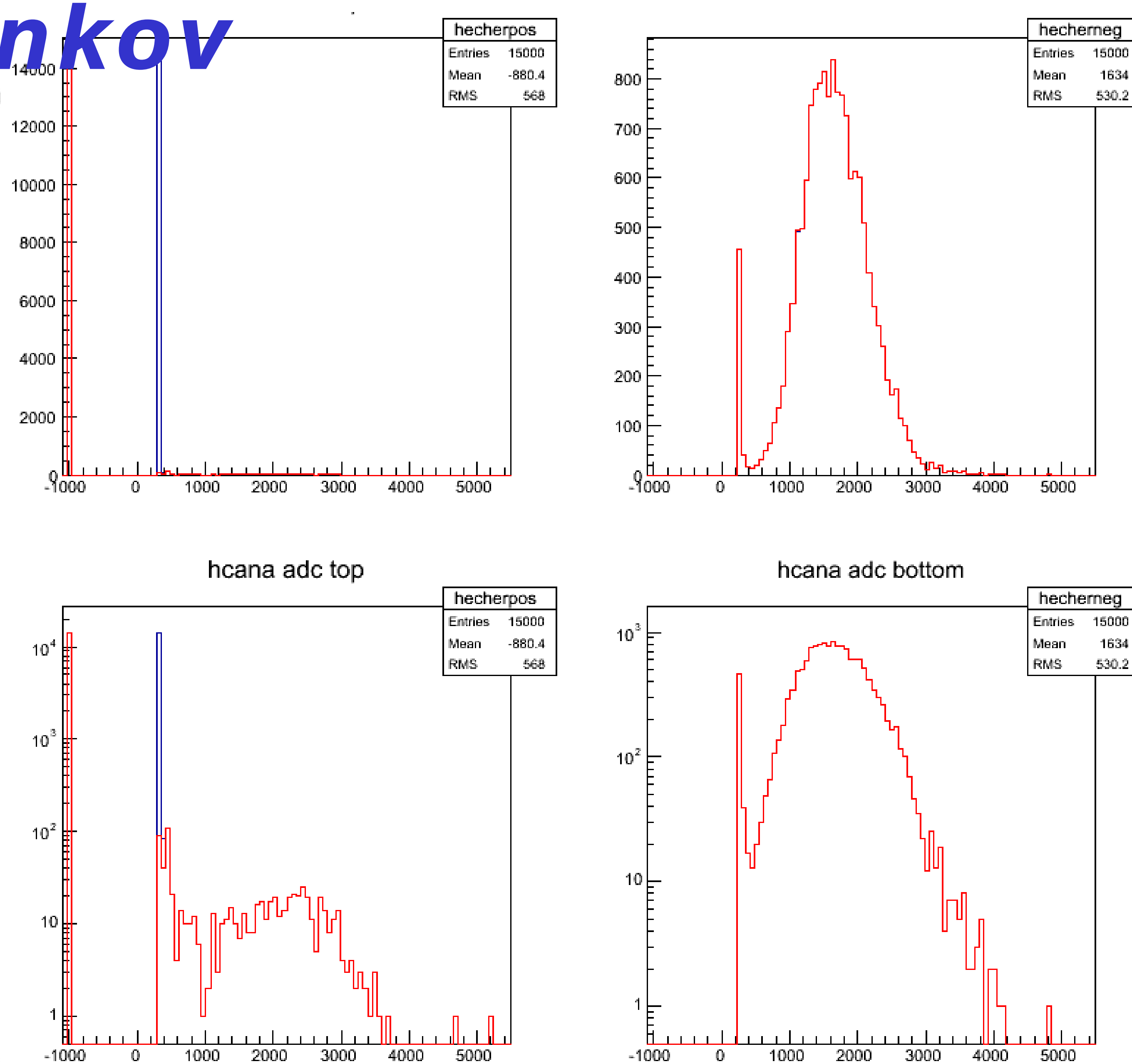


Cerenkov

- ***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***

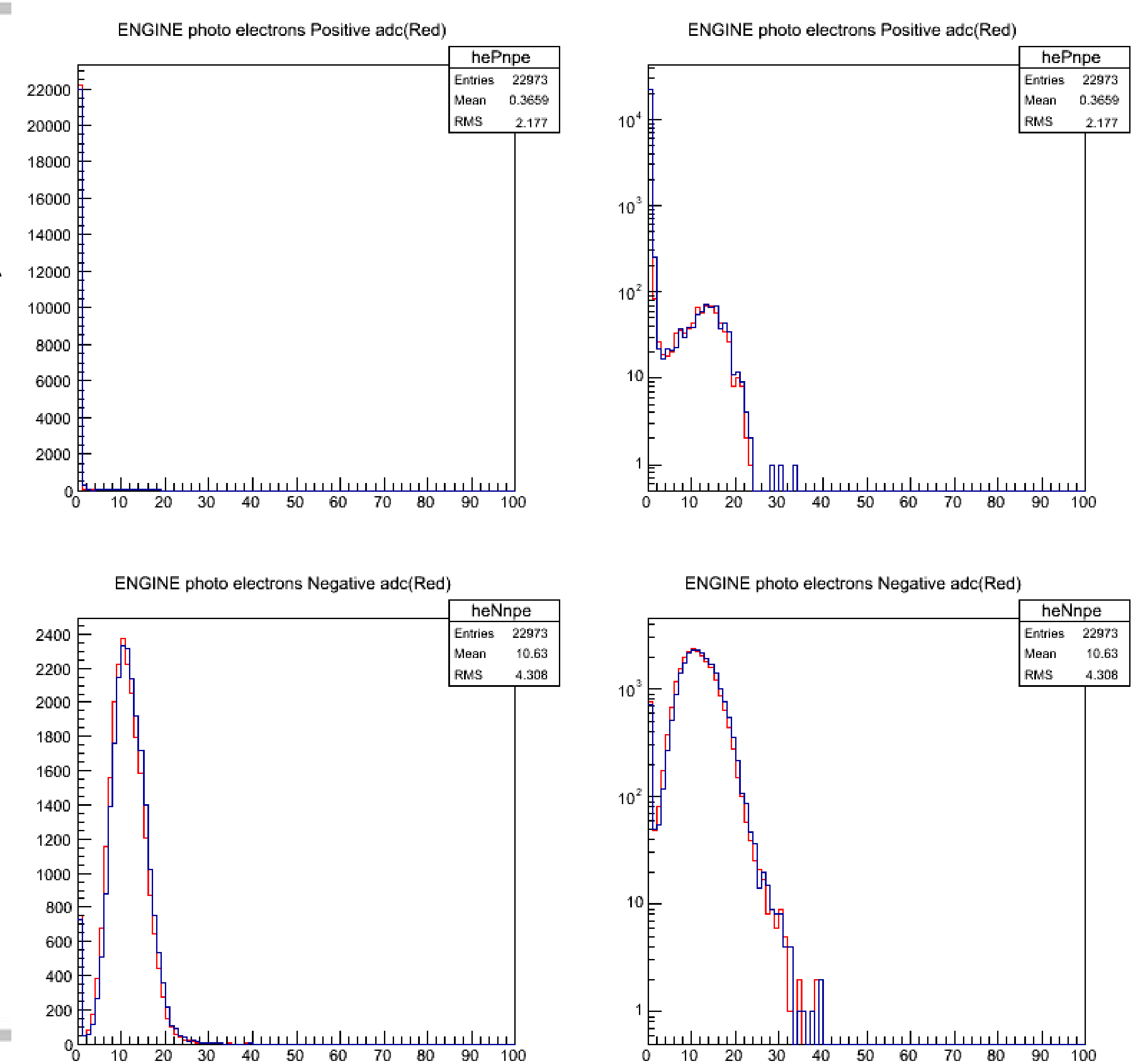
Cerenkov

- ***Cerenkov ADCs & TDCs***



Cerenkov

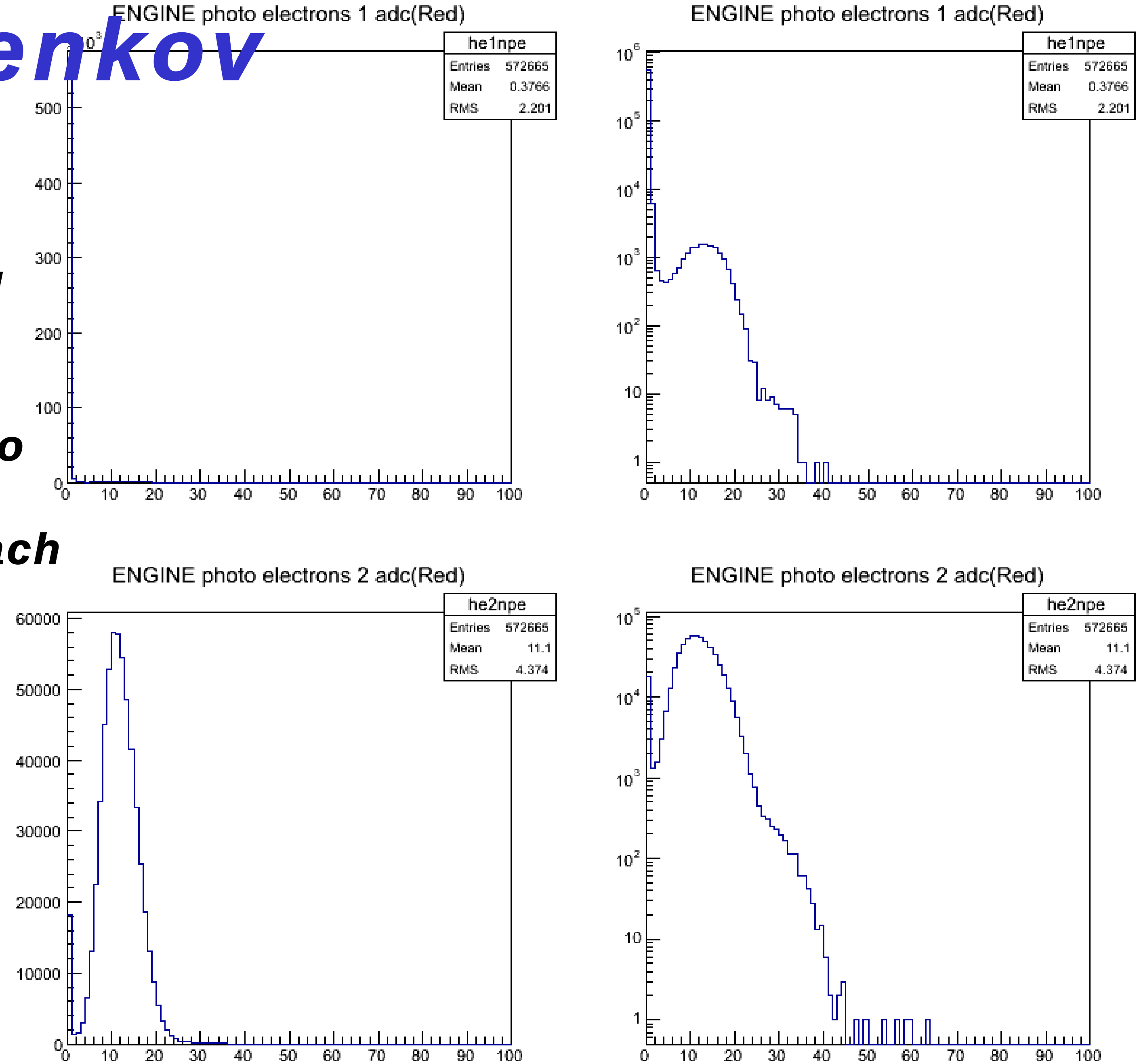
- **Cerenkov number of photoelectrons**
- ***Most of the disparity comes from the fact that at some point in the algorithm engine truncates the npe to an integer…***



Jefferson Lab

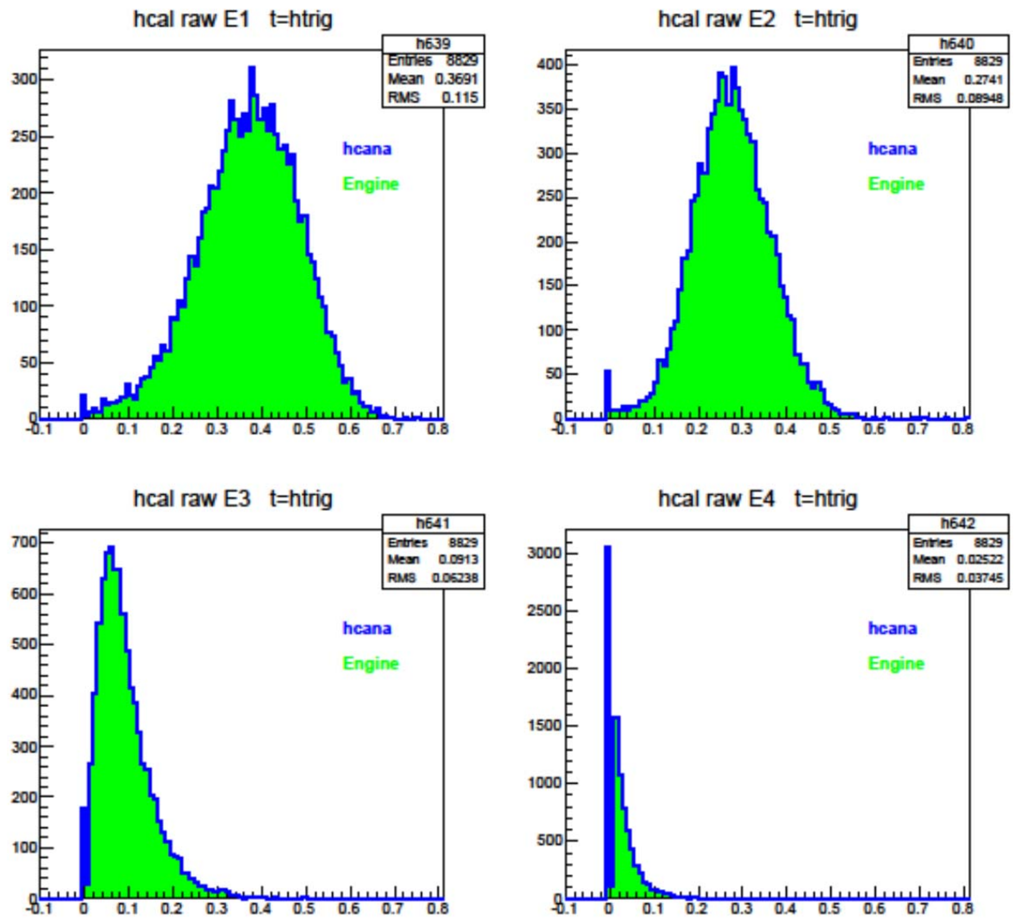
Cerenkov

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

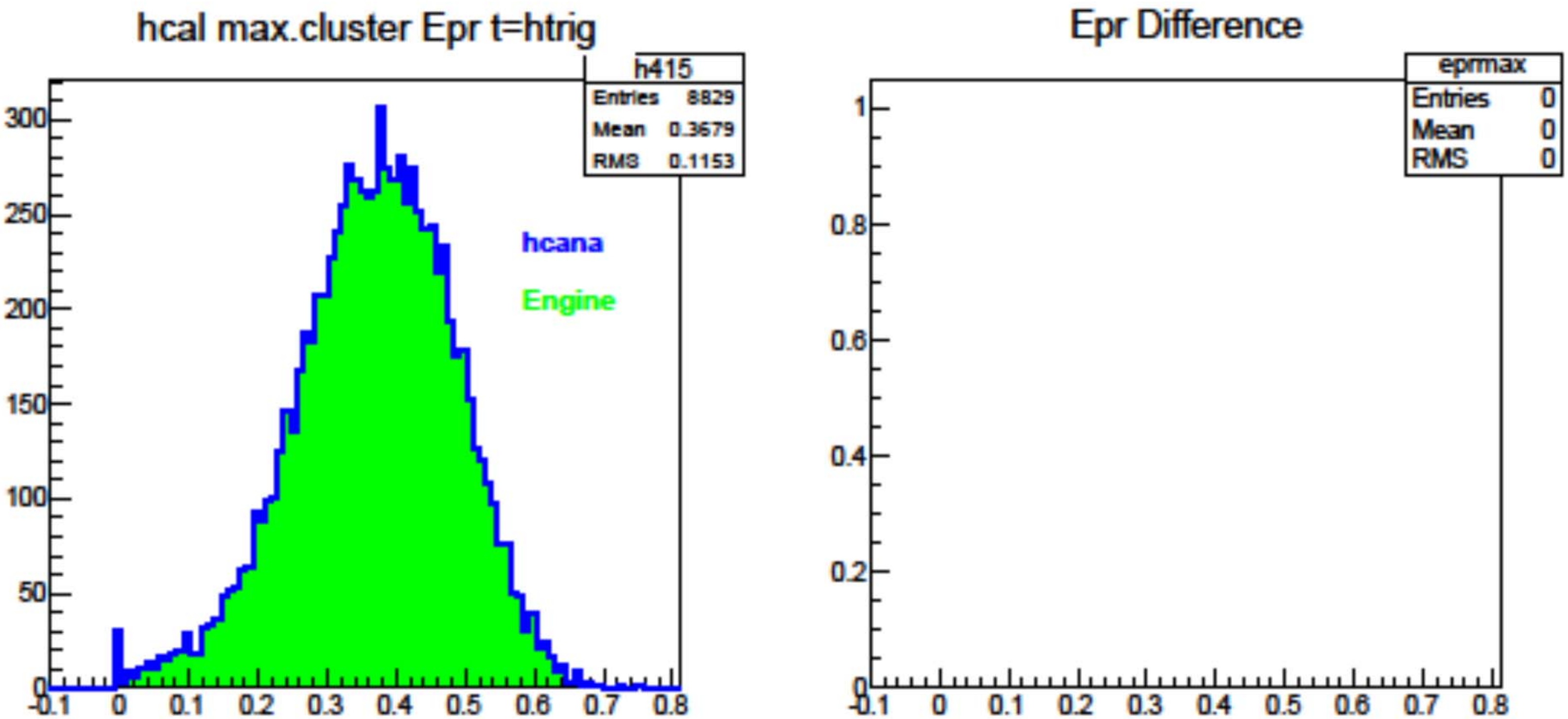


Calorimeter

- ***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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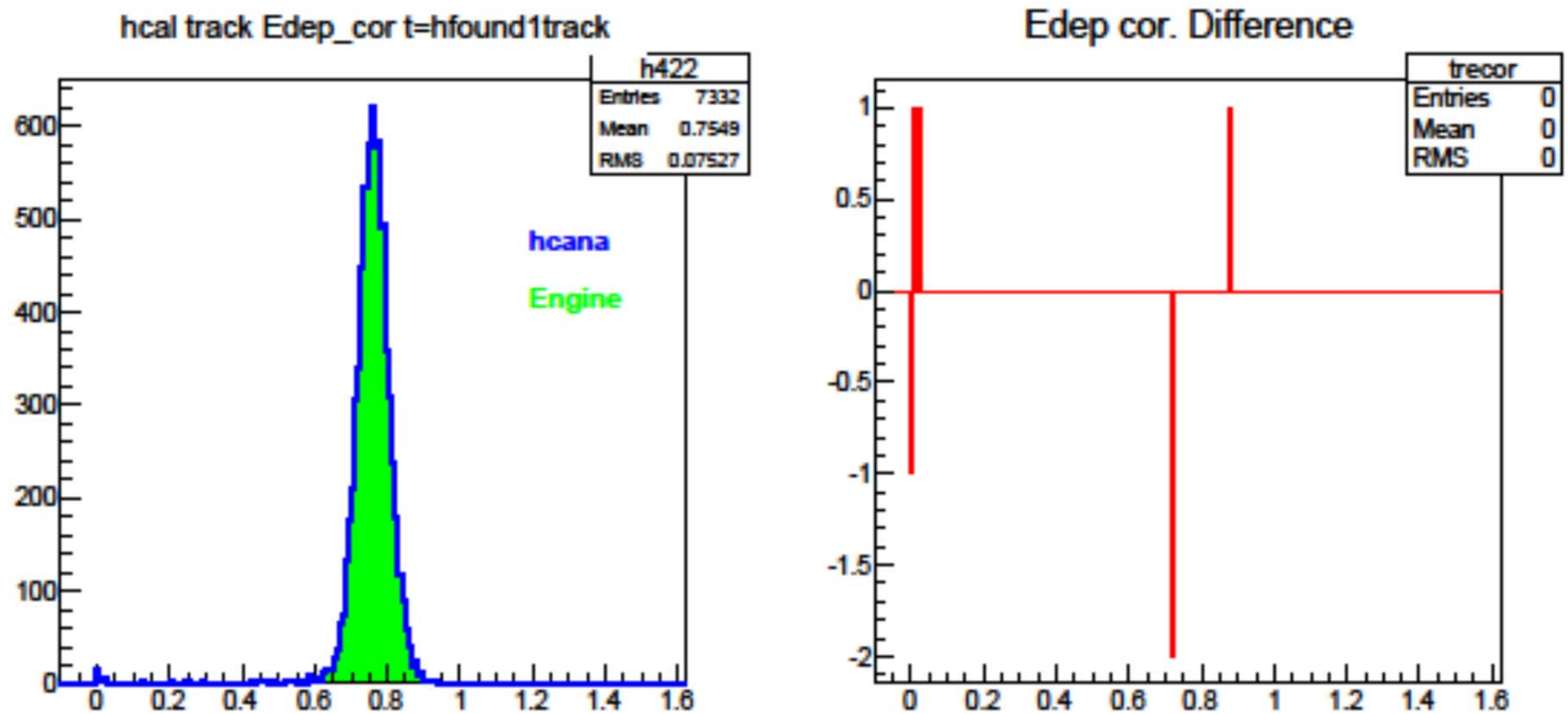
Calorimeter



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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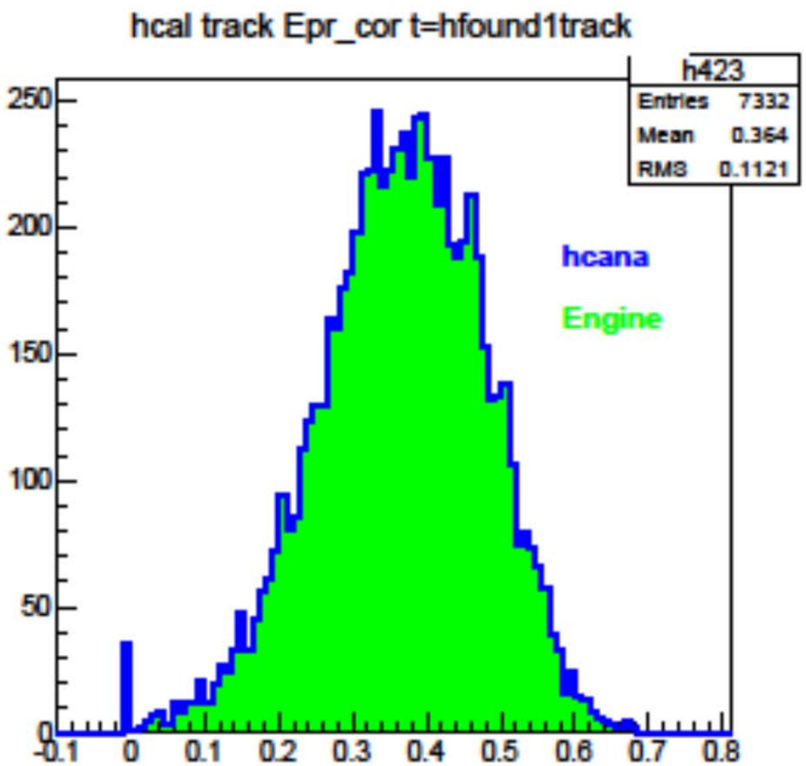
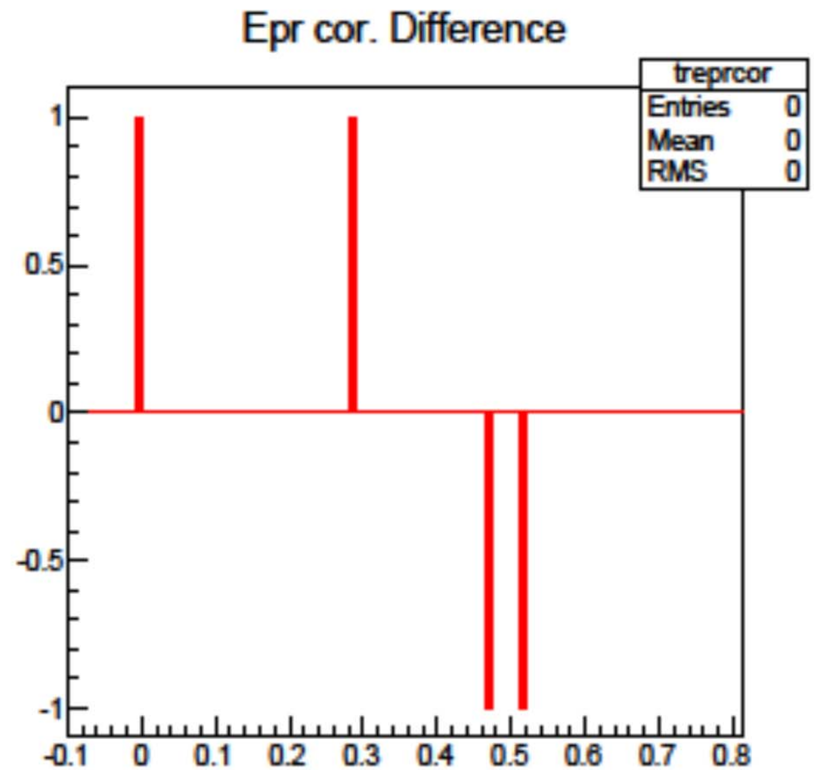
Calorimeter





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)