CERN 2012 BSD Analysis Update

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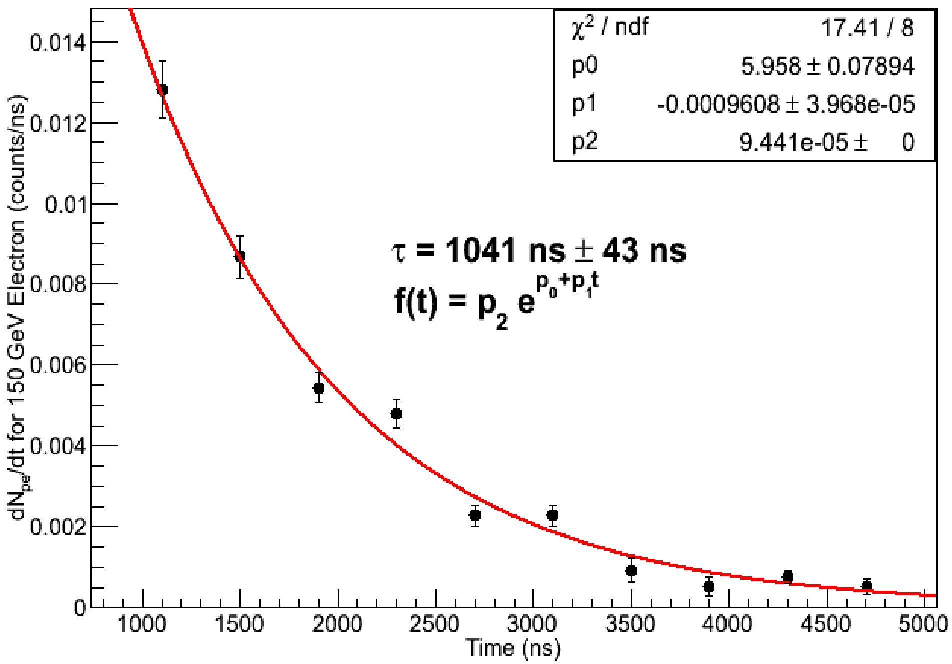
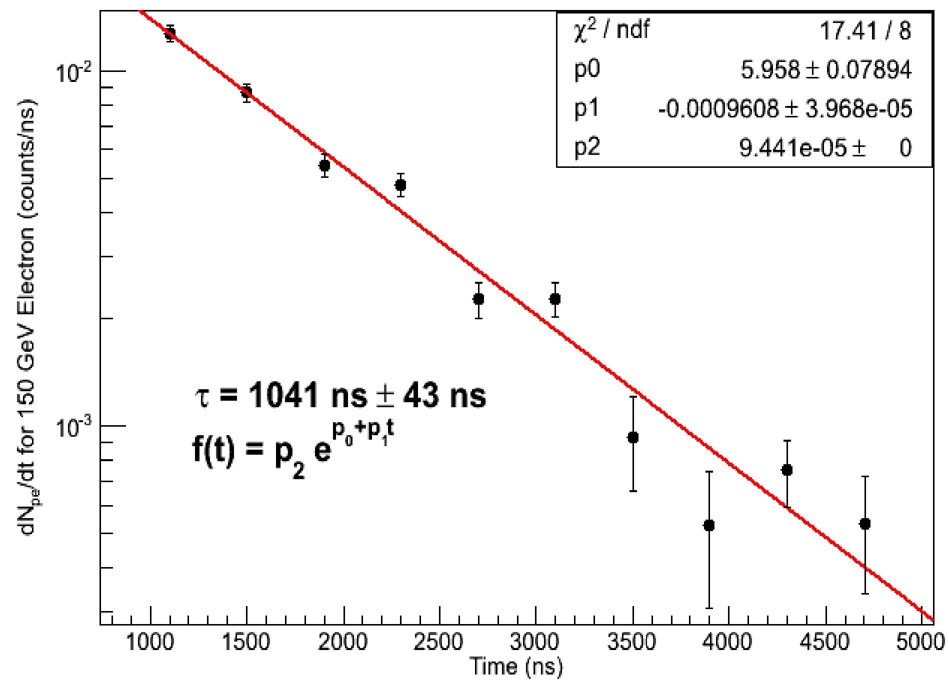
BSD Group Meeting

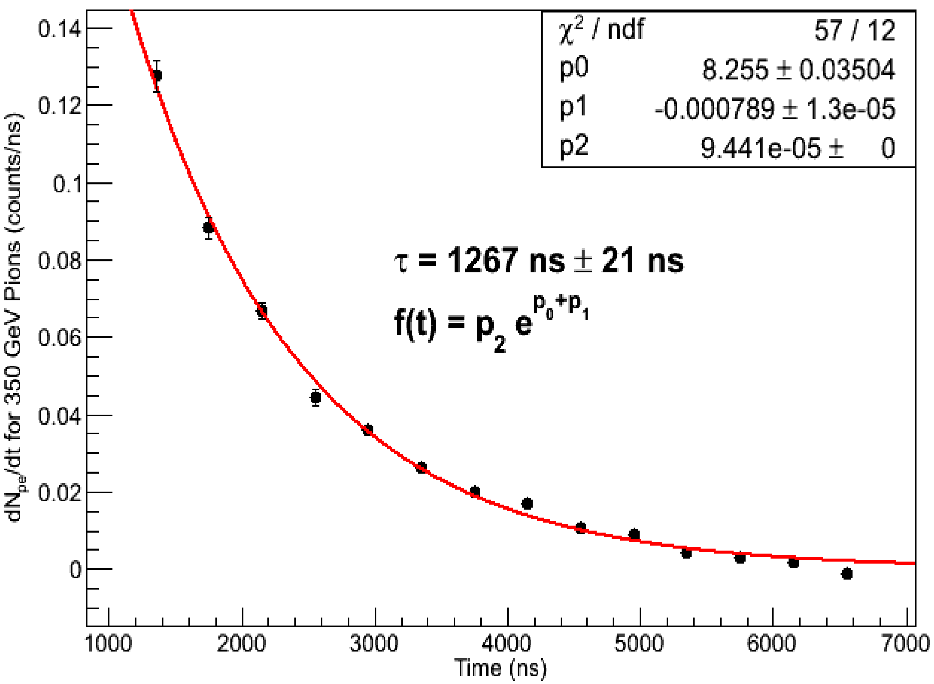
Scope Electron Data

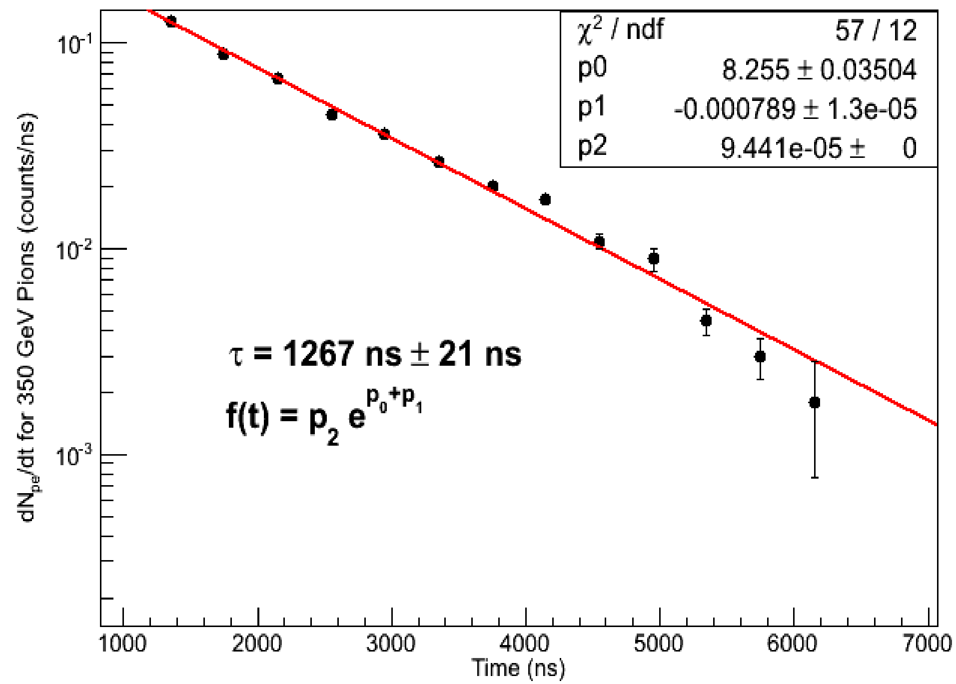




- Using PMT 1B, 150 GeV electron data from oscilloscope area measurements
- Error bars calculated as quadrature sum from three contributions:
  - Error in center point approximation for derivative
  - Standard error of mean in peak determination
  - Standard error of mean in pedestal determination (small)
- Parameter p2 is “fixed” (i.e. not allowed to vary with fit) as part of conversion from ADC channel count to PE count.
- 15 PE between 900 ns to 4500 ns

Scope Pion Data



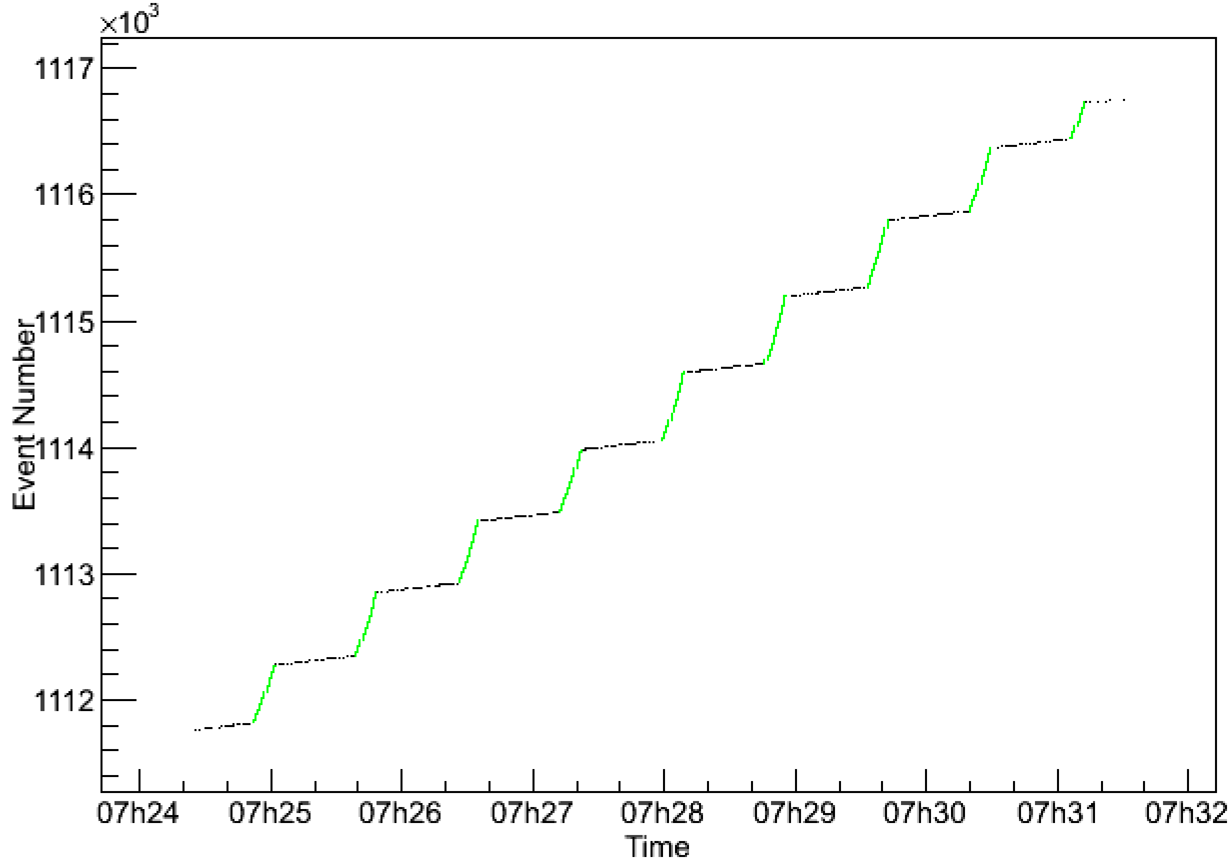


- Using PMT 1B, 350 GeV pion data from oscilloscope area measurements
- Error bars calculated as quadrature sum from two contributions:
  - Error in center point approximation for derivative
  - Standard error of mean in peak determination
- Parameter p2 is “fixed” (i.e. not allowed to vary with fit) as part of conversion from ADC channel count to PE count.
- 213 PE between 900 ns to 4500 ns

Initial Quality Cuts for 2249W Data

- Note: Using pion and electron energy scan data from runs with BSD slightly offset and BCD + TCD in place
- IsWithCal
  - Cuts 64.7% of electrons, 67.1% of pions
  - Requires that both BSD and CAL saw event (matched by event number)
  - CDAQ has much more dead time (~20 ms) than CAMAC readout (~300 us), so this cuts a lot of data
- fCHA[n] > 0 for n = 1 to 10
  - Cuts 0.3% of remaining electrons, 24.2% of remaining pions
  - Mostly from saturated channels (2249W puts out a "1" when saturated, so pedestal subtracted values are less than 0).
  - ***<u>Look at the 24.2% pions. This is large enough that it will affect Efrac distributions, since the cut is biased to remove large signal values.</u>***
- CALSum > 0
  - Cuts 0.4% of remaining electrons, 6.7% of remaining pions
  - Below pedestal events caused by width of CAL pedestal
  - Note that the next cut would clean these up anyway, so this cut is unnecessary.
- >40 MeV in 6 ***<u>consecutive</u>*** CAL layers (flight CAL trigger)
  - Cuts 9.4% of remaining electrons, 55.7% of remaining pions
  - Use approximate conversion 9 chan = 1 MeV (from S. Nutter) as rough conversion. This needs to be redone when CAL is gain calibrated.
  - ***<u>Look at efficiency of this cut with energy</u>***
- Out of 91174 electron events, 28991 remain
- Out of 65748 pion events, 6768 remain

IsWithCal For In Spill Events

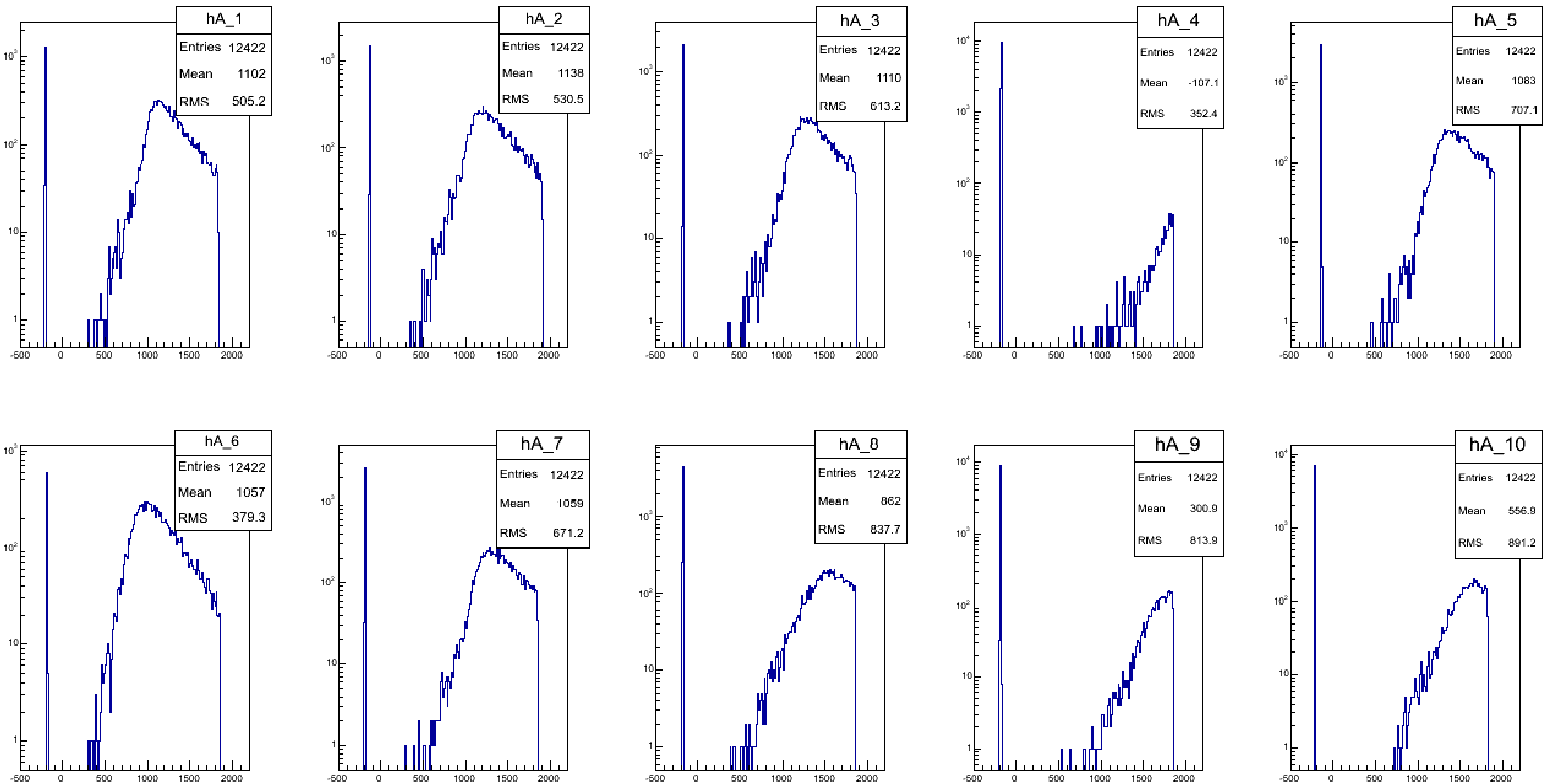


- Choosing “IsWithCal” is a good proxy for in spill events.
- Example plot for 150 GeV electron run BSDCALCombined_11-27-2012-13-24-15.root
  - Black: All events in run
  - Green: Events with “IsWithCal” flag
- Makes sense since this is the time window when the BSD and upstream scintillator counter triggers are well correlated.

fCHA[n] < 0

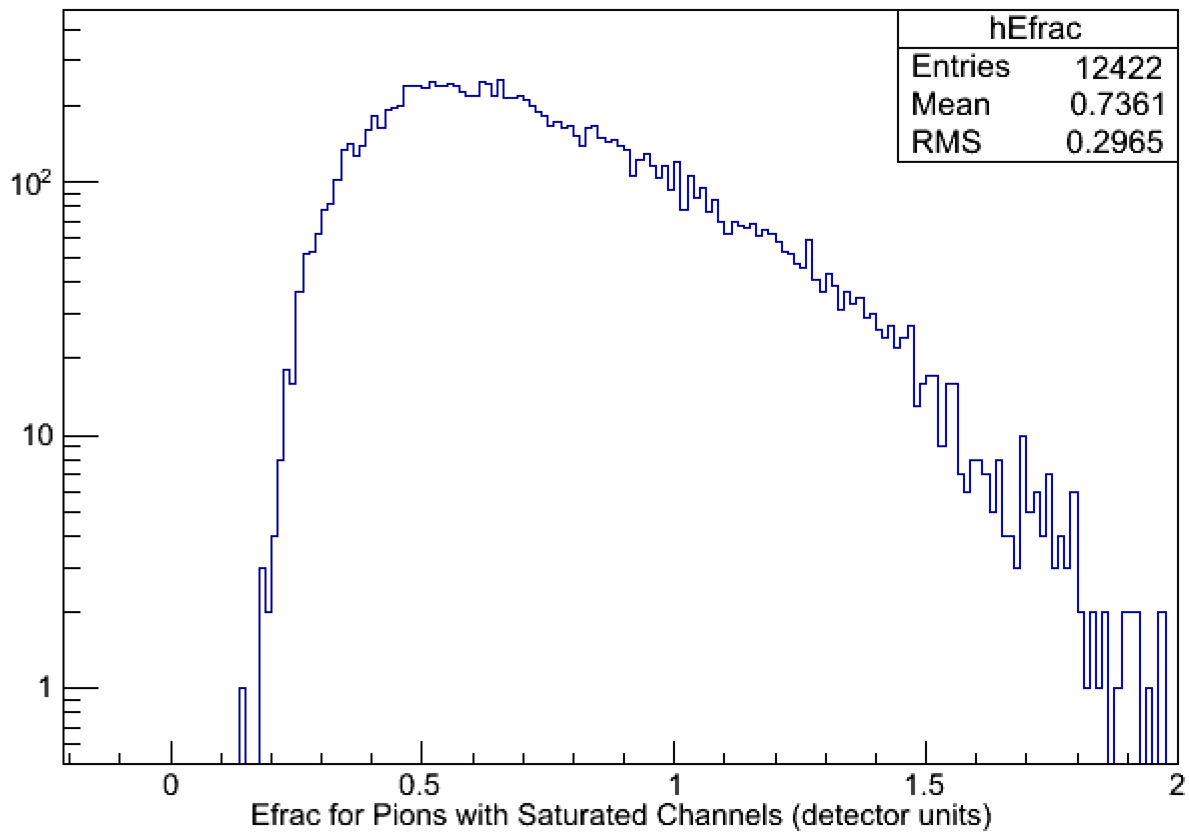
- The 2249W puts out a number much less than pedestal (typically “1”) when it saturates
- The fCHA branch is already pedestal subtracted, so these saturated values will show up as a large negative spike in channel histograms
- These saturated events are significant (especially for pions) because:
  - They represent large PE signals
  - They are much more common for pions (because of larger BSD late signal) than for electrons
- Hence, missing these events will throw off Efrac significantly

Looking at fCHA[n] < 0 Events



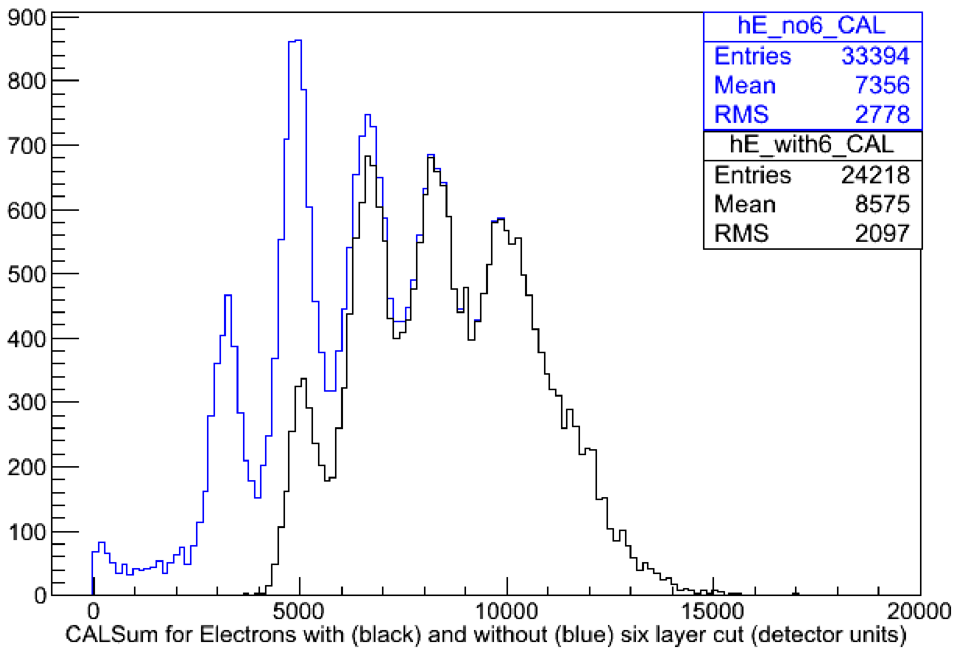
- Clearly, these are saturated events
- 96.3% have fCHA[4] saturated.
- 99.1% have either fCHA[4] or fCHA[9] saturated.

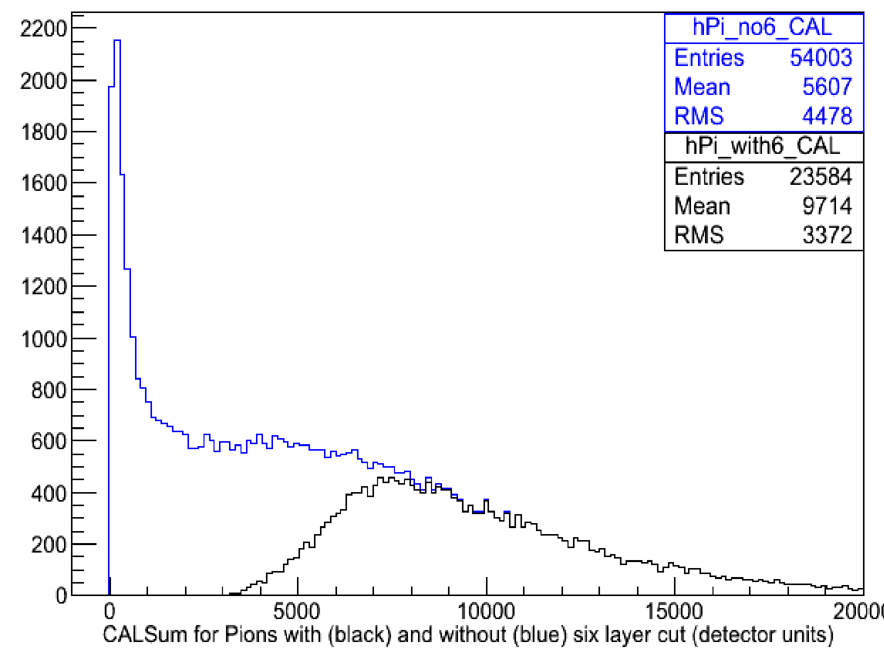
Saturated Event Solution



- Solution: If a channel is saturated, give it max value, 2048 channels. This is a good approximation, though it under estimates the signal sum a little bit
- All events with saturation (histogram above) then end up outside the electron Efrac range (Efrac < 0.1 in detector units). Thus, the slightly under estimated signal sum only influences the total histogram counts (a small effect), but not the counts for events in range of electron Efrac (a larger effect).

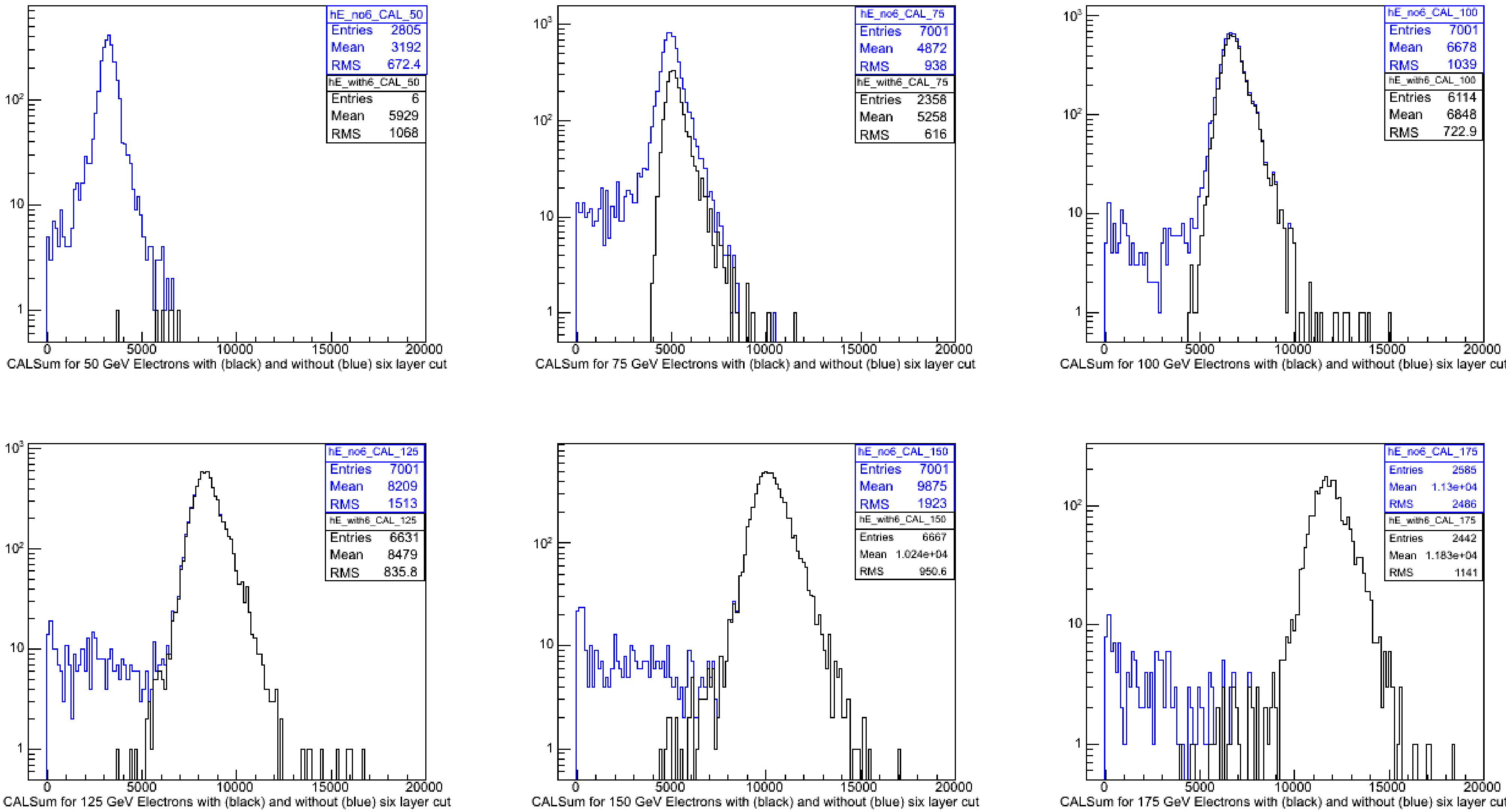
Effect of “Six Consecutive Layers >40 MeV” Cut on CALSum





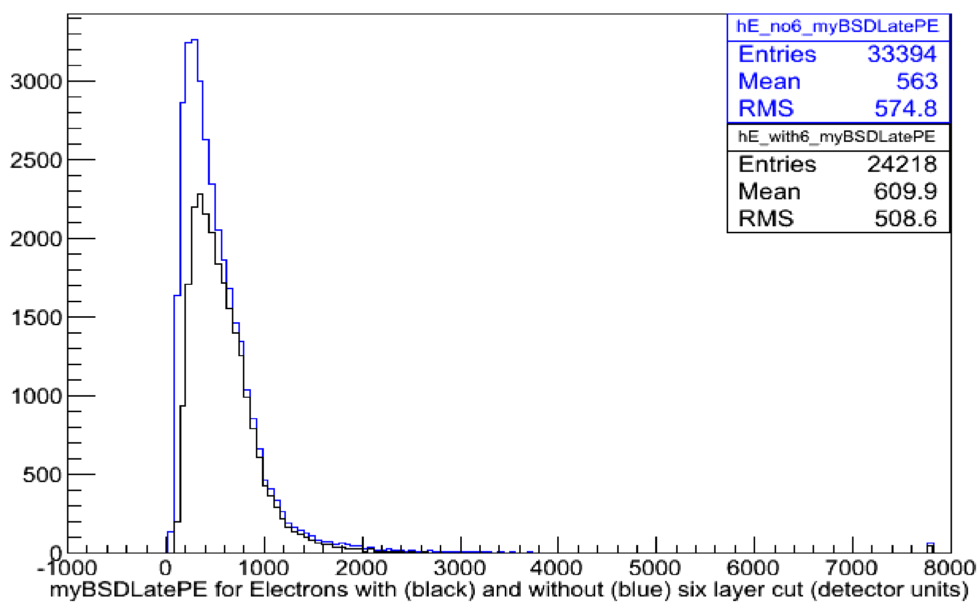
- Left histogram: Black is CALSum with equal numbers of events from electron runs at 50 GeV, 75 GeV, 100 GeV, 125 GeV, 150 GeV, and 175 GeV. Blue is remaining histogram after requiring CAL to have 6 consecutive layers with >40 MeV on this dataset.
- Right histogram: Black is CALSum with equal numbers of events from pion runs at 250 GeV, 300 GeV, and 350 GeV. Blue is remaining histogram after requiring CAL to have 6 consecutive layers with >40 MeV on this dataset.
- Note that the 6 layer cut removes many more low energy events than high energy events
- For analysis, must weight with equal amounts of all energies ***<u>AFTER</u>*** 6 layer cut.

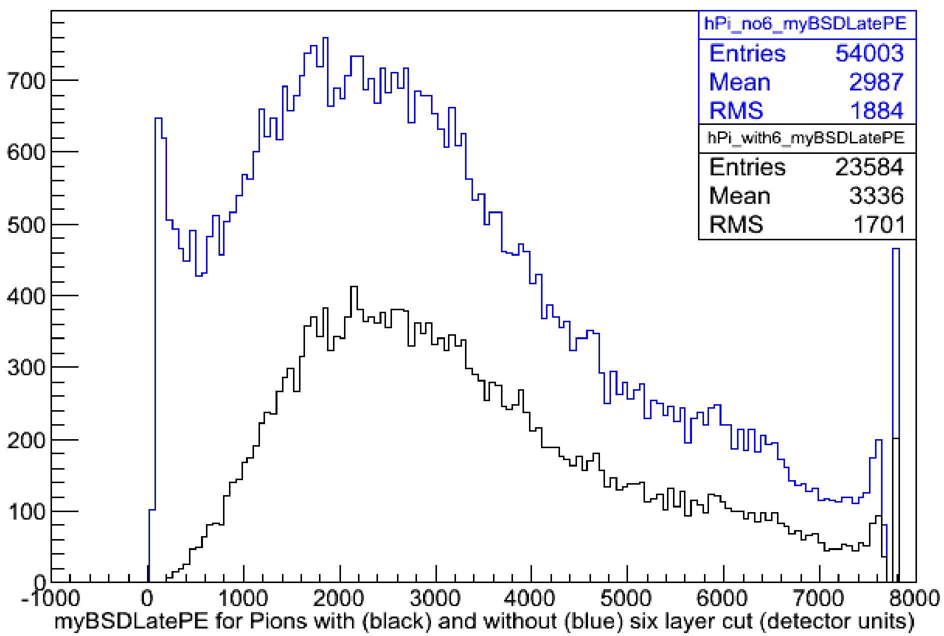
Another Effect of the 6 Layer Cut



- Electron beam is only ~75% pure, but this cut removes most of the impurities. (Pion beam is ~95% pure.)
- Only 6 events from the 50 GeV electron runs survive the 6 layer cut, so they will not be used in the remaining analysis.

Effect of “Six Consecutive Layer >40MeV” Cut on myBSDLatePE





- Note that the 6 layer cut removes much more of the low energy events than the high energy events
- For analysis, must weight with equal amounts of all energies ***AFTER*** 6 layer cut

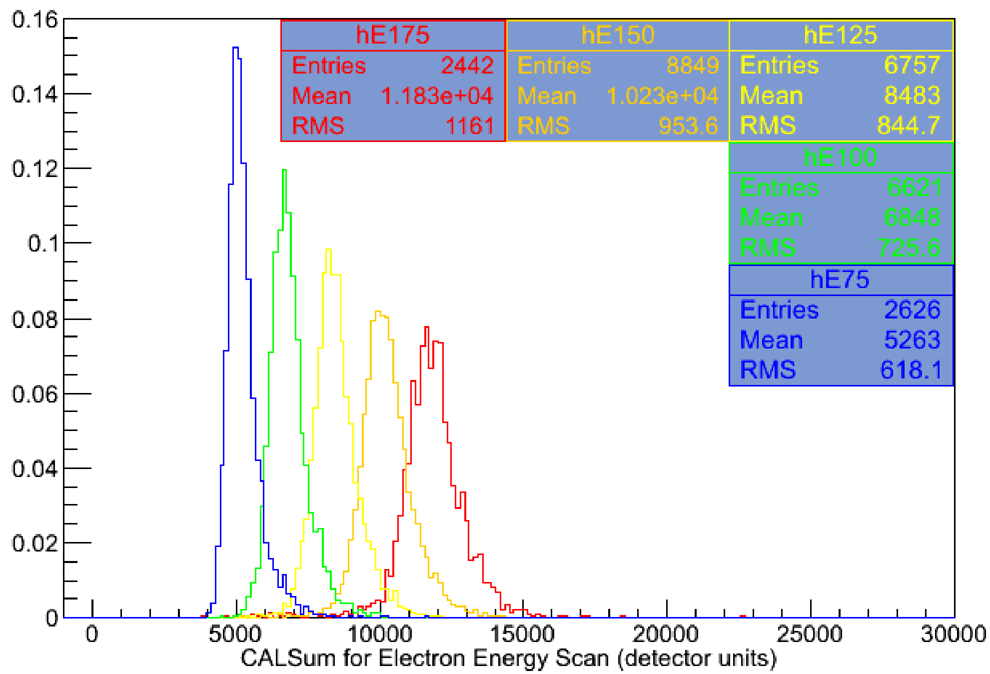
Revised Data Cuts and Conditioning

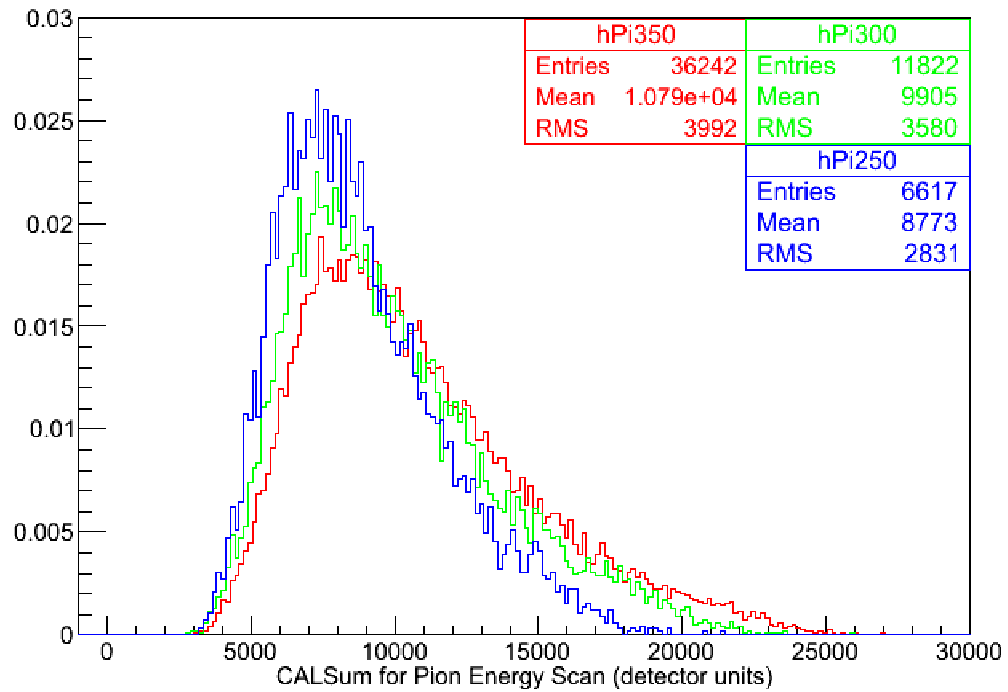
- IsWithCal
  - Cuts 64.7% of electrons, 64.1% of pions
- Set any fCHA[n] < 0 for n = 1 to 10 to 2048 channels. Use myBSDLatePE as gain converted PE sum of these.
  - Effects 0.3% of remaining electrons, 24.2% of remaining pions
- Require >40 MeV in 6 consecutive CAL layers (flight CAL trigger)
  - Cuts 9.9% of remaining electrons, 56.9% of remaining pions
- Out of 91174 electron events, 29029 remain
- Out of 65748 pion events, 9321 remain

Now what?

- Cuts and data conditioning measures have been outlined/verified
- Would like to make plots which are:
  - 1.) physically meaningful
  - 2.) can be compared with MC simulation data
- Choose to do analysis of CALSum, myBSDLatePE, Efrac, and rejection power vs. electron acceptance for 75 GeV-175 GeV electron energies and 250 GeV-350 GeV pion energies.
- Not all energy runs have the same amount of data, so we “mix” for equal fractions of all energies ***AFTER*** cuts and conditioning!

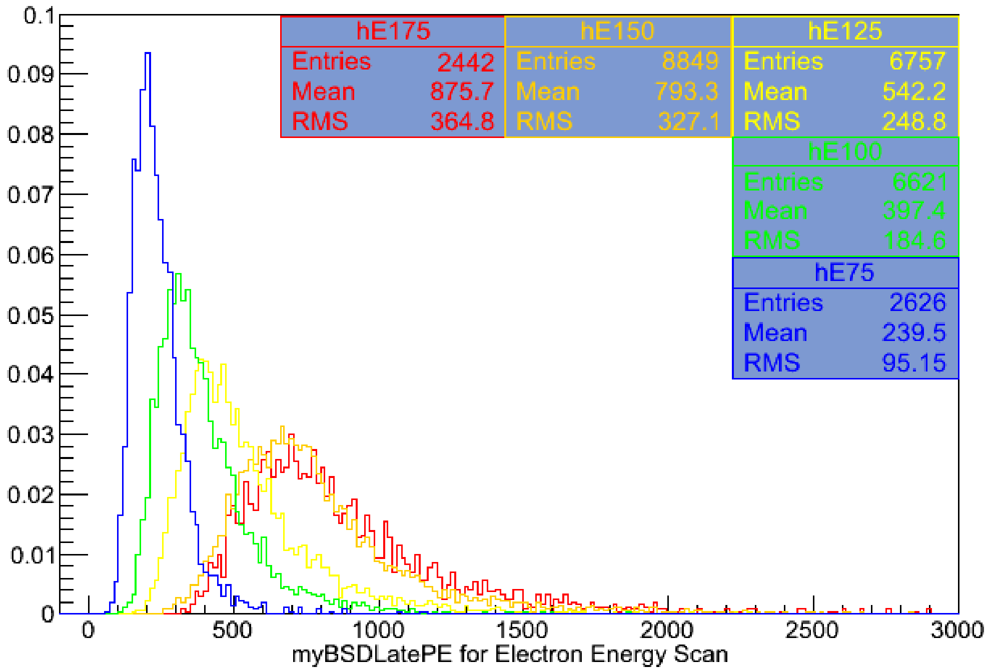
CAL Response With Particle Energy

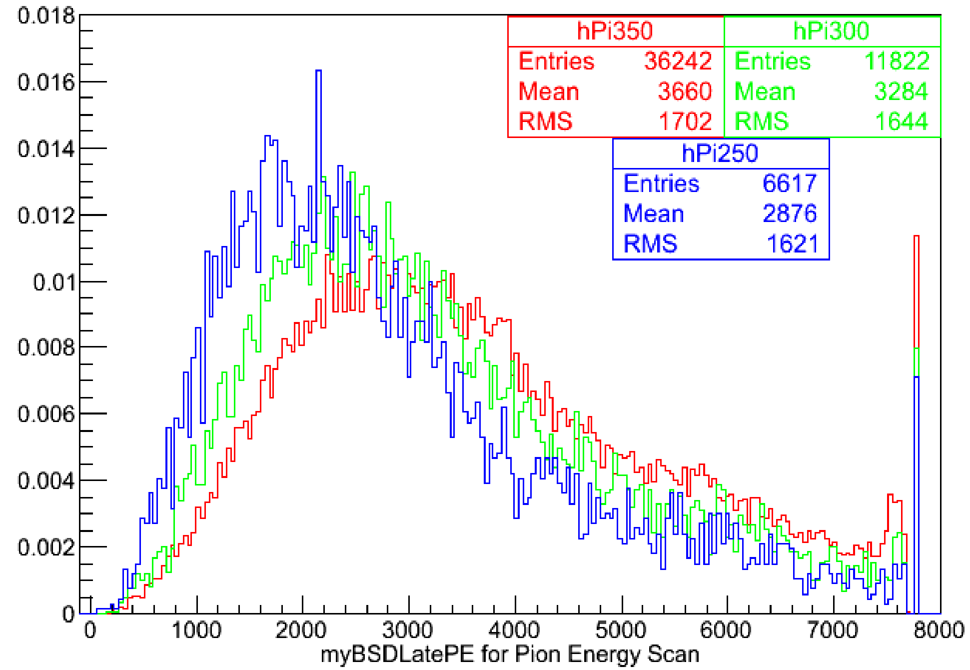




- Histograms are scaled to equal areas by total number of events and normalized such that total area is 1
- Note: 50 GeV electrons don't shower enough to meet the software “>40 MeV in 6 consecutive layers” cut. So they aren't included in these plots even though we have data for them.

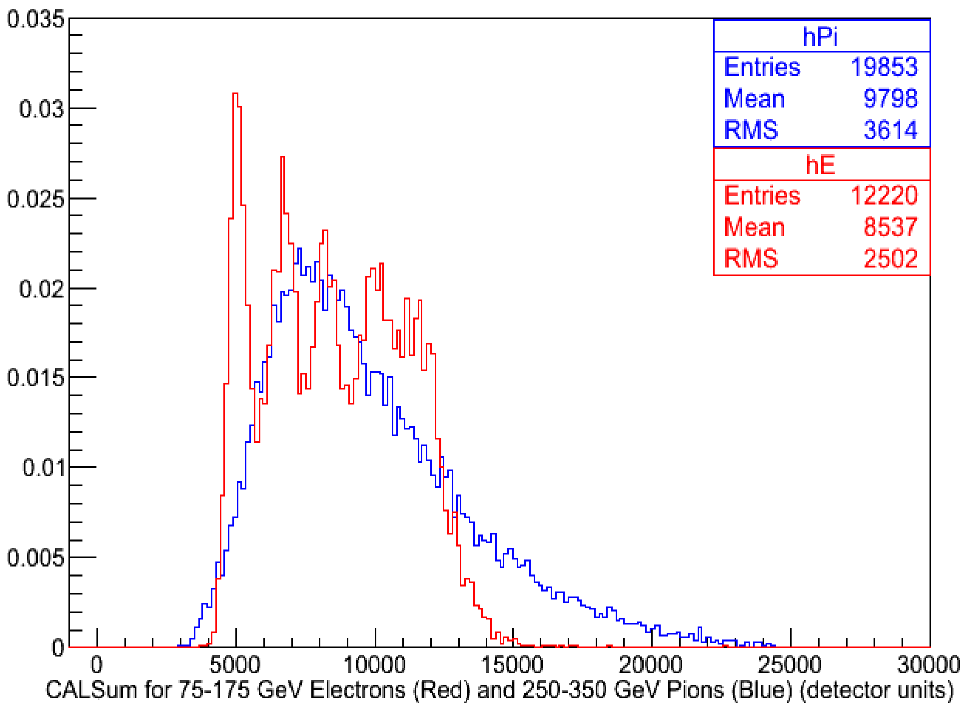
BSDLatePE Response With Particle Energy

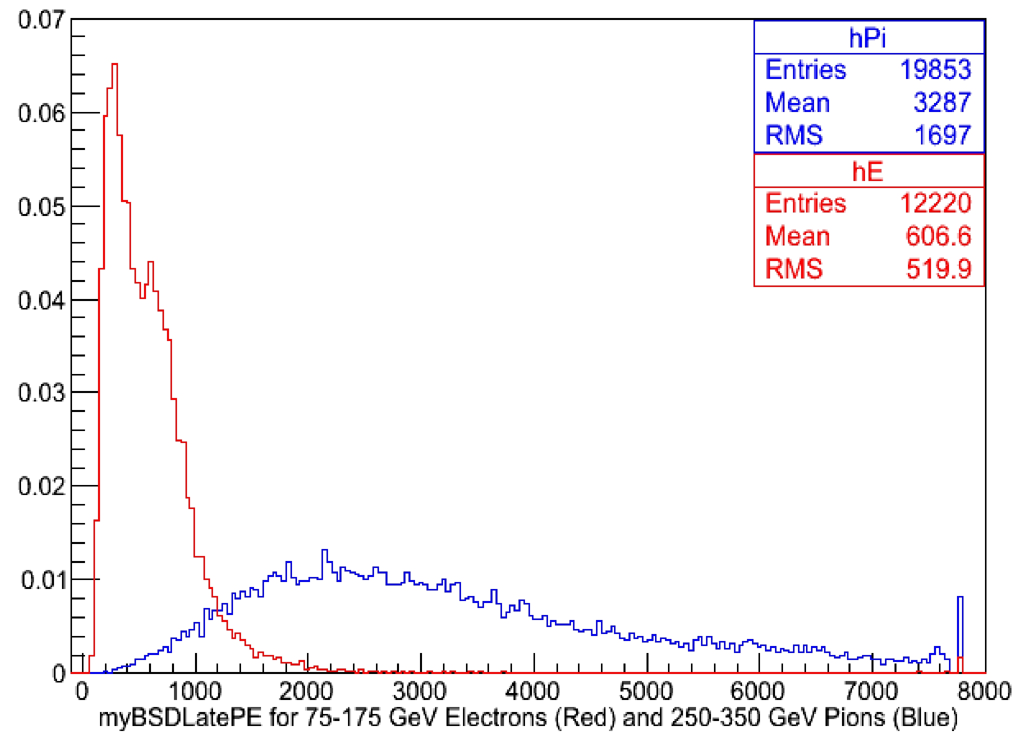




- Histograms are scaled to equal areas by total number of entries and normalized such that total area is 1
- Note:150 and 175 GeV electrons are quite similar

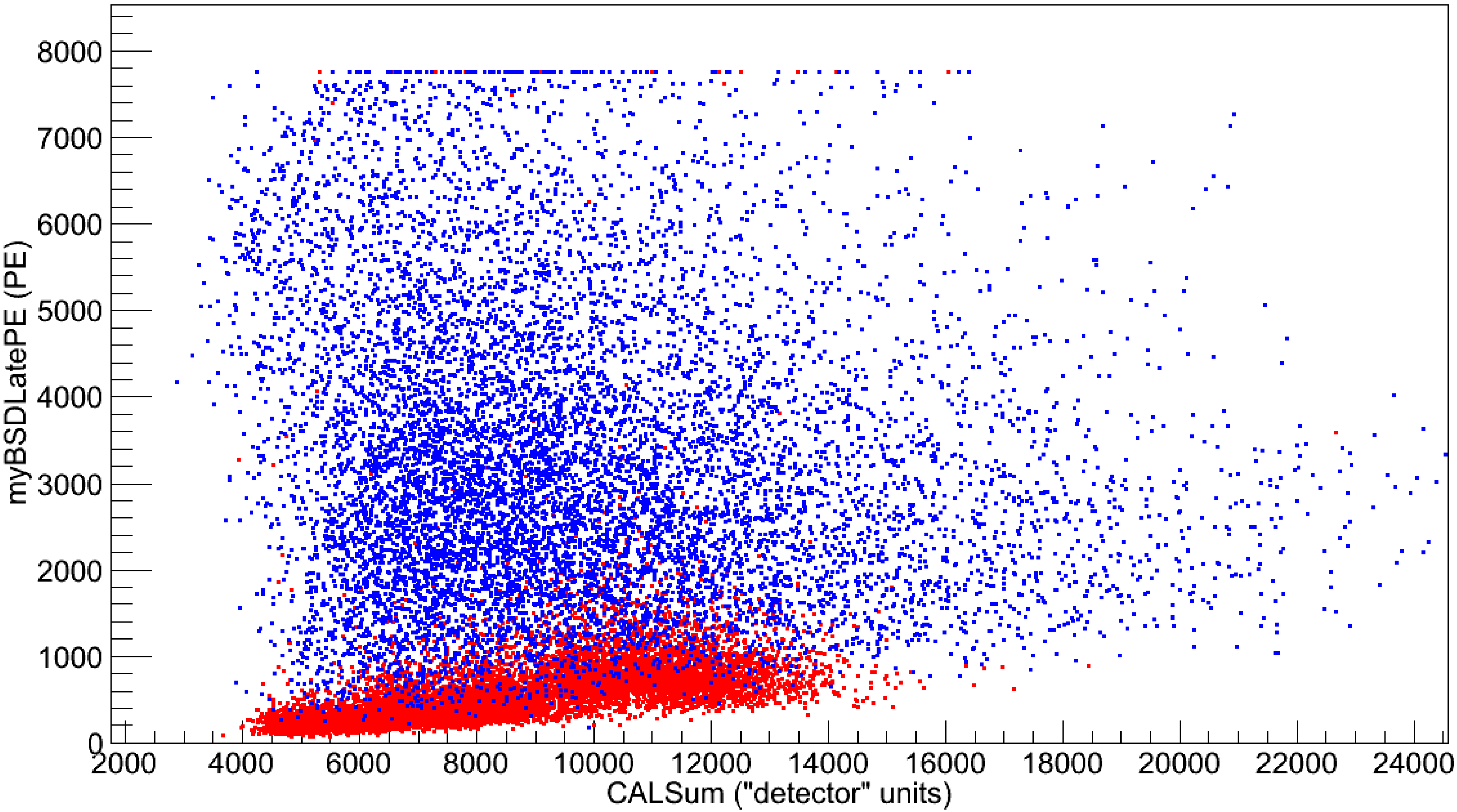
CALSum and BSDLatePE for 75-175 GeV Electron and 250-350 GeV Pions





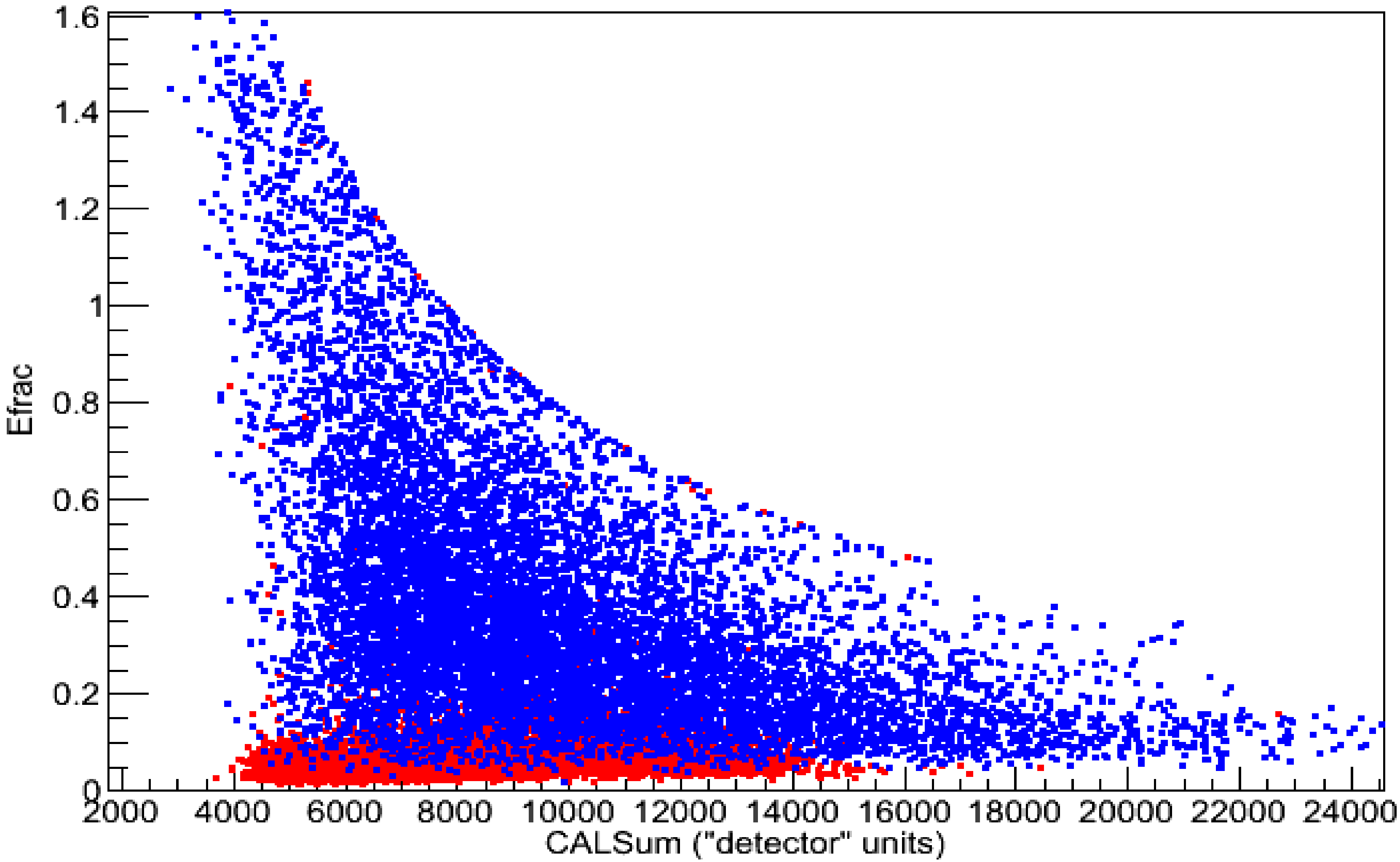
- Events have been selected from energy runs such that all energies are weighted equally
- Histograms scaled to equal areas by total number of entries and normalized such that total area is 1

BSD Late vs. CAL



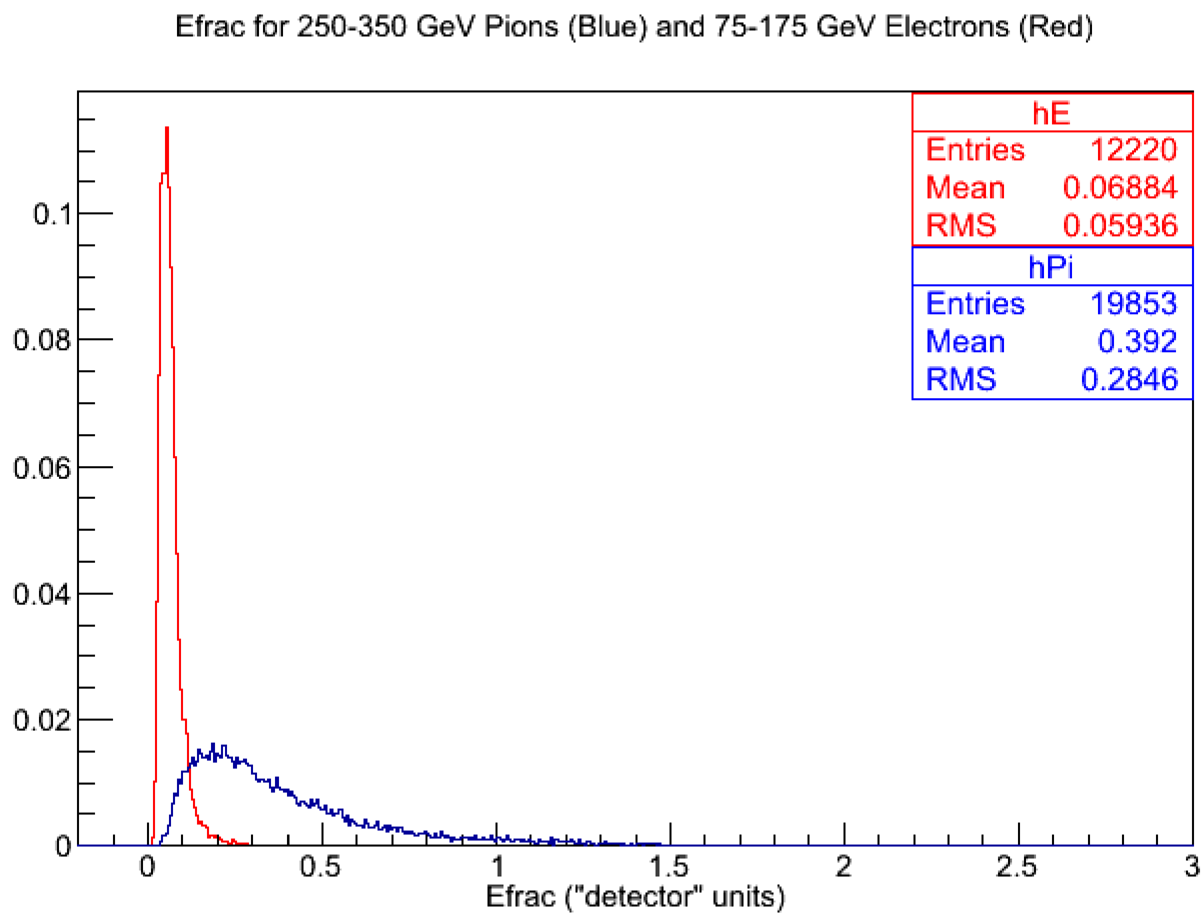
- 75-175 GeV electrons (red) and 250-350 GeV pions (blue)

Efrac vs. CALSum



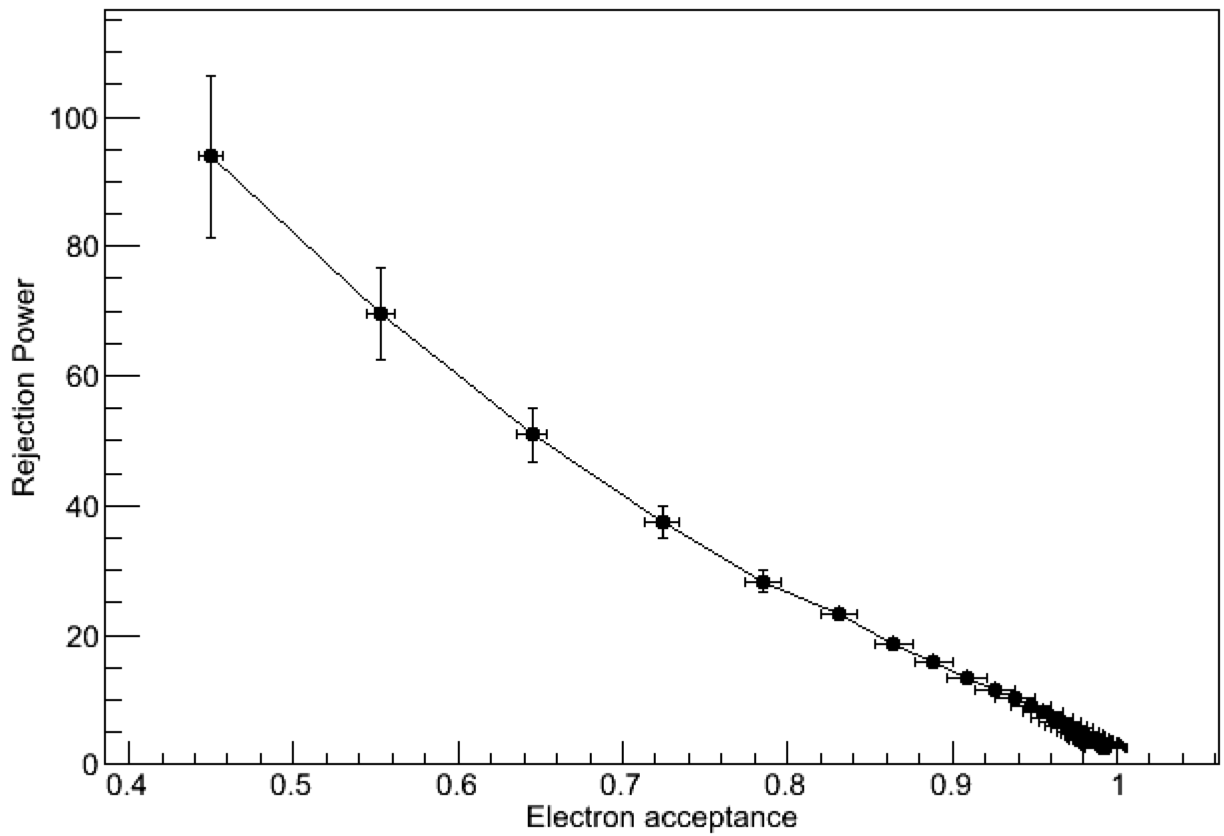
- 75-175 GeV electrons (red) and 250-350 GeV pions (blue)

Efrac For All Energies



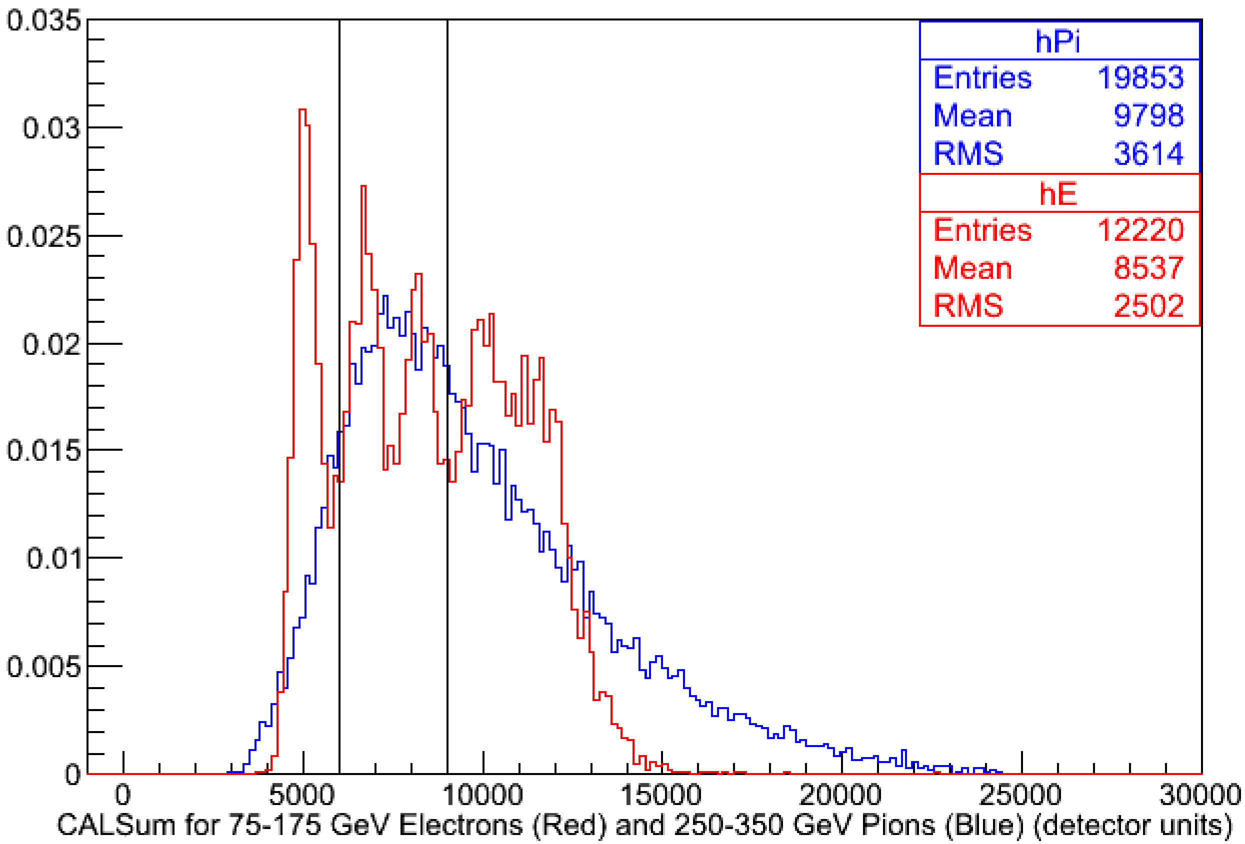
- Electron and pion histograms scaled to equal area by total number of entries and normalized such that total area is 1

Rejection Power vs. Electron Acceptance



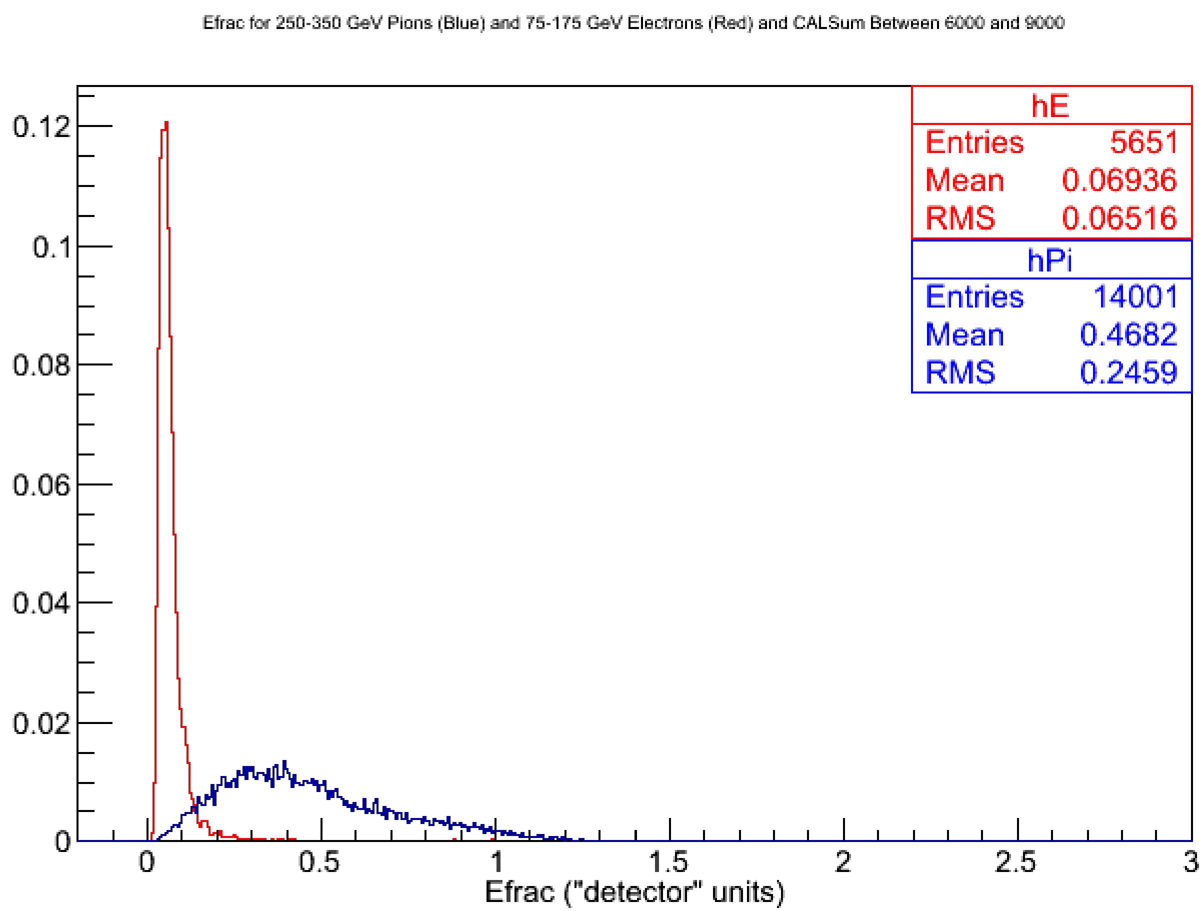
- Error bars propagated from statistics of Efrac histogram.

New Analysis: Cut on CALSum



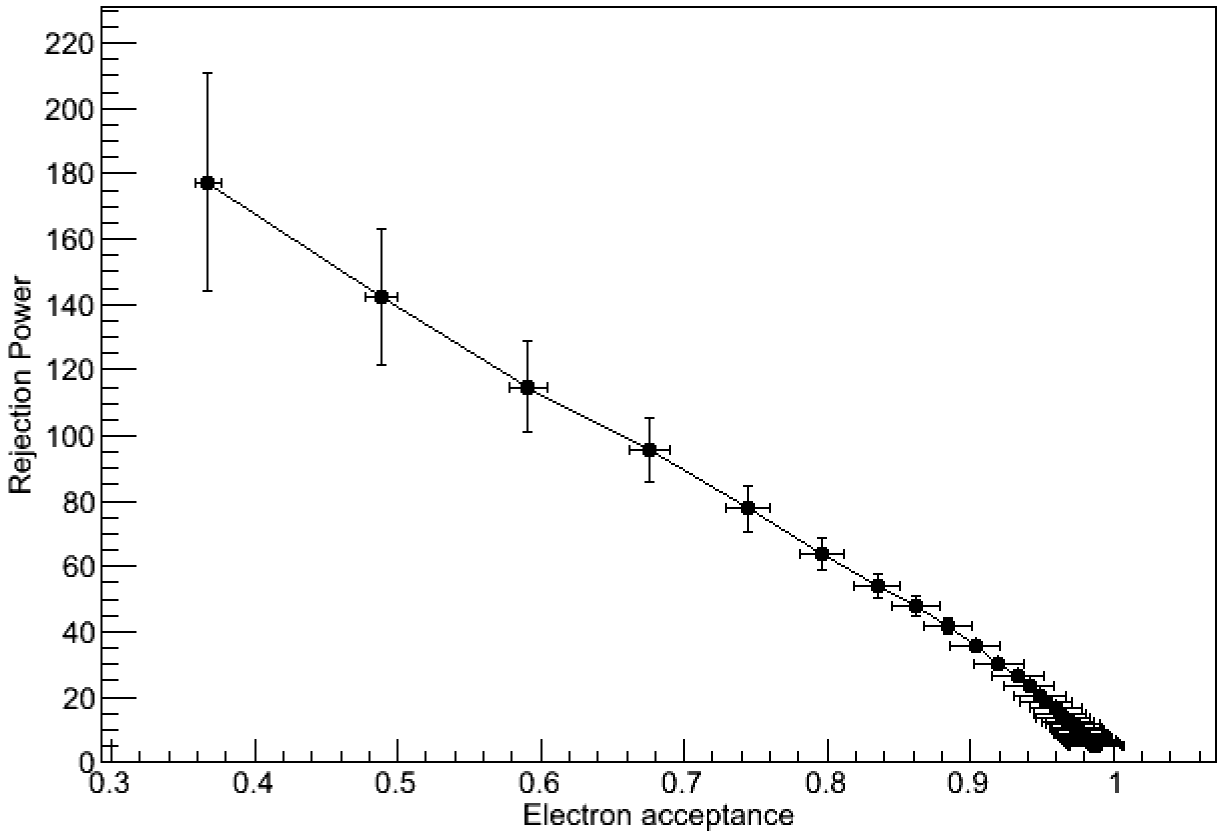
- Calculate Efrac, rejection ratio, and electron acceptance for CALSum between 6000 and 9000
- This is mostly 100 to 125 GeV electrons and 250 to 350 GeV pions

New Efrac



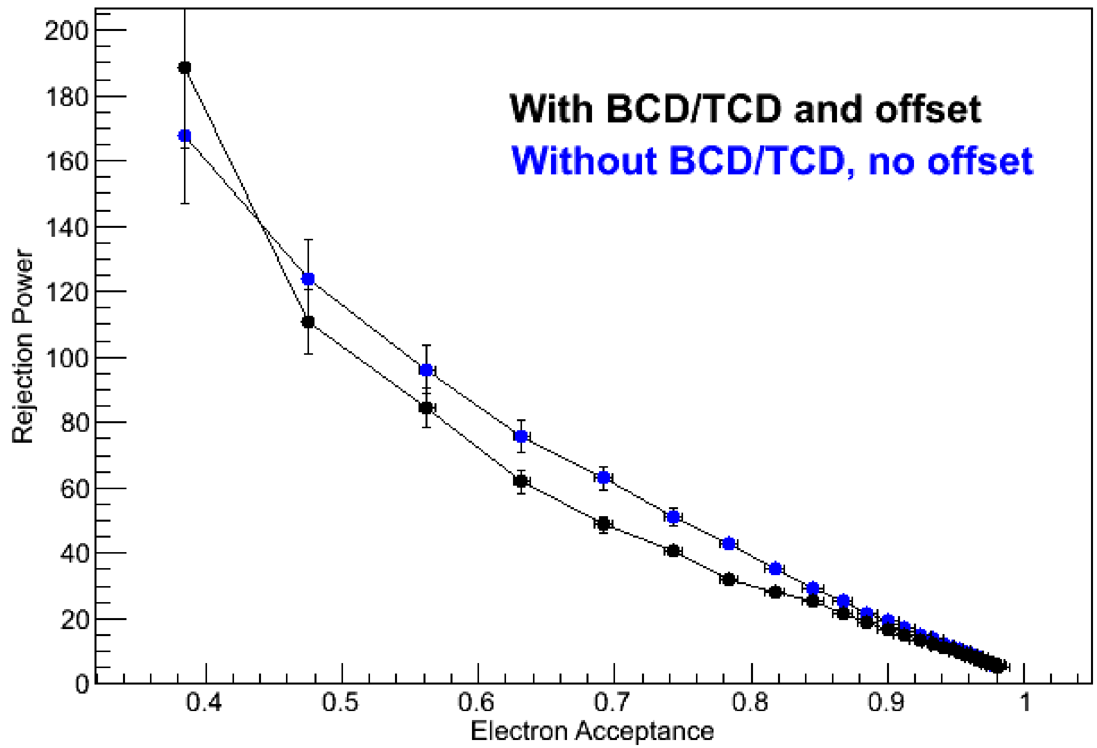
- Efrac for CALSum between 6000 to 9000

Rejection Power vs. Electron Acceptance



- Rejection power vs. Electron Acceptance for CALSum between 6000 and 9000
- Somewhat better than using all CALSum range

Rejection Power vs. Electron Acceptance



- 150 GeV electrons and 350 GeV pions
- Data from two different configurations:
  - BSD centered directly on center of CAL, no BCD/TCD
  - BSD offset somewhat, BCD/TCD in place
- Why so different?
  - Different configuration. Maybe geometry makes a difference?

Closing Comments

- Need MC runs matching the event run conditions we got.
- I'm taking suggestions on other plots/analysis tasks that can/should be tried out.