CERN 2012 BSD Analysis Update

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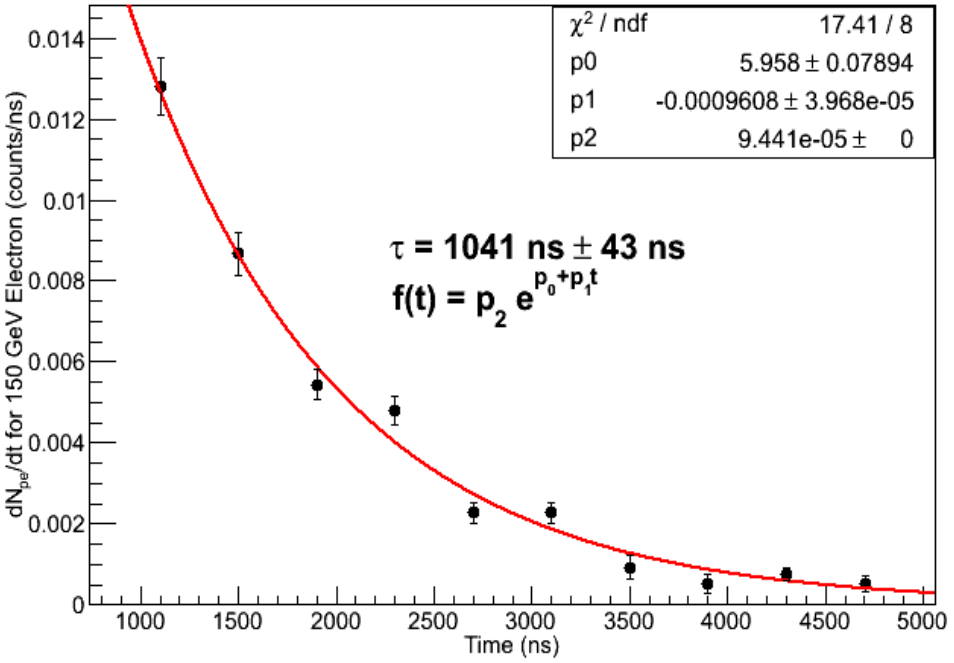
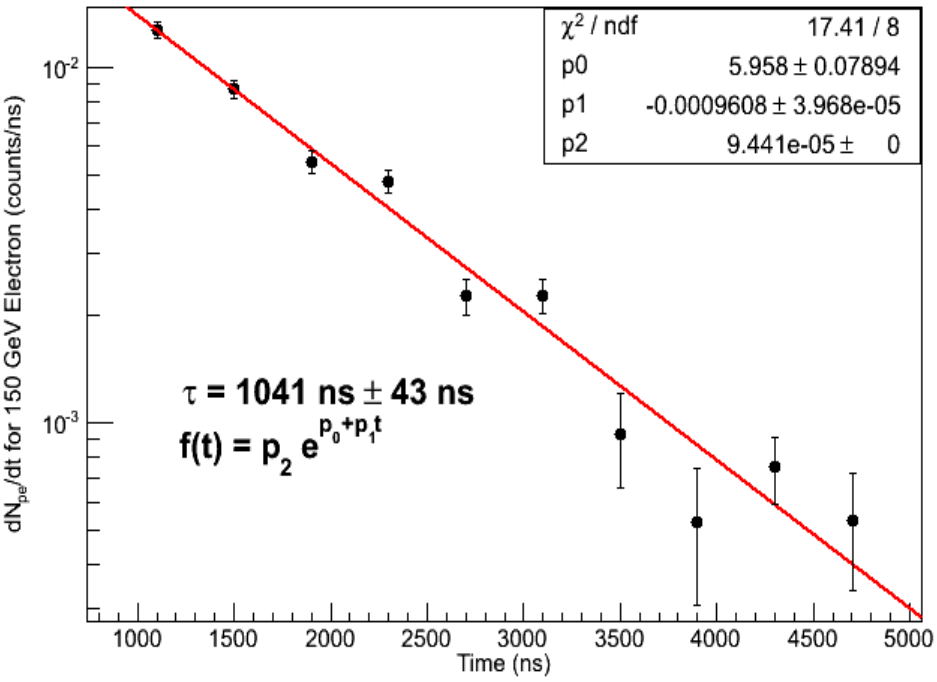
BSD Group Meeting

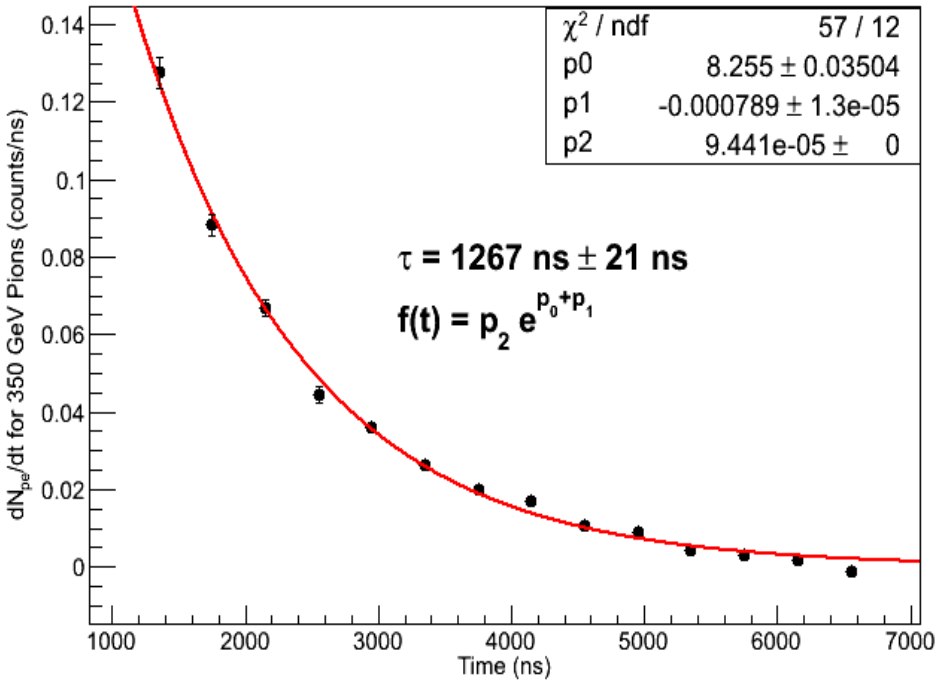
Scope Electron Data

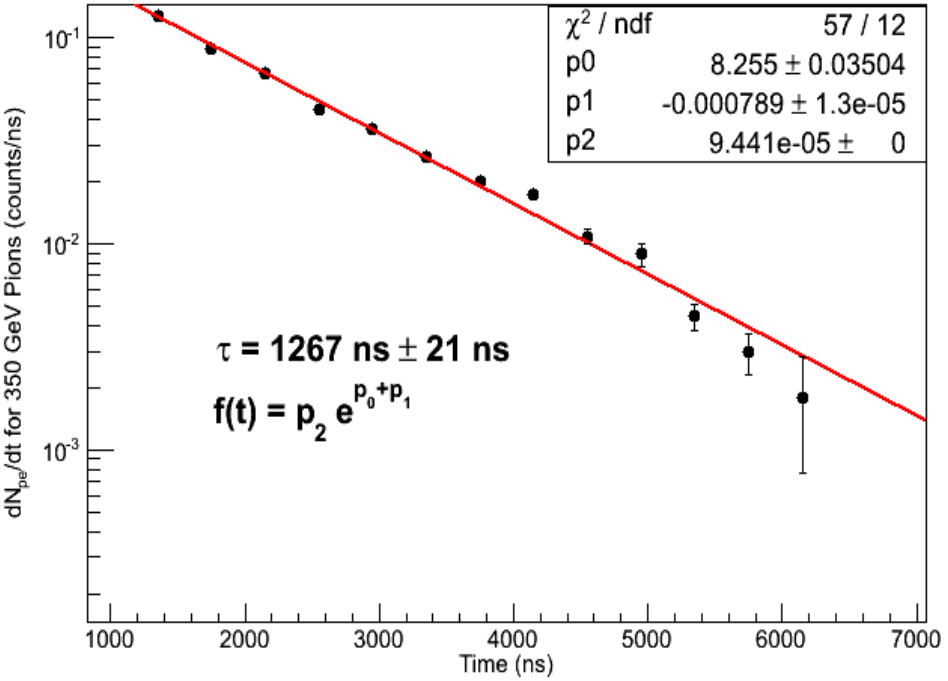




- Using PMT 1B, 150 GeV electron data
- Error bars calculated as quadrature sum from three contributions:
  - Error in center point approximation for derivative
  - Standard error of mean in peak determination
  - Standard error of mean in pedestal determination (small)
- 15 Pe between 900 ns to 4500 ns

Scope Pion Data



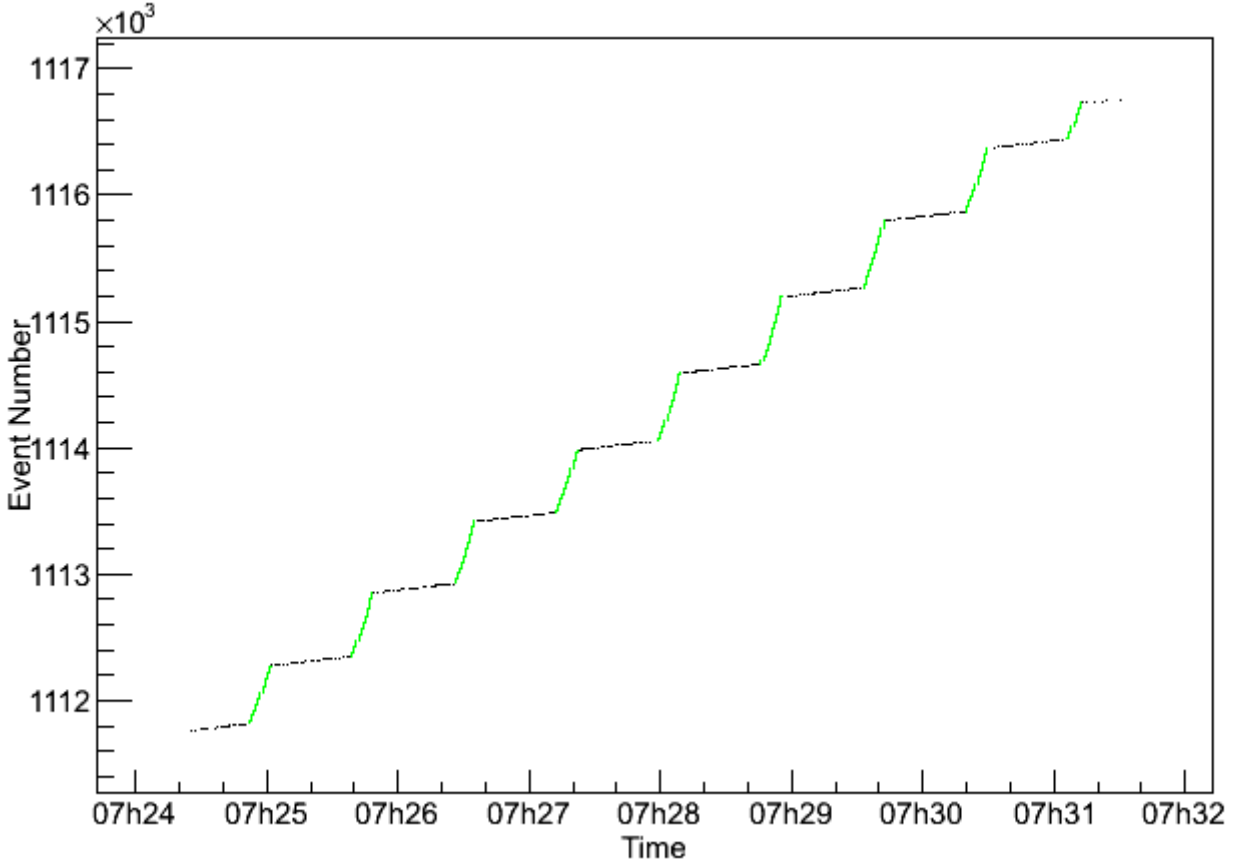


- Using PMT 1B, 350 GeV electron data
- Error bars calculated as quadrature sum from three contributions:
  - Error in center point approximation for derivative
  - Standard error of mean in peak determination
- 213 PE between 900 ns to 450 ns

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).
  - ***Look at the 24.2% pions. This is large enough that it will affect Efrac distributions, since the cut is biased for large signal values.***
- 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 likely unnecessary.
- >40 MeV in 6 ***consecutive*** CAL layers
  - 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.
  - ***Look at efficiency of this cut with energy***
- Out of 91174 electron events, 28991 remain
- Out of 65748 pion events, 6768 remain

IsWithCal for In Spill Events

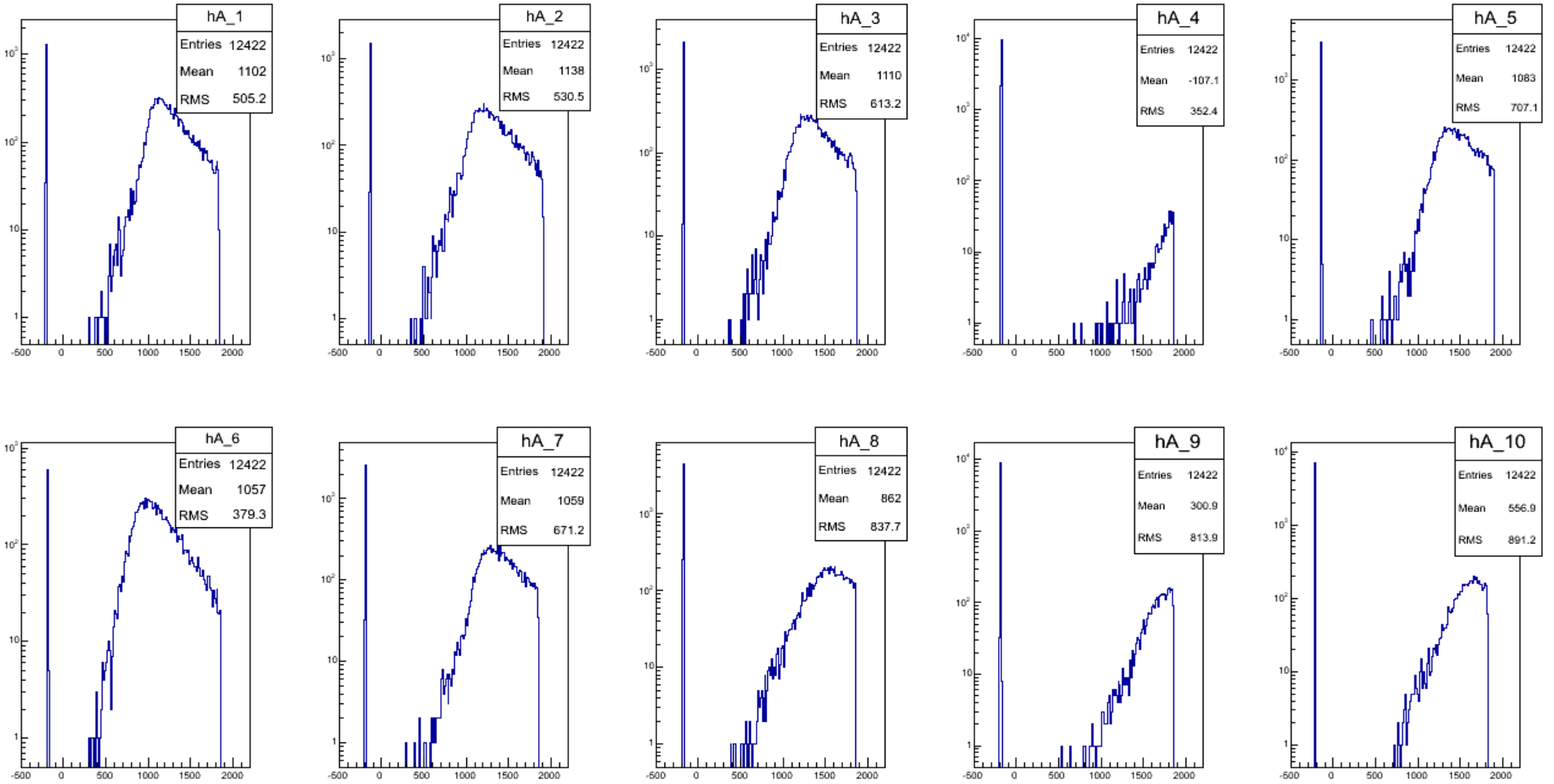


- Choosing “IsWithCal” is a good proxy for in spill events.
  - Black: All events in a particular run
  - Green: Events with “IsWithCal” flag
- Makes sense since this is the time window when the BSD and upstream scintillator counter triggers are well correlated.

fCHA[n] < 0

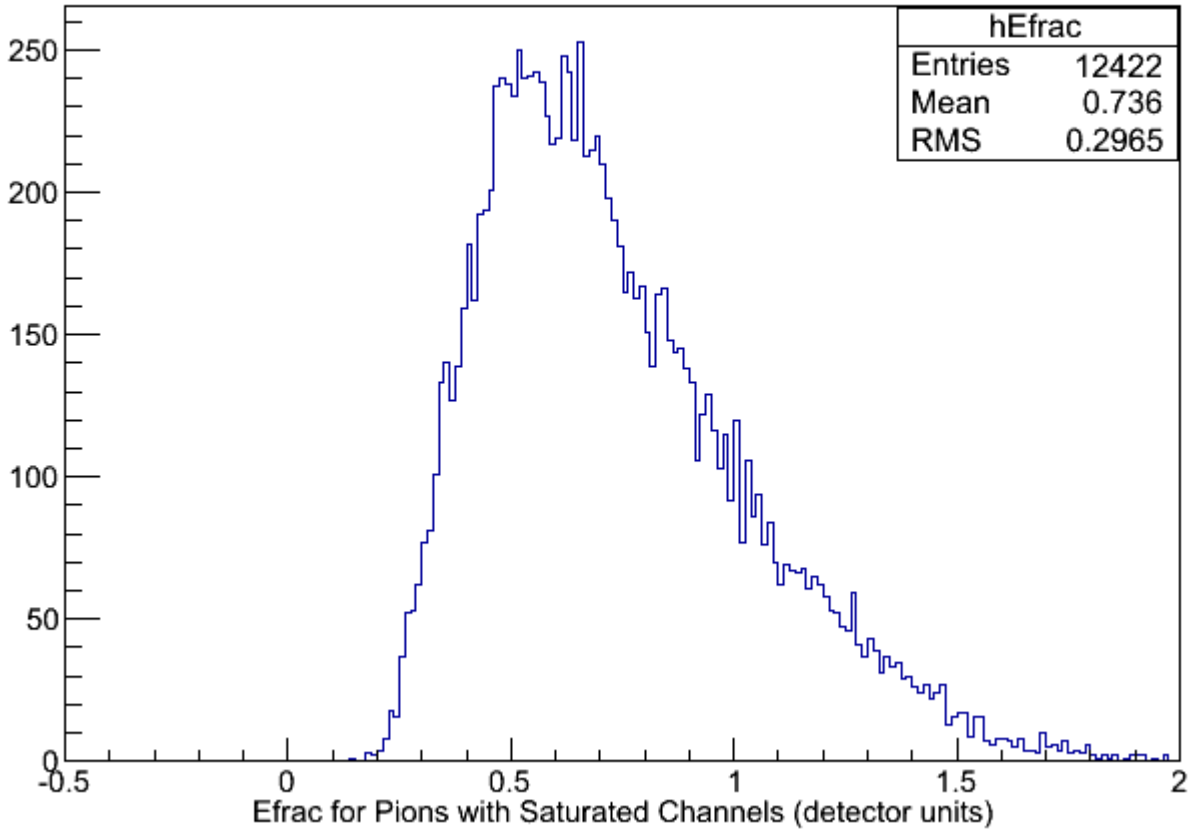
- The 2249W puts out a number much less than pedestal (typically “1”) when it saturates
- The fCHA branch is already pedestal subtracted, so these saturated values will show up as a large negative spike in channel histograms
- These saturated events are significant (especially for pions) because:
  -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

Looking at fCHA[n] < 0 Events



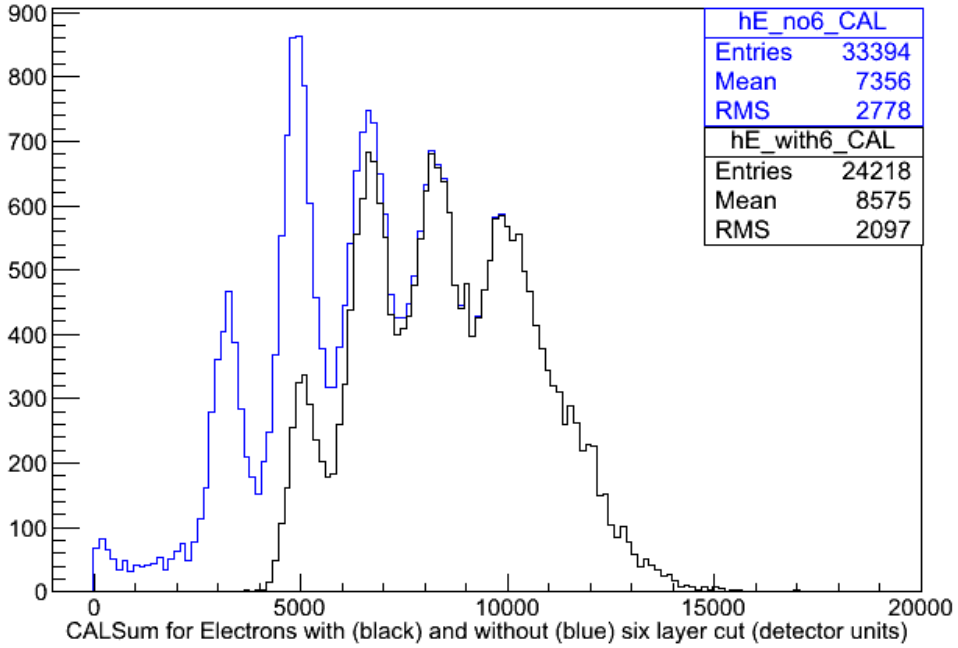
- 96.3% have fCHA[4] saturated.
- 99.1% have either fCHA[4] or fCHA[9] saturated.

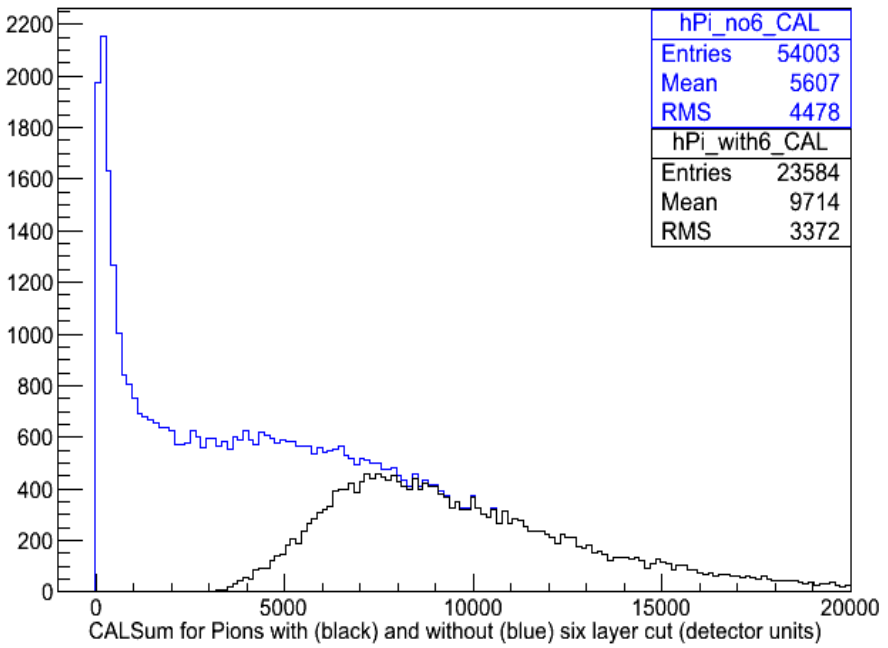
Saturated Event Solution



- 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 doesn't really matter in the end

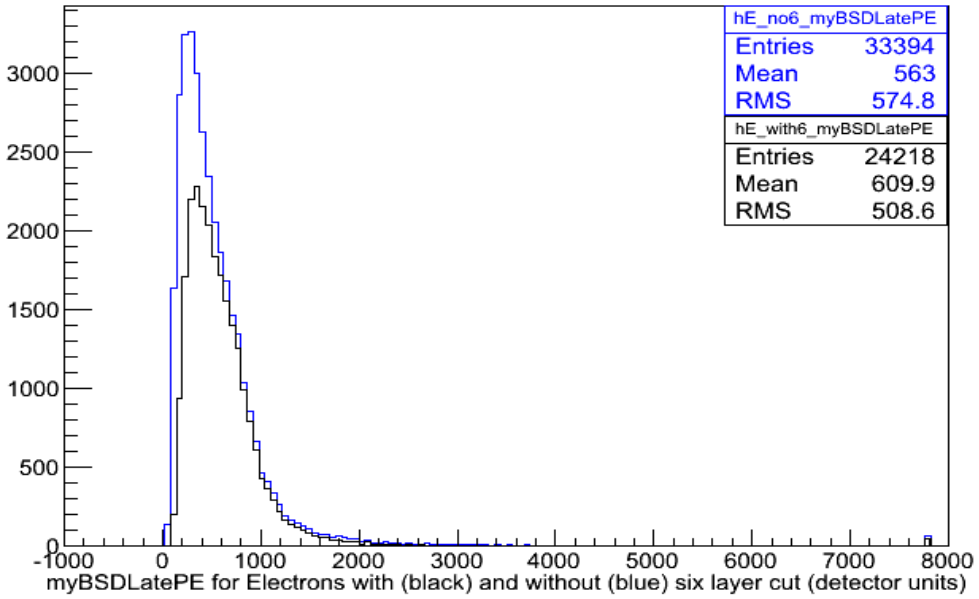
Effect of “Six Consecutive Layer >40MeV” Cut on CALSum

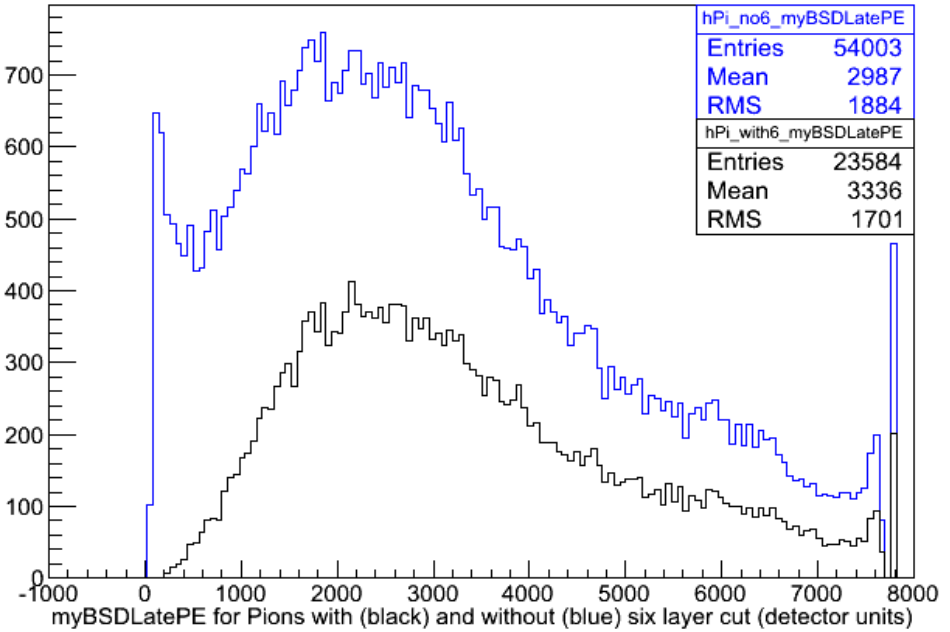




- Note that the 6 layer cut removes much more of the low energy events than the high energy events
- For analysis, must weight with equal amounts of all energies ***AFTER*** 6 layer cut
- Note: Electron beam is only ~75% pure, but this cut removes most of the impurities. Pion beam is ~95% pure

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

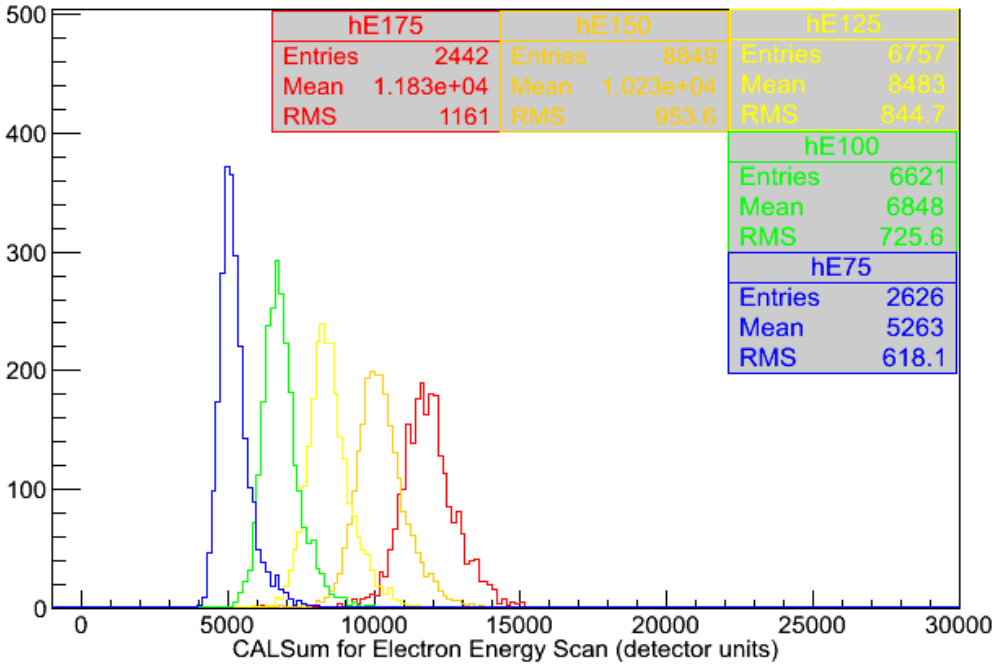
Revised Data Cuts and Conditioning

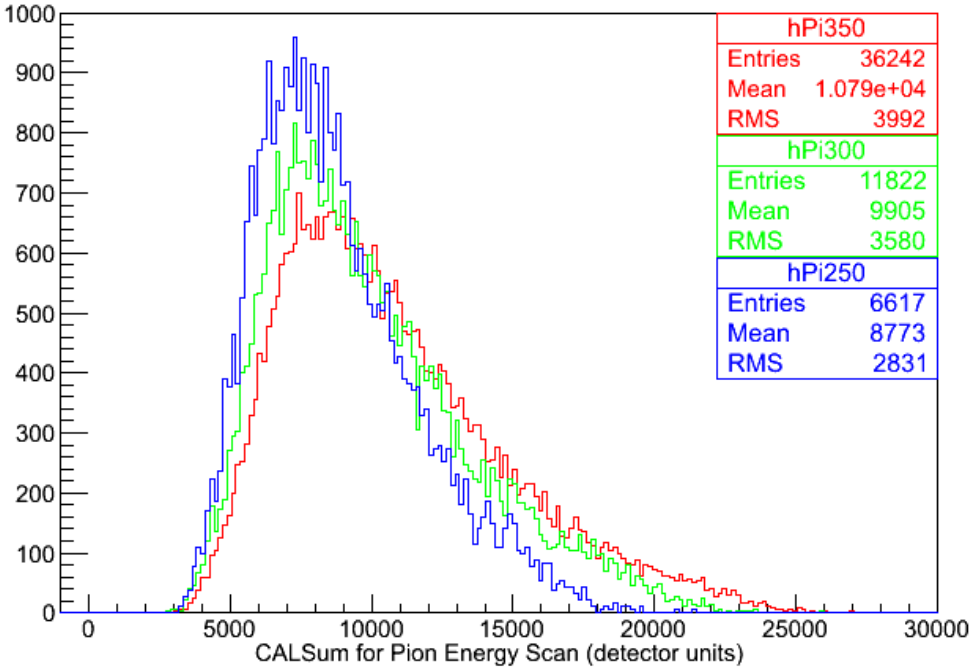
- IsWithCal
  - Cuts 64.7% of electrons, 64.1% of pions
- Set any fCHA[n] < 0 for n = 1 to 10 to 2048 channels. Use myBSDLatePE as gain converted PE sum of these.
  - Effects 0.3% of remaining electrons, 24.2% of remaining pions
- Require >40 MeV in 6 consecutive CAL layers
  - Cuts 9.9% of remaining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

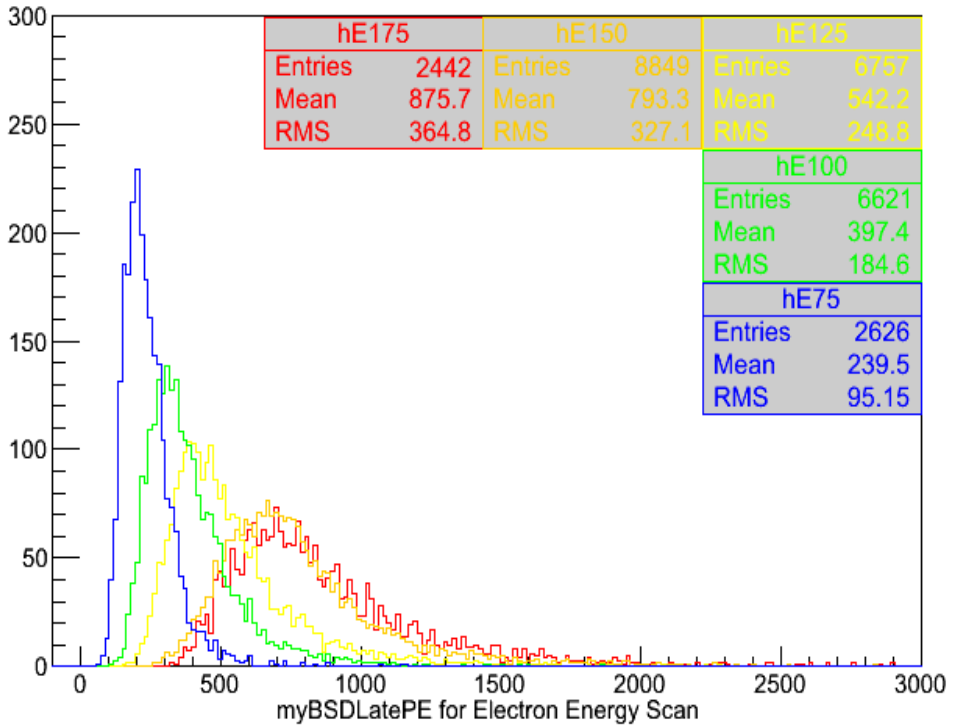
CAL Response With Particle Energy

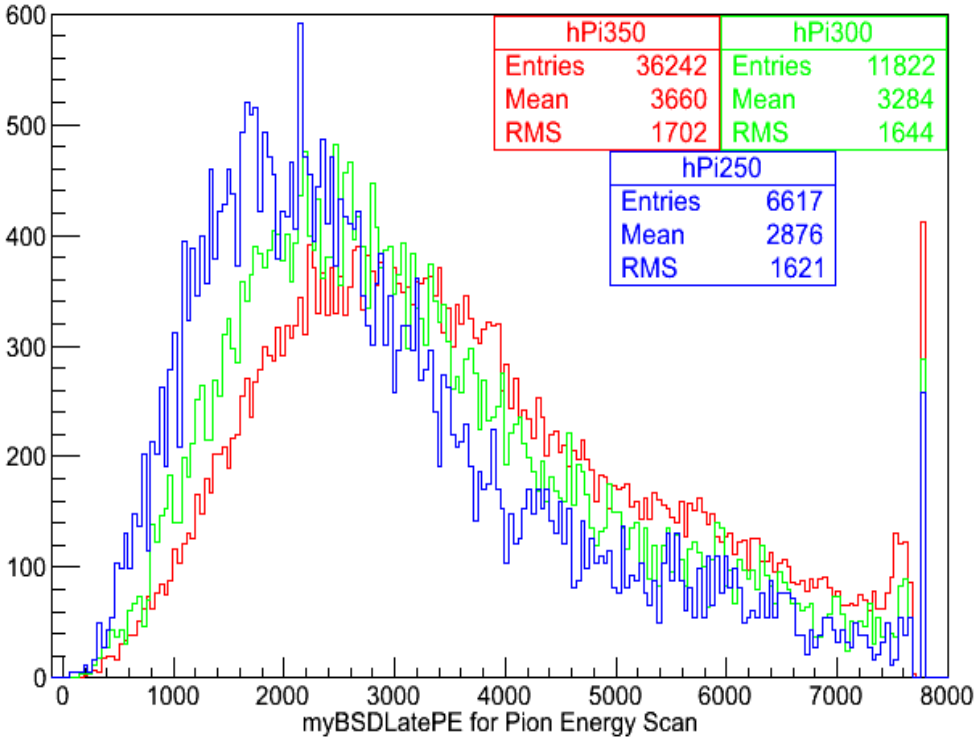




- Note: Histograms are scaled to similar heights by total number of events
- Note: 50 GeV electrons don't shower enough to meet the software”>40 MeV in 6 consecutive layers” cut. So they aren't included in these plots even though we have data for them.

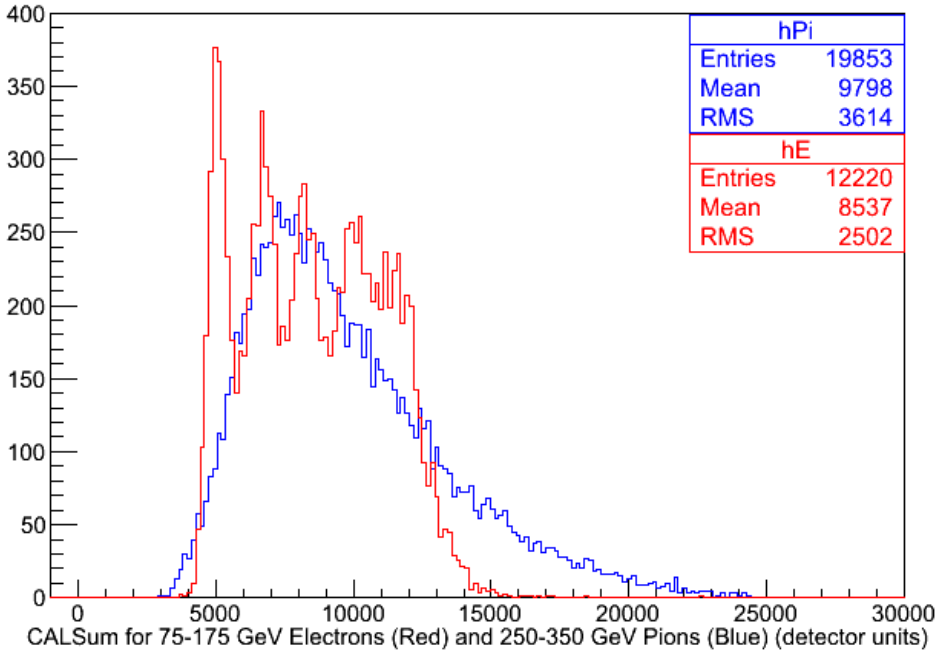
BSDLatePE Response With Particle Energy

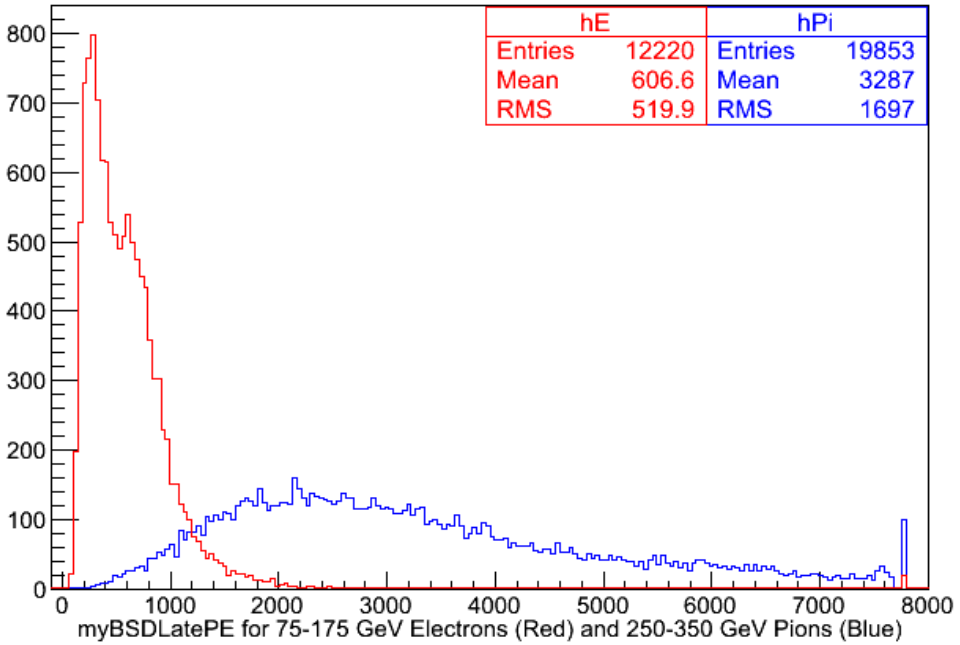




- Note: Histograms are scaled to similar height by total number of events
- Note: BSDLatePE for 150 GeV and 175 GeV electrons are quite similar...

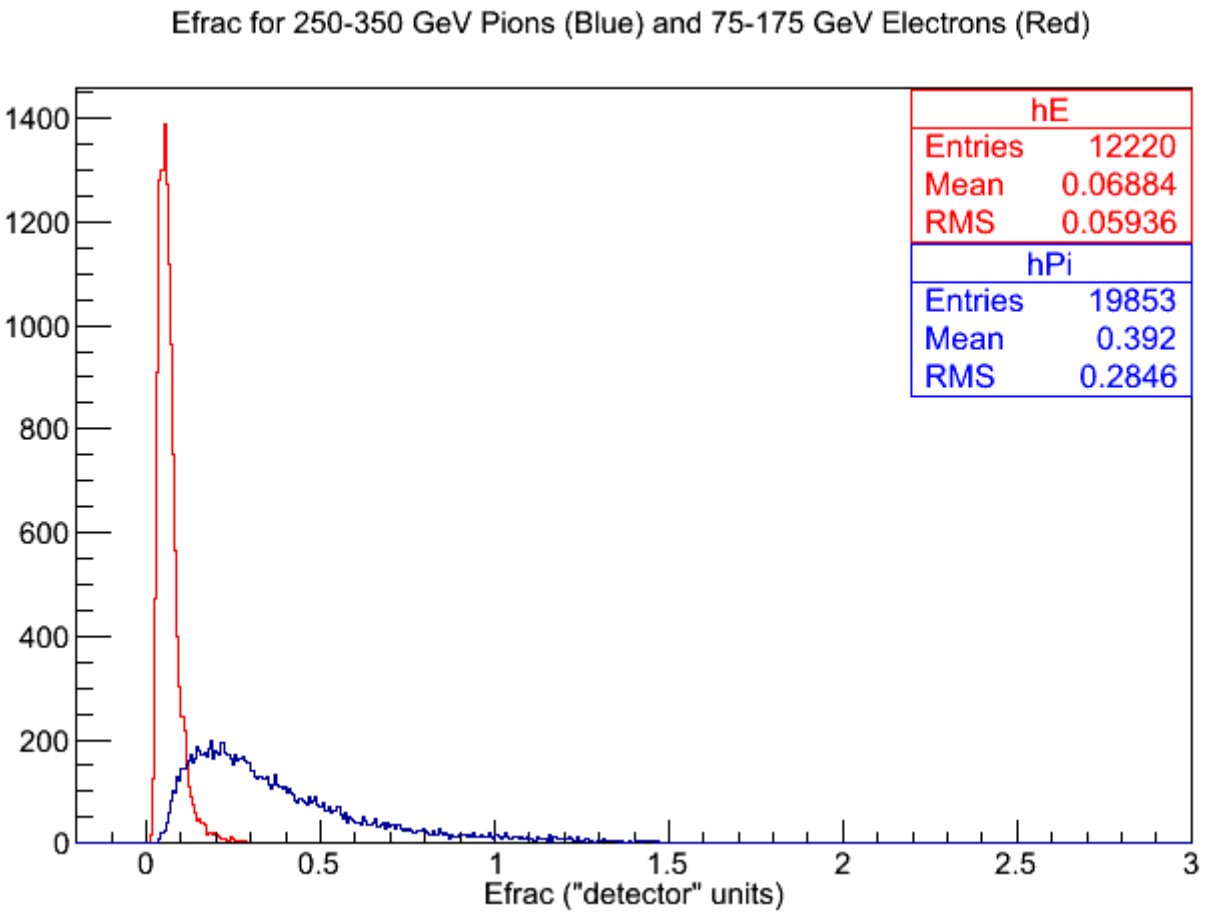
CALSum and BSDLatePE for 75-175 GeV Electron and 250-350 GeV Pions



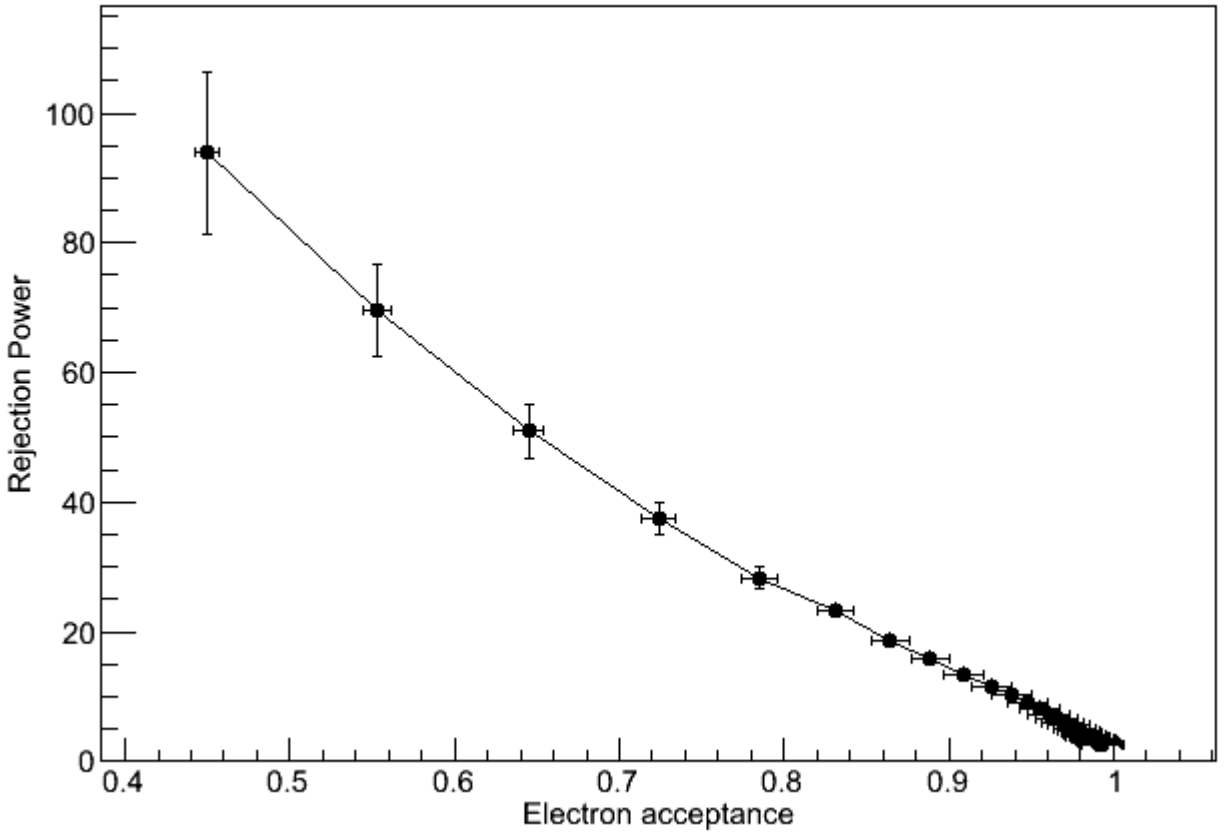


- Events have been selected from energy runs such that all are weighted equally

Efrac For All Energies

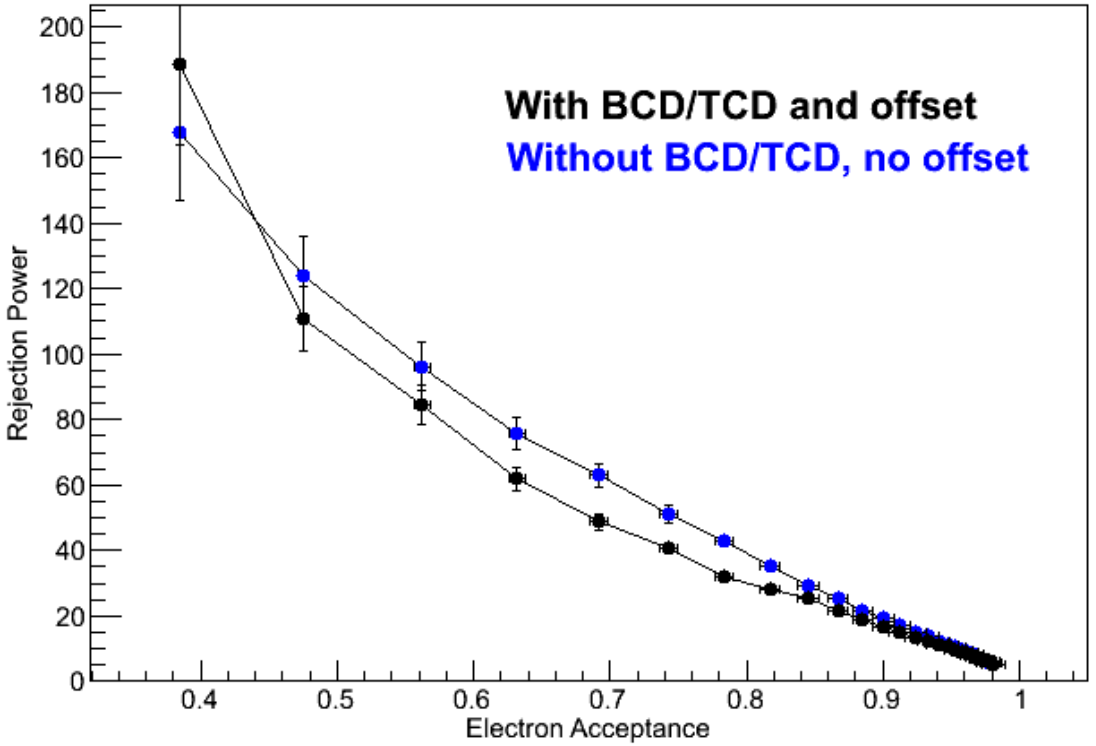


Rejection Power vs. Electron Acceptance



- Error bars propagated from statistics of Efrac histogram.

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?
  - The above was generated with “initial” cuts. Improved cuts may help (or hurt)?
  - Different configuration. Maybe geometry makes a difference?

Closing Comments

- Still some work in progress
- Most of the analysis issues/plots can be addressed fairly easily now.
- 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.