Electron Identification Again…

Very Preliminary

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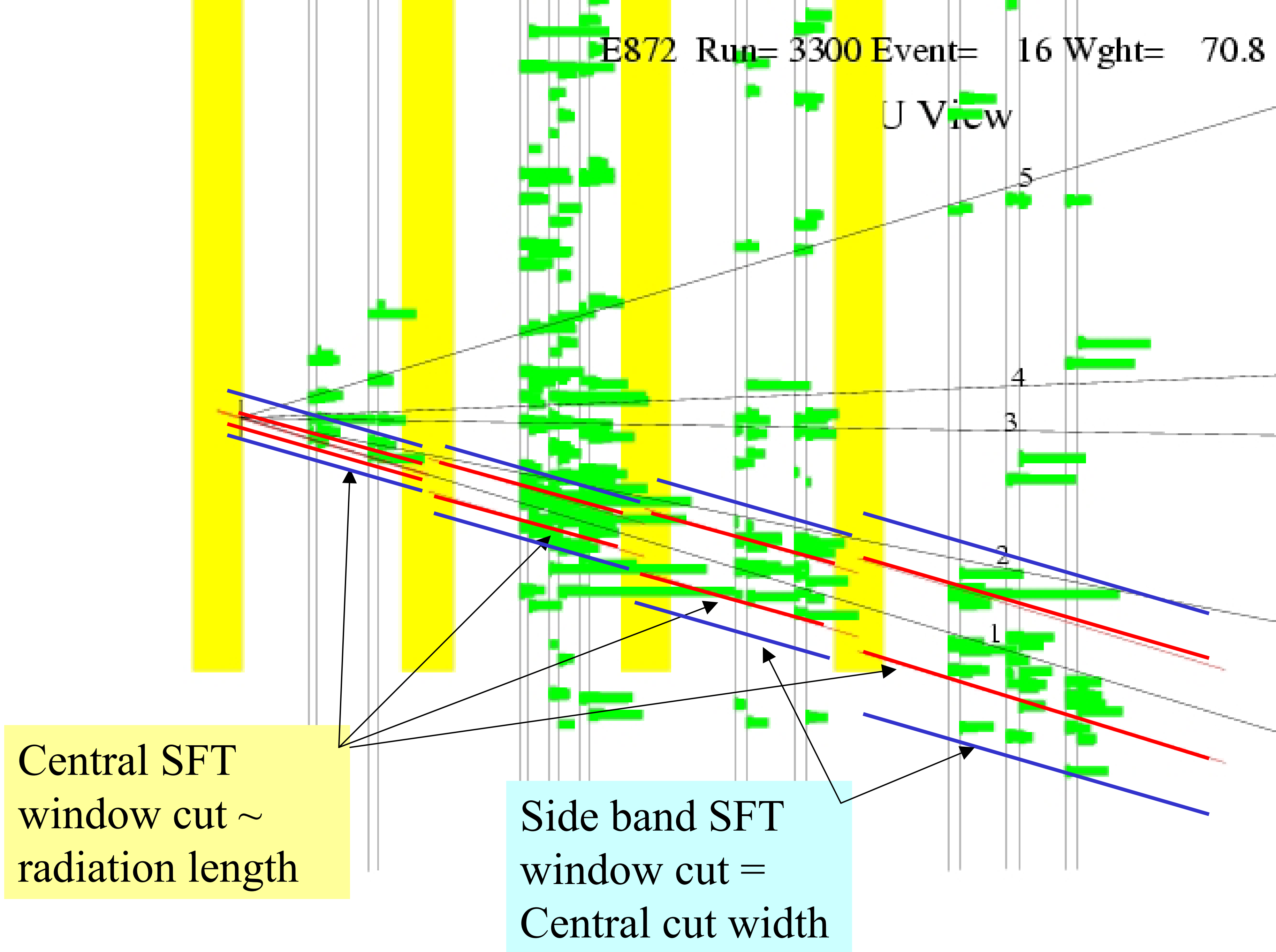
Electron ID code released

- Uses Pulse Height summation scheme described earlier
  - Sum PH in each station and view (next slide)
  - Sum PH in side bands
  - Compare PH in each view to minimize overlap
- Electron ID efficiency ~80% for E>20 GeV
- Hadron ID efficiency ~94%
- The code fails badly on some obvious “by-eye” events
- Why?
  - Tracks are handled separately
  - Cuts use PH at shower max only, PH difference between views


E872 Run= 3300 Event= 16 Wght= 70.8
U View
5
4
3
2
1
Central SFT window cut ~ radiation length
Side band SFT window cut = Central cut width

A Different Scheme

- Compare the SFT pulse height distribution in U,V,X in each plane with the expected distribution for various electron energies and track assignments
  - Expect better discrimination using longitudinal and transverse shower development information
  - Expect better discrimination at the edges of the SFT
- Use Particle Data Book (Grindhammer 2000) parameterization of GEANT EM radial and longitudinal energy deposition
  - Inadequate match to MC SFT showers
- Use E872MC generated electron showers to define the "expected distribution"
  - "Histo scheme"

Defining the “Expected Distribution”

- Generated 1k electrons in period 4 along the z=0 axis
- Equal # of events with energies of 10, 20, 40 and 60 GeV
- Events generated in all targets
- Standard Geant thresholds

Histo scheme - Parameterization (eidhist)

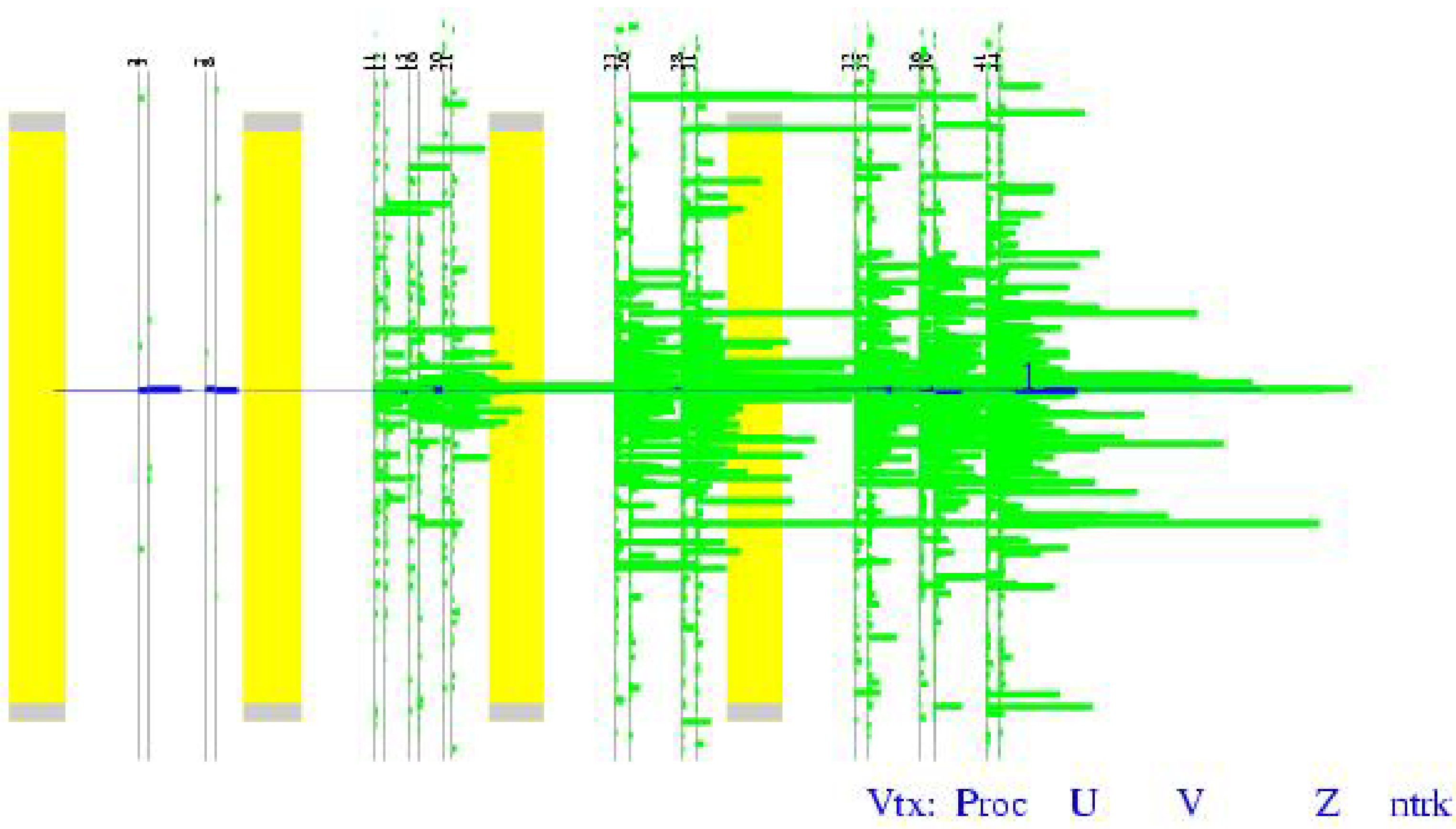
- Define 4 radiation length (t) bins (2 < t <10)
- Define 4 electron energy bins (0-15, 15-30, 30-50, 60+)
- Create a temporary histogram (array) of 80 1 cm bins for one SFT plane – Fill with hit pulseheights
- Remove spikes due to slow particles
  - "Spike" = Bin with PH > 5 MIP's and adjacent bins < 20% of the central bin
- Define a "folded" SFT shower shape histogram of size 40 (cm) x 4 (t bins) x 4 (E bins)
  - Folding is done around the track projection (Z axis)

Histo Scheme - Parameterization

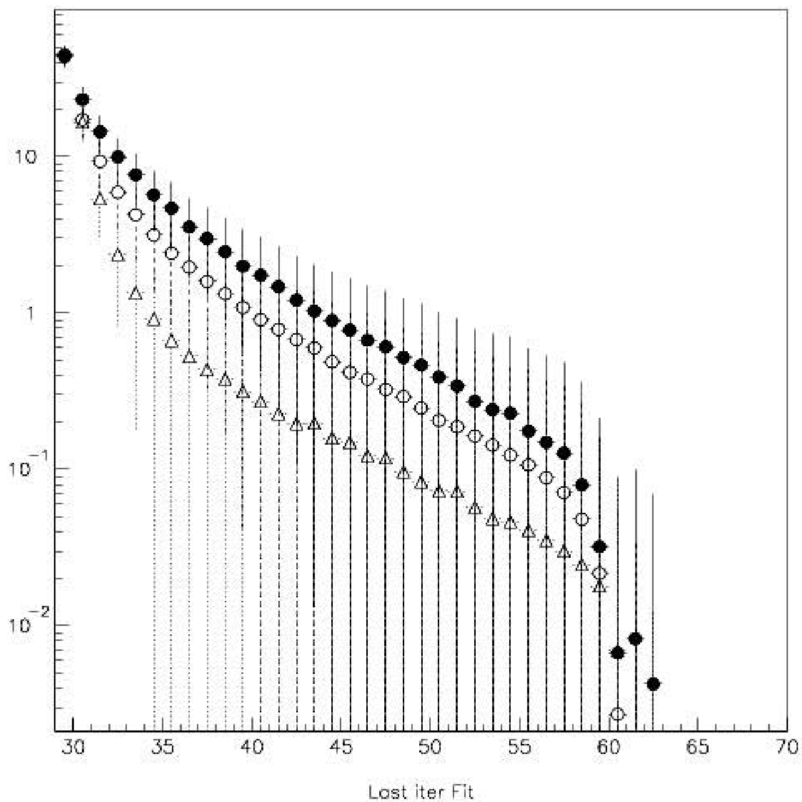
- Fill the folded histogram and write the averaged shower shape histogram (and error histogram) to file
- Determine EMCal response (eid_emclu.sf)
  - Sum EMCal clusters within abs(Y) < 20 cm and abs(X) < 10 cm = Σ(Eclus)
  - Create 4 t bins with 0 < t < 10
  - Determine average Σ(Eclus), error and the expected Y deviation error (δY) between the track intersection and the center of energy in the window for each t and E bin
  - Write results to file
- The folded SFT histogram is the "expected" shower distribution for an electron with E,t in an average sense
  - The file (eid.dat) would reside in the E872code area

U View

60 GeV Electron

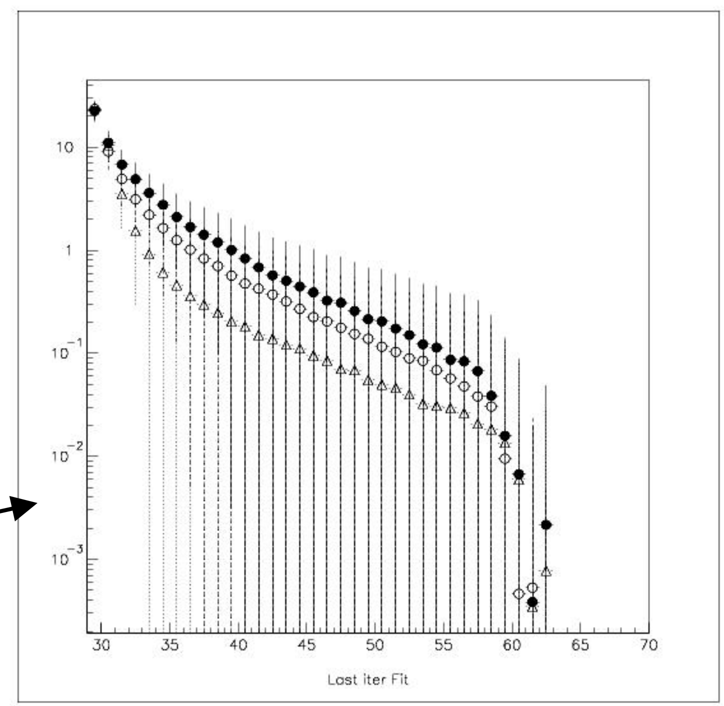


60 GeV Electron



Folded shower histo for
t=2.6 X0 △
t=4.7 X0 ○
t=6.7 X0 ●

20 GeV Electron

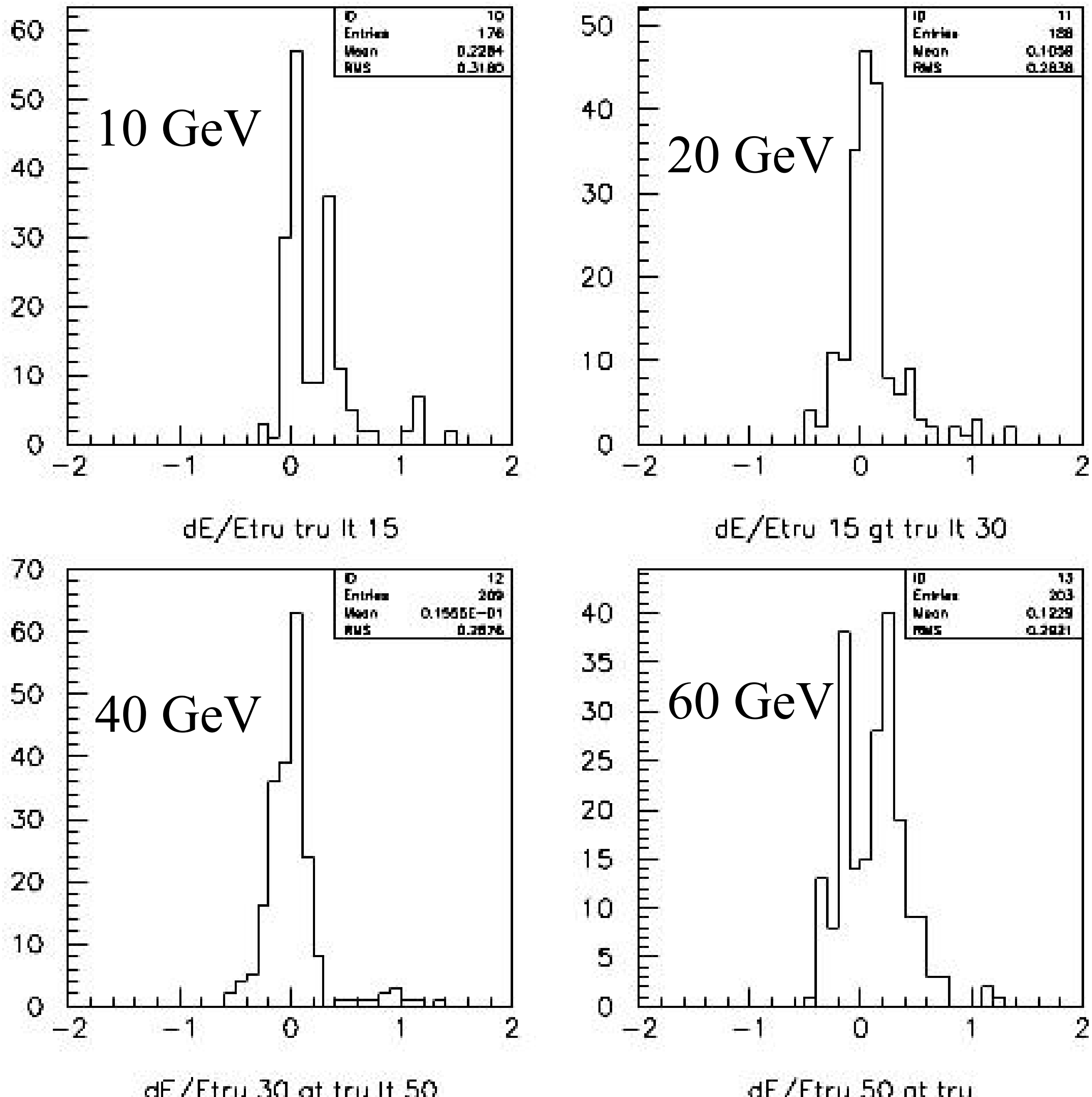


Histo Scheme – Setup (eidanal)

- Create 3 histograms in U,V,X of size 80 x 1 cm for each SFT plane
  - PHPL: Fill with hit pulseheights and remove spikes
  - PHTR: Fill with expected distribution
  - PHTRS: Fill with errors in the expected distribution
- Project each track to each plane and determine the track intersection bin (tkbin)
  - Get a rough estimate of the electromagnetic energy by summing the SFT PH near the track
  - Hadrons that lie near a shower will have erroneous EM energy
- Sort the tracks by decreasing EM energy

Histo Scheme - Fitting

- Fill the PHTR histogram for track 1 by unfolding the folded histogram around the track intersection bin tkbin
  - The expected bin PH is determined by interpolation (10 < E < 60) or extrapolation (E < 10, E > 60)
- Calculate $\chi^2_{SF} = \Sigma(PHPL - PHTR)/(PHTRS + \sigma_{PH})$
  - $\sigma_{PH} = [0.3 + 0.04\,(6.5\text{-}t)^2\,] * PHPL$
    - χ^2 contribution where PHTR =0, higher weight at shower max
- Calculate $\chi^2_{EMCAL} = (\Sigma(Eclus) - \Sigma(Eclus\ expect))/error + (\delta Y - \delta Y\ expect)/error$
- Vary E to minimize total $\chi^2 = 0.5(\chi^2_{SF} + \chi^2_{EMCAL})$
  - Use parabolic interpolation to estimate E
  - Estimate σE by finding $\chi_{min}^2 + 1$ *(not done yet)*


10 GeV
ID 10
Entries 176
Mean 0.2284
RMS 0.3180
dE/Etru tru lt 15
20 GeV
ID 11
Entries 188
Mean 0.1058
RMS 0.2838
dE/Etru 15 gt tru lt 30
40 GeV
ID 12
Entries 209
dE/Etru 30 gt tru lt 50
60 GeV
ID 13
Entries 203
Mean 0.1229
dE/Etru 50 gt tru

30% error

What's Next

- Check code using standard MC
  - Develop χ^2 cuts for electron/hadron discrimination
  - Cases with similar χ^2 for multiple electrons
  - Hadrons embedded in photon conversion showers
- Data