Electron Identification + Event Characterization + Monte Carlo Problems

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Update

- Presented results at last meeting on electron tagging using Emulsion, SFT pulse height and EMCal energy

	True Electrons 472			True Hadrons 1330		
Tagger	0	1	2	3	4	5
ALL	14%	72%	14%	5%	58%	37%
EMC	28%	51%	21%	6%	45%	48%
SFT	16%	62%	21%	8%	69%	24%
EML	1%	51%	47%	1%	98%	2%

No information

True e → tagged e

True e → tagged π

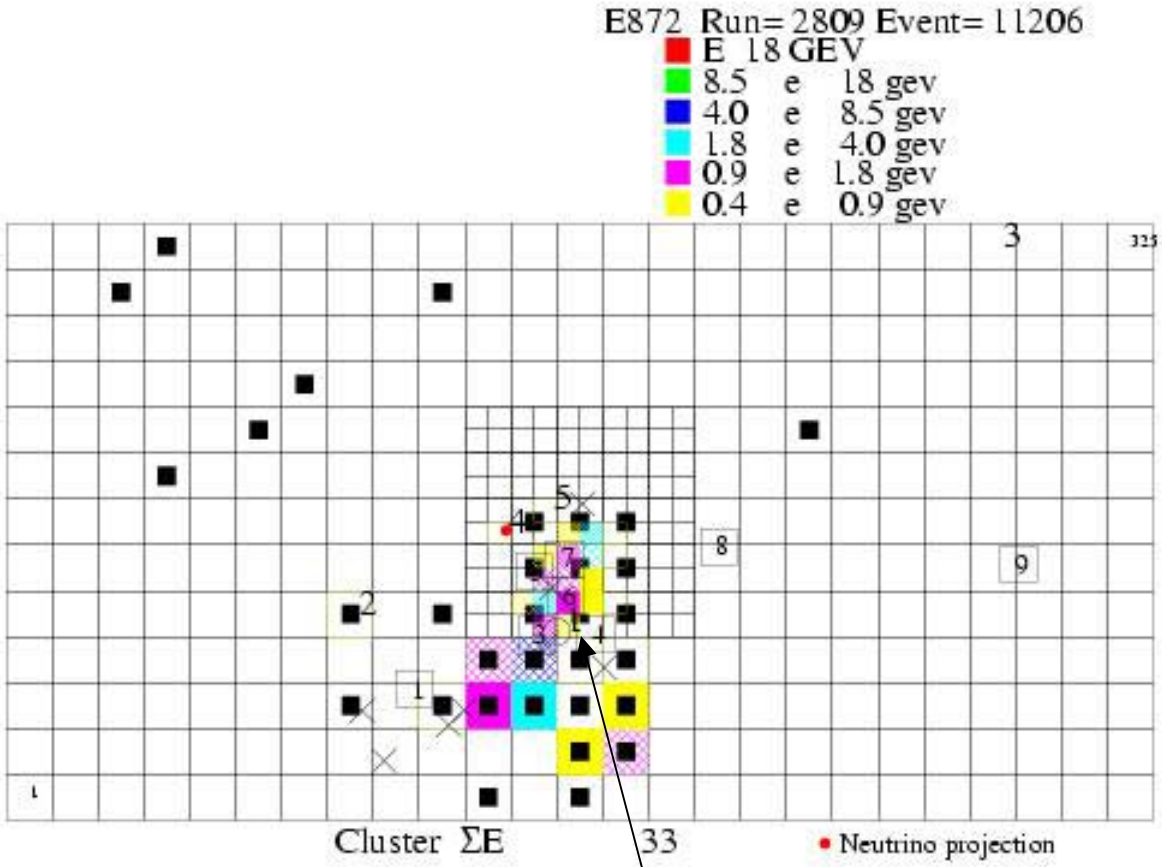
No information

True π → tagged π

True π → tagged e

Update

- Can not use SFT and EMCal for electron ID for tracks that are close together (~40 mr)
  - SFT showers overlap
  - Track association to cluster is not unique unless DC tracking is very good
- Looked at ANN CCe and NC events with several tracks close to a large EMCal cluster (> 10 GeV)
  - ~25% of ANN CCe events have cluster confusion
  - Example on next slide

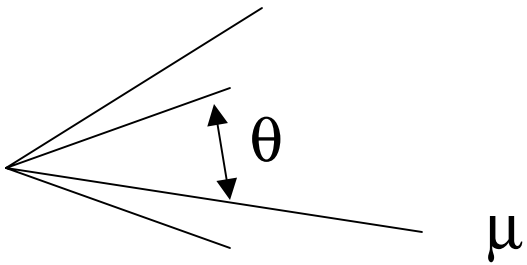


1	32.7
2	0.3
3	0.2
4	0.3
5	0.3

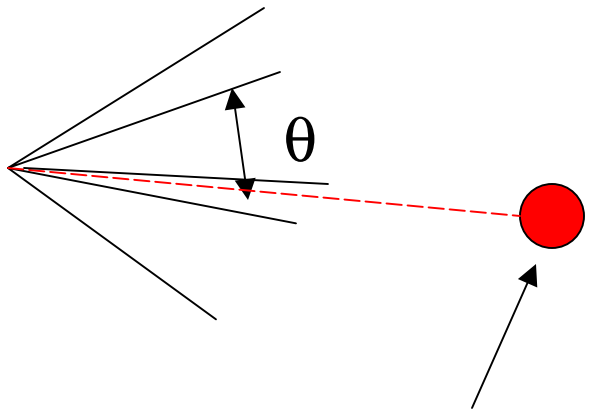
5 Close tracks
MCS mom ~20 GeV max, 48 plates

Picking the "Primary" lepton

CCmu



"CCe"

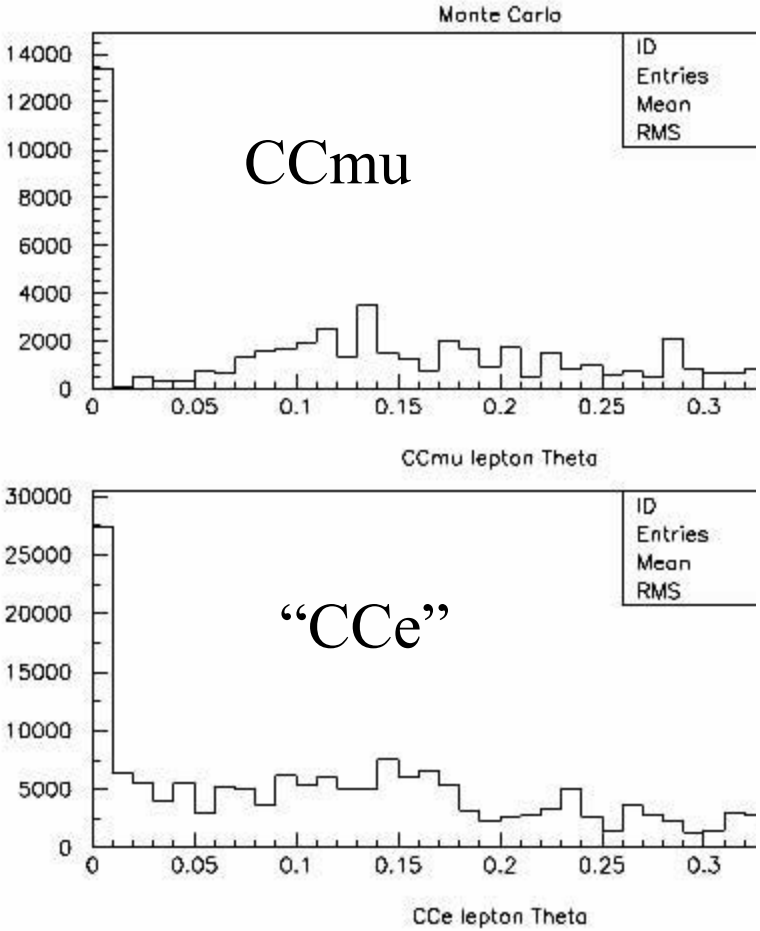


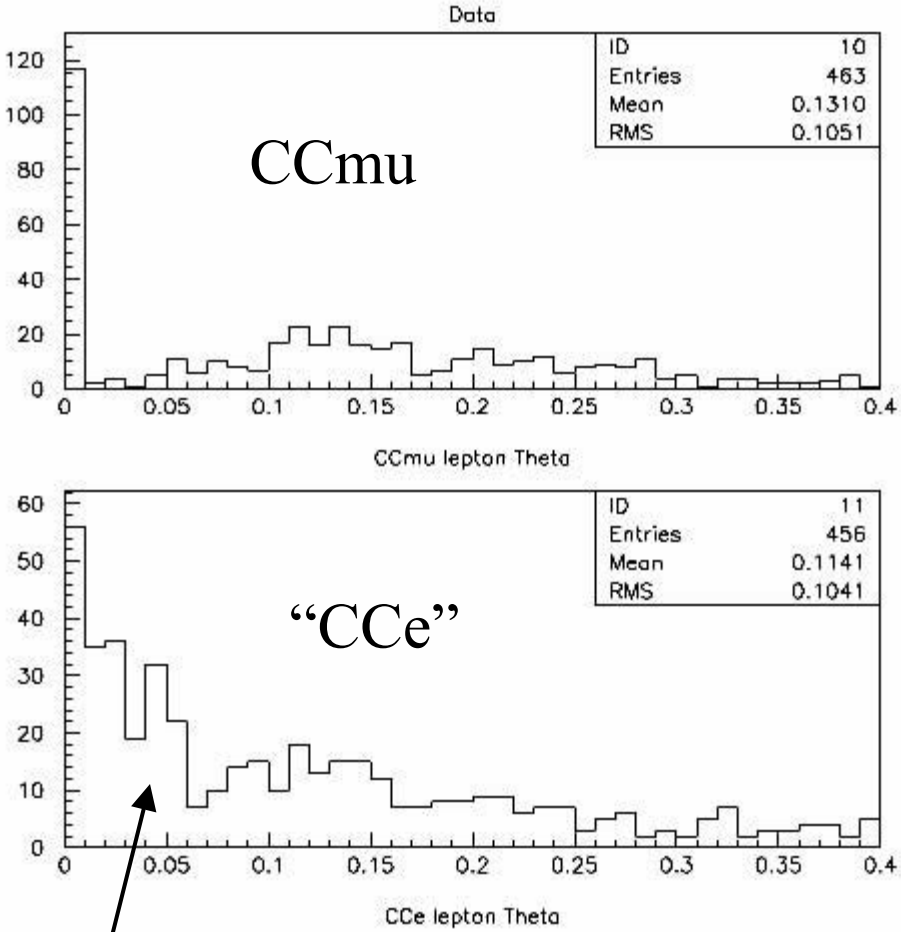
Largest EMCal cluster
> 10 GeV

Note that ANN CCe sample contains ~25% NC events

Monte Carlo

Data

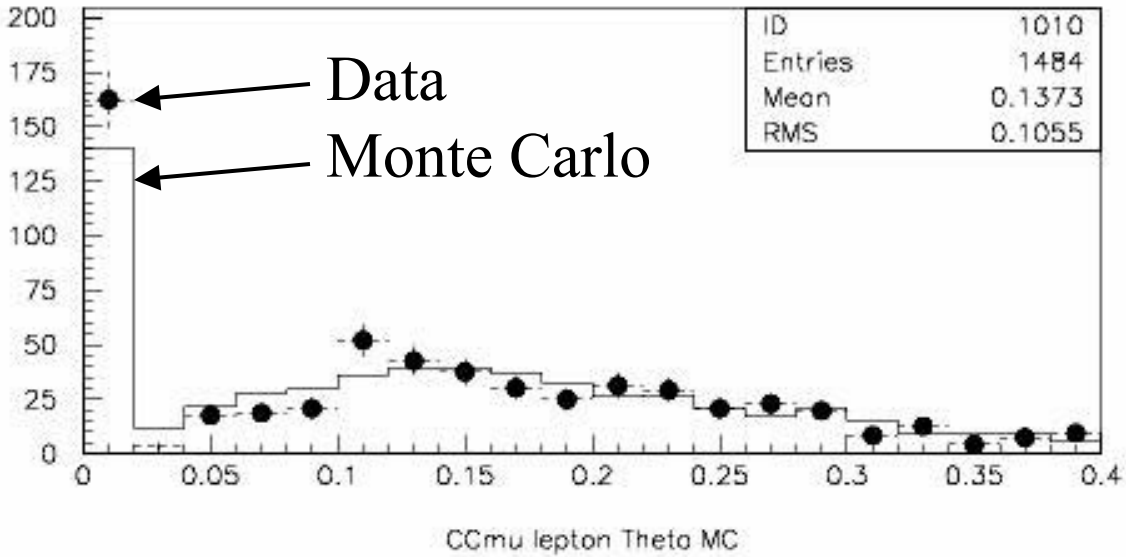




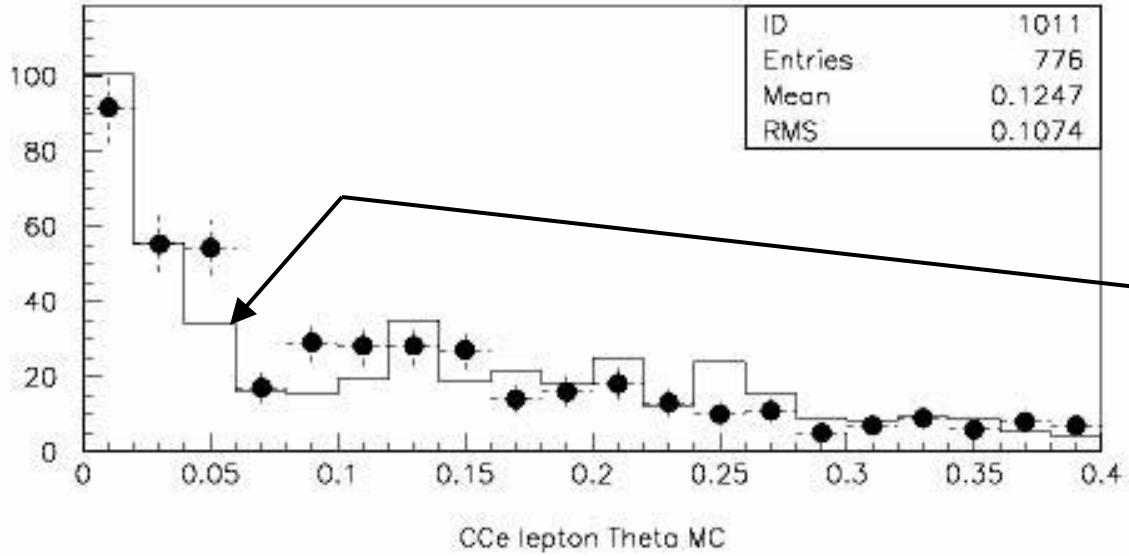
Too many tracks close to EMCal cluster

Resolution

- Monte Carlo problem
  - No more than 300 hits/particle type were written to the output file
  - No error messages
  - Problem significant when writing m-files
- Fixed problem and generated 2000 Period 4 events with m-files



MC events are higher multiplicity



Good agreement
~60% true CCe
~40% true NC

Event Characterization

- Use muon tagging and electron ID to characterize Monte Carlo events
- CCmu = tagged muon
- CCe = tagged electron w $\delta\phi > 1.5$

Reconstructed

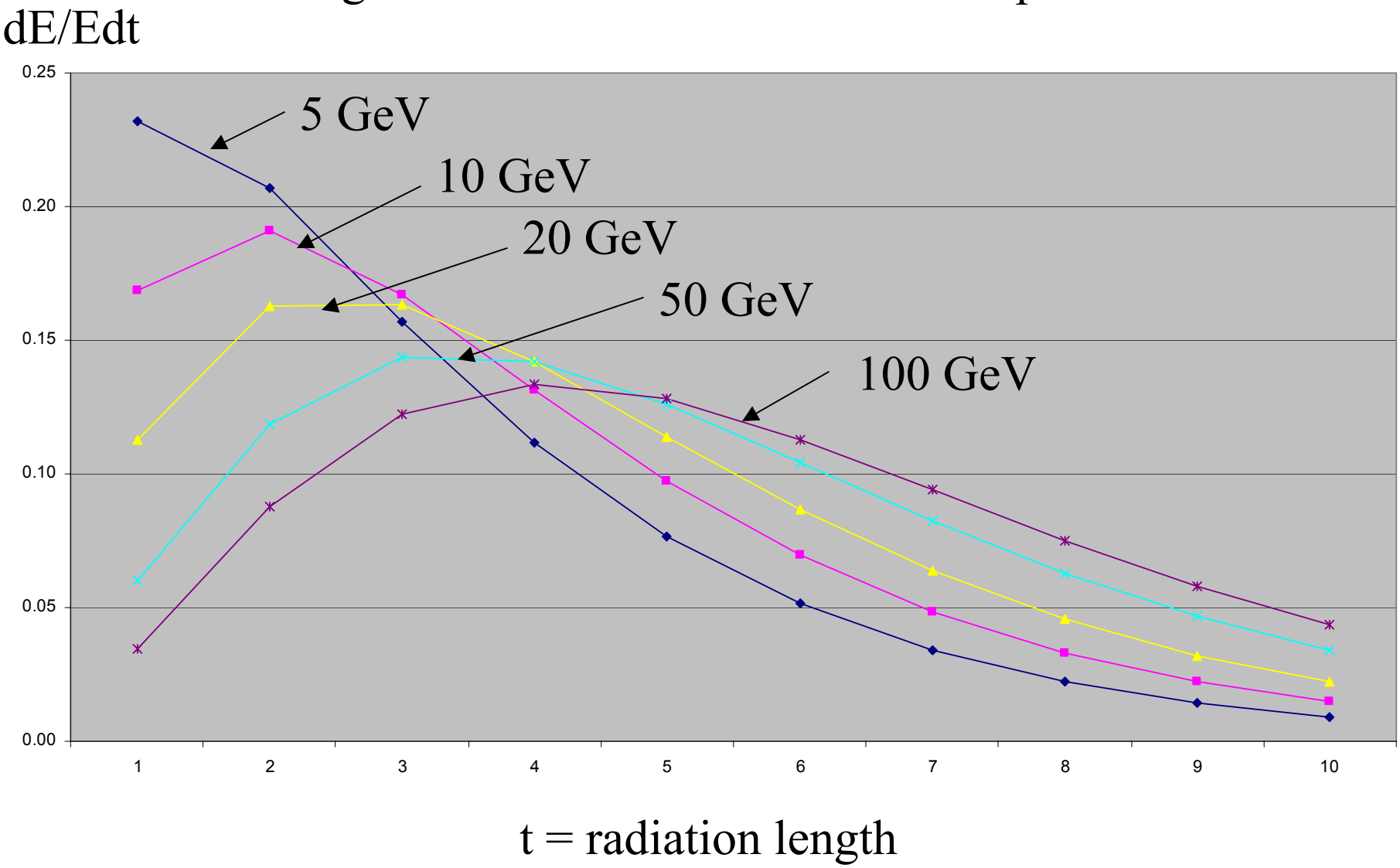
True

	CCmu	CCe	NC
CCmu	72%	12%	17%
CCe	1%	88%	11%
NC	4%	27%	69%
Tau	3%	55%	42%

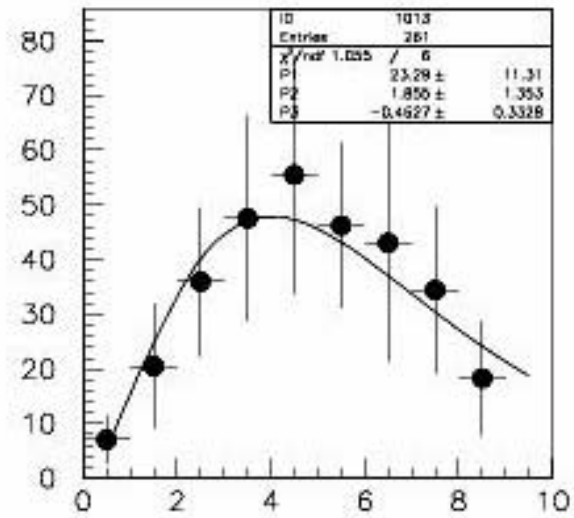
Improvements

- Current version of electron ID uses SFT pulse height and EMCal cluster cuts
- Working on improvements to use longitudinal shower development in SFT stations
  - Find SFT pulse height vs radiation length, EMCal cluster energy vs radiation length from MC + errors
  - Calculate χ^2 for electrons & pions in several energy bins
  - Should improve efficiency and give a rough estimate of electron energy

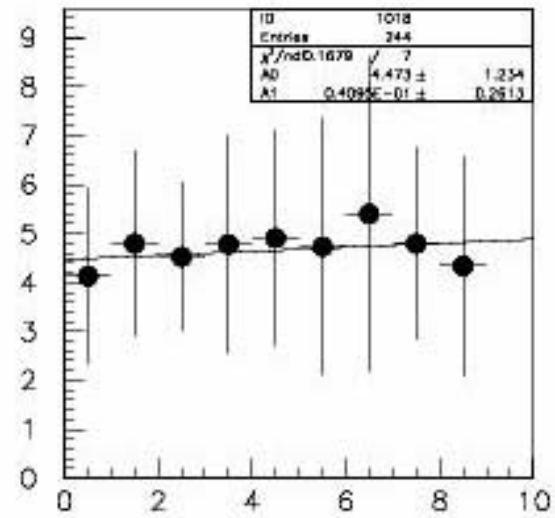
Longitudinal Electron Shower Development



SFT Pulse height vs radiation length

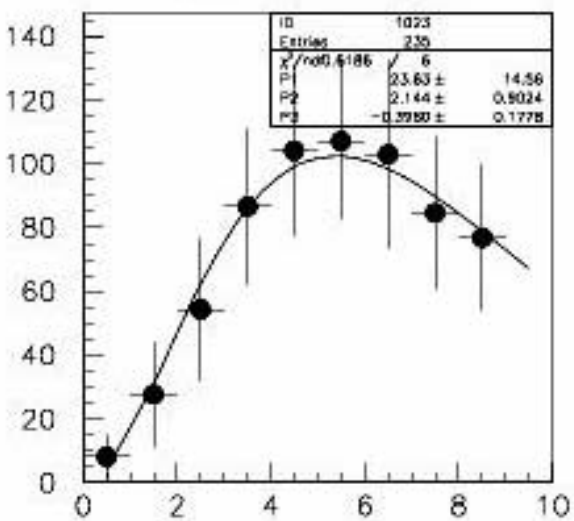


phsum vs t 10 GeV e

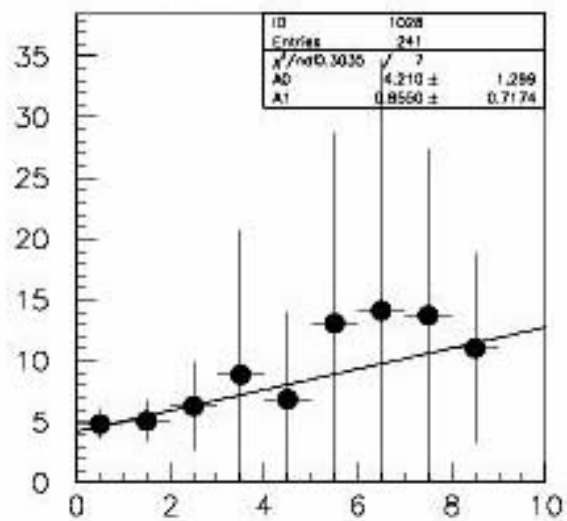


phsum vs t 10 GeV pi

10 GeV e/π



phsum vs t 20 GeV e

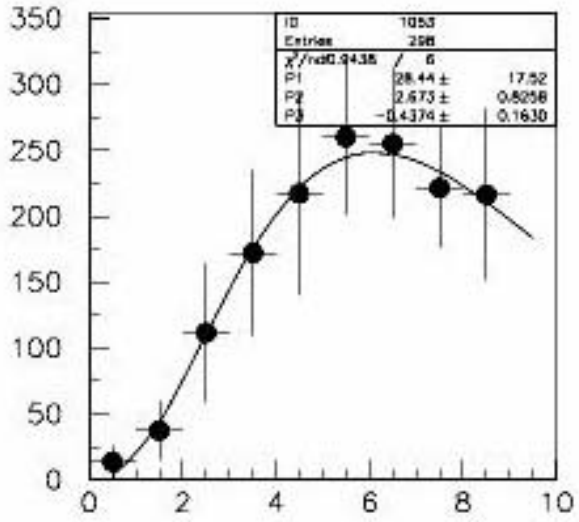


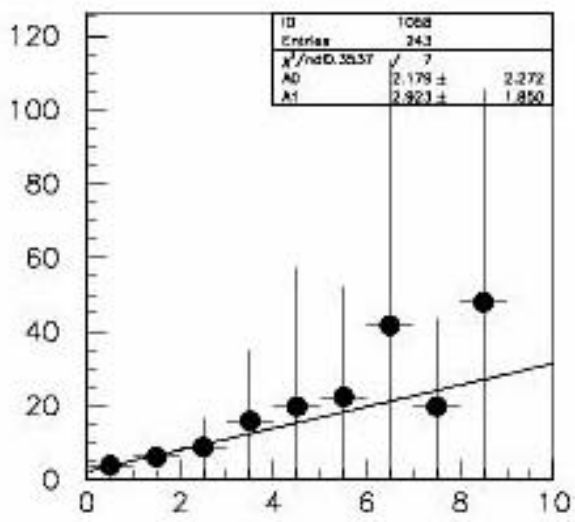
phsum vs t 20 GeV pi

20 GeV e/π

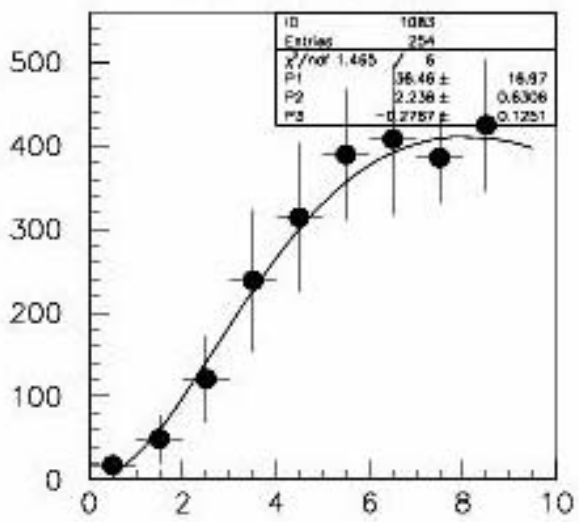
SFT Pulse height window cut =.002*radlen

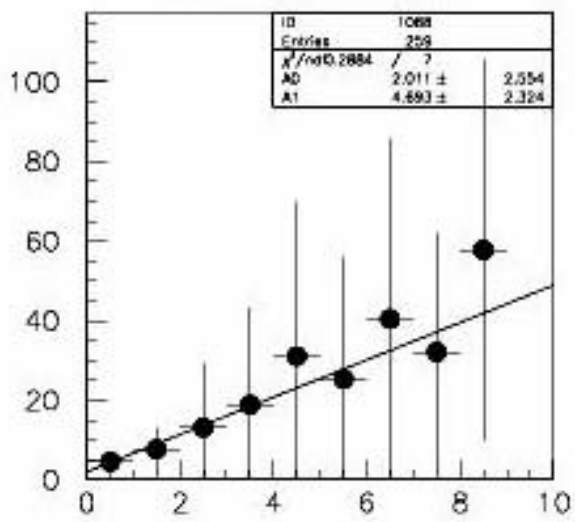
SFT Pulse height vs radiation length



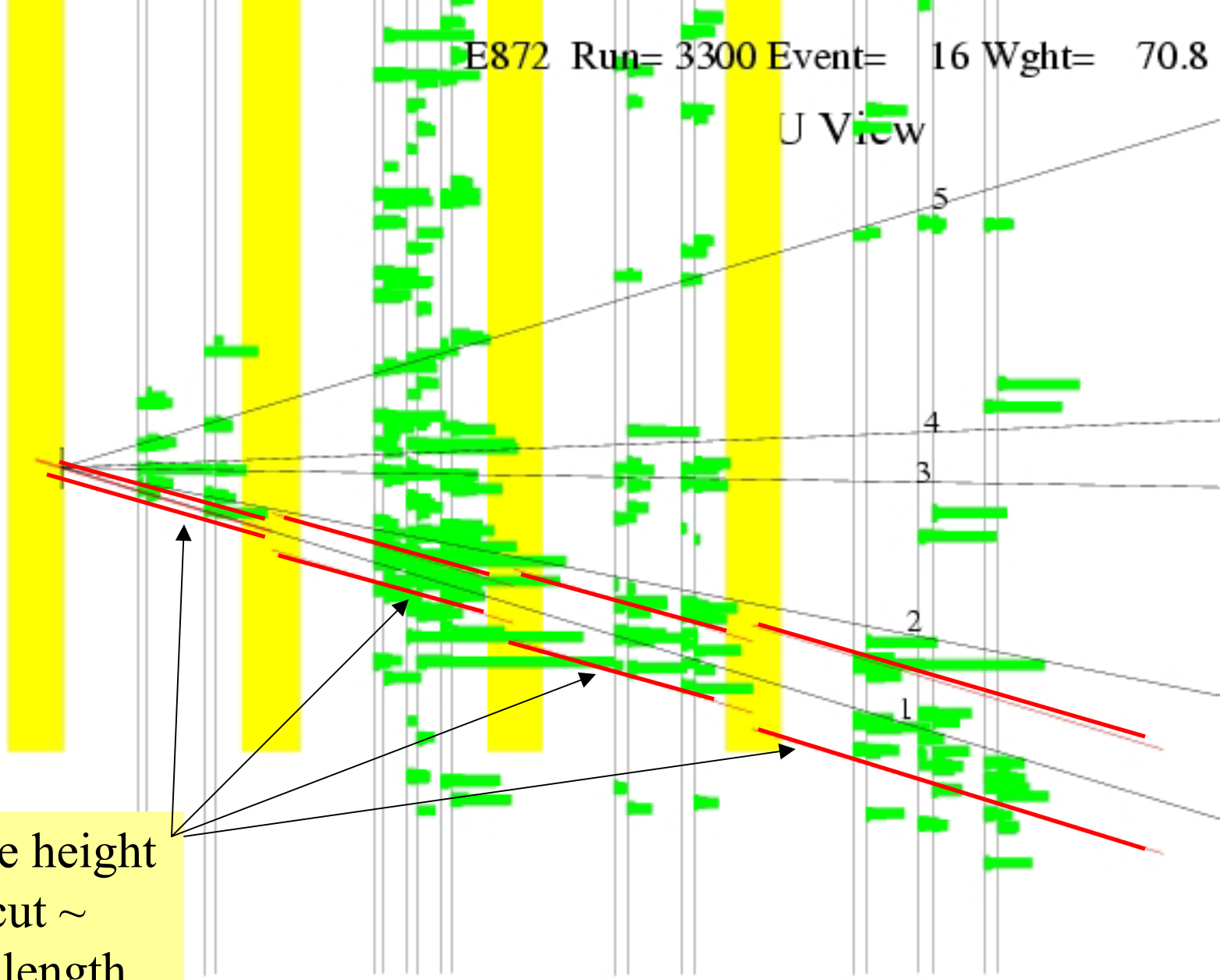


50 GeV e/π



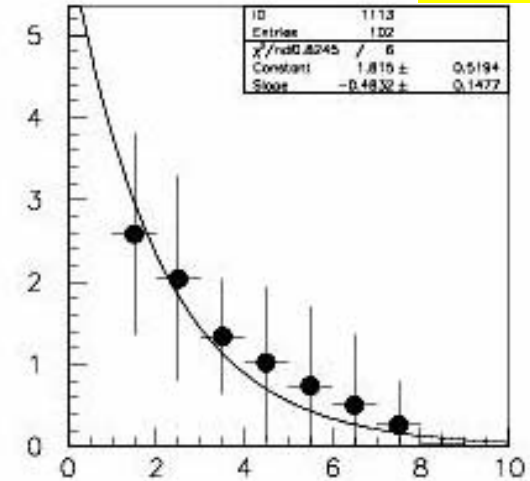


80 GeV e/π

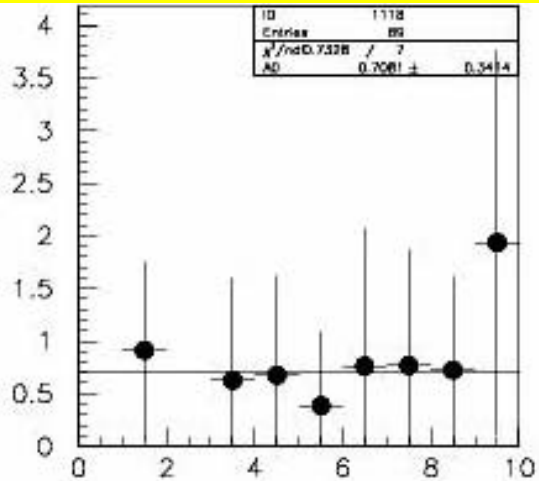


SFT Pulse height window cut ~ radiation length

EMCal Energy vs radiation length

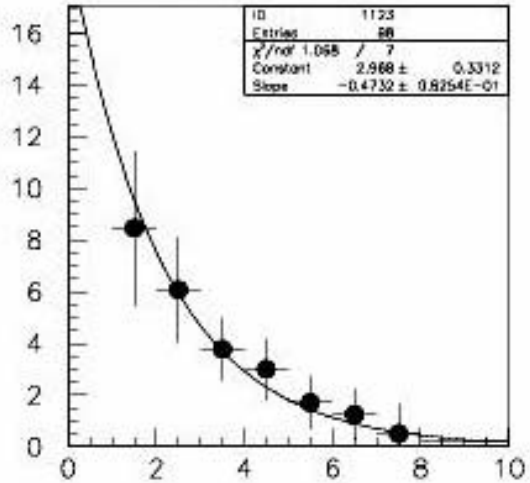


EMCal vs t 10 GeV e

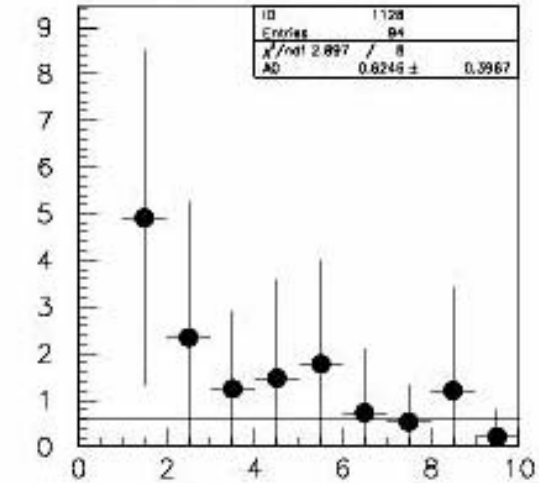


EMCal vs t 10 GeV pi

10 GeV e/π



EMCal vs t 20 GeV e



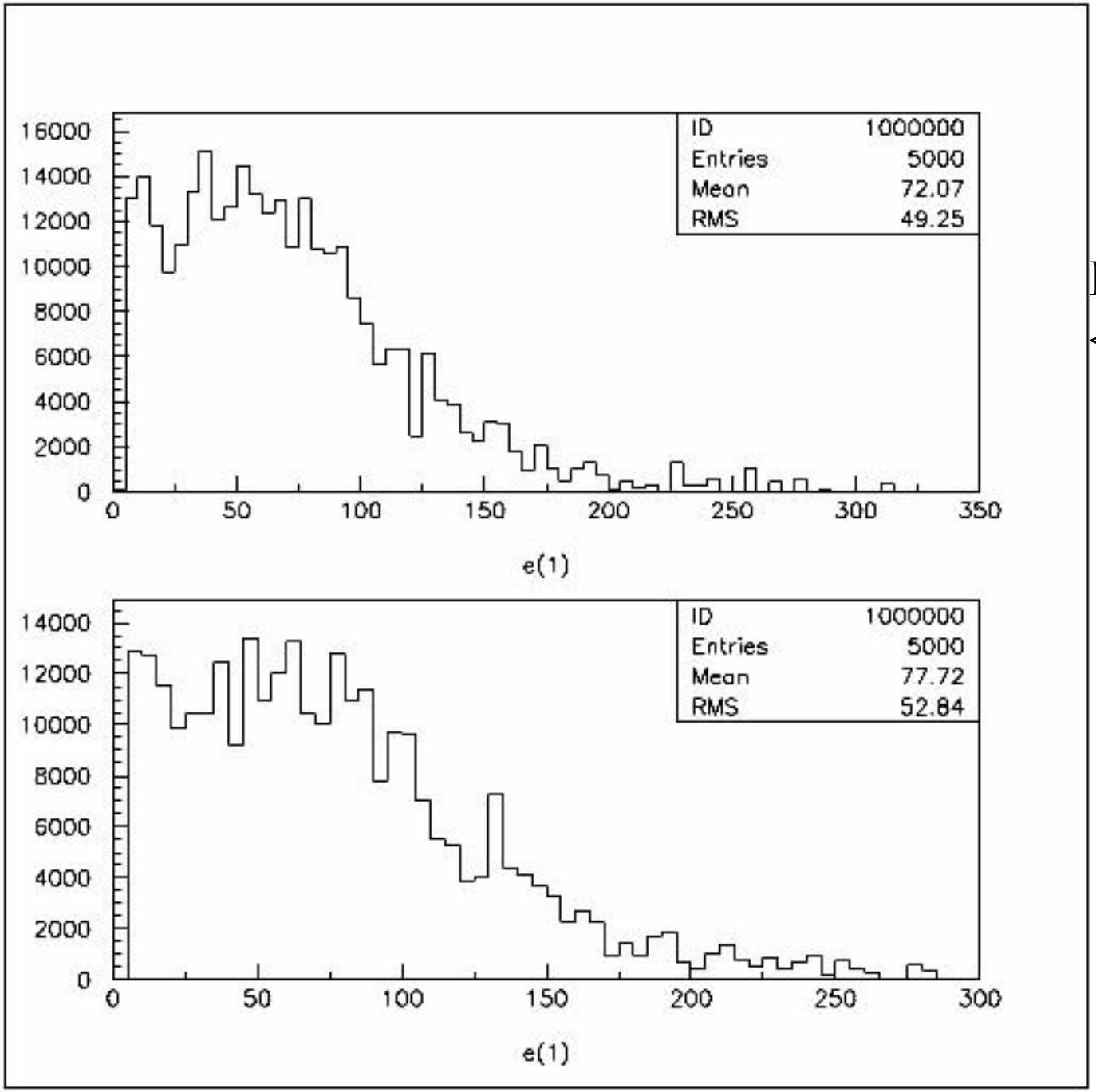
EMCal vs t 20 GeV pi

20 GeV e/π

Sum of calorimeter energy within 25 cm of track

Another MC problem found

- Branching ratios for charm were mis-coded in the Monte Carlo (mc_inc.sf)
- All >2 body decays $D \rightarrow K^{*}l\nu$, $K0l\nu$, $\phi l\nu$, $\pi l\nu$, $\rho l\nu$
- Problem has been fixed but not yet released



Library version
<Eν> = 72 GeV

Corrected
<Eν> = 78 GeV

Summary & Plans

- Spent 1 month investigating a potentially interesting effect in CC electron events
  - DONUT has a unique sample of CCe events
  - Fixed MC problem and find good match to data
- MC/data comparison requires modeling the location efficiency (or waiting for Phase 3)
- Working on improvements to electron ID