Electron Tagging

W Emulsion, SFT, EMCal
Evaluation w data

Bruce Baller
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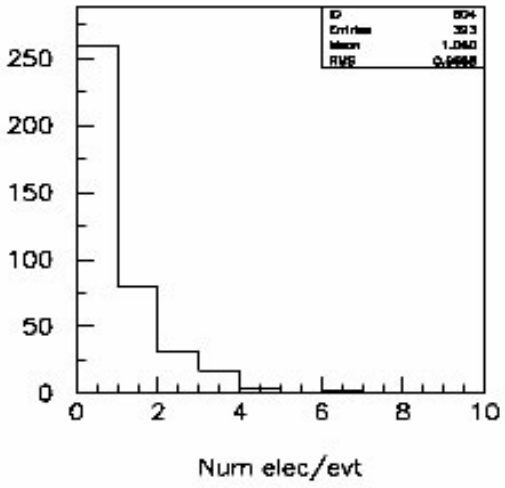
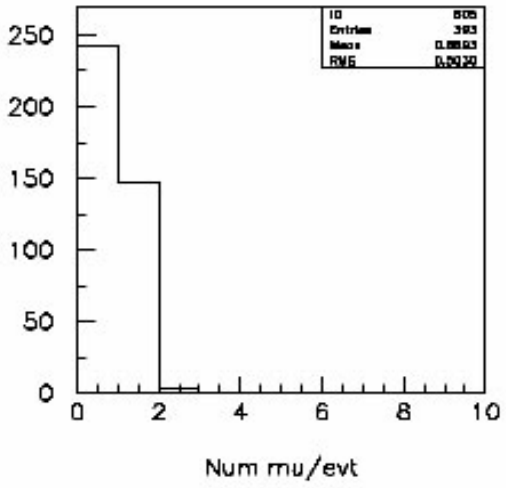
Update on Tagging

- Added muon tag to scheme
  - Muon tag takes priority
- Electron tagging code is largely unchanged since last report
  - Increased EMCal window cut from 20 cm to 25 cm
- Identify primary lepton in each event
  - One muon tagged track
  - Electron tagged track with highest EMCal cluster energy
  - Ignore event if more than 1 track close to the same EMCal cluster or multi-muon
- Evaluate code on 393 located events
  - Check $\Delta\phi$ distributions for muon and electron events
  - NOTE: No follow-down m-files for many events

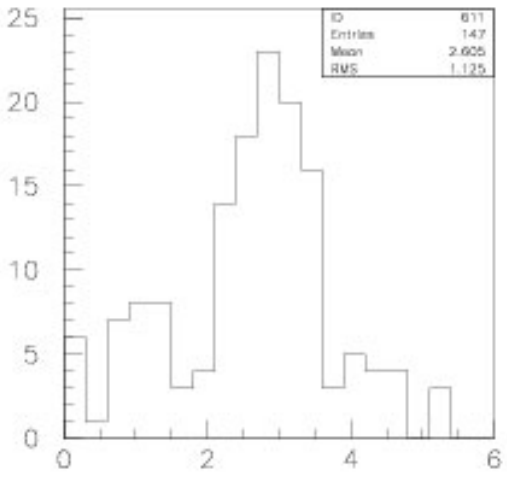
Number of electron/muon tagged tracks/event

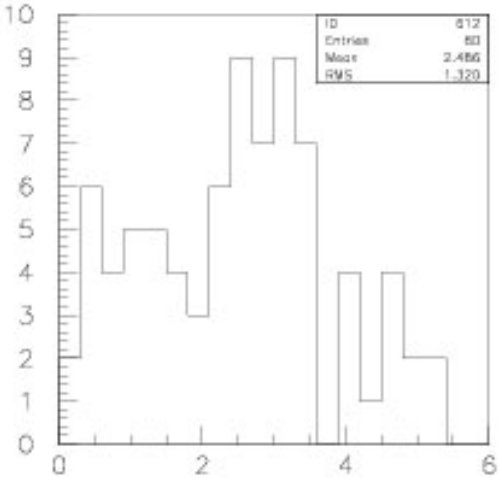


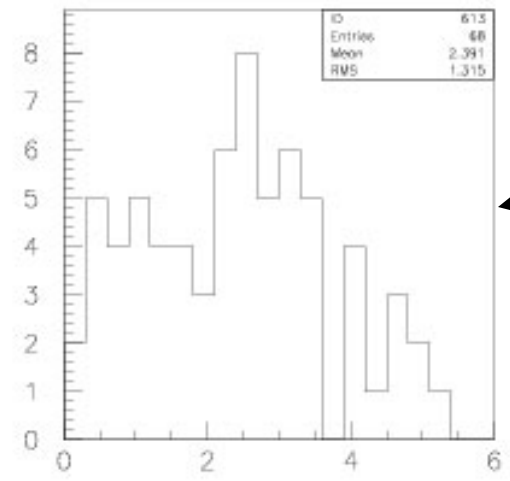


120 events with
> 0 electrons

147 events with
1 muon







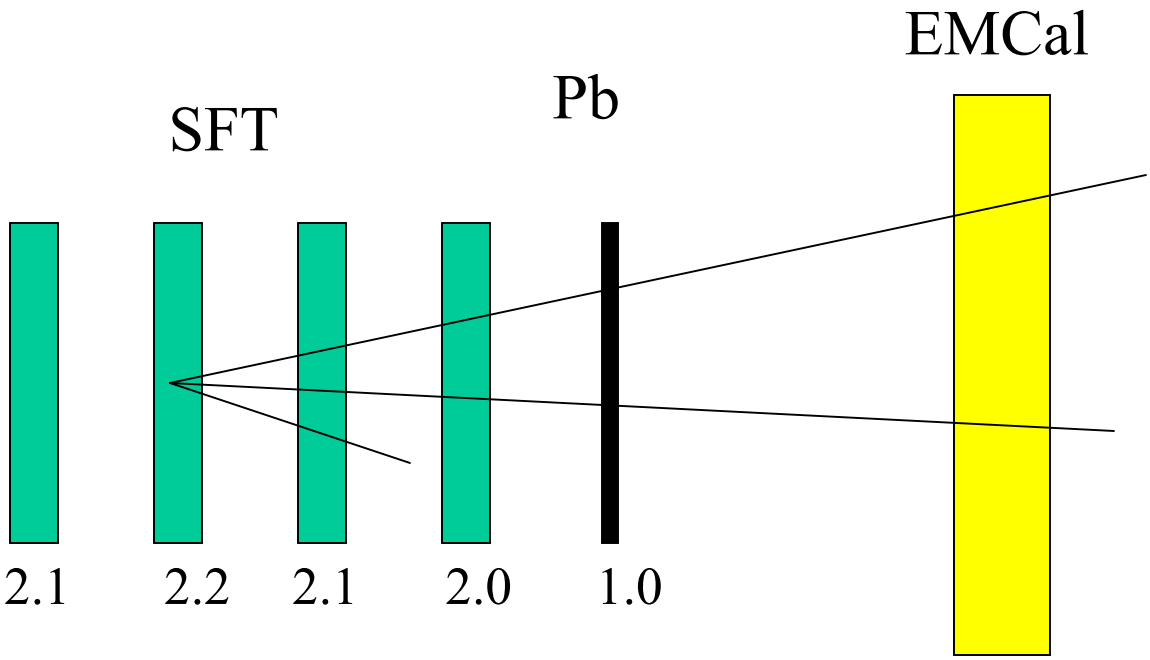
Require only
1 electron tagged
track

Summary

- Expect higher background in electron $\Delta\phi$ distributions compared to muon events
  - NC events with electrons are included
  - Tracking electrons is difficult
    - Electrons shower. Muons don't
- Suggestions for improvements
  - Compare MCS track momentum with estimated electron energy
  - Neural network?
  - Visual scanning?

Radiation length cuts

- EMC and SFT taggers use cuts based on accumulated radiation length in each station
- Use variant of Byron's code in new routine getradlen.sf



- Returns array of radiation length in each SFT station & EMCal
  - Radstn(4), emcrad
- Ex: radstn = (0, 1, 3.1, 5.1) emcrad= 6.1

EMC tagger

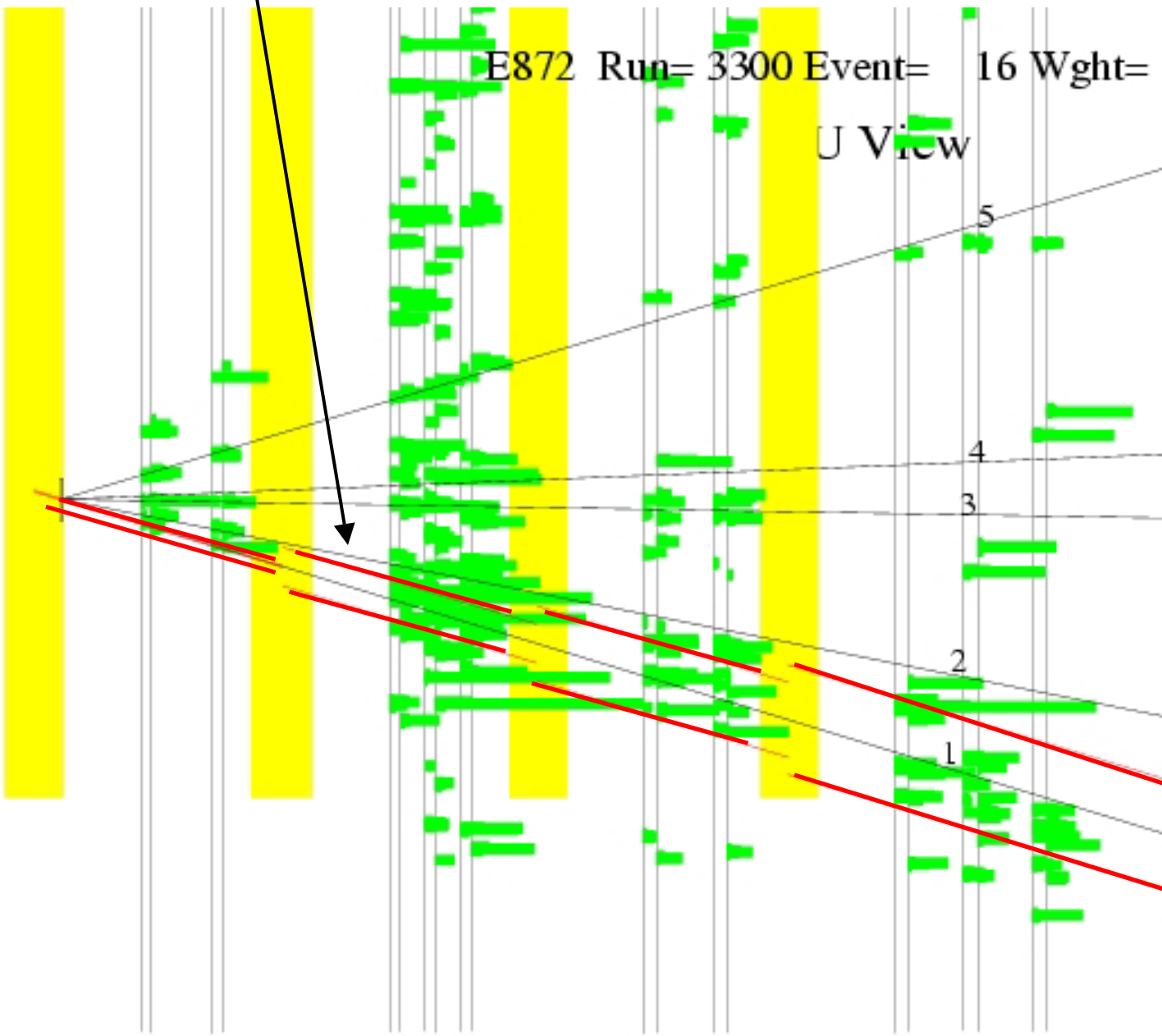
- Define a window (win = 20 cm) on the face of the calorimeter for matching primary tracks to clusters
- Only consider primary tracks separated by $\delta\theta >$ win/(zcal – zvtx) from other tracks
- Require tracks project to face of calorimeter and nseg > 2
- Set a track flag bit to indicate that track passes EMC tagger cuts
- Define min cluster energy cut
  - Ecut = 0.8*(7 – emcrad)
  - Min ecut = 0.3
- Find closest cluster to track projection with eclus > ecut and $\delta r < 20$ cm
- Set “EMC_TAG” track flag bit
- Store cluster energy in track array

SFT Tagger

- Consider tracks with nseg > 2
- Only consider primary tracks separated by $\delta\theta > 40$ mr from other primary tracks
- Set a track flag bit to indicate that track passes SFT tagger track cuts
- Define a window for each SFT station for summing pulse height
  - EM shower width ~ radiation length
  - Determine scale factor by scanning MC events to maximize pulse height and minimize pulse height cross-talk between tracks
  - Cut = 0.002 * radstn(stn)
- Sum PH in each view (X,U,V) within cut
- Count number of planes traversed
- Normalize PH to MIP's/plane traversed
- Correct PH in X plane (4 fiber planes)

SFT window cut for 29 GeV electron

<PH> = 20 MIP's/plane



SFT Tagger - Cont

- Determine PH difference in the views
  - Eliminates false positives - hadron tracks with overlapping EM shower in one view

  <PH> = (PHX +PHU +PHV)/3

  PH rms = $[(PHX–PHU)^2 + (PHX\text{-}PHV)^2 + (PHU\text{-}PHV)^2]^{1/2}$/<PH>
- "SFT_TAG" = <PH> > 10 MIP's/plane & PH rms < 0.5
- Set "SFT_TAG" track flag bit
- Store <PH> and PH rms in track array

- One **could** correct PH from overlapping showers in one view using information in the other views

Combining Tagger Results

- EML/SFT are complementary to EMCal
  - Brehm tracks in emulsion → large PH in SFT → reduced EMCal energy
  - Energy sharing dependent on emulsion target station & radiation length
- Define ALL tagger which uses EML, SFT and EMC tagger results
- Ordered set of cuts
- ALL = EML_TAG
- $\overline{\text{ALL}}$ • SFT_TAG • EMC_TAG
- $\overline{\text{ALL}}$ • EMC_TAG • STN > 2
- $\overline{\text{ALL}}$ • (STN >1 • STN < 4) • <PH> > 15 MIP/PLANE

MC Tagger Results

- Evaluate efficiency and rate of false positives on 500 electron CC events in Period 4
- Define track class

  0 = True electron failed all tagger track selection cuts

  1 = True electron correctly tagged

  2 = True electron tagged as hadron

  3 = True hadron tagged as electron

  4 = True hadron tagged as hadron

  5 = True hadron failed all tagger track selection cuts

MC Tagger Results

Track class

	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%

- 72% of electrons correctly tagged
- 5% of hadrons tagged as electrons

- Other bits of information
- 12% of events have >1 electron attached to the primary (IP < 5 micron)
- The true primary electron is tagged in 86% of electron CC events

What next?

- Check failed true electron tags
  - I checked 23 class 2 events with evt_wght > 30
  - 18 event tracks have true electron energy < 10 GeV
  - 21 tracks have no brehm tracks visible in the emulsion
  - 12 tracks failed the SFT tagger 10 MIP cut
  - 9 tracks missed the EMCal
  - 4 tracks have no EMCal cluster < 20 cm
  - 9 tracks failed the EMCal ecut (Eclus < 1 GeV)
- Possible improvements
  - Not much room for improvement in EMC or EML
  - SFT: Unfold overlapping showers
- Send tagging results to Nonaka?