Event selection and MC shower structure for pions in the Si-W ECAL with 2008 data

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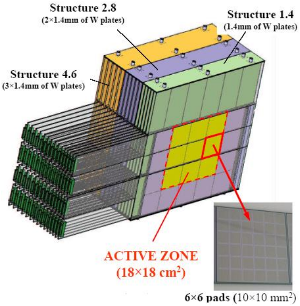
The SiW ECAL in 2008

Figure: Si-W ECAL prototype used at FNAL: 30 layers fully equipped



ECAL = sandwich of Si (detector) and W (absorber) layers

Needs preselection for good events.

- $1 \times 1\ cm^2$ Si pixels, 9720 channels
- 1 layer of $1.4mm = 0.4X_0$
- 3 different W depths: 3 stacks
- depth $= 24X_0 = 1\lambda_I$

Selected "pi-" runs (July 2008) :

- 2 GeV, trigger v22, includes !C1&!C2
- 4-6 GeV, trigger v24, includes !C1&!C2
- 8-10 GeV, trigger v27, includes C1

Preselection

Cuts for reconstructed events :

- At least one Cherenkov trigger active in “trigger andenable”
- isBeamTrigger() in “trigger event”
- ECAL cluster’s c.o.g. in the central wafer

Cuts for simulated events :

- TrackerHit (just before ECAL) inside central wafer
- No decay of the pion before the ECAL (d$\sim$6 m, cτ $\sim$7.8 m)

Cut on muons ? Not easy with these low energies...

Conditions on shower containment

Figure: Figure showing staggering of the ECAL in x direction

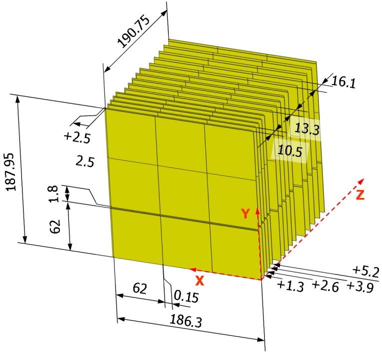
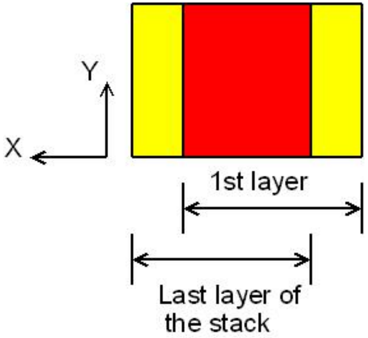
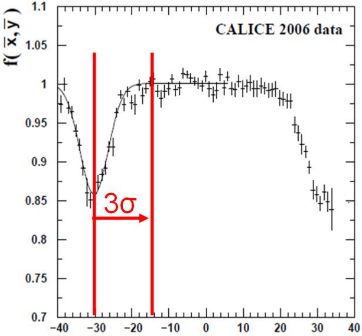


Figure: Naive selection of the cut area inside the central wafer



Would it be more clever to do it like Cristina ?

Figure: Cuts used by Cristina, done with electron runs from 2006



To do on an electron sample of 2008 (TB data). Result different from pion data. Which one to be used ?

Is it a second order effect ? $\Rightarrow$ Keep previous naive cut.

Cuts on muons

Figure: 3D histogram showing ECAL-HCAL-TCMT energies in MIPs

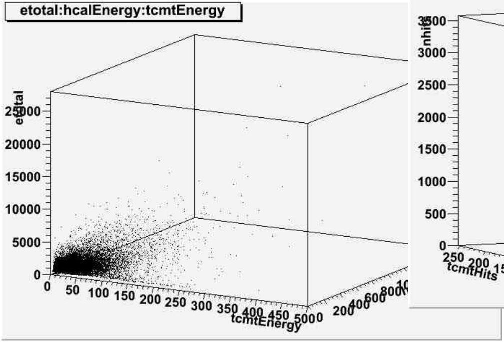
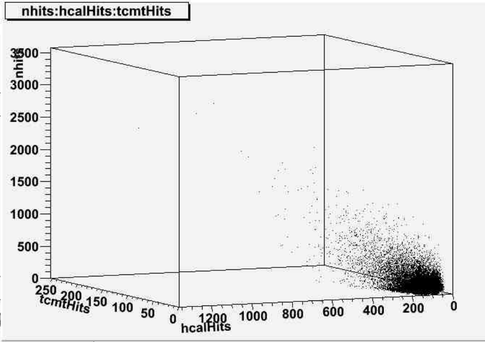


Figure: 3D histogram showing ECAL-HCAL-TCMT hits



Not easy to separate muons at these low energies. What to do ?

Selected events (numbers)

		Initial #	→	selected #	
2 GeV	16 runs	210k	→	26k	(12%)
4 GeV	5 runs	407k	→	132k	(33%)
6 GeV	1 run	114k	→	52k	(46%)
8 GeV	4 runs	551k	→	293k	(53%)
10 GeV	6 runs	768k	→	426k	(57%)

Main effect from "c.o.g. cut". Smaller efficiencies at low energies because the beam is larger.
Maybe a problem in the selection chain that writes too few events : under investigation.

A first look at the Cherenkov

2 different trigger configurations :

2, 4, 6 GeV : !C1&!C2

8, 10 GeV : C1

Figure: Cherenkov bits as a function of the total deposited energy (MIPs), 2 GeV

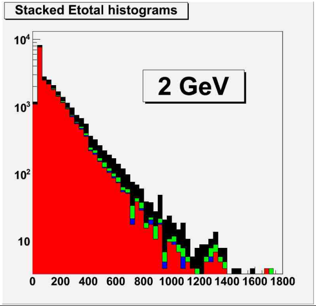
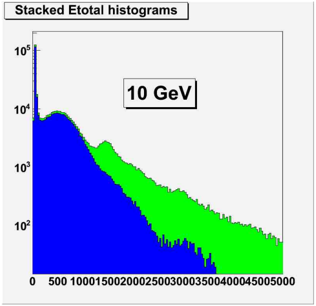
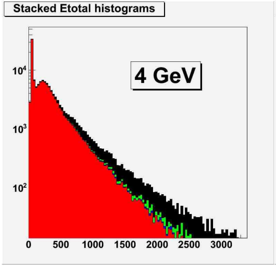


Figure: Cherenkov bits as a function of the total deposited energy (MIPs), 10 GeV



Other energies

Figure: Cherenkov bits as a function of the total deposited energy (MIPs), 4 & 6 GeV



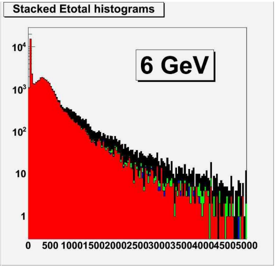
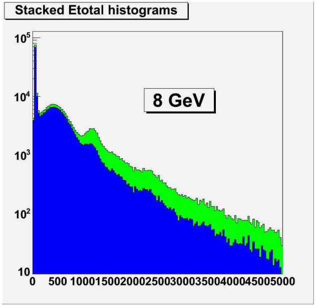
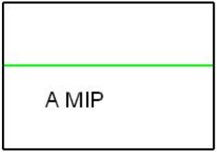


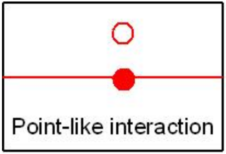
Figure: Cherenkov bits as a function of the total deposited energy (MIPs), 8 GeV

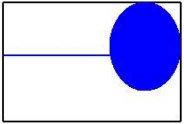


Different shapes to characterize

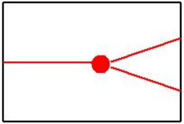
Final goal now : characterize those 4 kinds of interactions seen.







Interaction "fireball" shape



Interaction "fork" shape

"Usual" types of interaction.

The most promising types of interactions for particle flow.

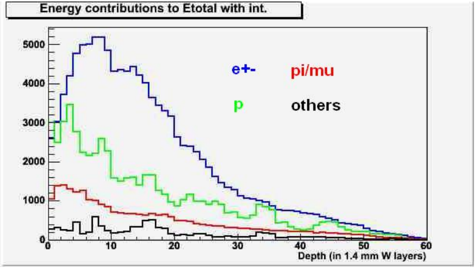
First look at 10 GeV simulations - QGSP BERT

We look at the MC shower structure starting from interaction, in depths equivalent to 1.4 mm W layers i.e. ECAL = 60 layers.

1k events only (selected, out of 2k events)

Waiting for new simulations

Figure: Interaction criteria applied to interacting particles (FireBall)



Slightly different from David's showers... Statistical effect ?

No interaction : peaked layer seen or pure MIP in the ECAL

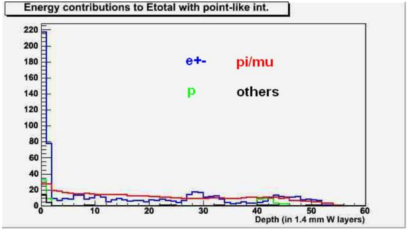


Figure: MC composition of peaked interactions

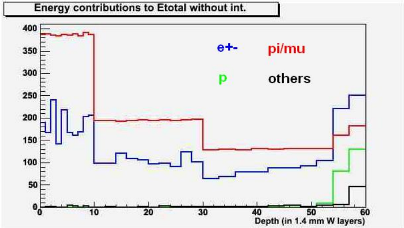


Figure: MC composition of MIPs

Essentially energy deposition by electrons/positrons in the two first layers : delta-rays

Shows the sampling structure of the ECAL. Some interactions in the last layer seen.

Conclusion and Outlook

- To be released on CALICE TWiki: MipFinder, InteractionFinder Processors
- Aim to separate point-like and bifurcation (fork shape) events : eye scanning to select a pure sample and use NN
- To do (or not) : strong cut in central wafer and muon rejection (I am not sure it will be efficient at these low energies)
- Waiting for new simulations with different physics lists for data-MC comparison.

Now, we are almost able to differentiate all kinds of hadronic interactions : good for future PFA applications

Thank you for your attention, any comments are welcome.