First interaction layer and shower structure for pions in the Si-W ECAL with 2008 data

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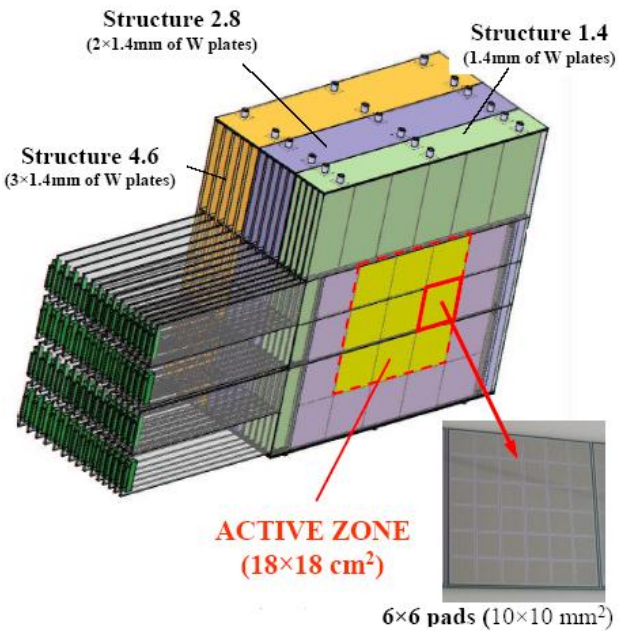
The SiW ECAL in 2008

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



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

- $1 \times 1\ cm^2$ 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

Conditions on shower containment

Figure: Figure showing staggering of the ECAL in x direction

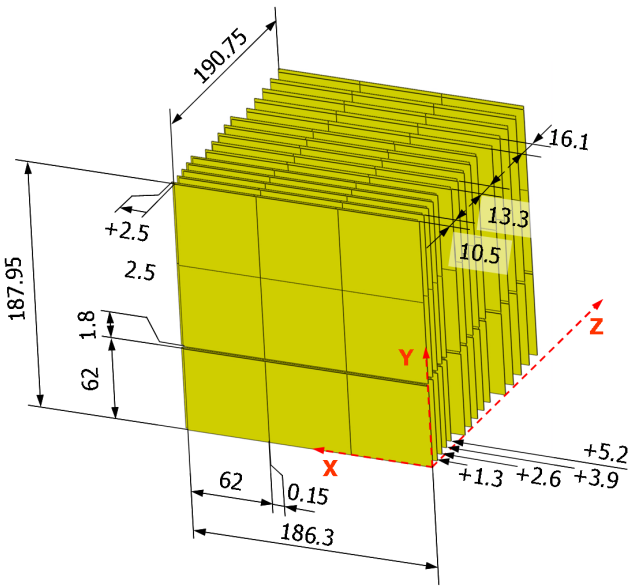
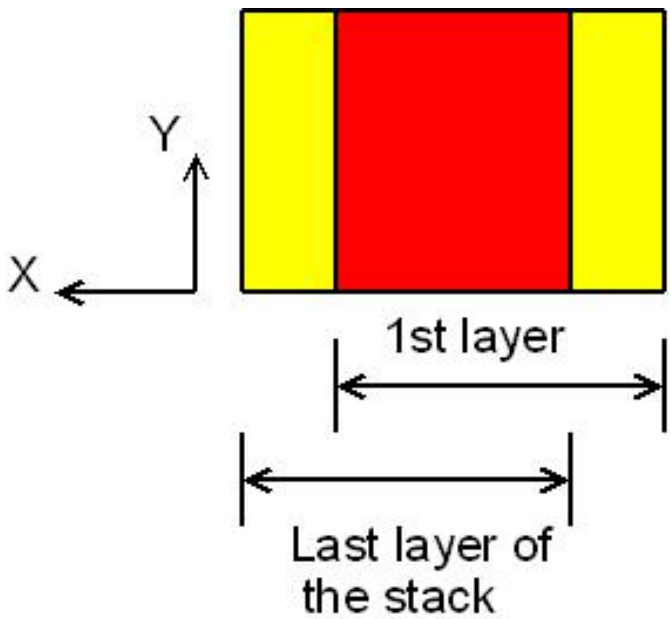


Figure: Naive selection of the cut area inside the central wafer



Used : $-22\,mm < x_{grav} < 30\,mm$; $-30\,mm < y_{grav} < 30\,mm$

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.

MC study : correlation between real IL and the found one

MC layer is defined by the endpoint of the MCParticle.
IF layer is defined by the InteractionFinder algorithm.

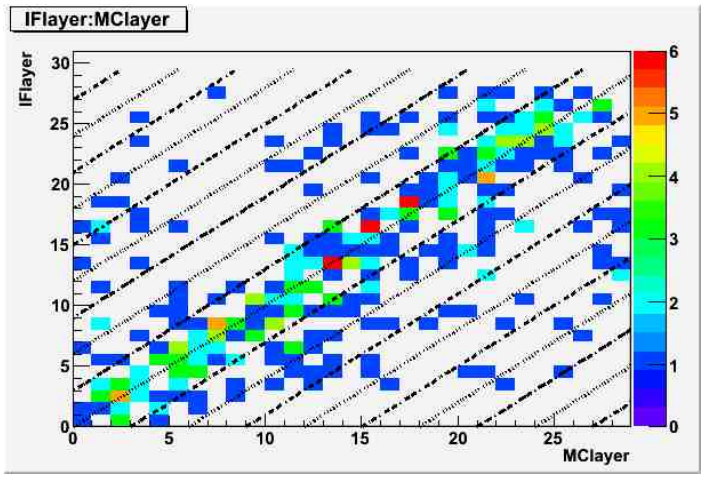


Figure: IF layer vs MC layer : 2 GeV pions ($\sim$ 200 events)

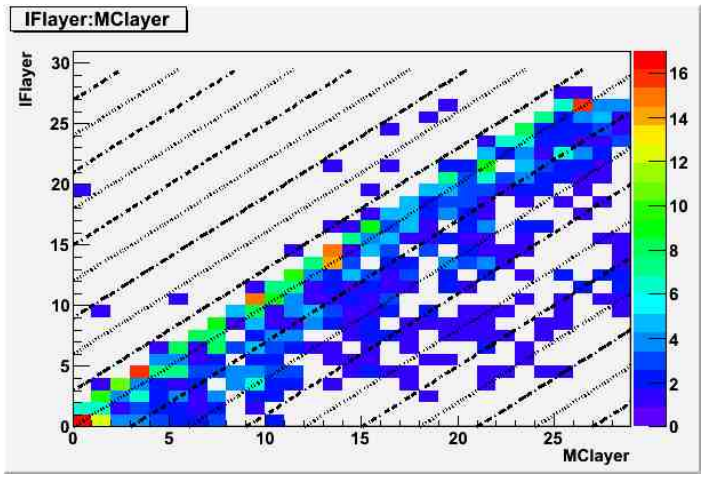


Figure: IF layer vs MC layer : 10 GeV pions ($\sim$ 500 events)

Clearly the cuts are not well optimised and there is some energy dependence !
Reason : algorithm developped with eye-scanning over $\sim$ 200 events at 2 and 8 GeV.

Energy dependence of the correlation

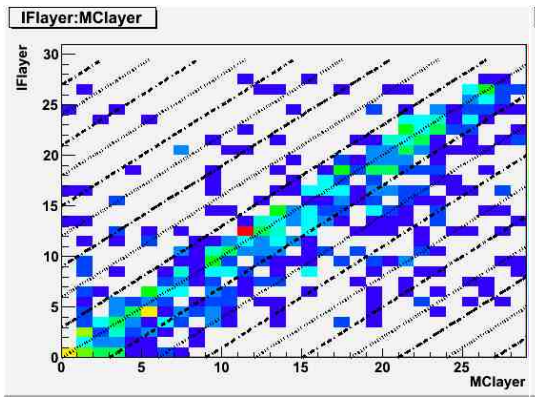


Figure: IF layer vs MC layer : 4 GeV pions

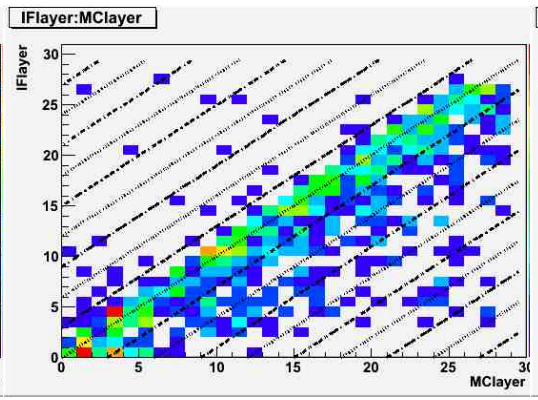


Figure: IF layer vs MC layer : 6 GeV pions

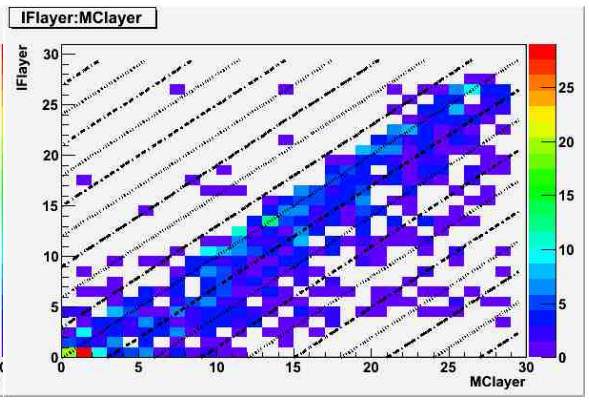
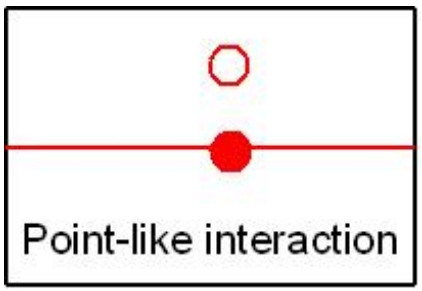
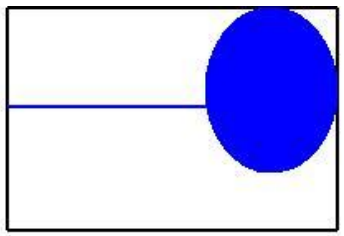


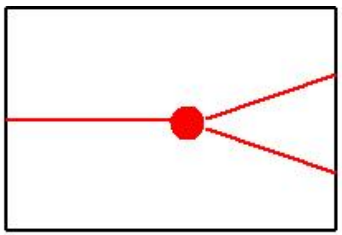
Figure: IF layer vs MC layer : 8 GeV pions

Different shapes to characterize

Final goal : characterize those 4 kinds of interactions seen.




Interaction "fireball" shape


Interaction "fork" shape

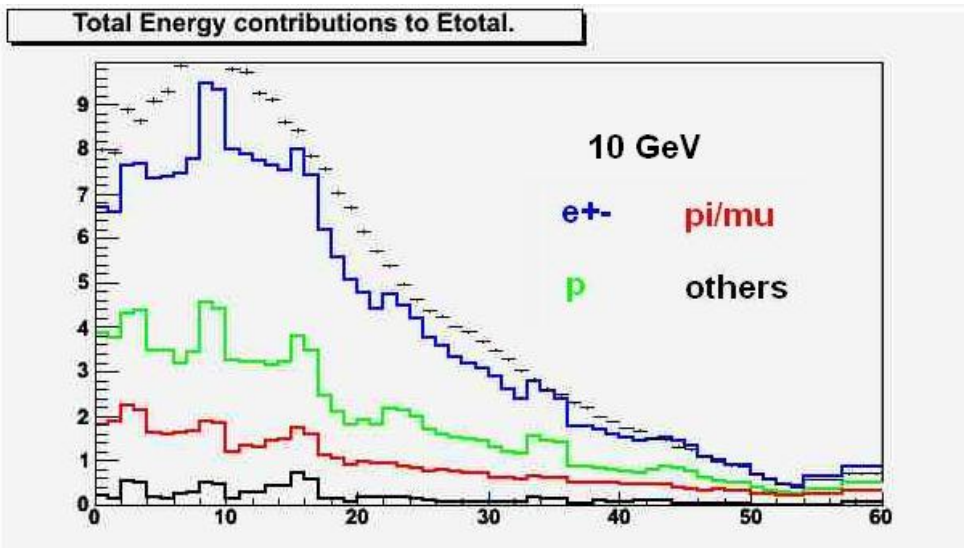
"Usual" types of interaction.

The most promising types of interactions for particle flow. Not yet distinguished.

Simulations at 10 GeV - QGSP BERT

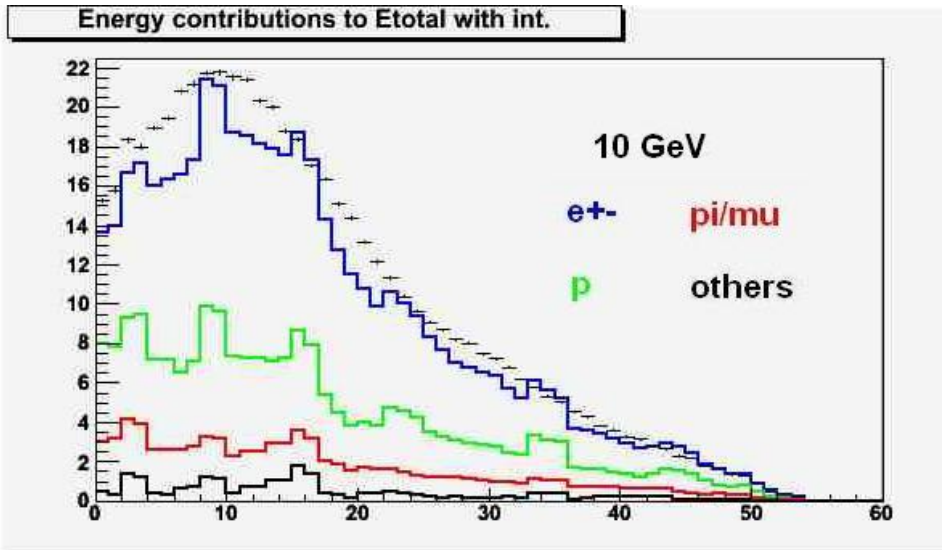
We look at the MC shower structure starting from interaction, in depths equivalent to 1.4 mm W layers i.e. ECAL = 60 layers.
MC : 1k events only (selected, out of 2k events) TO BE UPDATED SOON !!

Figure: Global results : all type of events taken into account. When interaction layer found, keep $5 < IL < 20$ for further studies



Interaction found : FireBall event ($5 < IL < 20$)

Figure: Interaction criteria applied to interacting particles (FireBall)



Peaked layer ($5 < PL < 20$) seen or pure MIP in the ECAL

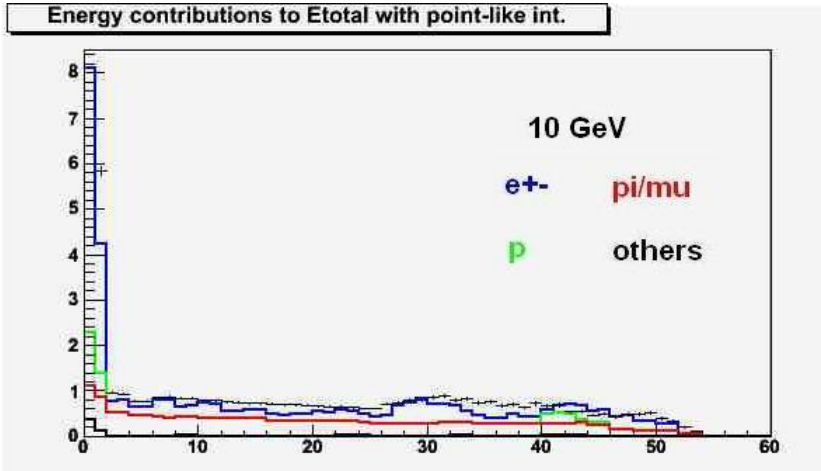


Figure: MC composition of peaked interactions

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

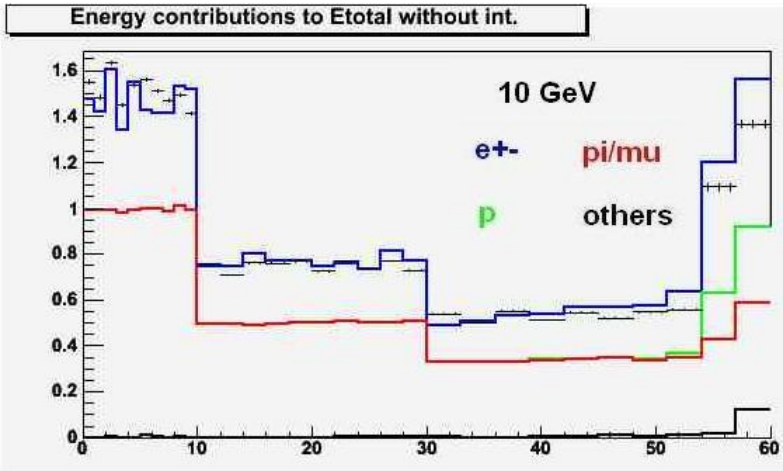


Figure: MC composition of MIPs

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

Comparison between various energies

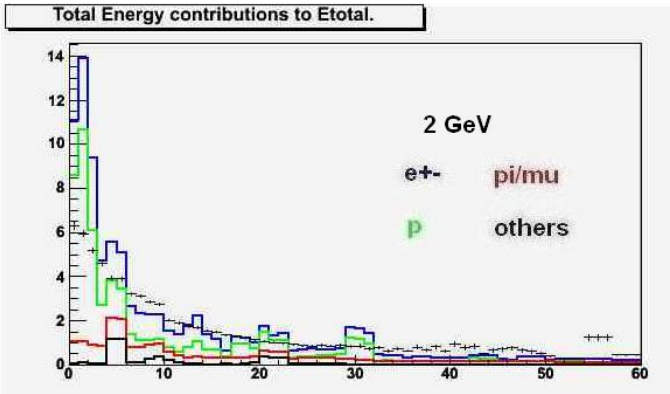


Figure: MC composition at 2 GeV

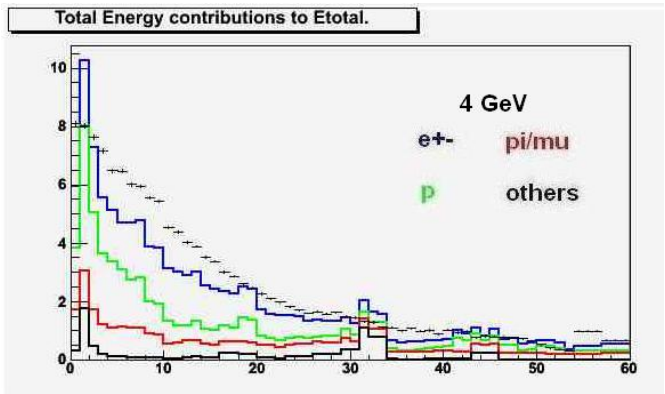


Figure: MC composition at 4 GeV

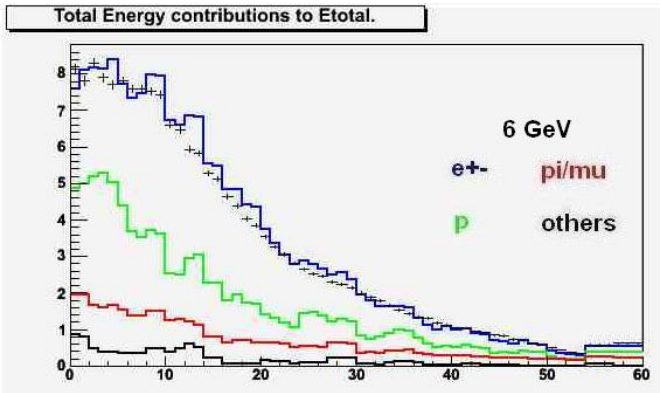


Figure: MC composition at 6 GeV

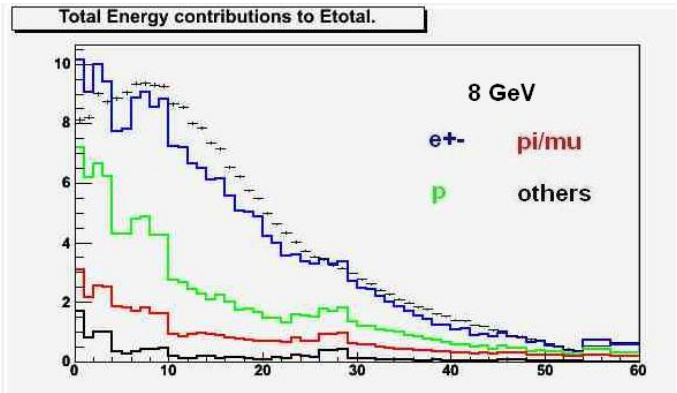


Figure: MC composition at 8 GeV

Conclusion and Outlook

- Released on CALICE TWiki: MipFinder, InteractionFinder Processors. Modifications will come.
- InteractionFinder will be reviewed with more energy dependent cuts
- More physics lists will be watched (Aim to produce our own files at LAL for more flexibility for data-MC comparison.)
- Comparison between various physics lists and different energies will be shown next time
- Aim to separate point-like and bifurcation (fork shape) events
- With new MC samples and the analysis chain almost ready $\rightarrow$ Aim for a note and presentation at CALOR2010

Thank you for your attention, any comments are welcome.