Status of hadron analysis in the SiW ECAL for the FNAL 2008 testbeam

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Work presentend in Daegu (02/20/2009)

- Data - MC comparison started with 2006 simulations at 6, 8 and 10 GeV
- Work on the Cherenkov counter started : study ongoing, no results today
- ECAL used as a tracker : first interaction found and started using clusteriser

Today

- comparison with new 2008 simulation available at 2 and 8 GeV (thanks Shaojun)
- first step to validate the clusteriser algorithm

Note : no Cherenkov is taken into account here

Data taken at FNAL in July 2008 vs new MC samples

- May: instabilities of the ECAL due to some electronic noise
- July: good and stable running period

N events (triggers)	p (GeV)
460 k (-v22,-v25)	2
820 k (-v24)	4
110 k (-v23,-v27,-v31)	6
540 k (-v27)	8
500 k (-v27)	10

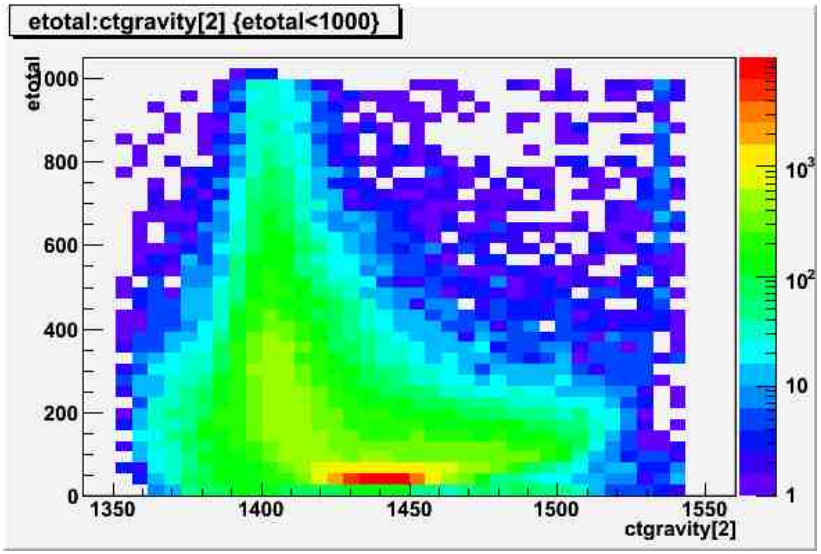
Data available

2 GeV and 8 GeV simulated data with 3 physics lists : LHEP, QGSP BERT, LCPhys. # events = 300k of each kind

Calibration: MIP peak adjustment $E_{new} = E_{Sim}(MIP) \times 1.045$

An overview at 8 GeV

Figure: 2D histogram of the 8 GeV runs showing the total energy deposited in the ECAL versus the center of gravity of the shower.



Thanks to Hengne for preparing the reconstructed data.

Visible information

Possible identification of electrons, pions and MIP particles

Note: 2 e^- events present $\Rightarrow$ trigger inefficiency and polluted beam

Goal here: Remove MIPs and e^-, compare with simulated data.

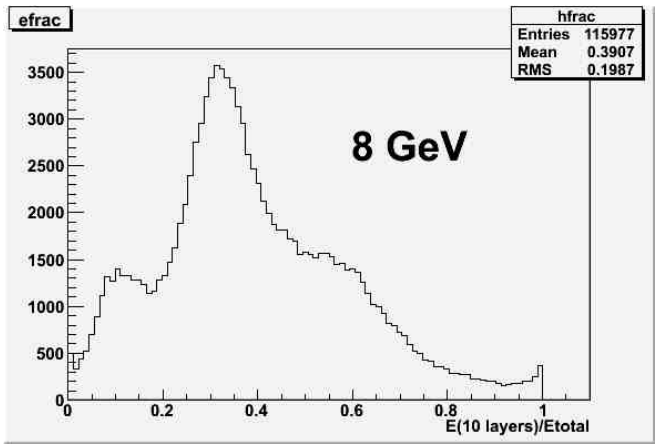
Major problem: HCAL information not available $\rightarrow$ select the pions with the ECAL

Cuts employed for interacting pions

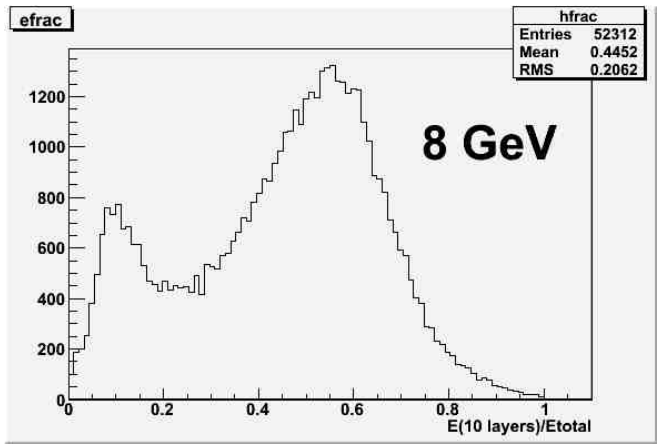
Cuts for electrons and MIPs

E_{frac}=E(10 layers $\sim 4X_0$)/E_{total} < 0.2 & $nhits > 40$

Note: previous cuts $E_{frac} < 0.16$ and $nhits > 50$



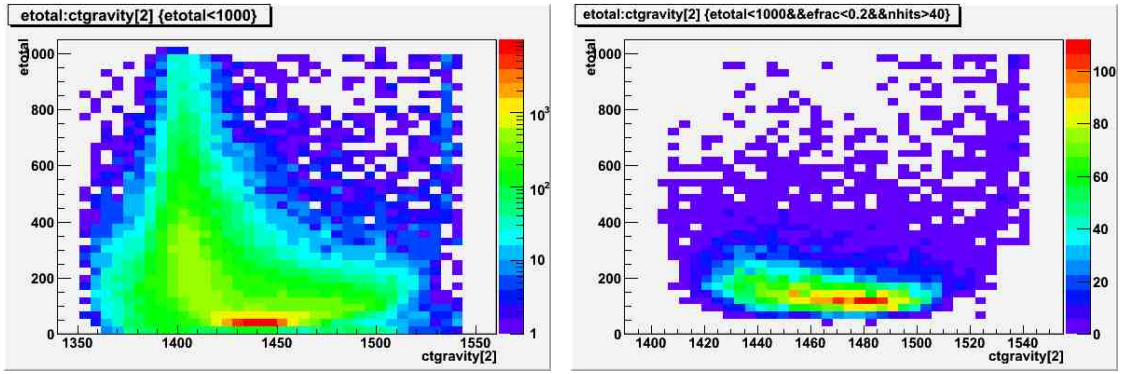
(a) Fraction of the energy contained in the 10 first layers over the total energy (E_{frac}).



(b) E_{frac} with $nhits > 40$

Figure: Choice for the energy fraction cut

Event rejection at 2 and 8 GeV



(a) Before cuts (b) After cuts

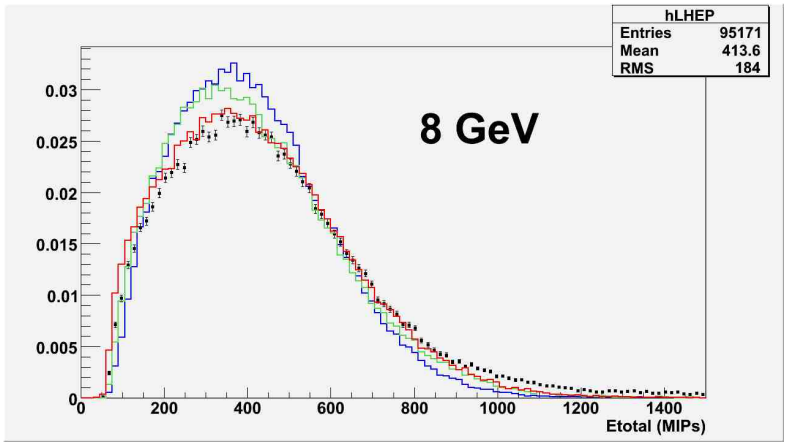
Figure: 2D histograms of total deposited energy vs c.o.g. at 8 GeV

Same cuts applied for TB and MC data.

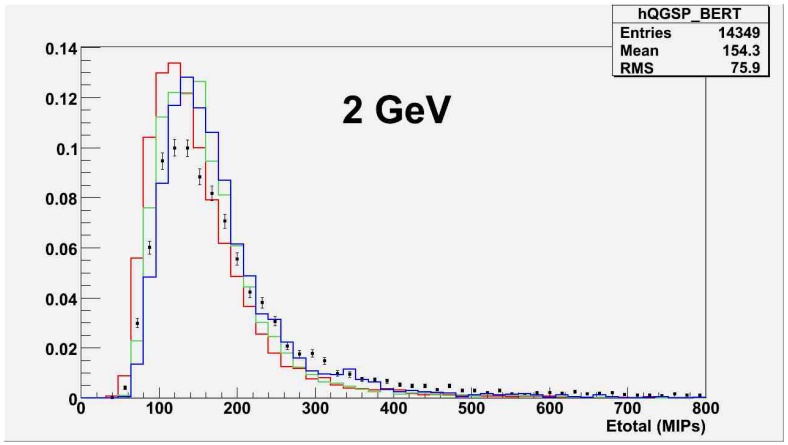
Physics	2 GeV	8 GeV
TB	7.8% (9108 evts)	35% (104961 evts)
LHEP	6.1% (4551 evts)	40% (95171 evts)
QGSP BERT	17.5% (14349 evts)	40% (95467 evts)
LCPhys	8.0% (5925 evts)	38% (90559 evts)

Comparison with the MC data : deposited energy

Figure: Deposited energy after cuts. TB, LHEP, QGSP BERT, LCPhys



(a) 8 GeV

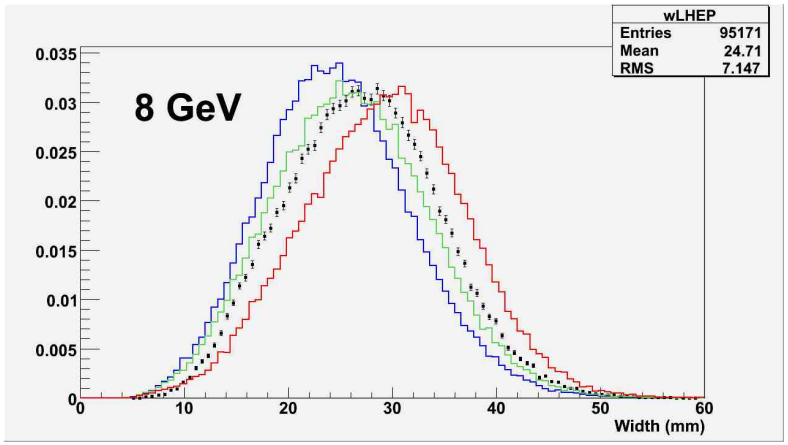


(b) 2 GeV

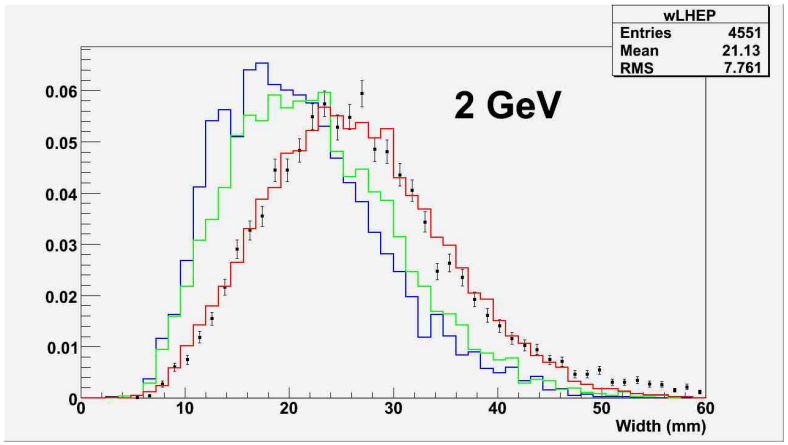
No real model fits the data : QGSP BERT seems to work at 8 GeV but no more at 2 GeV... Normalization issue?
Some electrons are still remaining in the tail of the TB data.

Comparison with the MC data : width of the cluster

Figure: Width of the shower after cuts. TB, LHEP, QGSP BERT, LCPhys



(a) 8 GeV

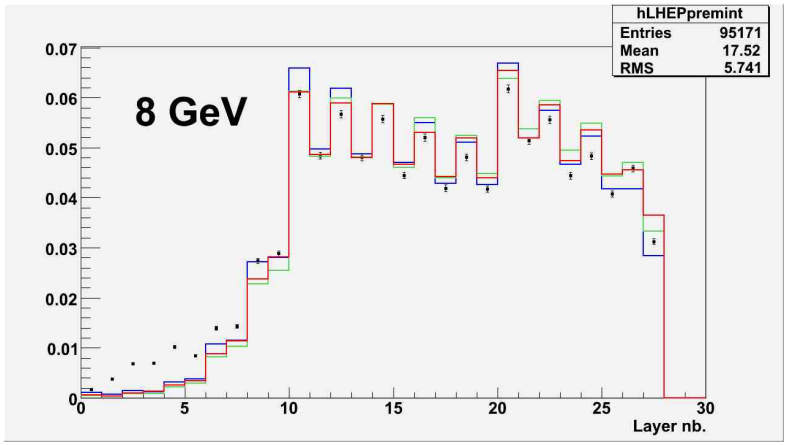


(b) 2 GeV

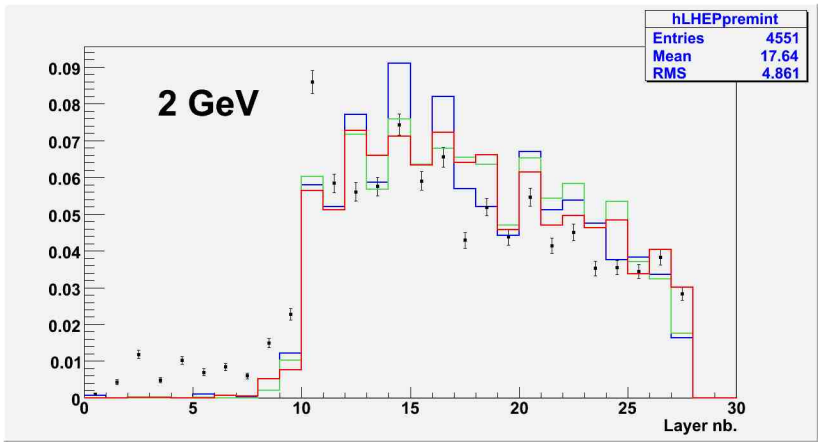
No model to fit the data again : QGSP BERT seems fine at 2 GeV but not at 8 GeV...

Comparison with the MC data : first interaction layer

Figure: Layer of first interaction after cuts. TB, LHEP, QGSP BERT, LCPhys



(a) 8 GeV



(b) 2 GeV

Condition for first interaction : having 3 layers with $E > 10 MIPs$.
The first one is the interaction layer.
Tendency reproduced but... electrons remaining ? spike layer 10 ?

Disentangling the hadronic shower in the ECAL

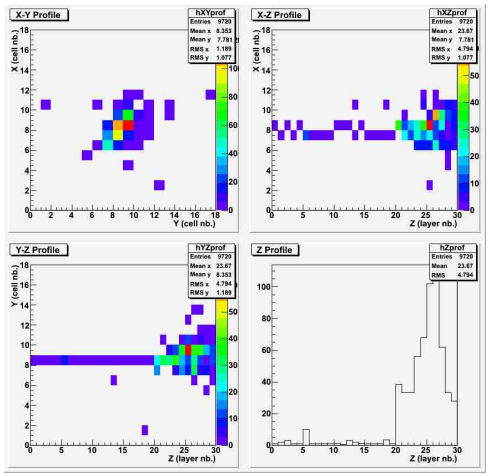


Figure: TB event Projections in the XY / XZ / YZ planes and Z profile of the event. Energies are in MIP.

Use of the Clusteriser algorithm developped by Götz Gaycken at LLR in the calice_reco package.

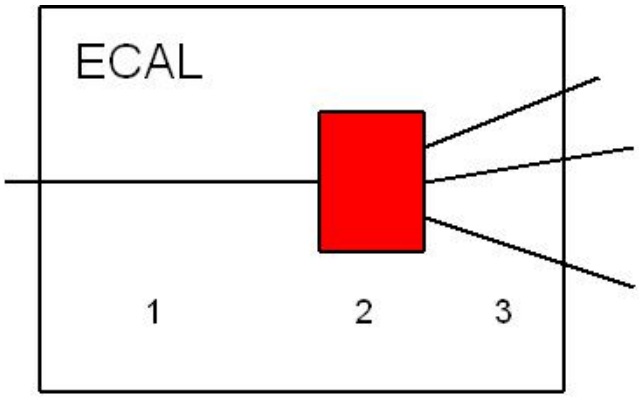


Figure: Clusterising scheme

1. Cluster the MIP before the interaction layer
2. Investigate the interaction region
3. Find new clusters after the interaction region

Application of the clusteriser : first step

We first want to count the number of particles entering the ECAL i.e. count the number of clusters in the 5 first layers.

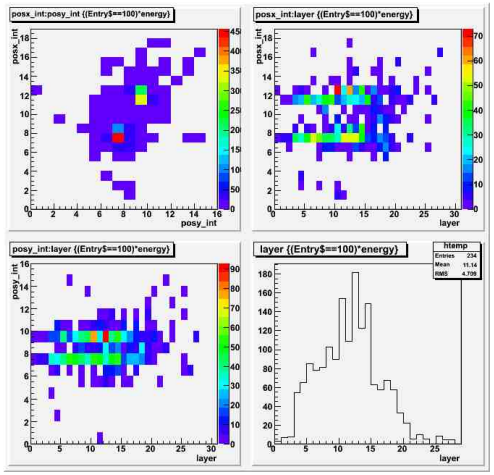


Figure: Finds 2 "particles" (rejects isolated hits)

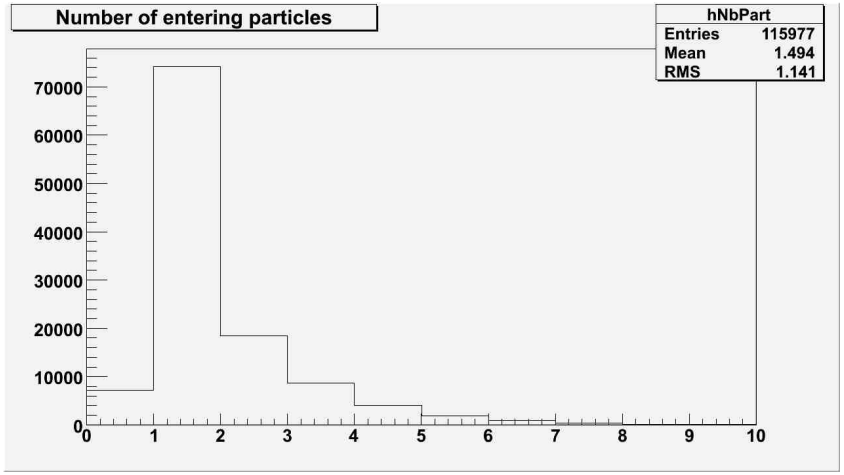


Figure: Applied to FNAL data : number of entering particles at 2 GeV

Fraction of non single particle events

2 GeV	4 GeV	6 GeV	8 GeV	10 GeV
36%	41%	33%	31%	34%

Summary

- Comparison between new MC data at 2 and 8 GeV done : no physics list can be chosen for the data
- First application of the clustering in the ECAL : count the number of entering particles
- Improvements possible : selecting pions, rejecting multiple particle events

Thank you for your attention, any comments are welcome.