EM Showers in the AHCAL

Status Report on AHCal Detector Understanding

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Reconstruction – '06 Status – '07 Quality

Mip Calibration

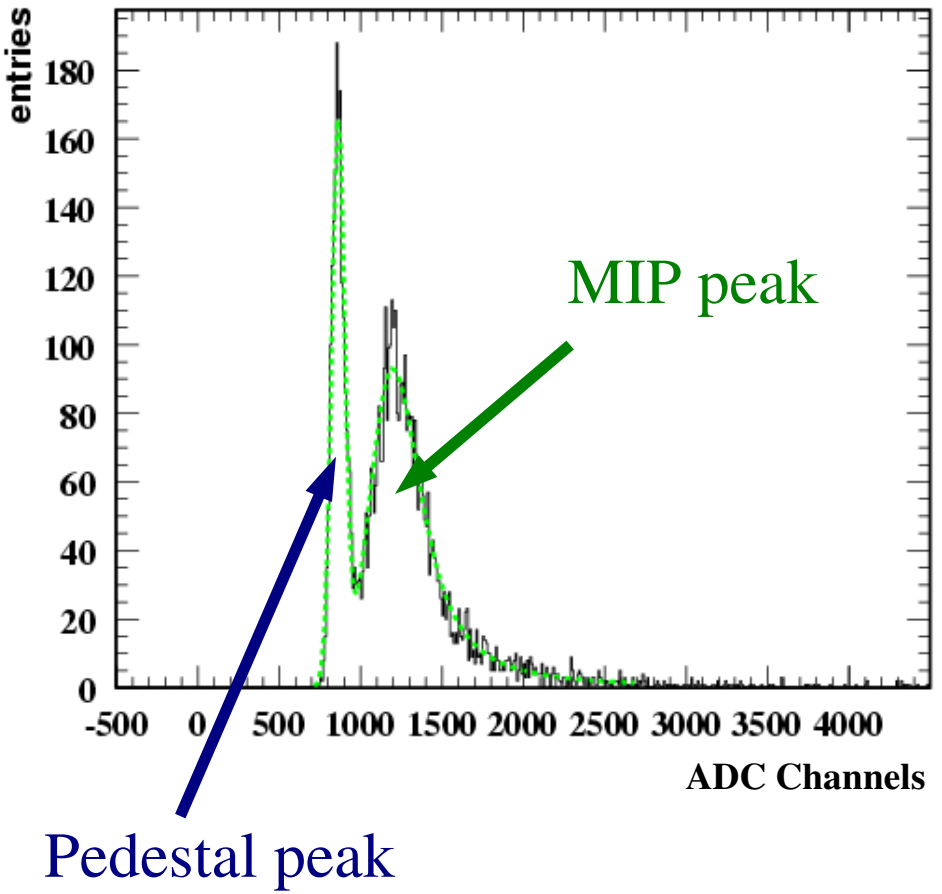
Equalization of all channels done by simple physics process:
Response to passage of minimum ionizing particle

Mip is energy scale and is also accessible in MC

Zero-suppression:
reject hits below 0.5 Mip

Calibration at CERN:
muons in parasitic running

Mip uncertainties directly affect reconstructed energy



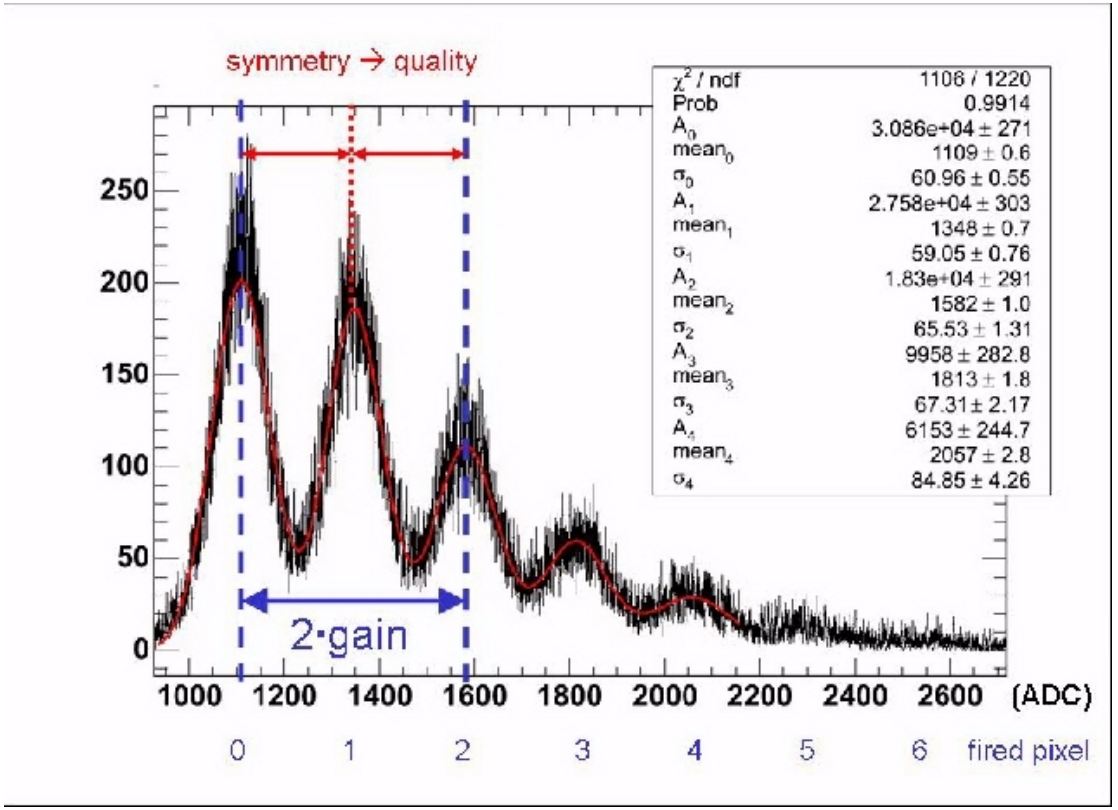
Saturation Correction

SiPM are non-linear due to limited number of pixels plus dead-time

Correction is done with saturation curves measured for each device

Natural scale of saturation
is amplitude in pixel

SiPM allow observation
of single pixel peaks
(two LED measurements)



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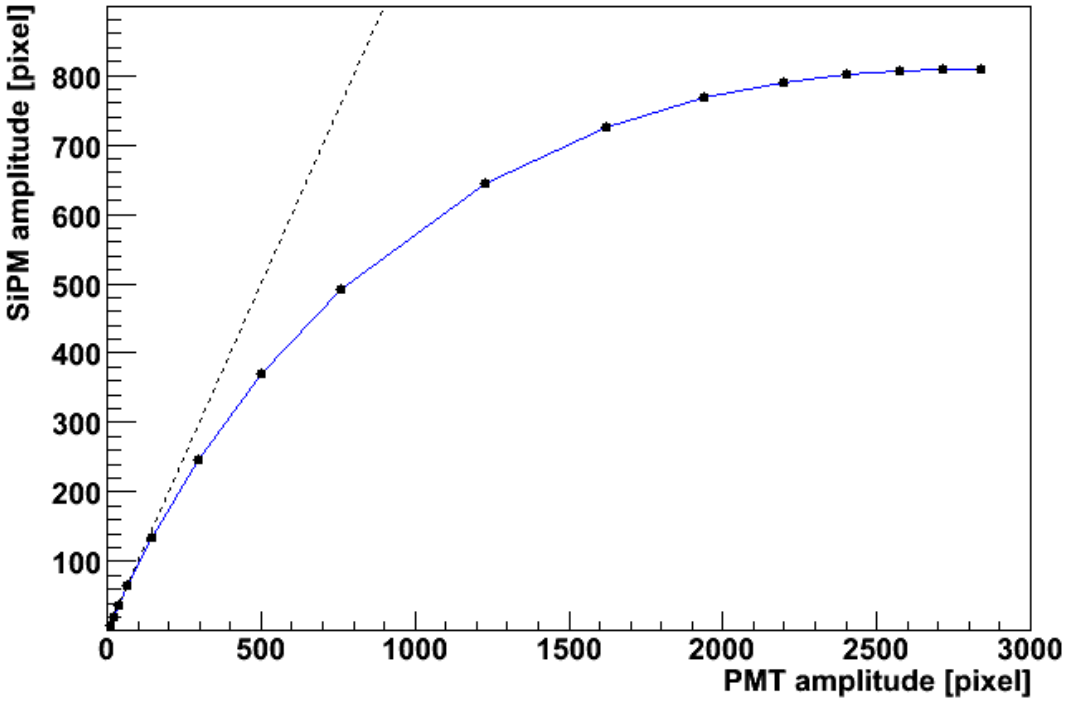
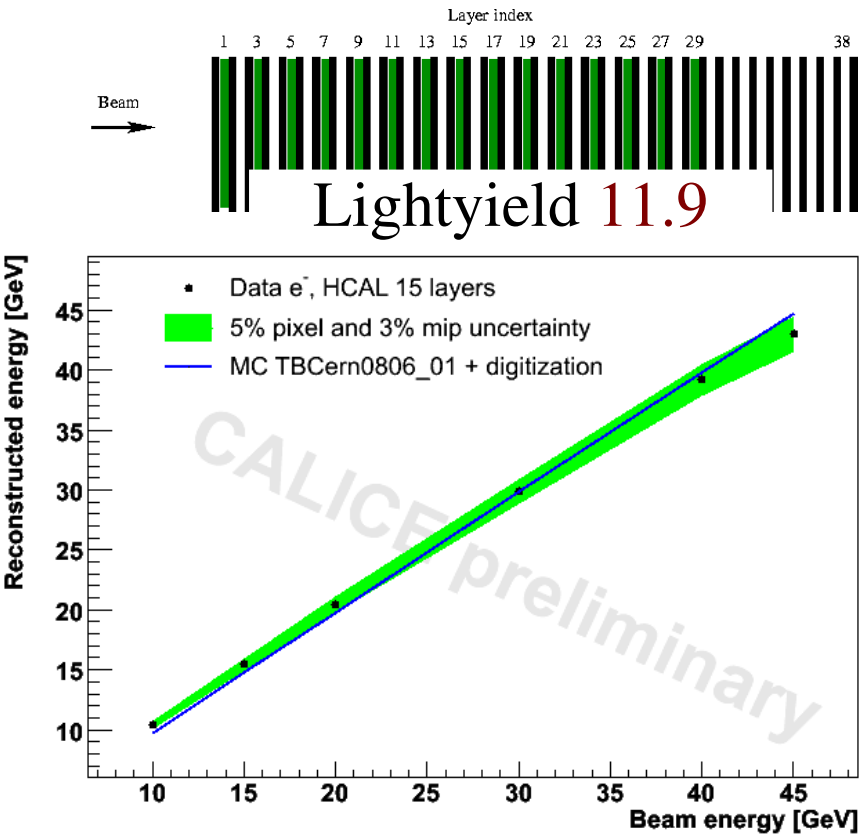
Saturation curve measured for each SiPM on test bench



Gain uncertainties affect only correction during energy reconstruction

2006 EM Data Conclusions



August 2006 data:

- 15 layers with double sampling
- Electrons from 10 to 45 GeV
- Benchmark analysis LCWS'07:
  - * calibration + sat. correction
  - * 'channel sum analysis'
  - * energy scale
  - * MC digitization

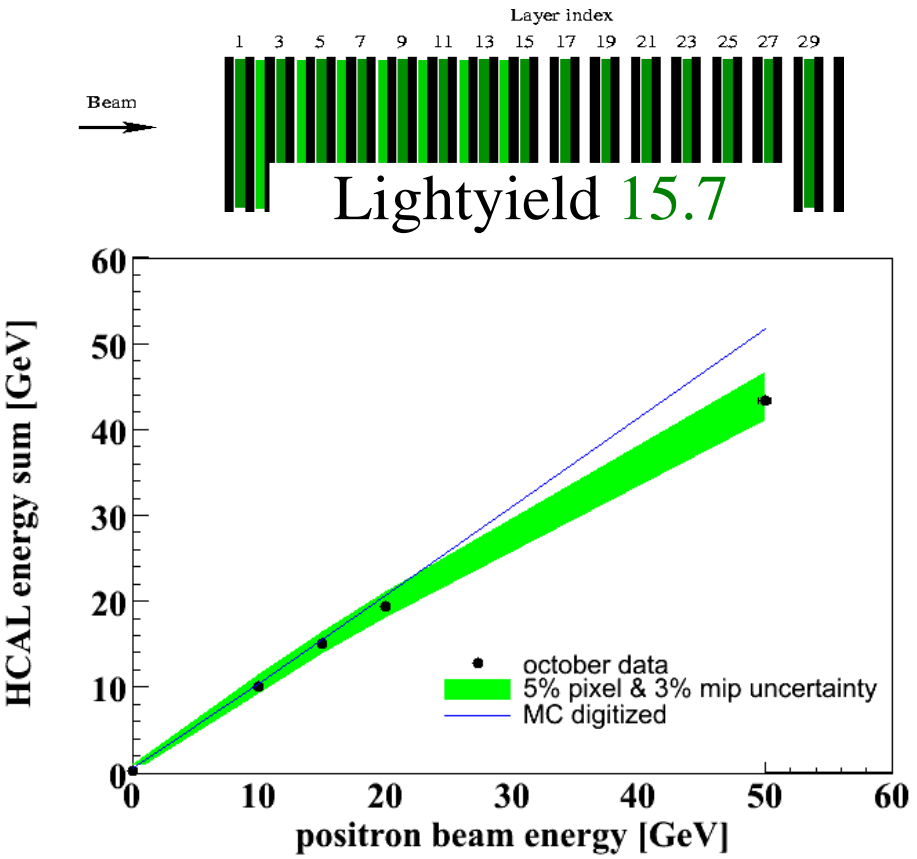
Data improvement wishlist:

- Instrumentation
- Lightyield / operation voltage
- About 1.1GeV noise energy

2006 EM Data Conclusions

October 2006 data:

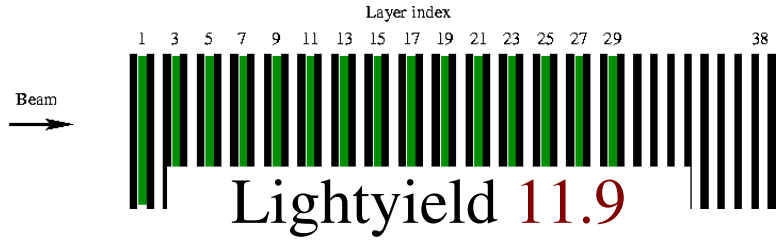
- Fill up instrumentation gaps from front, full instr. from EM point of view
- Positrons from 10 to 50GeV
- Adjust operation voltage to reach design lightyield of 15
- HW modification to eliminate coherent noise, reduced by about one order of magnitude



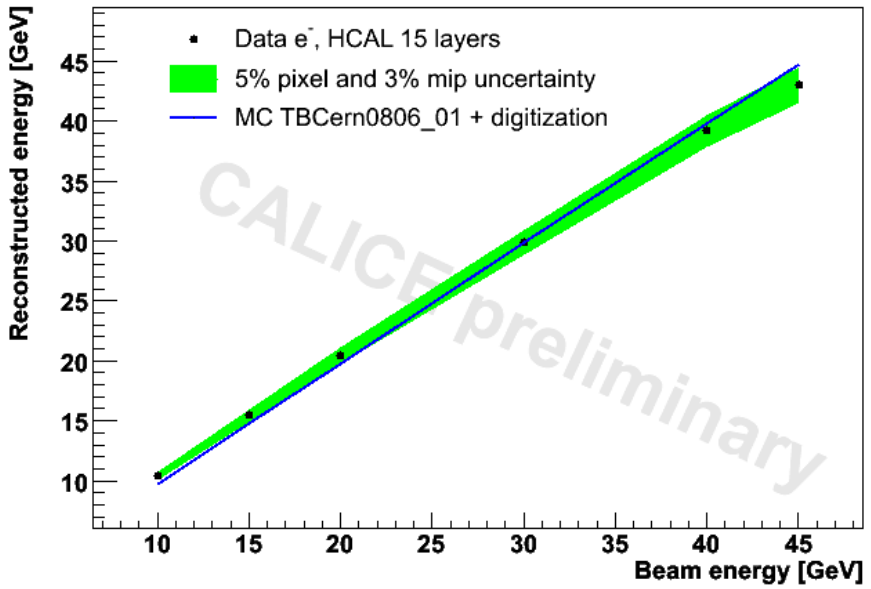
Also flaws:

- Big gap in beam energy

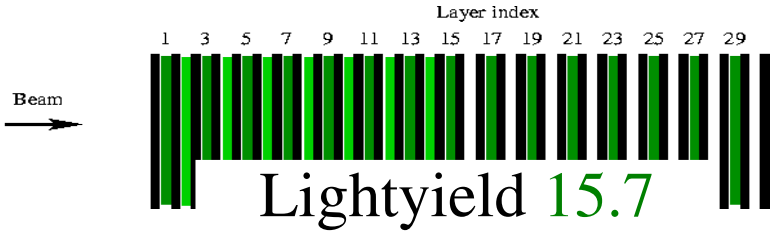
2006 EM Data Conclusions



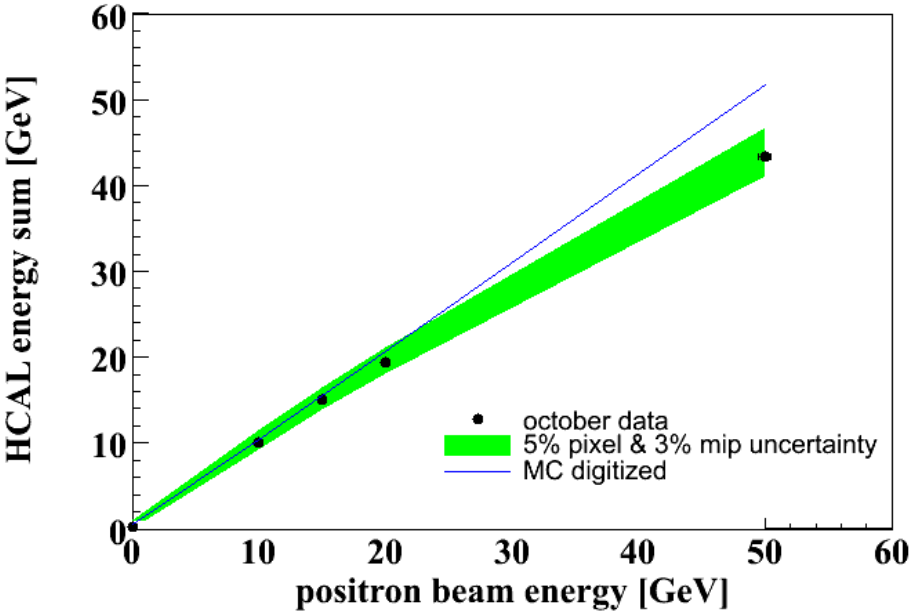
Lightyield 11.9



Aug. '06: 33.3 Mip/GeV
normal instrumentation



Lightyield 15.7



Oct '06: 32.4 Mip/GeV
normal instrumentation

Studies currently being wrapped up, but distraction is large...

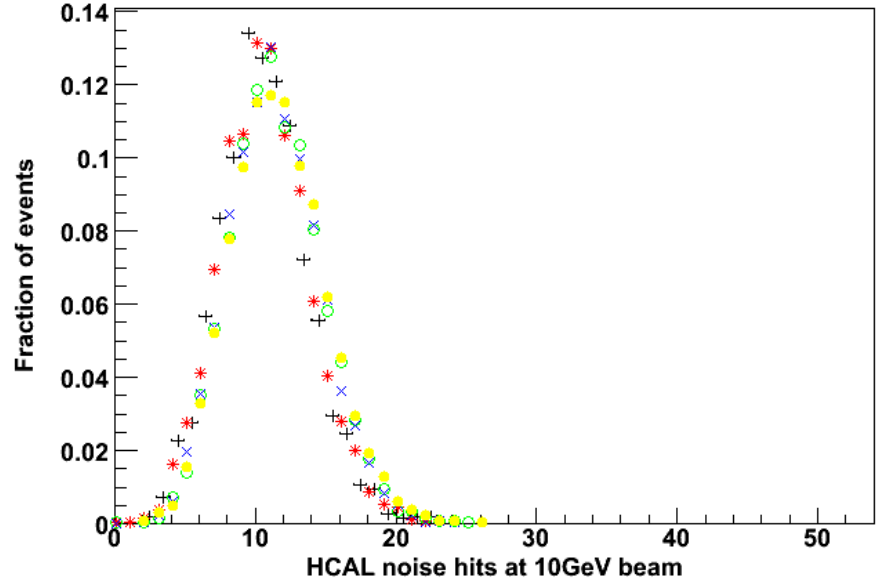
2007 Data Set

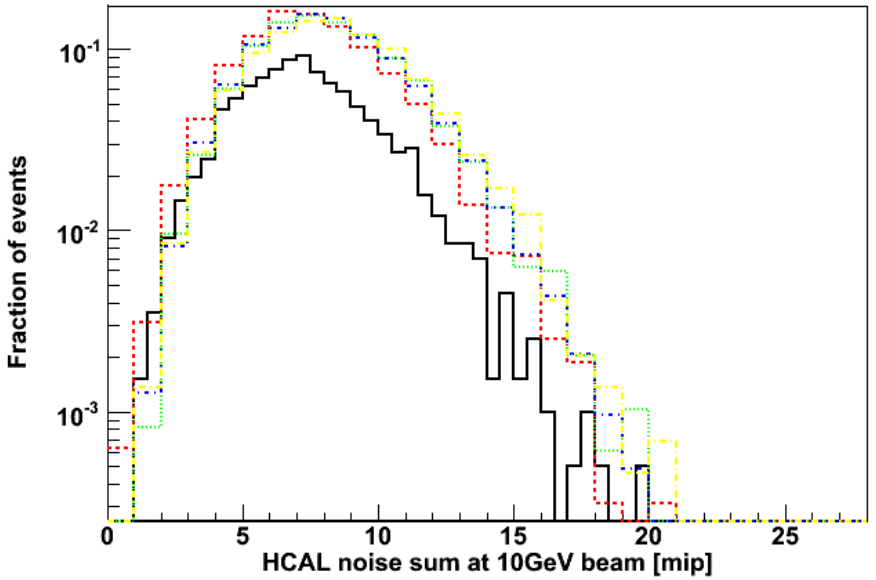
Full matrix in beam energy and incidence angle available,
often even with two stage positions

angle	0°		10°	20°		30°		
position	-8.8,6.2	0.0,0.0	0.0,0.0	0.0,0.0	-6.0,0.0	0.0,0.0	+6.0,0.0	-6.0,0.0
6 GeV								350392
10 GeV	350118	350144	350171	350247	350278	350320	350346	350385
15 GeV	350117	350145	350172	350245	350273	350317	350347	350387
20 GeV	350114	350140	350173	350244	350265	350316	350348	350389
25 GeV	350113		350191	350243	350264	350315	350349	
30 GeV	350132	350146	350190	350242	350263	350313	350350	
40 GeV	350110	350147	350172	350241	350262	350312	350351	
50 GeV	350128	350154	350173	350240	350261	350311	350352	

In the following: similar analysis with preliminary calibrations,
~5800 out of 7608 channels included

Noise Occupancy



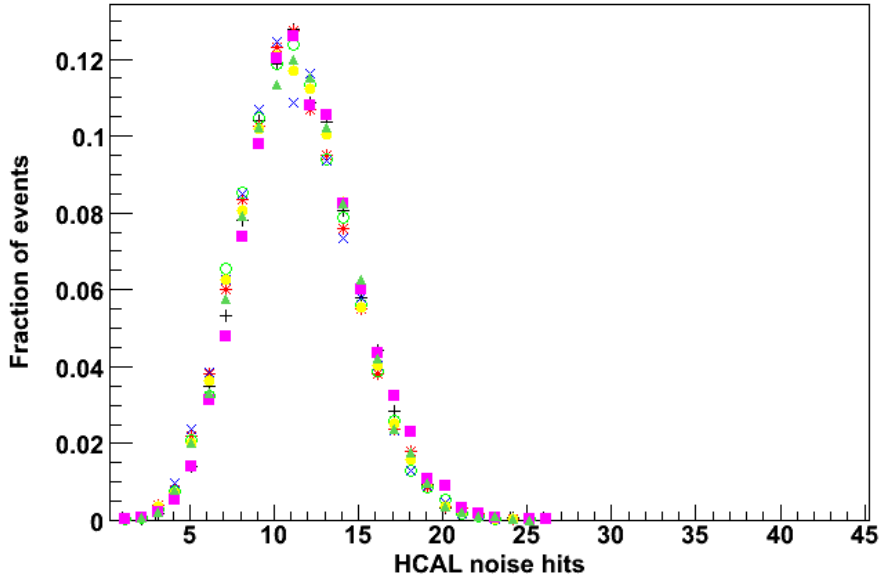


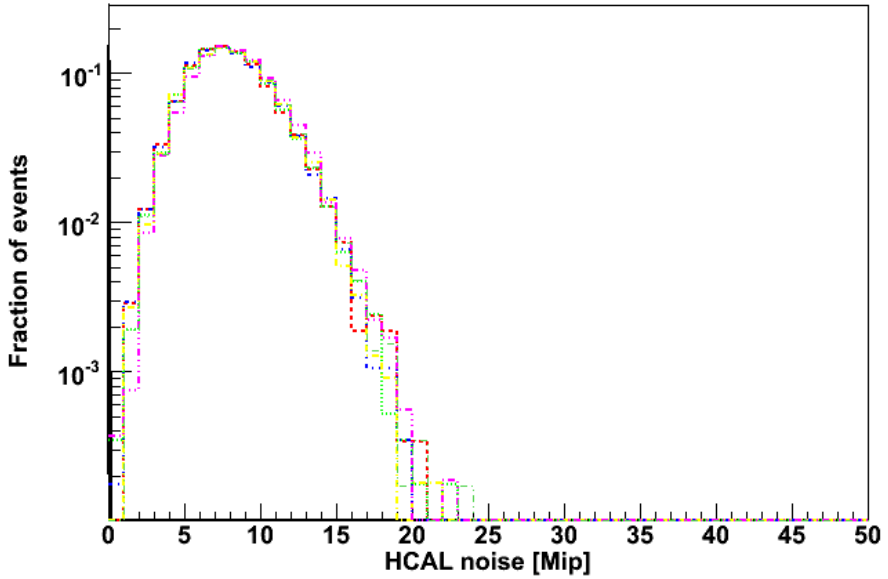
Stable noise conditions
– all angles at same energy
– all energies at same angle

On average 11 noise hits
in ¾ of the calorimeter

Total energy is about 8 Mip

Noise Occupancy





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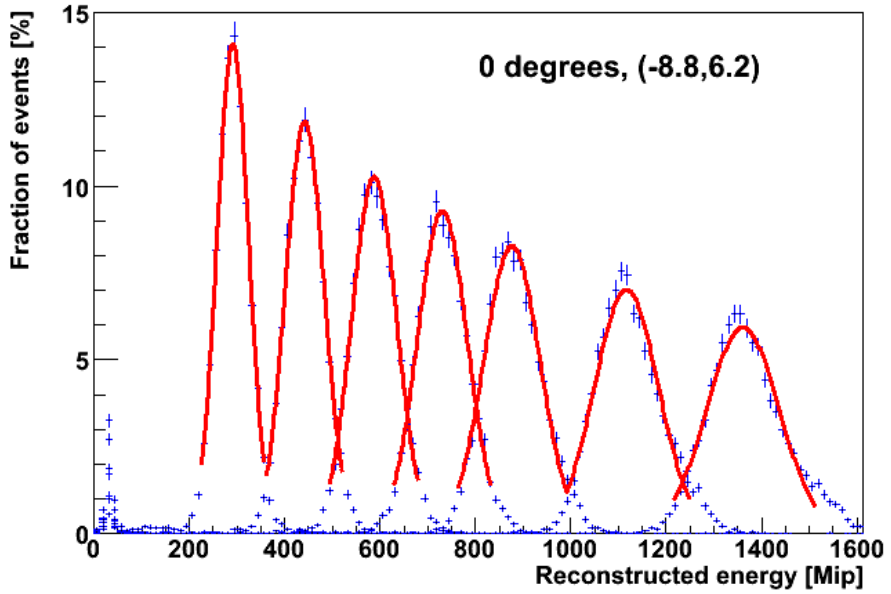
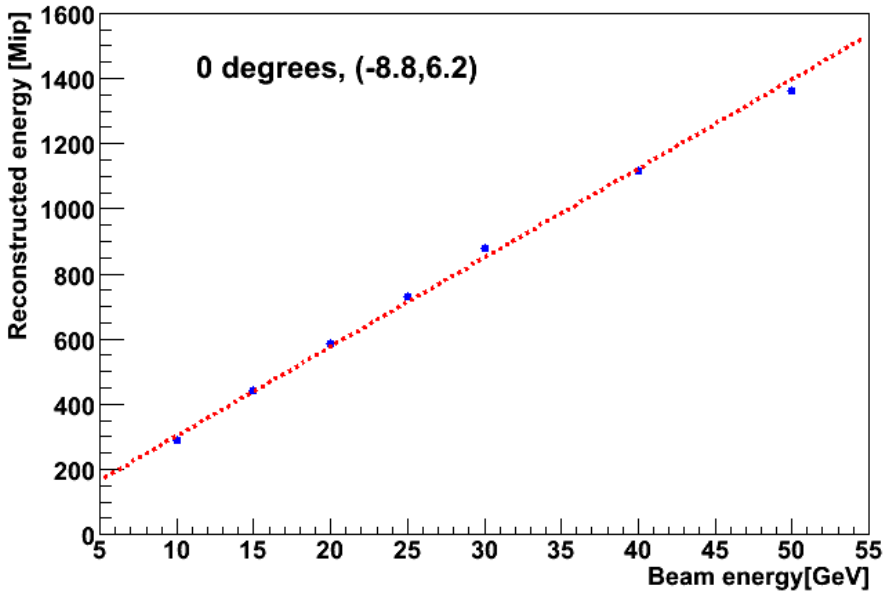
Energy Scale





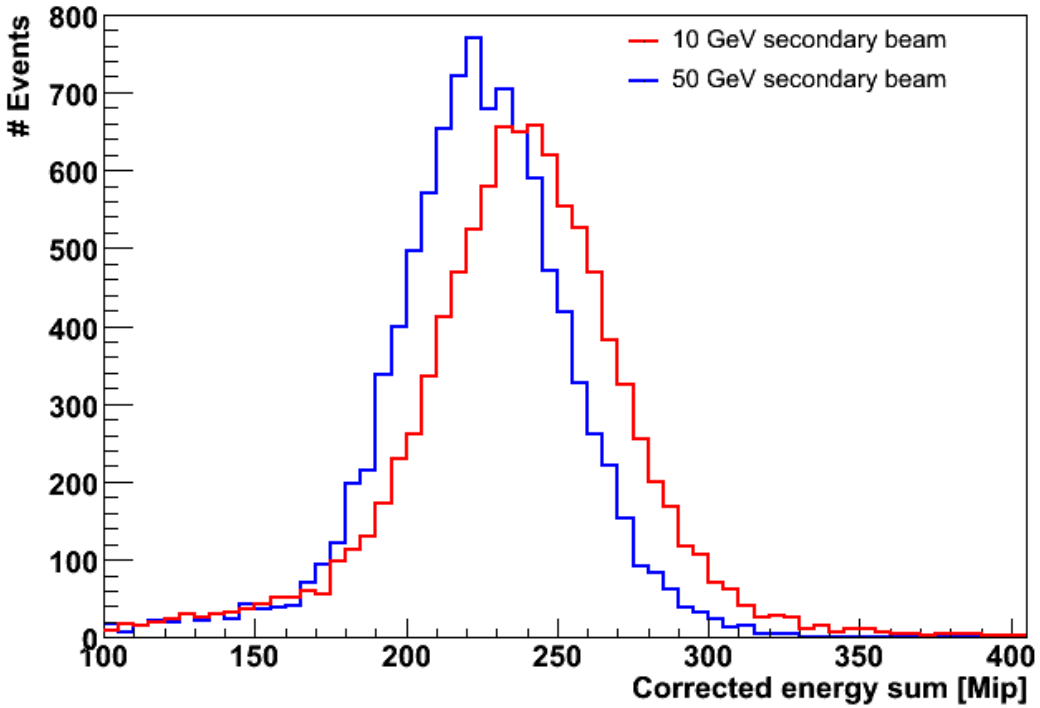
Very preliminary conversion factor from 20 GeV and 10 GeV beam

angle; pos.	GeV/mip	mip/GeV
0; -8.8,6.2	0.0336	29.76
0; 0.0,0.0	0.0307	32.57
10; 0.0,0.0	0.0287	34.84
20; 0.0,0.0	0.0266	37.59
20; -6.0,0.0	0.0289	34.60
30; 0.0,0.0	0.0298	33.56
average:	0.0297	33.65

Preliminary calibrations, sanity check only !!

What's up Next?

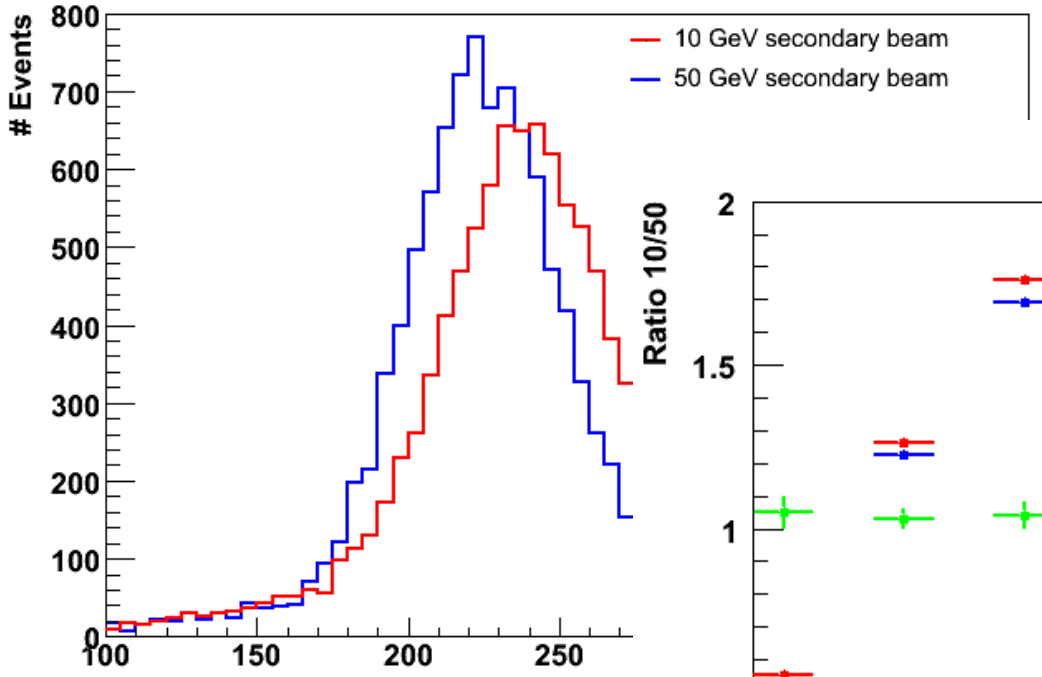
August '06: 10GeV e^- tertiary from 10GeV / 50GeV π^- secondary beam



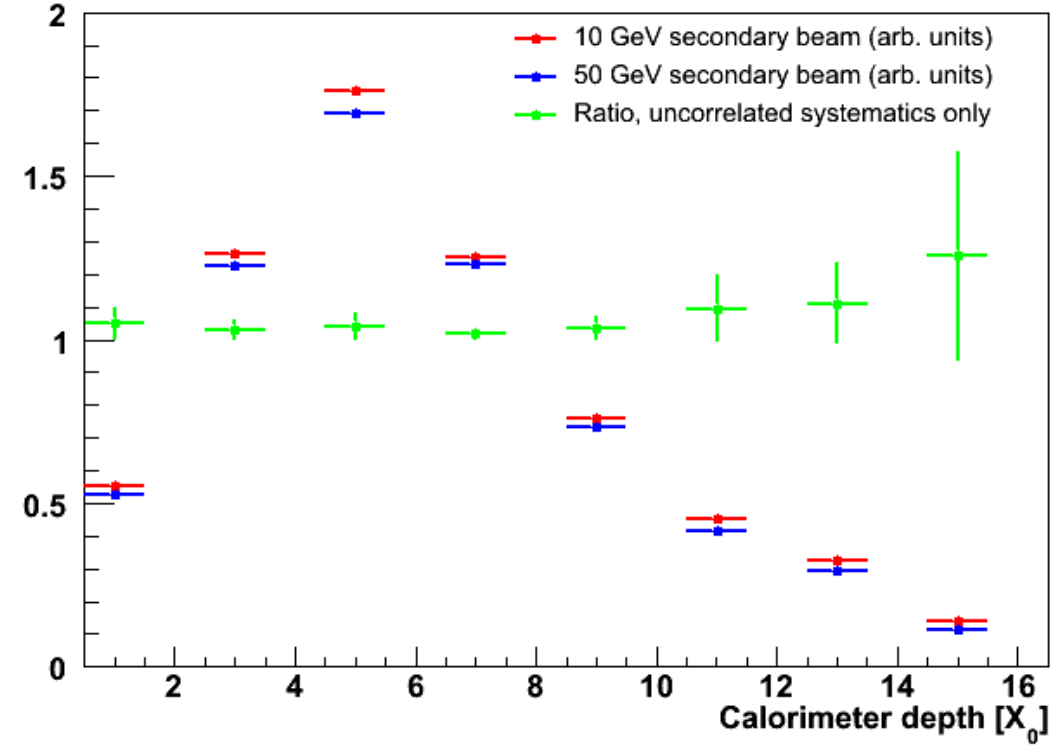
Data taken 2 days apart
with significant T change

What's up Next?

10GeV e from 10GeV / 50GeV pi in August 2006



No beam effect!
Pure calibration issue



Data taken 2 days apart
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Conclusions

August '06 data is 'reference sample', benchmark analysis LCWS'07

This is where the detector is best understood and where future correction procedures (temperature dependent calibrations, light cross-talk, dead cells, ...) have to be applied and varified first

On level of average calibrations, the detector is understood and under control for large band-width of conditions and operation modes

Complete set of average calibrations for 2007 not as simple as for 2006, but are available by now (see talk by B. Lutz)

Next steps are temperature dependent calibration and saturation corr.

More corrections in pipe to take full advantage of AHCal potentials