Electromagnetic Showers in the HCAL prototype 2007 testbeam data

- *Reconstruction*
- *Noise*
- *Data*
- *Resolution*

Nanda Wattimena - HCAL main meeting 19.12.2007

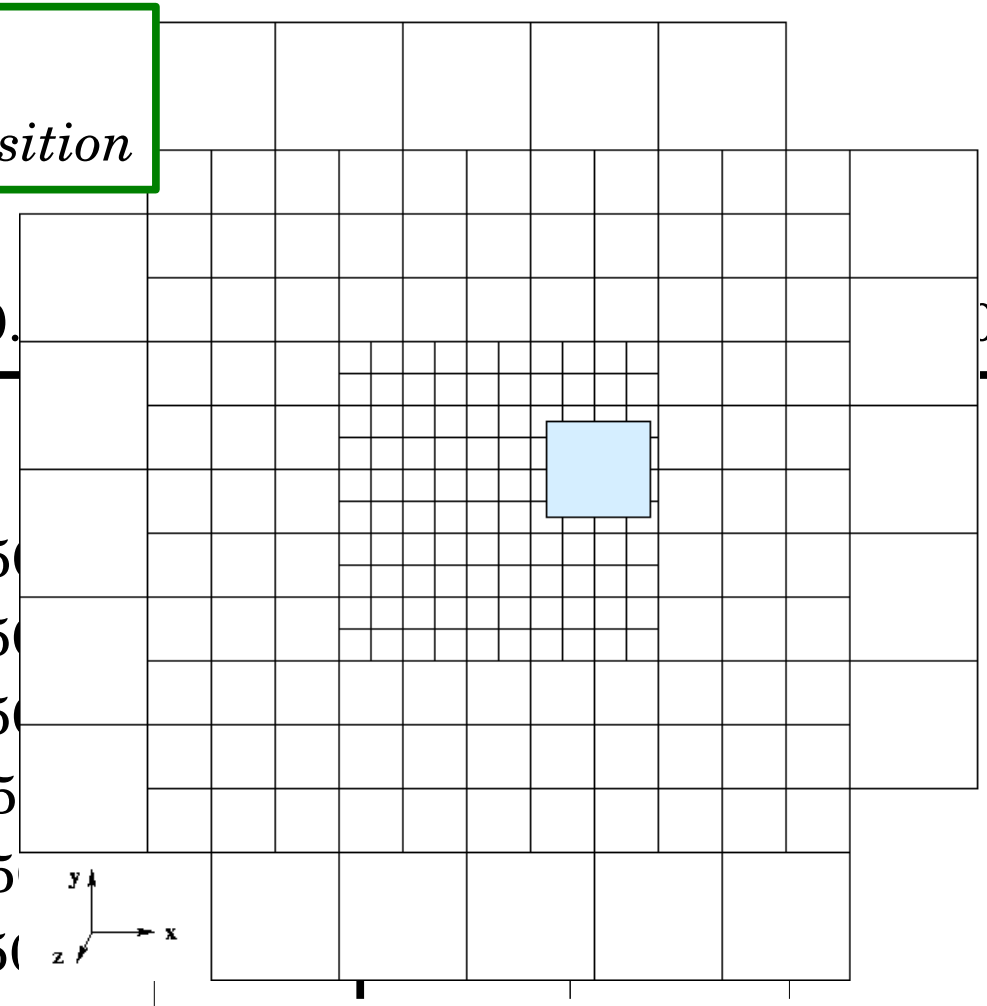
2007 Positron Data

angle:	0º		10º	20º		30º		
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	

2007 Positron Data

this talk:
0°; -8.8,+6.2 position

angle:	0º		10º	
position:	-8.8,6.2	0.0,0.0	0.0,0.0	0.
6 GeV				
10 GeV	350118	350144	350171	35
15 GeV	350117	350145	350172	35
20 GeV	350114	350140	350173	35
25 GeV	350113		350191	35
30 GeV	350132	350146	350190	35
40 GeV	350110	350147	350172	35
50 GeV	350128	350154	350173	350240



⊙ *beam in z-direction*

Reconstruction

official software framework (`flcini caliceSoft`)

- `MyIntegratedHcalCalibrationProcessor`
- mapping from `cd_calice_cernbeam_XXX`
- calibration data from `cd_calice/Hcal/abc*/Preliminary`

collect first 10,000 selected events

(`B`, `S`, `Ch`, `10x10` on; `P`, `Ca`, `O`, `100x100` off)

cutting at 0.5 MIP

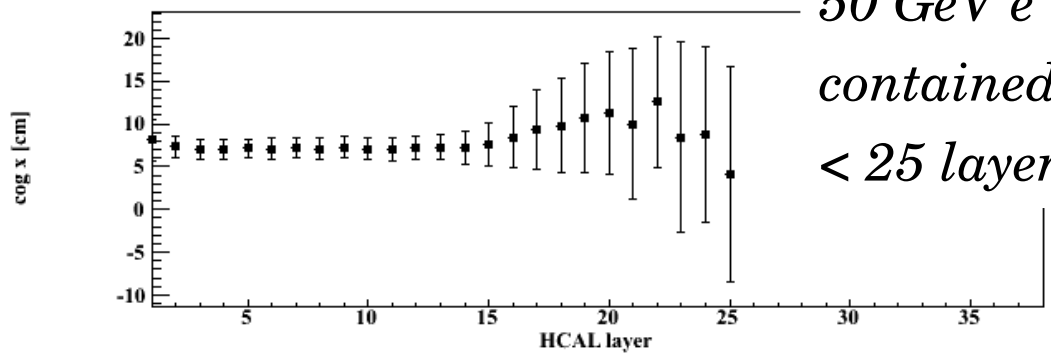
no temperature corrections

assume 5% systematic error due to calibration uncertainties

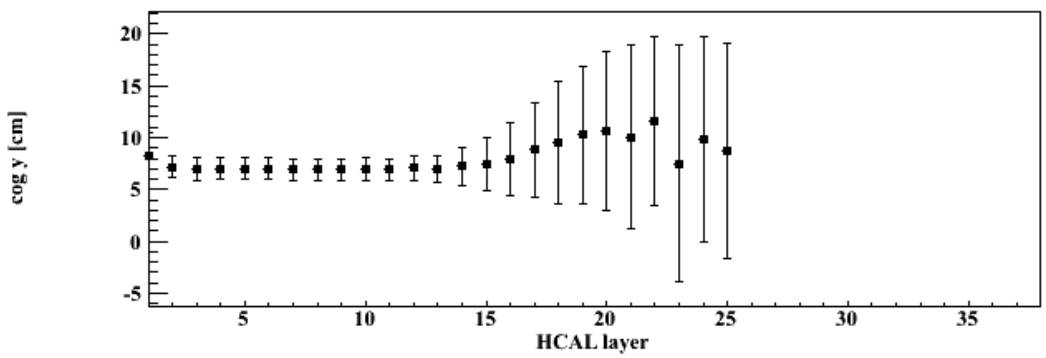
- fit energy sum from -2 to +2 sigma

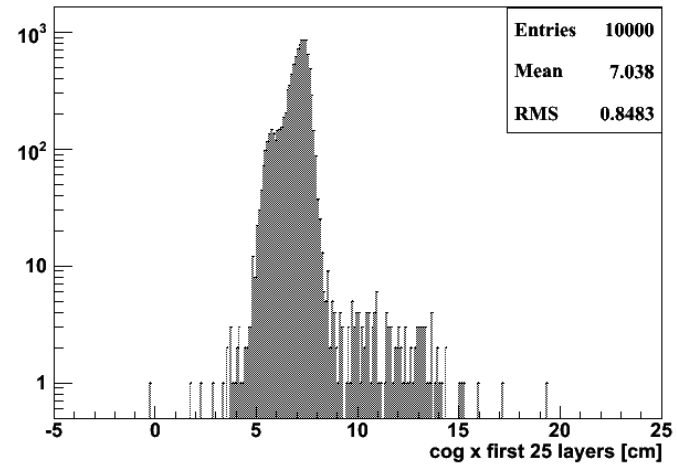
`* Gain / Inter / MIP`

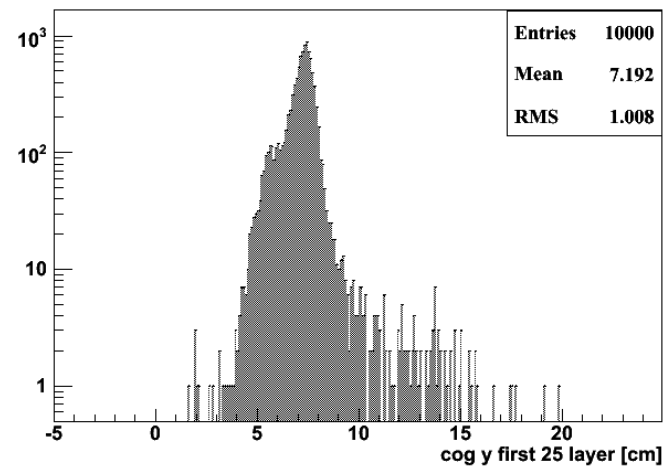
Beam Profile



50 GeV e^+ shower contained in < 25 layers

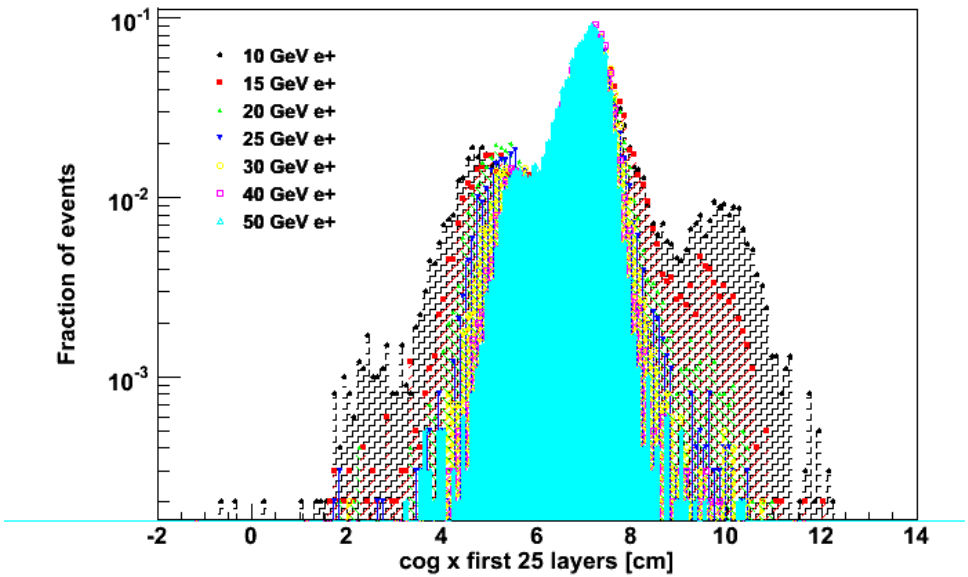


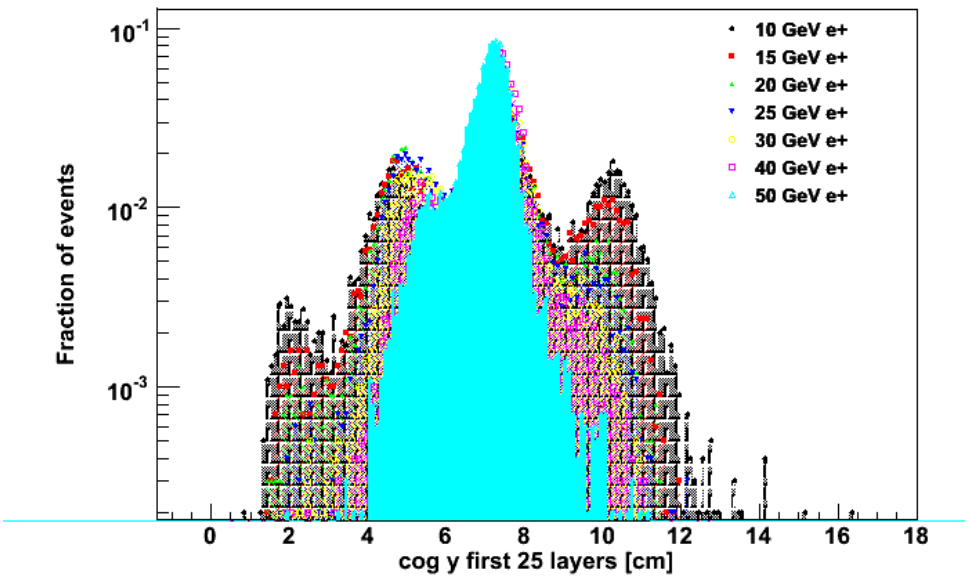




	cog_x [cm]		*cog_ y* [cm]	
	mean	*RMS*	*mean*	*RMS*
first 25	*7.04*	*0.85*	*7.19*	*1.01*
first10	*7.24*	*1.33*	*7.12*	*1.18*

Beam Profile





E_{beam}	cog_x	RMS	cog_y	RMS
10 GeV	7.88 cm	2.70	7.50 cm	2.25
15 GeV	7.46 cm	2.17	7.23 cm	1.64
20 GeV	7.10 cm	1.85	7.04 cm	1.36
25 GeV	7.09 cm	1.65	7.05 cm	1.18
30 GeV	7.27 cm	1.22	7.11 cm	0.94
40 GeV	7.24 cm	1.33	7.12 cm	1.18
50 GeV	7.11 cm	1.45	7.11 cm	1.08

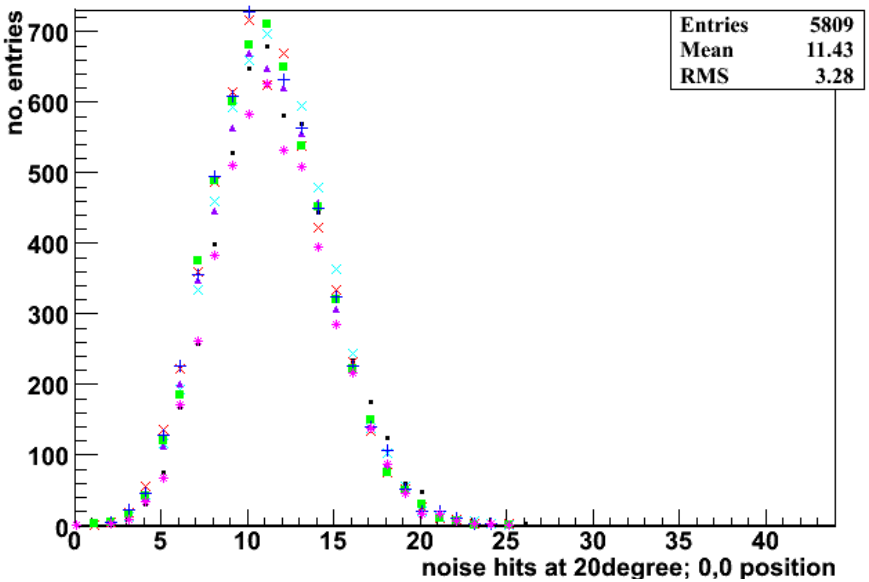
cog in the first 10 layers stays constant but beam profile gets broader for lower beam energies

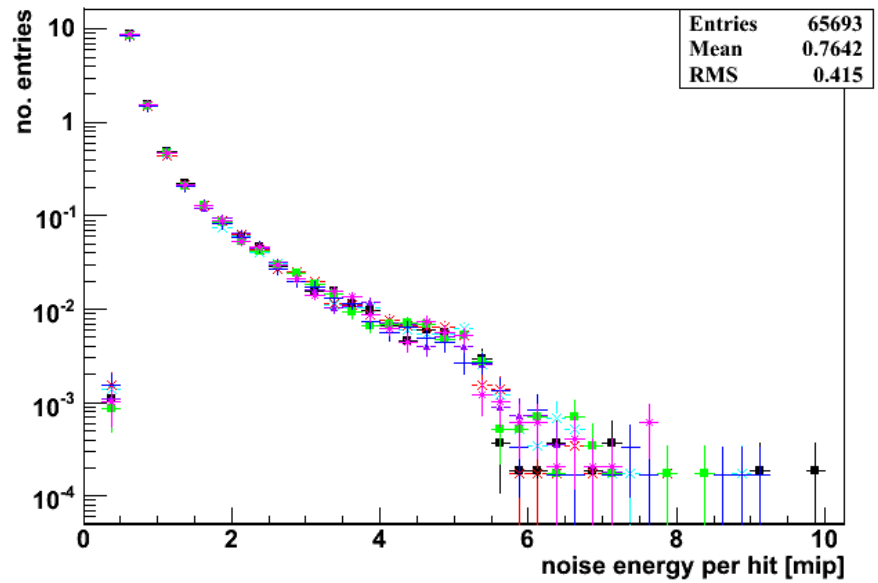
Uncalibrated channel

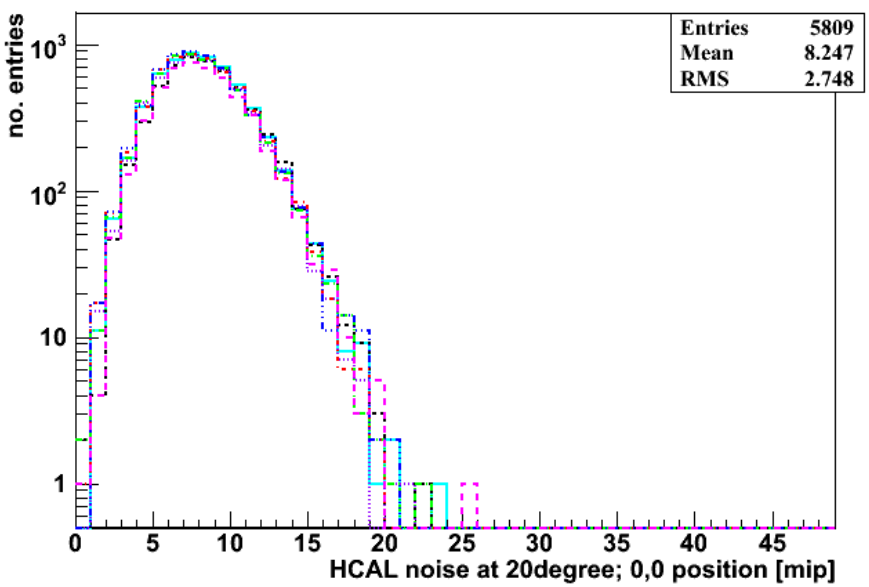
- *118 channels (out of 7608 = 1.6 %)*
  without MIP calibration
- *13 channel (out of 1292 = 1.0 %)*
  within region of interest
  (4x4 tiles per layer covered by 10x10 trigger
  *+ 1 tile to each side ($R_M \approx 2.5$ cm) * 38 layer)*
- *5 channel (out of 850 = 0.6 %)*
  within the first 25 layers of this region

➪ *Not many, but not corrected for!*

Noise







stable noise conditions for all energies:

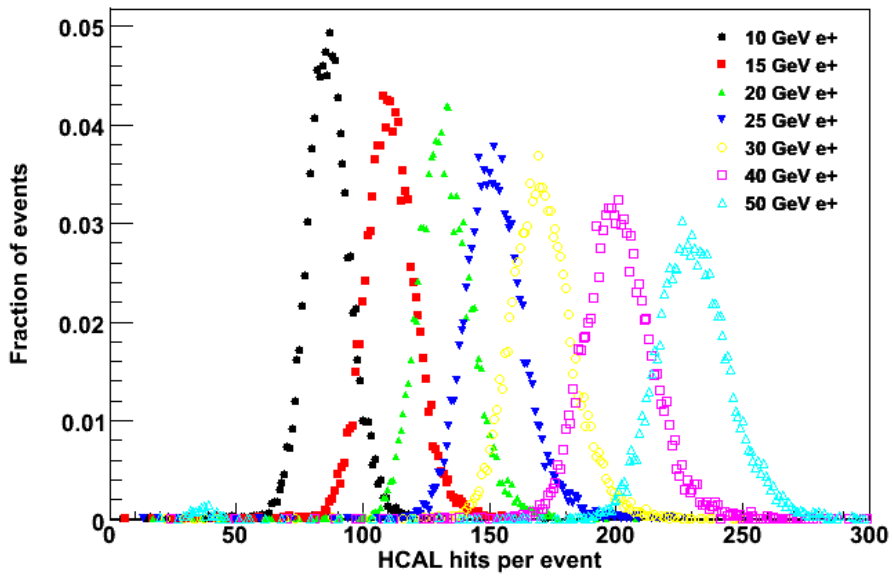
~11 noise hits per event above 0.5 mip

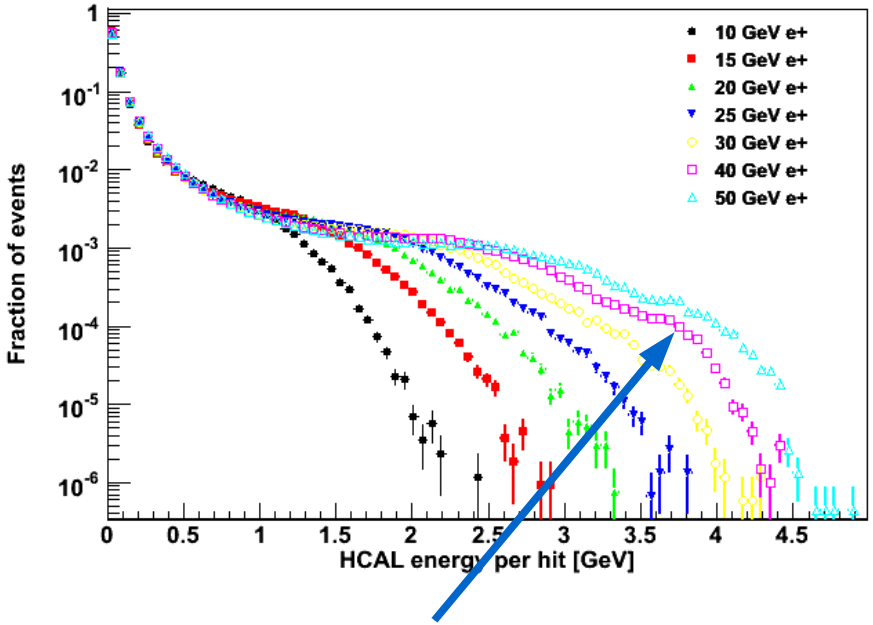
with mean energy of ~0.8 mip per hit

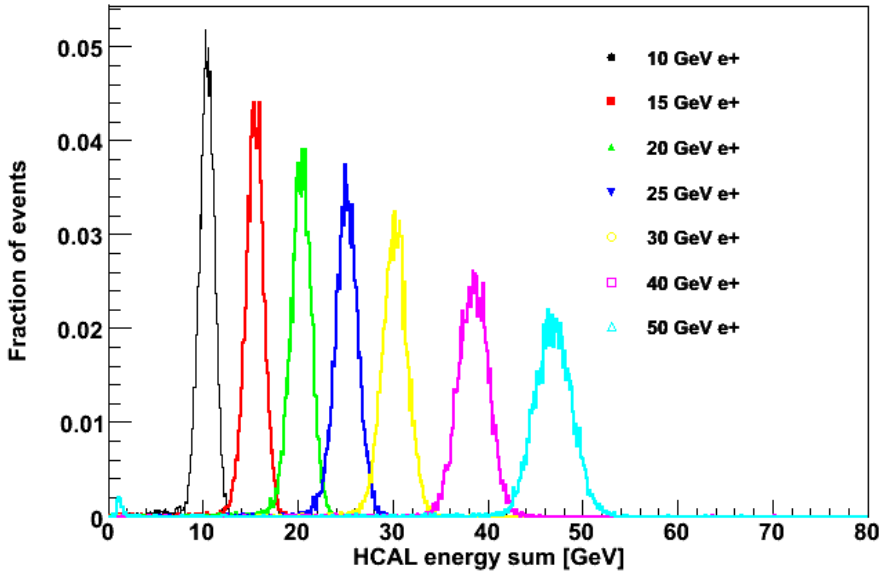
-> ~8 mip ≈ 280 MeV noise

in the full detector

Data

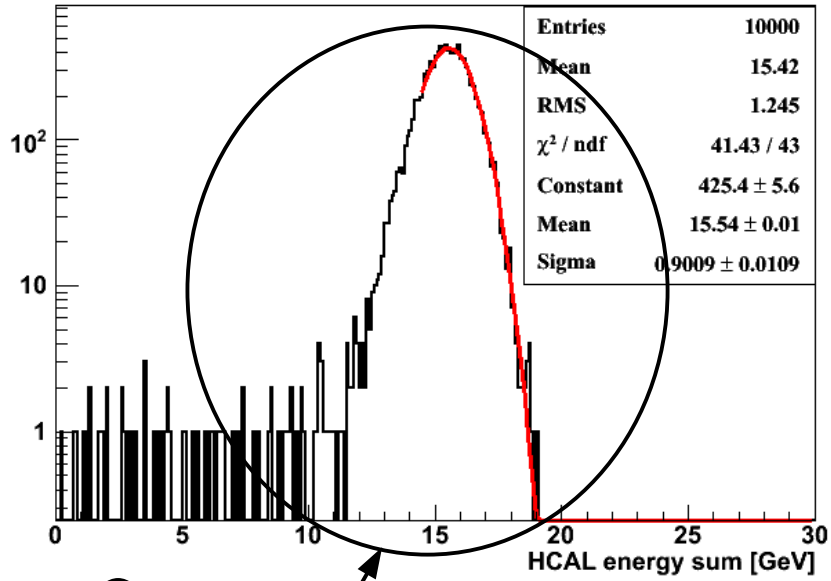


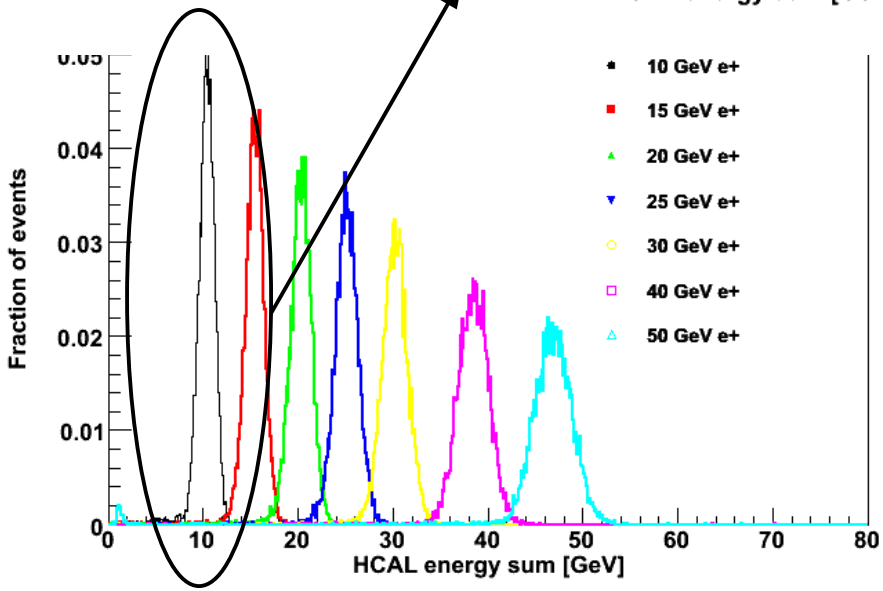


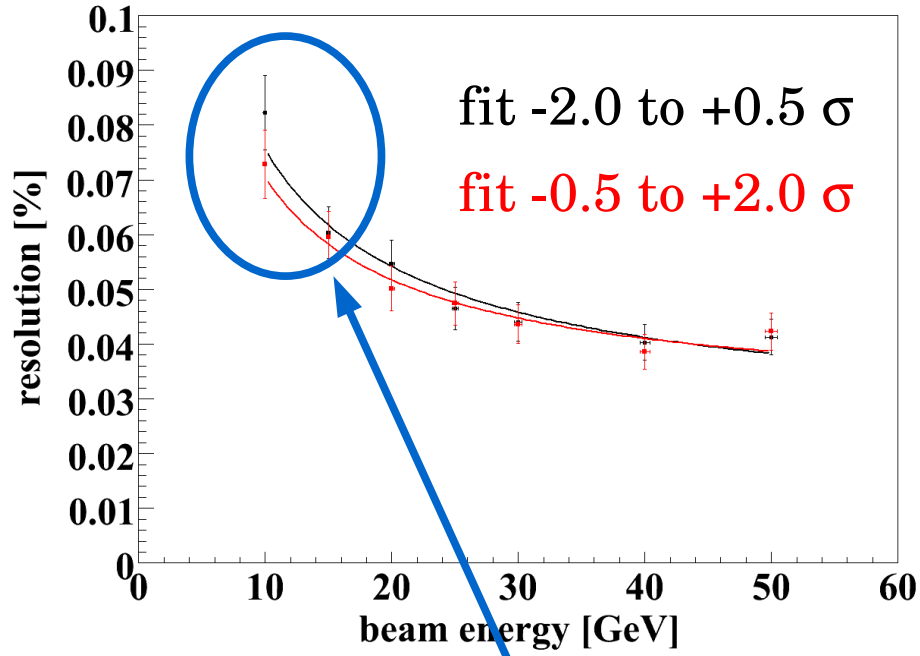


- *still saturation effects visible for high energies*
- *slightly asymmetric energy sum for low energies (tail to the left; pion contamination?)*

Data

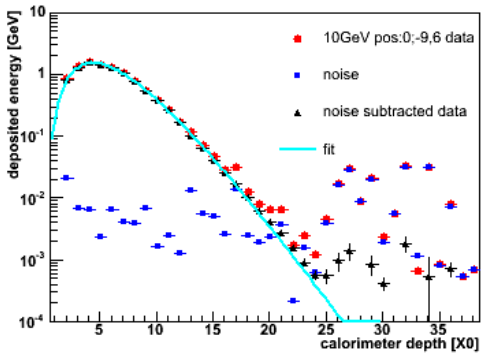


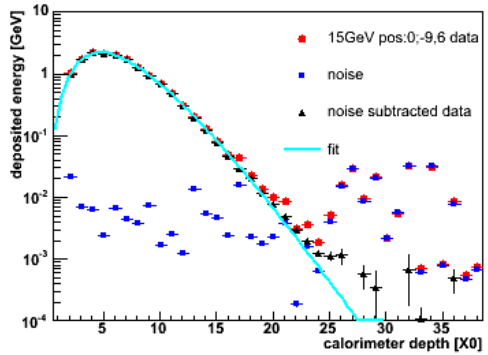


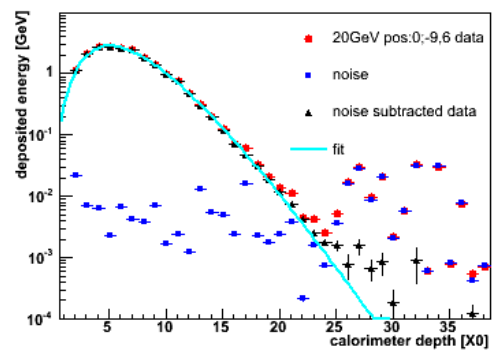


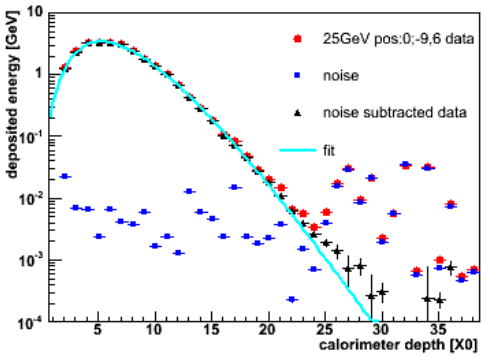
- *still saturation effects visible for high energies*
- *slightly asymmetric energy sum for low energies (tail to the left; pion contamination?)*

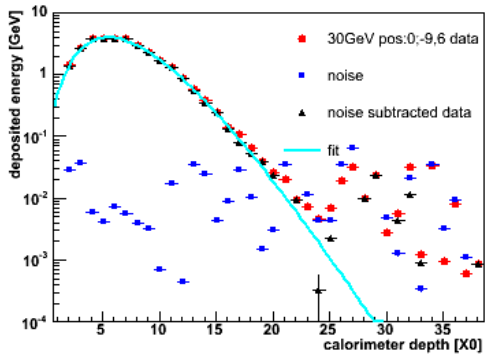
Longitudinal Profiles

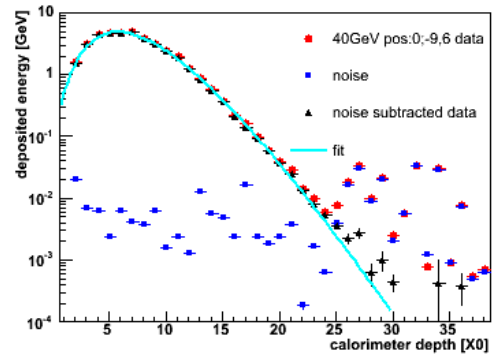


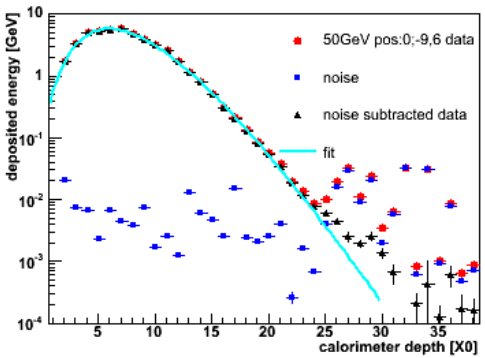




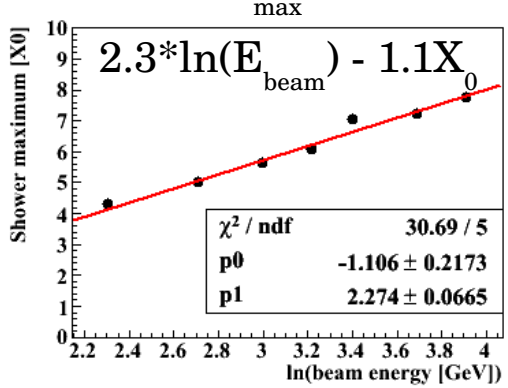


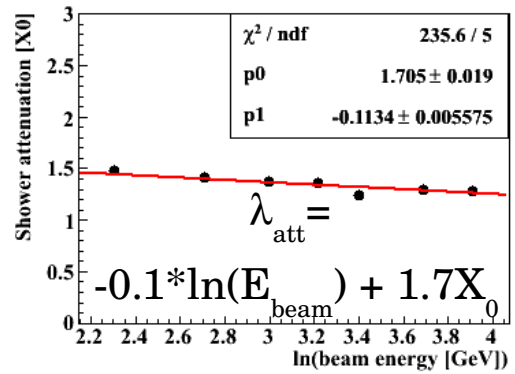




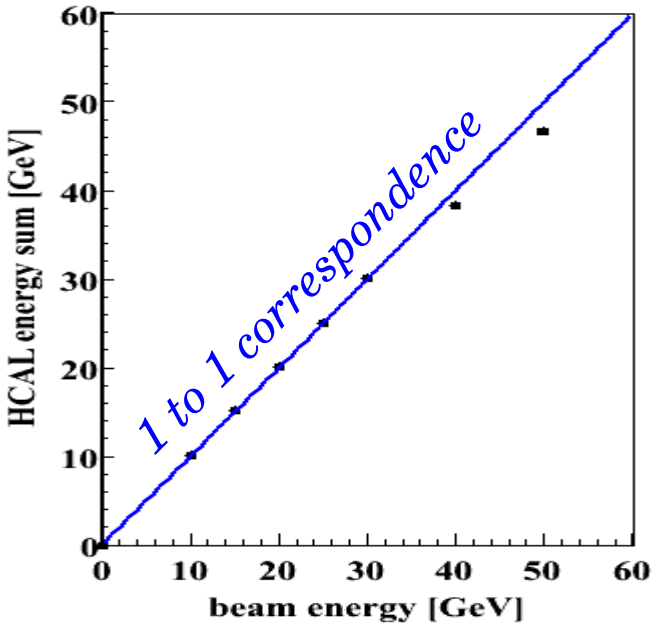


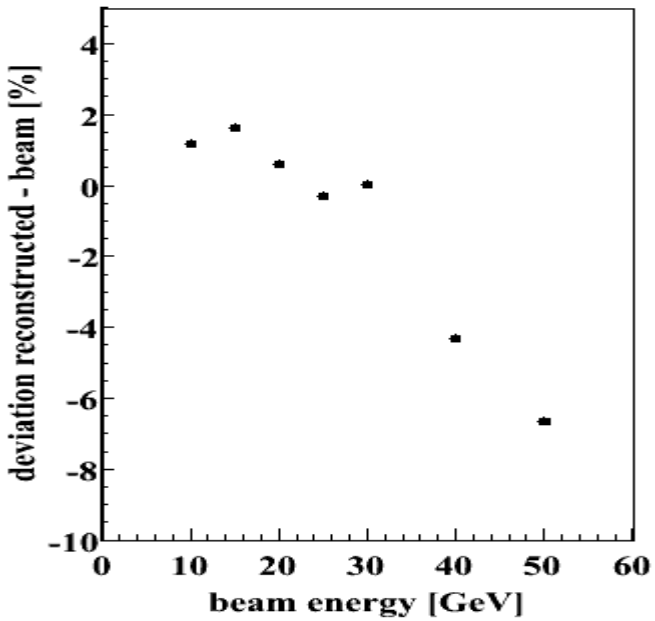
$t_{max} =$





Linearity





Sampling Fraction:

- 1mip = 0.0308GeV
- 1GeV = 32.5mip

fixed by 20GeV – 10 GeV ≙ 10 GeV

linearity better:

- *8% for 50GeV* e^+
- *2% for ≤ 30GeV* e^+

Resolution

Fit to prototype data only:

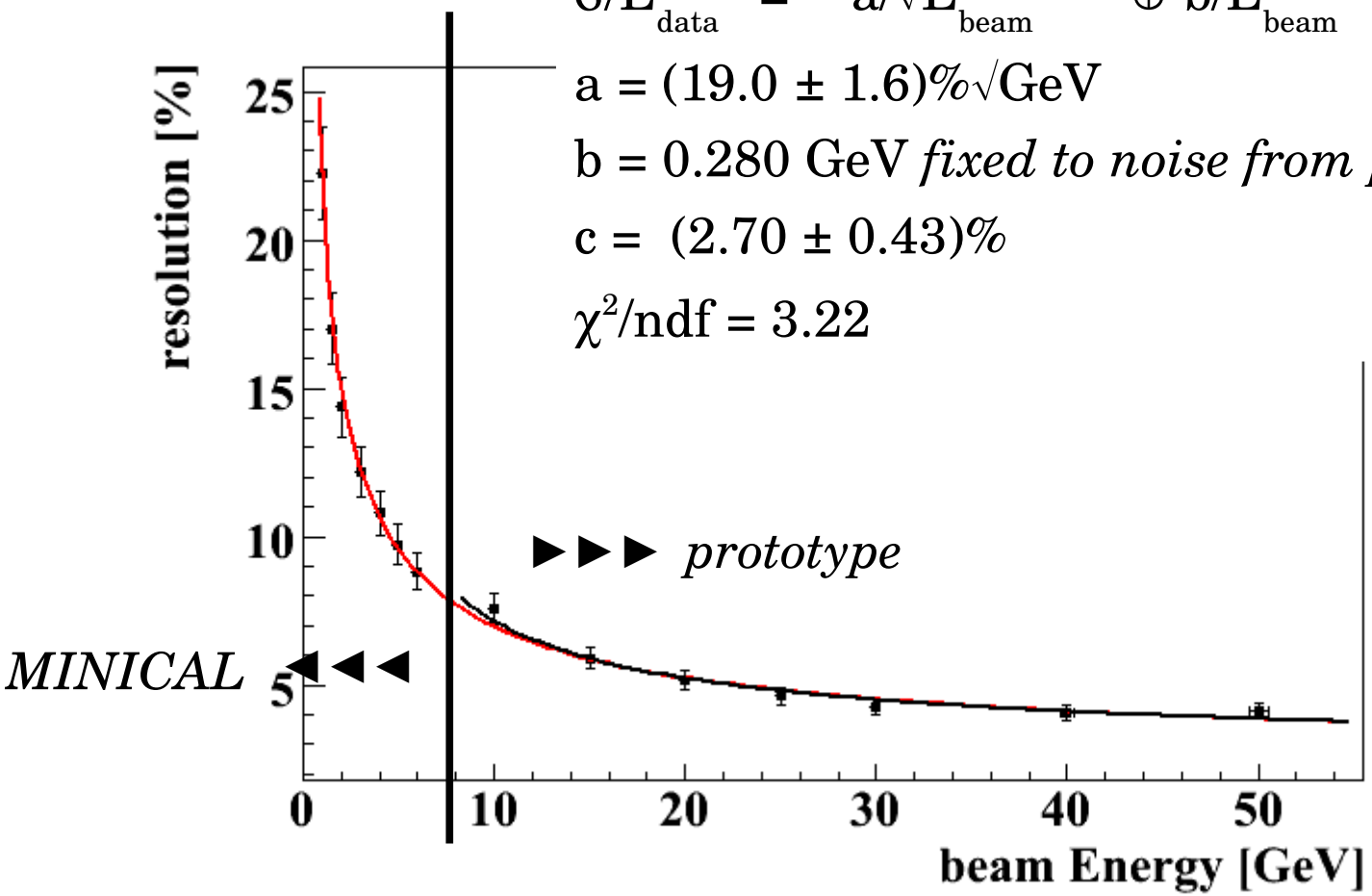
$\sigma/E_{data} = a/\sqrt{E_{beam}} \oplus b/E_{beam} \oplus c$

$a = (19.0 \pm 1.6)\%\sqrt{GeV}$

$b = 0.280$ GeV *fixed to noise from pedestal measurement*

$c = (2.70 \pm 0.43)\%$

$\chi^2/ndf = 3.22$



Summary & Outlook

- *analysis of 2007 positron data with official software possible*
- *results look promising*
- $\sigma/E_{data} = (19 \pm 1.6)\ \%\sqrt{GeV}\ /\ \sqrt{E_{beam}} \oplus b\ /\ E_{beam} \oplus (2.70 \pm 0.43)\%$

with noise fixed to b = 0.28GeV

(MINICAL: $\sigma/E_{data} = (20.7 \pm 0.7)\%/\sqrt{E_{beam}} \oplus (2.66 \pm 1.33)\%$)

- *can be improved by:*
  - *better event selection / only analyse relevant volume (-> noise reduction)*
  - *treatment of missing saturation curves / calibration data*

Next:

- *MC comparison (not yet available)*
- *T correction (-> Alex talk)*
- *rotated data analysis*
- ...