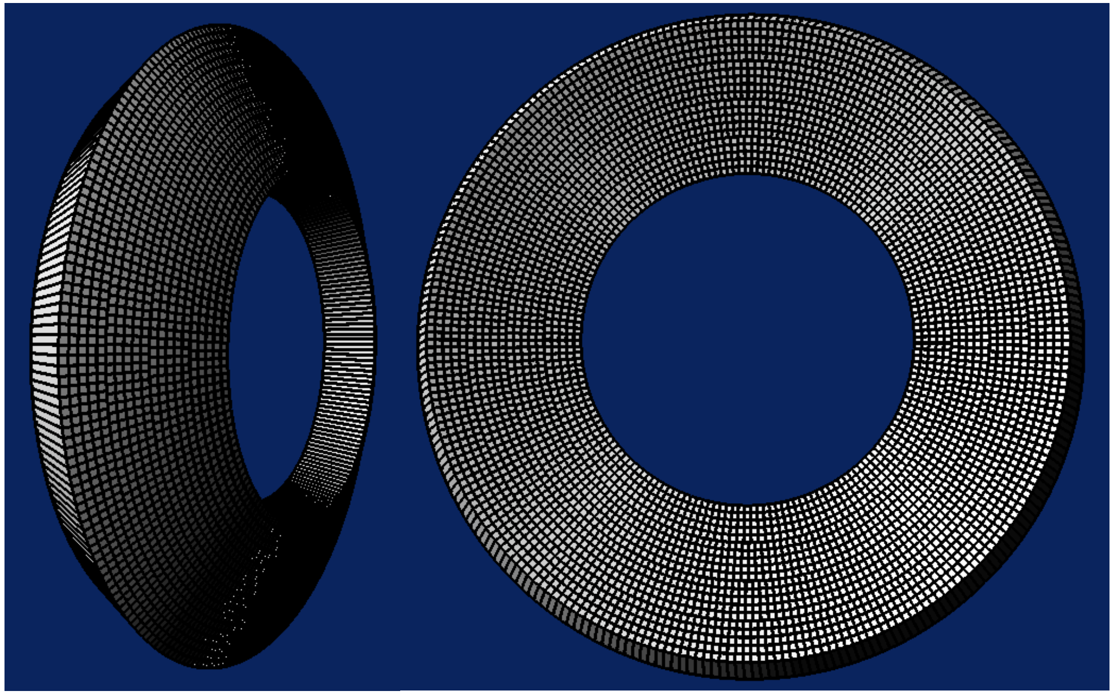
Fwd ECAL Parameterisation (for e/γ)

SuperB Computing Workshop
Frascati
16/12/08



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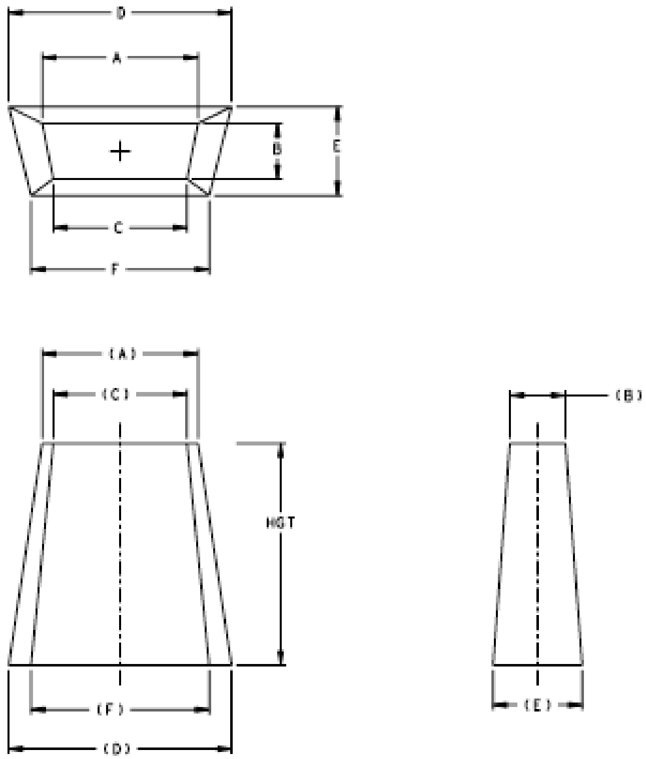
Crystals Dimensions

LSO crystas

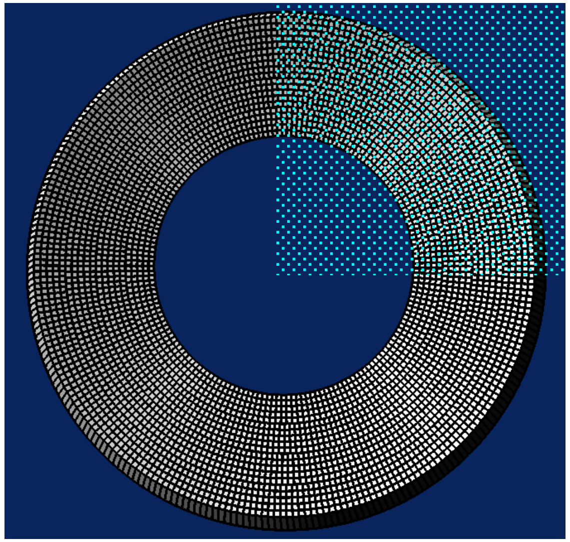
- depth: 20 cm ~17.5 X_0
- Crystas arranged in 20 rings within 5x5 modules

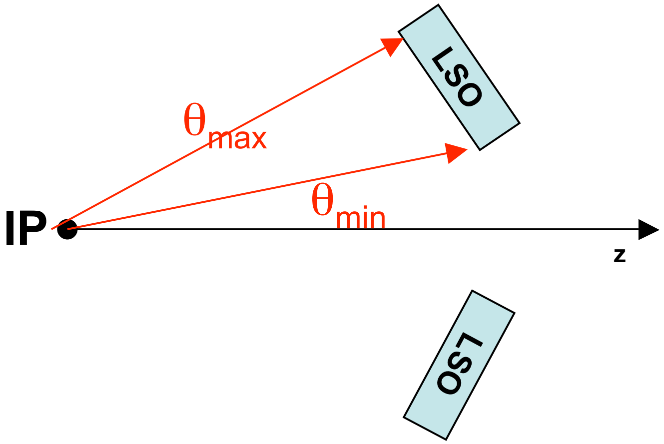
Group	Ring	A	B	C	D	E	F
175 Xtals/Ring 35 Modules	1	19.48	23.12	18.72	21.37	25.65	20.52
	2	20.26	23.12	19.50	22.23	25.65	21.38
	3	21.04	23.12	20.28	23.09	25.65	22.25
	4	21.82	23.12	21.05	23.96	25.65	23.11
	5	22.60	23.12	21.83	24.82	25.65	23.97
205 Xtals/Ring 41 Modules	6	19.92	23.12	19.27	21.95	25.65	21.22
	7	20.59	23.12	19.94	22.68	25.65	21.96
	8	21.25	23.12	20.60	23.42	25.65	22.70
	9	21.92	23.12	21.27	24.16	25.65	23.43
	10	22.58	23.12	21.93	24.89	25.65	24.17
235 Xtals/Ring 45 Modules	11	20.25	23.12	19.68	22.38	25.65	21.75
	12	20.83	23.12	20.26	23.02	25.65	22.39
	13	21.41	23.12	20.84	23.66	25.65	23.03
	14	21.99	23.12	21.42	24.31	25.65	23.67
	15	22.57	23.12	22.00	24.95	25.65	24.32
265 Xtals/Ring 53 Modules	16	20.51	23.12	20.00	22.71	25.65	22.15
	17	21.02	23.12	20.52	23.28	25.65	22.72
	18	21.54	23.12	21.03	23.85	25.65	23.29
	19	22.05	23.12	21.55	24.42	25.65	23.86
	20	22.57	23.12	22.06	24.99	25.65	24.43

4400 Crystals



Generated beams



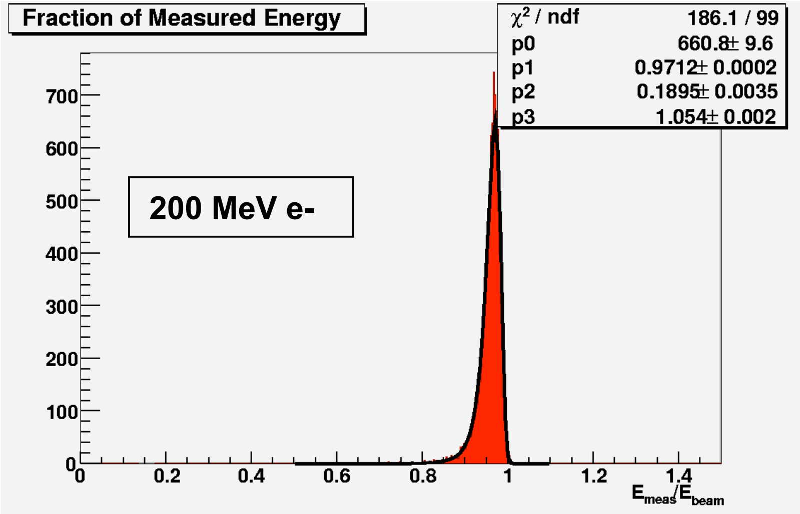


- Particles:
  - e- γ
- Energies:
  - 50, 100, 200, 350, 500, 750, 1000, 2000, 5000, 7000 MeV
- Surface:
  - Particles uniformely distribuited in one quandrant between θ_{min} - θ_{max}
- Primary vertex position:
  - Interaction point (x=y=z=0)

Energy Reconstruction

Algorithm:

1. Get Xtal deposited energy
2. Perform Poisson smearing with 8k pe/MeV
   - Value obtained by measurements in PG and Caltech
3. Assign 1% calibration error to crystals
   - Reconstruct with 8k±1% pe/MeV
4. Apply minimum energy cut for each xtal
   - 1 MeV to be tuned
5. Sum Xtal energy



Comments:

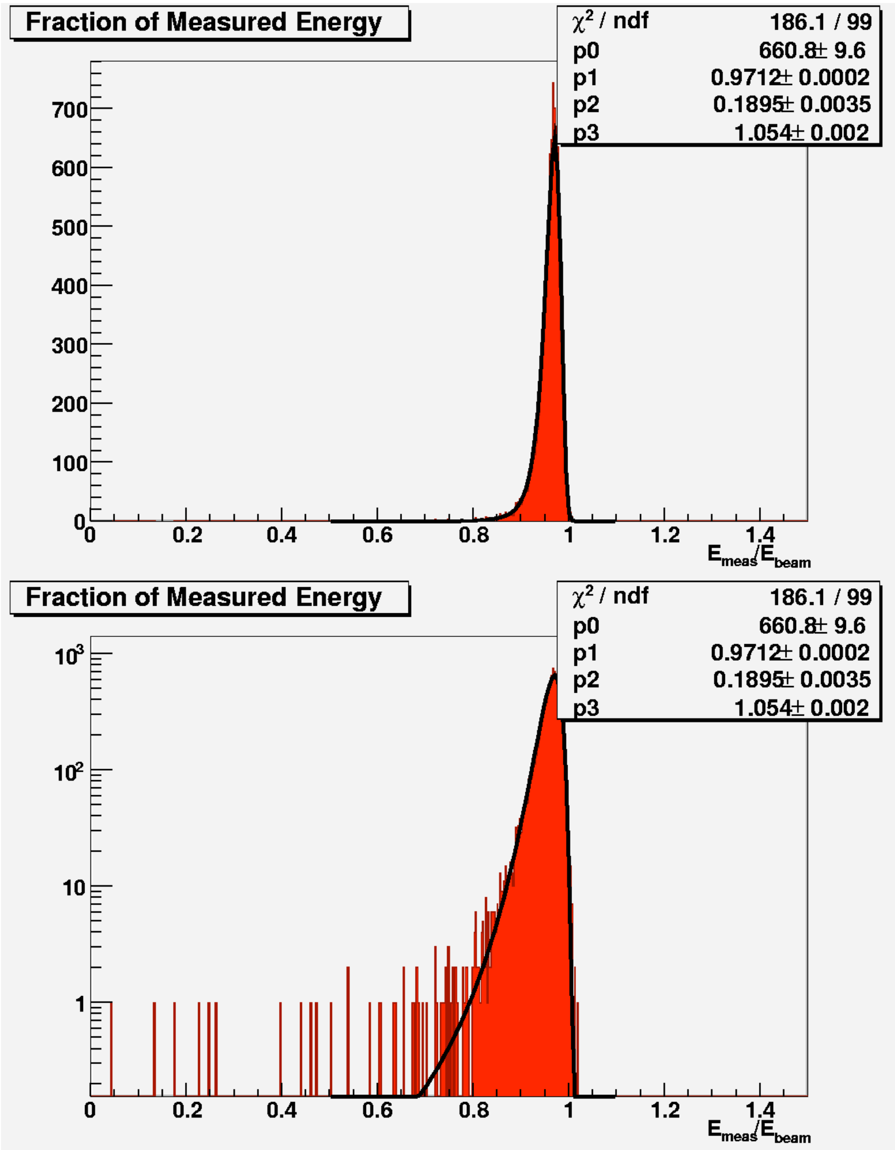
- All distributions have asymmetric low energy tails
  - Backsplash for low E particles
  - Forward leakege for high E particles
- Energy distributions fit with asymmetric Gauss function: $\sigma = \sigma(E)$
- Proposed parameterisation uses fit of p1,p2,p3 vs Energy

$$F(x) = P_0 e^{-\frac{(x-P_1)^2}{2[P_2(P_3-x)]^2}}$$

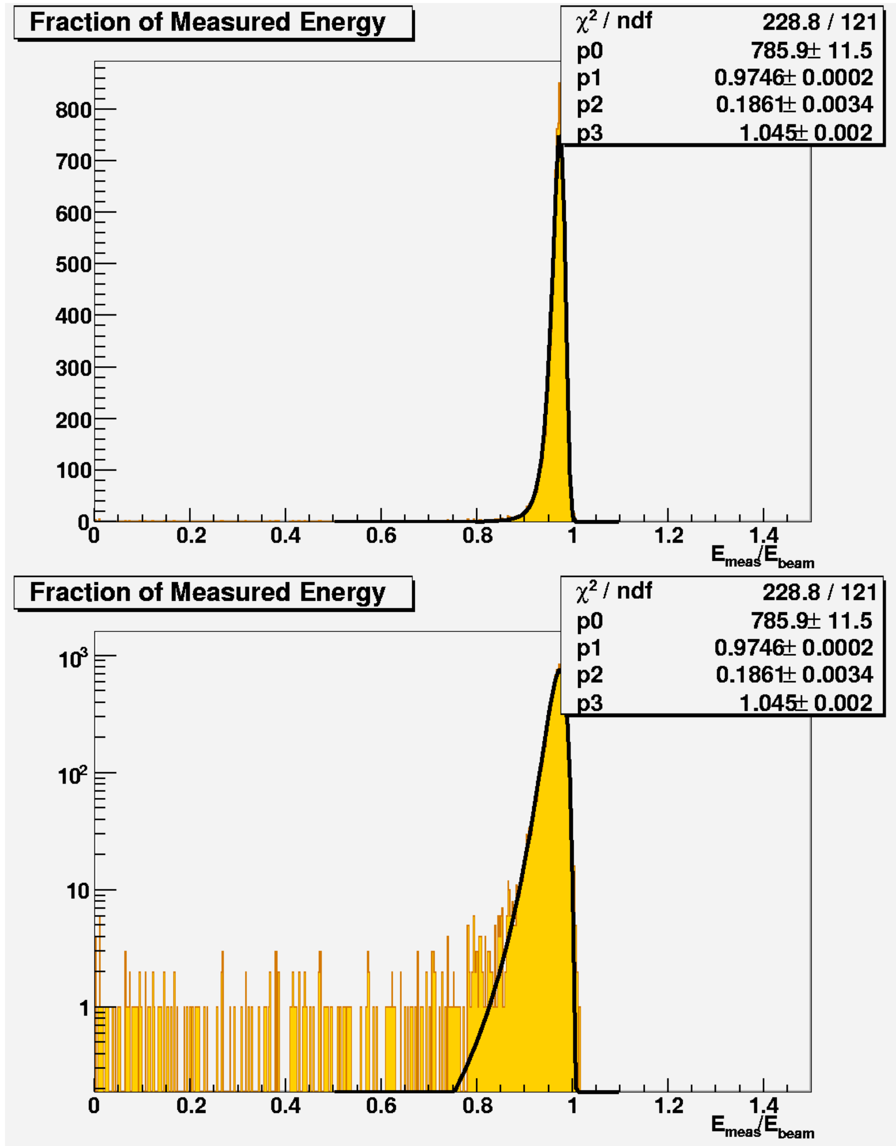
- •P1 : most probable value (mpv)
- •P2(P3-x) : running σ

Energy distribution examples

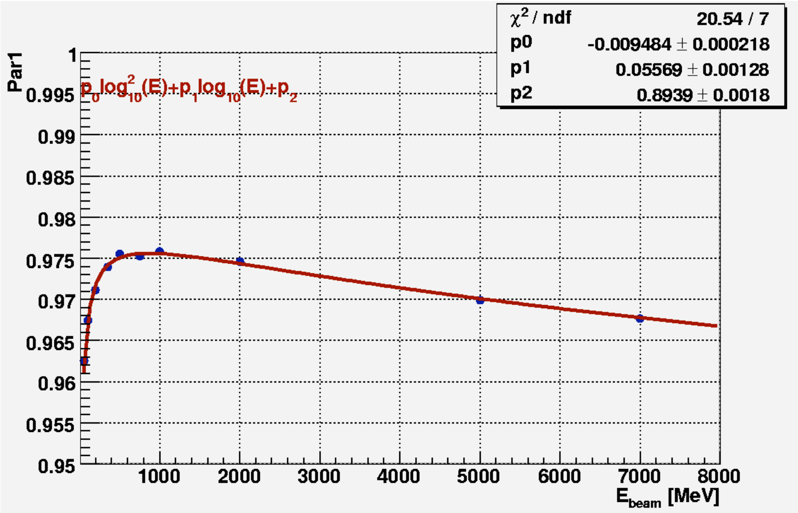
200 MeV e-

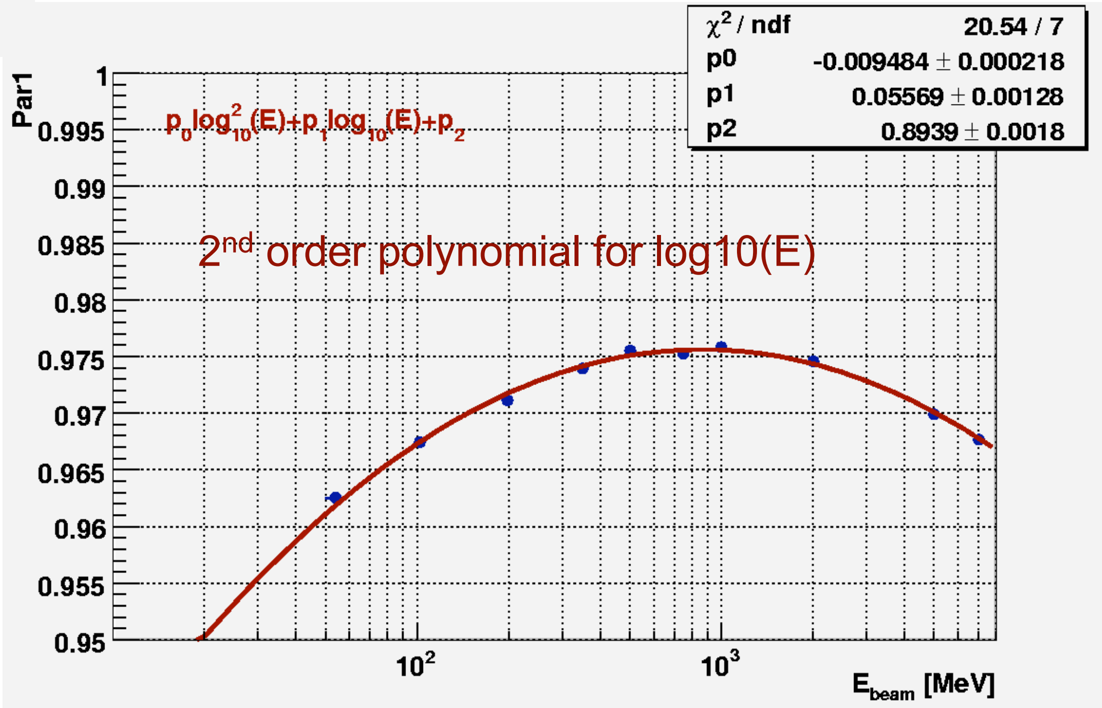


2 GeV e-

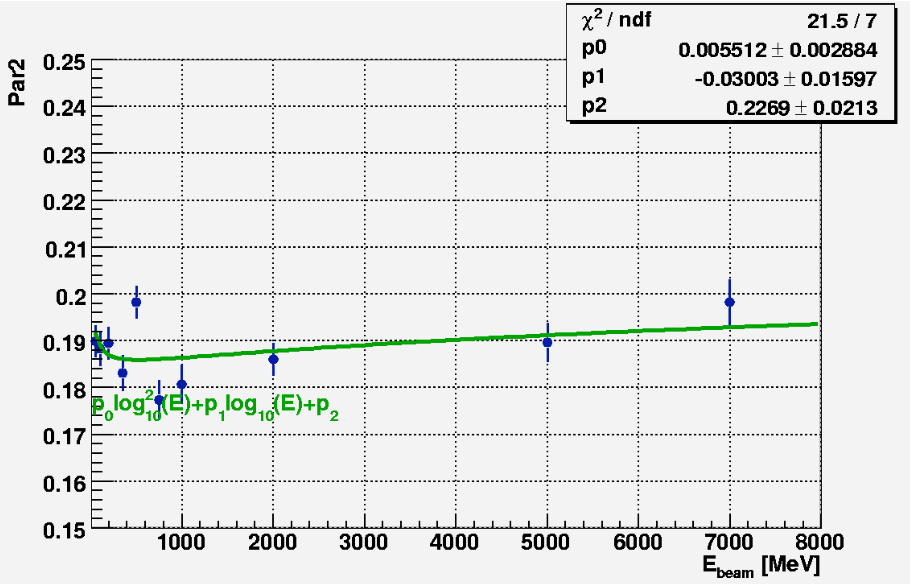


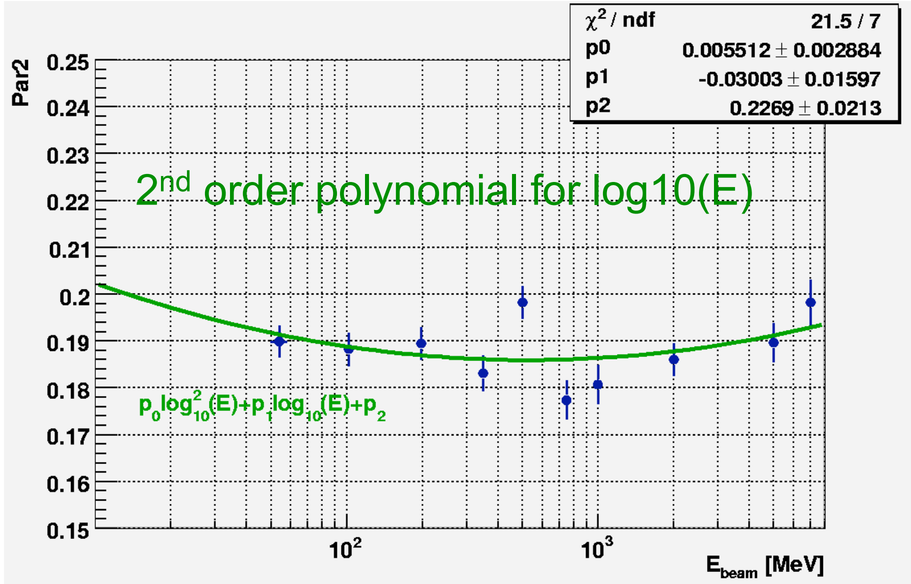
Emeas Fit par1(mpv) vs Energy: e-

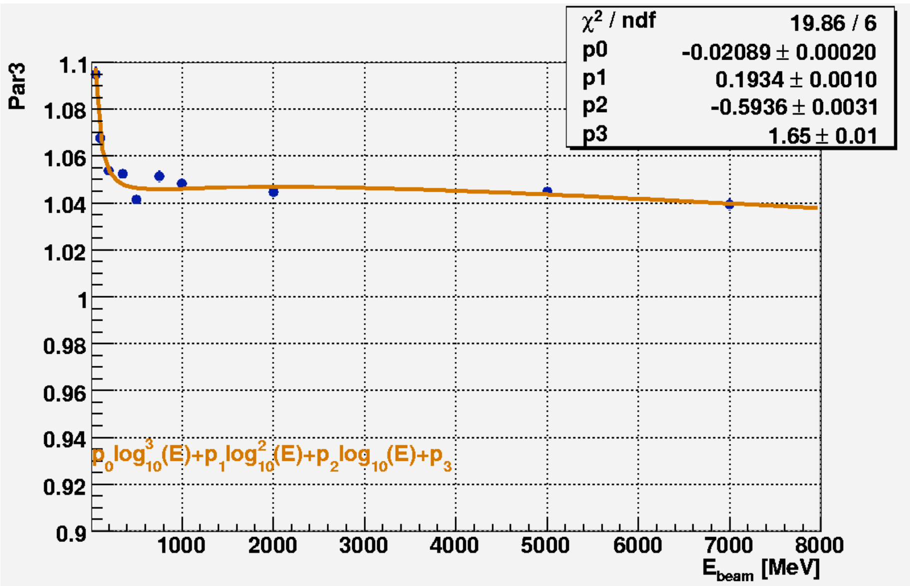


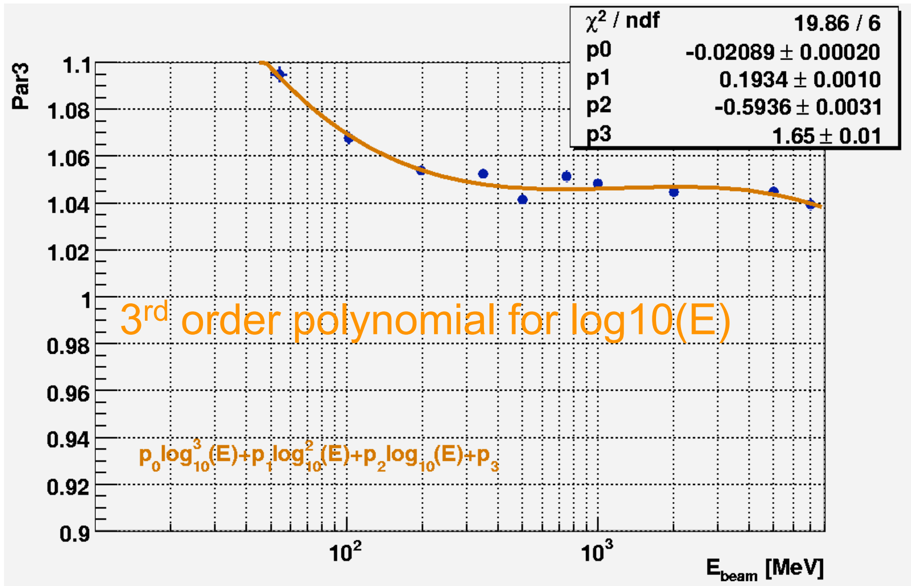


Emeas Fit par2 and par3 vs Energy: e-

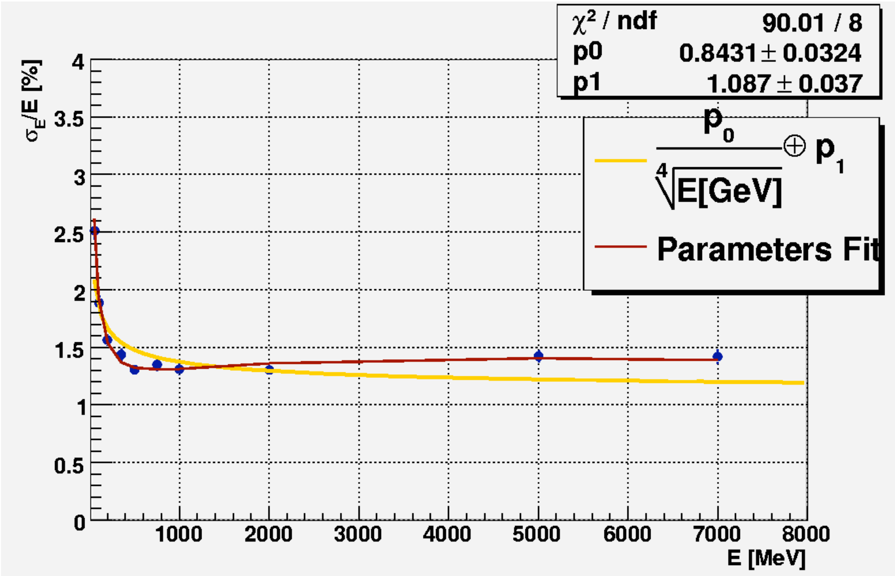


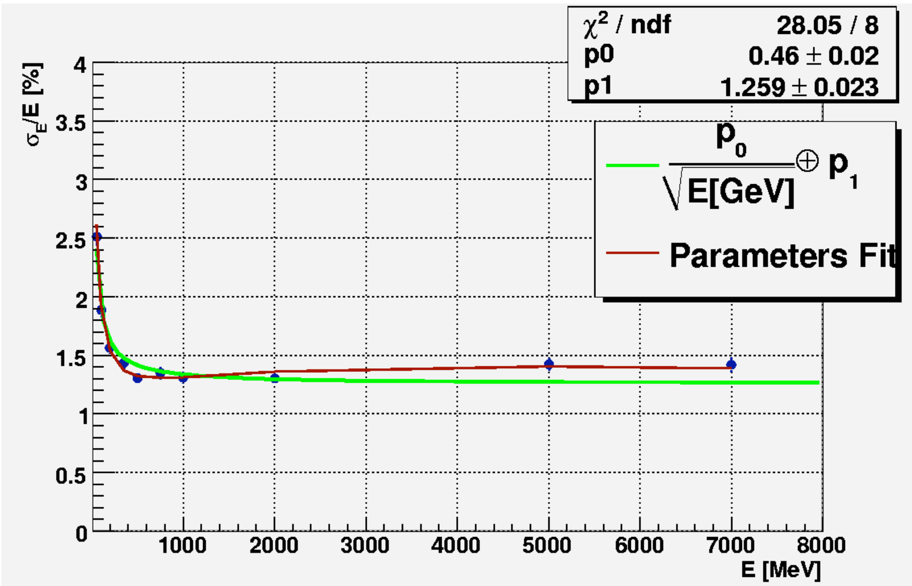






Energy Resolution vs Energy: e-





- To show the energy resolution use the running sigma value at the peak : σ(mpv)
  - Slightly underestimates the real distribution width
- Compare measured points with results from parameters fit
- Fit measured points with

$$\frac{\sigma(E)}{E} = \frac{p_0}{\sqrt[4]{E[GeV]}} \oplus p_1$$

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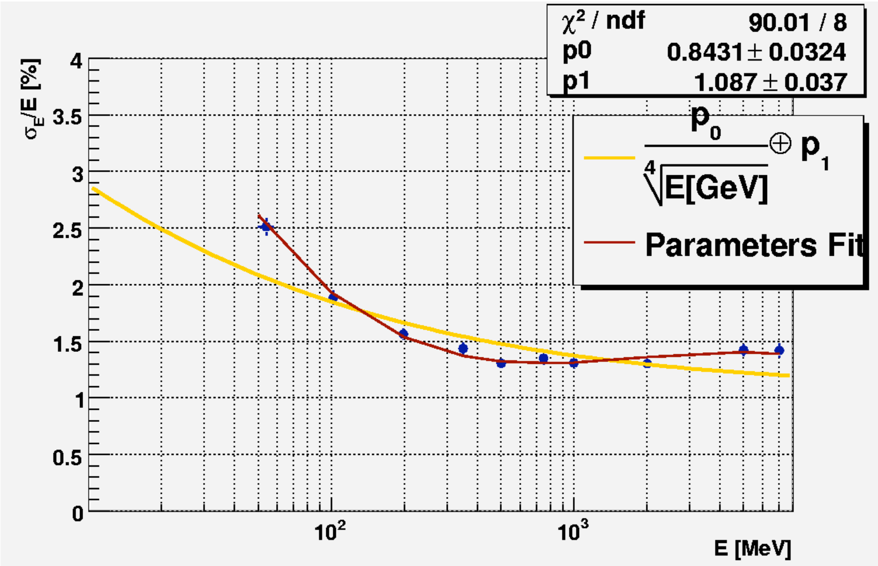
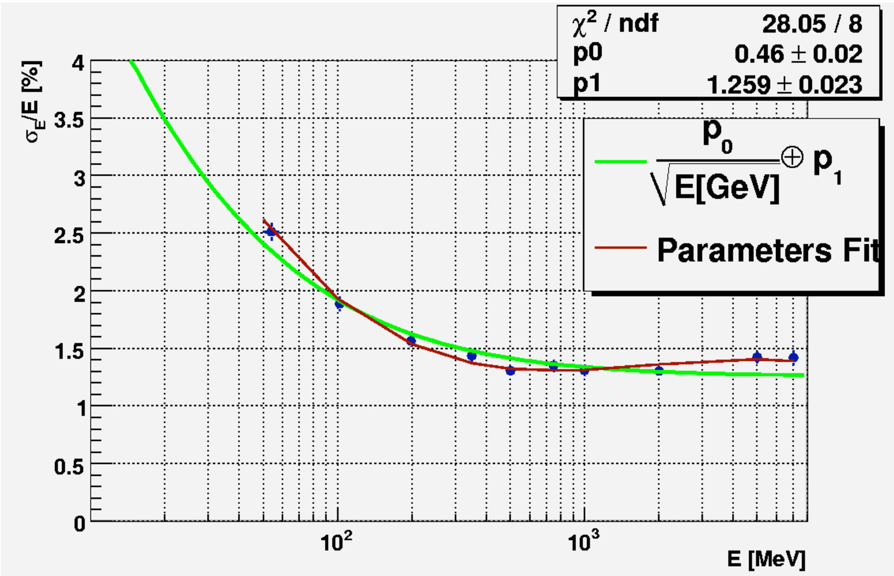
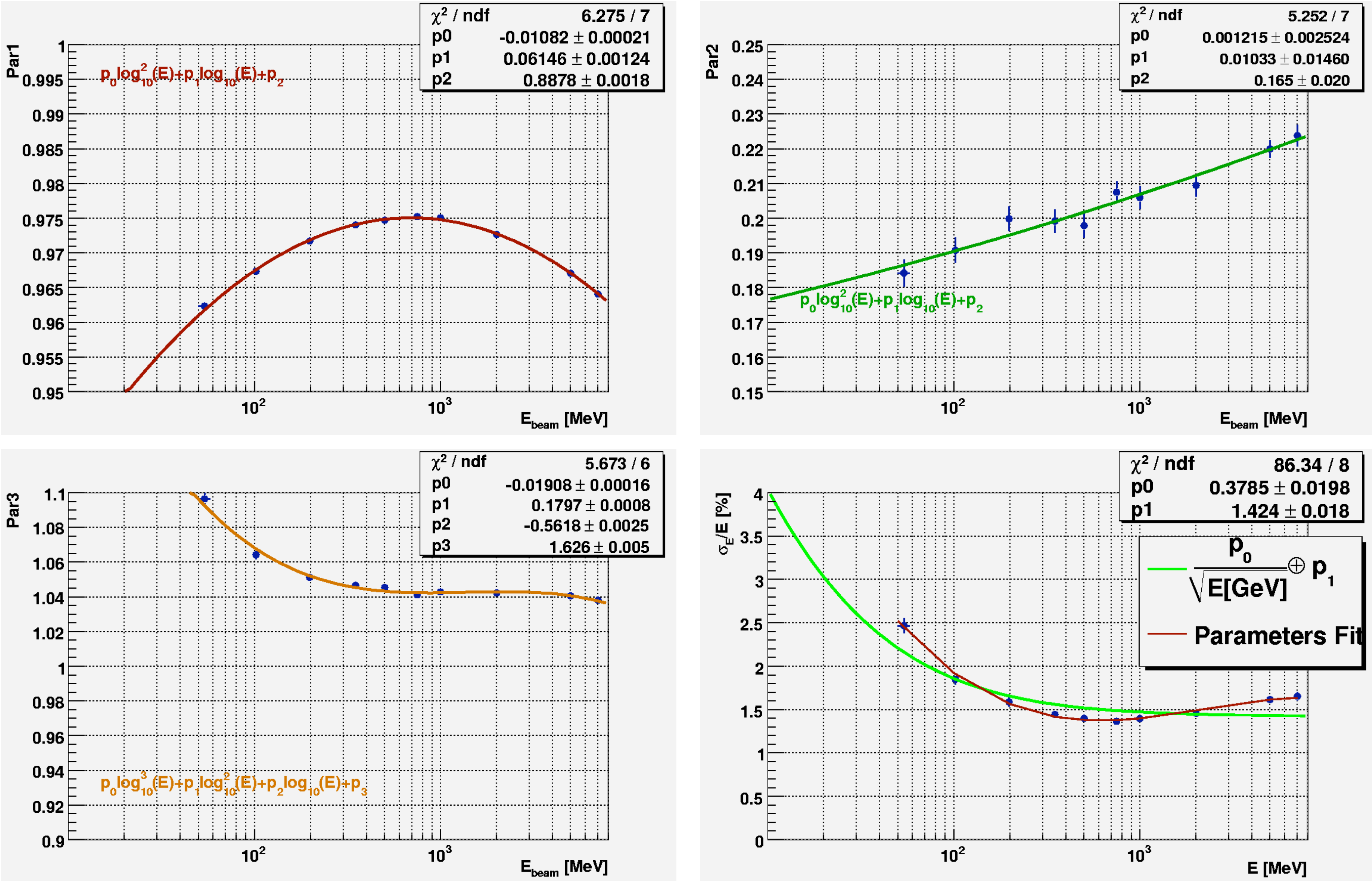
Energy Resolution vs Energy (log scale): e-



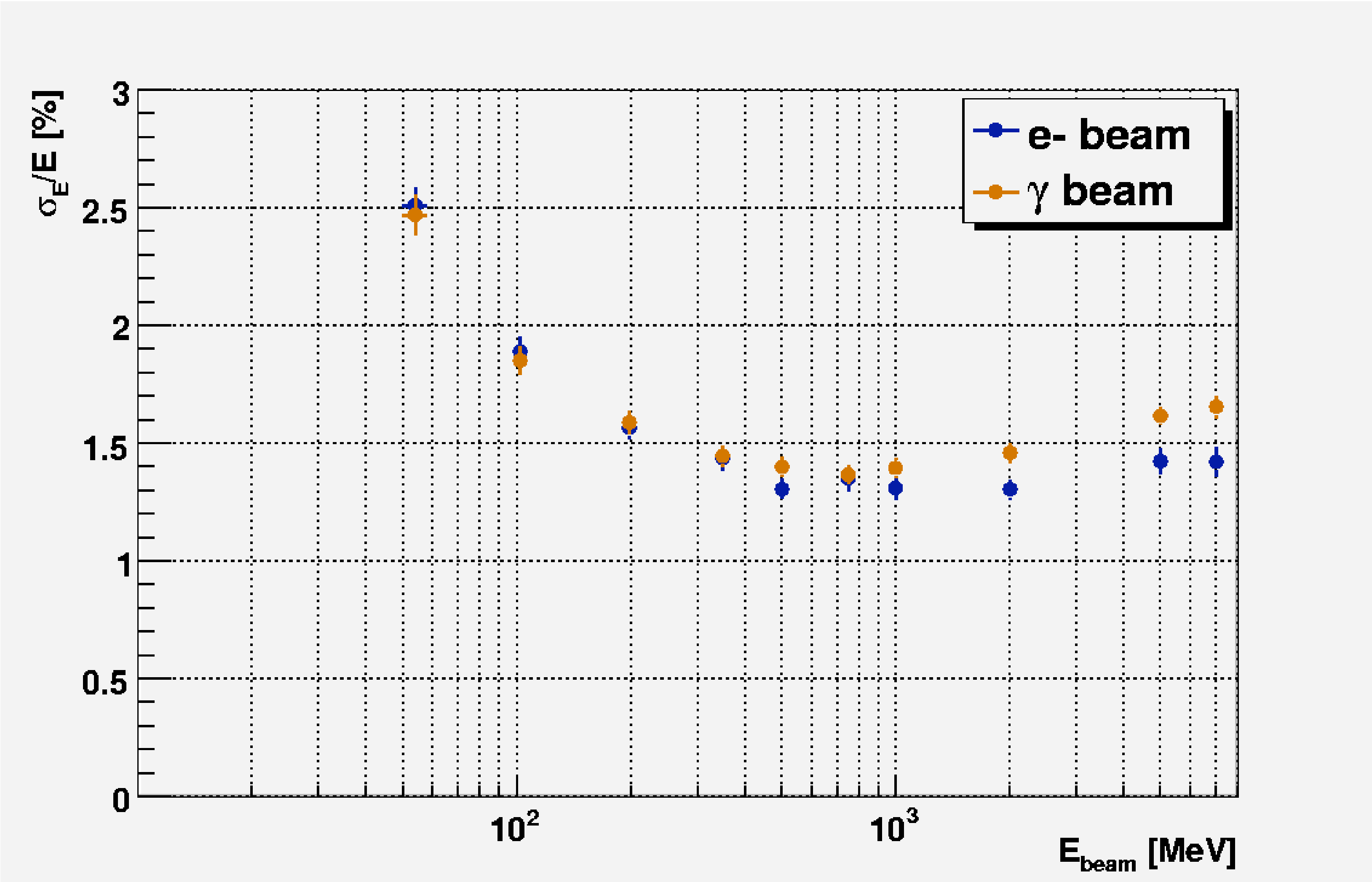


- The best representation is given by the single parameters fit (par0,par1, par2 for measured energy distribution)
- The fit with sqrt(E) seems to give a better agreement

Fits for γs


χ² / ndf 6.275 / 7
p0 -0.01082 ± 0.00021
p1 0.06146 ± 0.00124
p2 0.8878 ± 0.0018
Par1
p0log²10(E)+p1log10(E)+p2
Ebeam [MeV]
χ² / ndf 5.252 / 7
p0 0.001215 ± 0.002524
p1 0.01033 ± 0.01460
p2 0.165 ± 0.020
Par2
p0log²10(E)+p1log10(E)+p2
Ebeam [MeV]
χ² / ndf 5.673 / 6
p0 -0.01908 ± 0.00016
p1 0.1797 ± 0.0008
p2 -0.5618 ± 0.0025
p3 1.626 ± 0.005
Par3
p0log³10(E)+p1log²10(E)+p2log10(E)+p3
Ebeam [MeV]
χ² / ndf 86.34 / 8
p0 0.3785 ± 0.0198
p1 1.424 ± 0.018
σE/E [%]
p0/√E[GeV] ⊕ p1
Parameters Fit
E [MeV]

e- γ comparison



Conclusions

- Next steps
  - Study of the cluster size and transverse shower development
  - Angular resolution
  - Hadron showers
- How to implement the the parameterisation in the Fast Simulatio code ?