Energy resolution studies at PS and SPS

- LAT energy reconstruction
- tagged gammas at PS
- electrons at SPS

3 algorithms for a huge phase space

Parametric method (Bill Atwood) :

- parameterized shower profile model
- from 20 MeV to 300 GeV and over the full field of view
- http://www-glast.slac.stanford.edu/software/AnaGroup/Atwood-EnergyRecon-2May2005.ppt

Max likelihood method (Pol d'Avezac) :

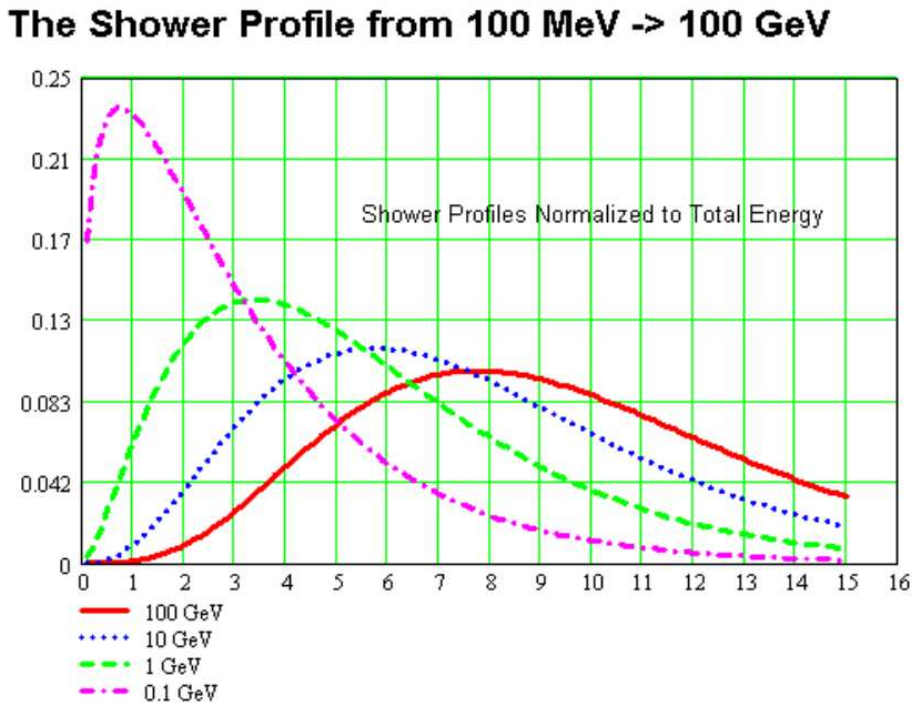
- replaces the former last-layer method + uses NHits in tracker
- from 50 MeV to 300 GeV and up to 50^o
- http://polywww.in2p3.fr/glast/CalLikelihood.pdf

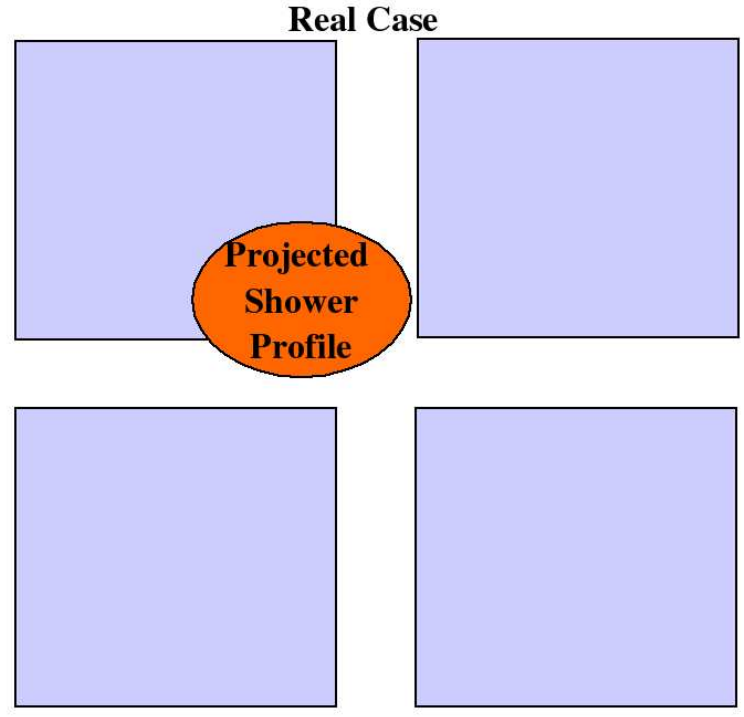
Full profile fit method (Philippe Bruel) :

- extension of previous 1D method to a full 3D shower profile fit
- from $\sim$1 GeV to 300 GeV and over the full field of view
- http://polywww.in2p3.fr/$\sim$bruel/CalFullProfi le.ps

Parametric method

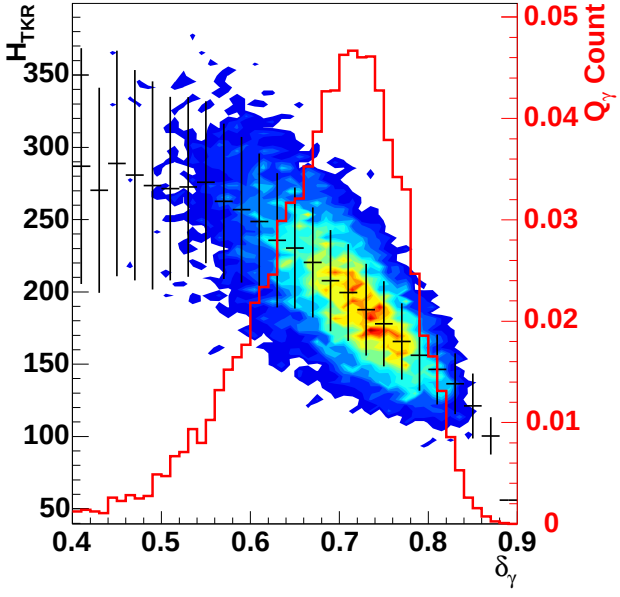
- EvtEnergyCorr
- $\left\langle \frac{dE(t)}{dt} \right\rangle = E \times \frac{(\beta t)^{\alpha-1} \beta e^{-\beta t}}{\Gamma(\alpha)}$ where t is the length in rad. length
- b scales the depth and $a \rightarrow$ the energy centroid $< t >= a/b$
- + corrections (edge, leakage, tracker)
- direction given by (VtxXYZ0 $\rightarrow$ cal centroid)

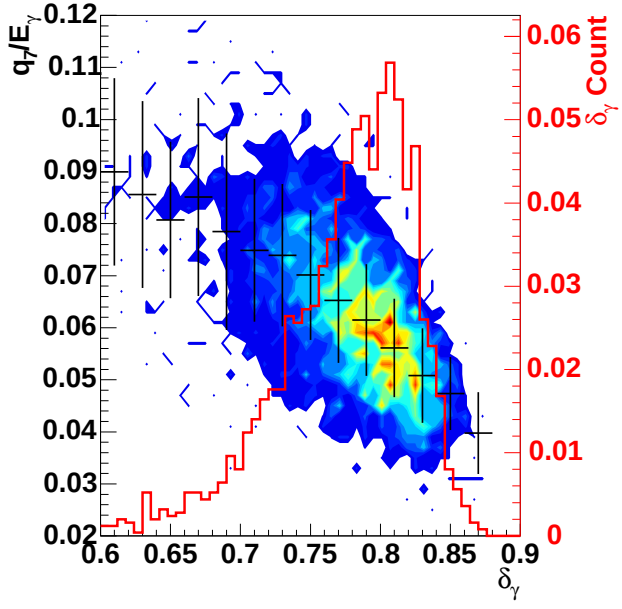


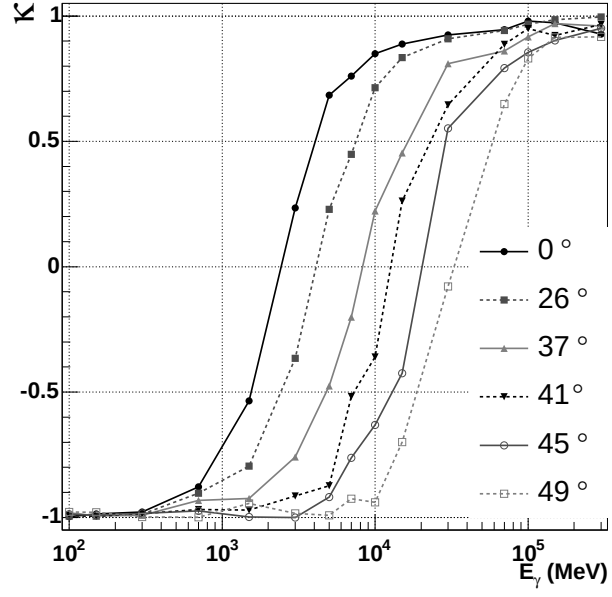


Maximum likelihood method

- CalTklEnergy, CalLllEnergy → CalLikEnergy (CalRecon v6r3) + modifications
- makes use of correlation between NHits and E_{cal}, and last layer E and E_{cal}
- various classes defined by cuts
- direction given by VtxXYZDir

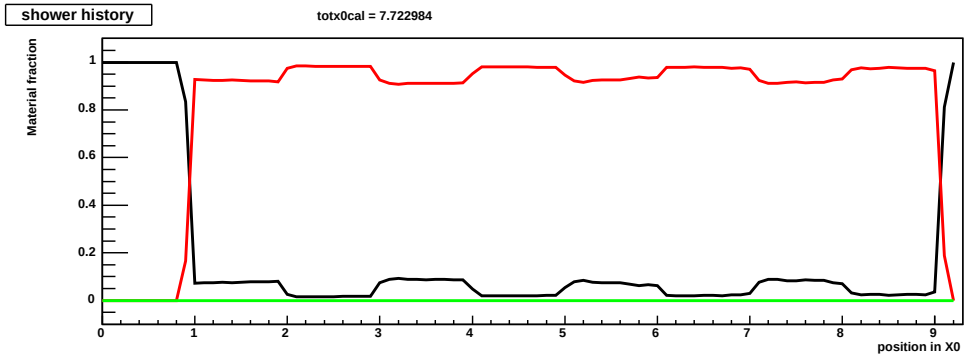


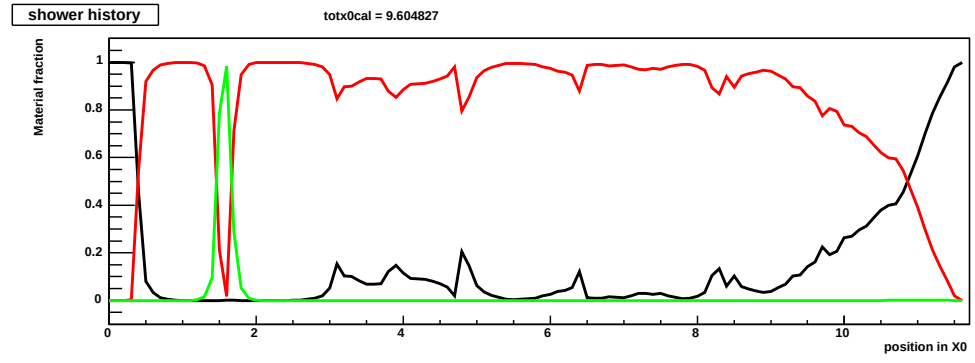


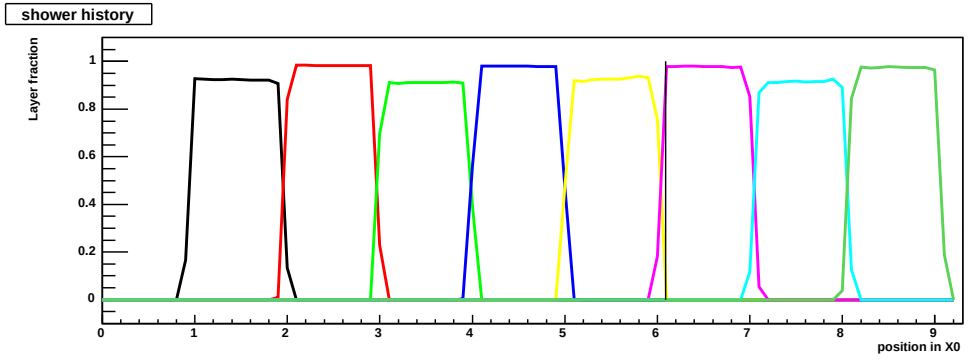


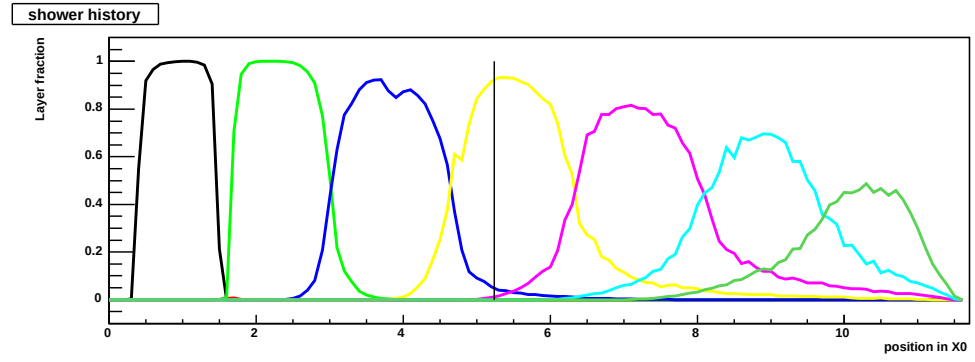
Full profile method

- CalCfpEnergy + modifications
- profile fit + fluctuations of shower parameters and 3D shape of the shower
- direction given by VtxXYZDir



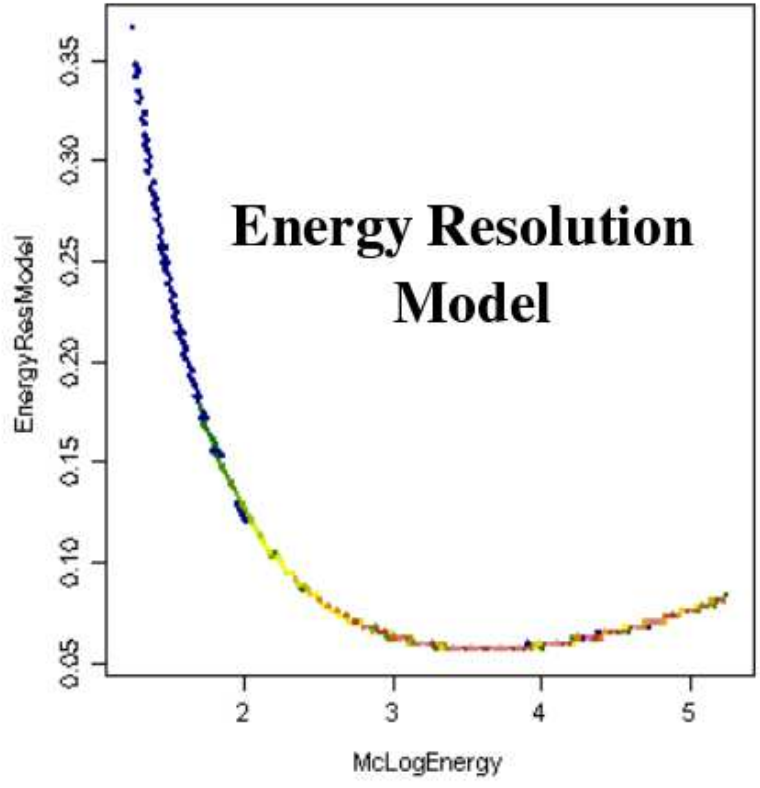


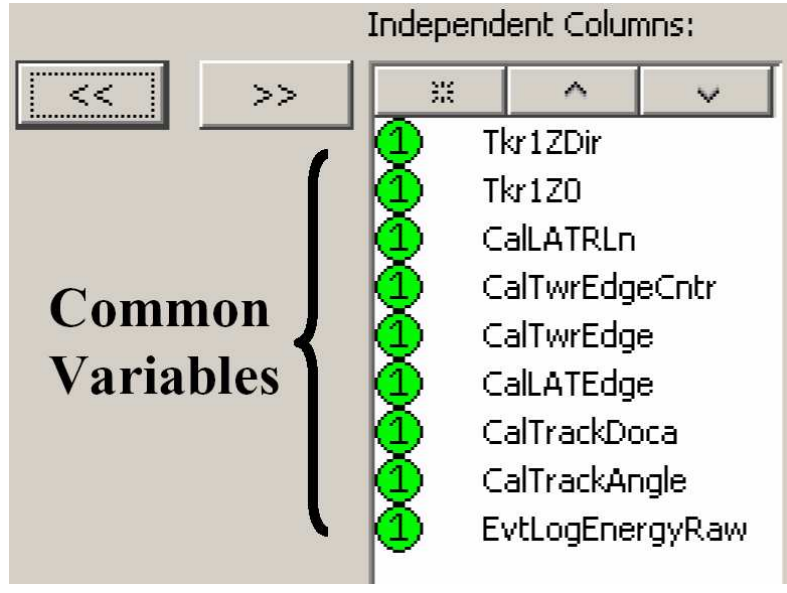




Energy classification trees

- CTBBestEnergy
- one CT for each method : comparing to
  $\sigma_{model} = 0.02 + 0.6/log(E)^{2.5} + 0.005(log(E) - 2)^2$
- many variables are used



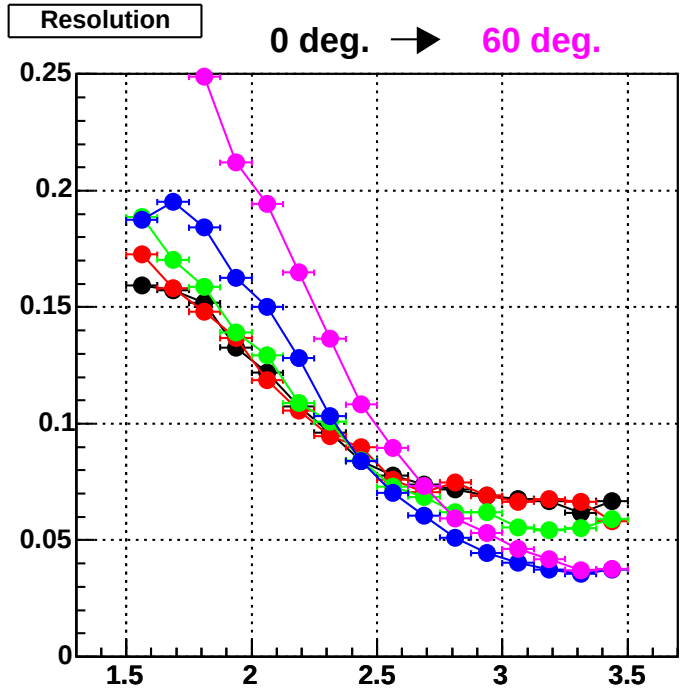


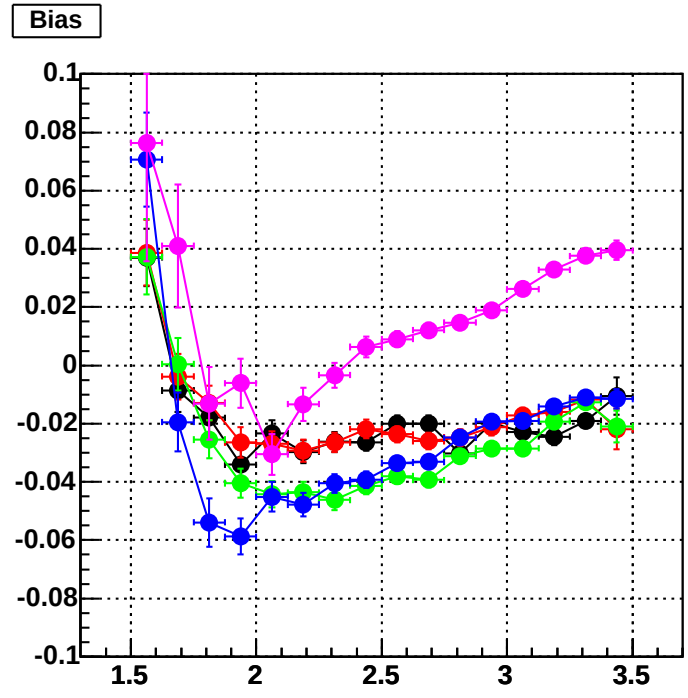
At CERN : what and how ?

- energy measurement (resolution, bias, tails)
- but also many other variables
- identify the more interesting confi gurations
- estimate the statistics we need

Tagged gammas at PS

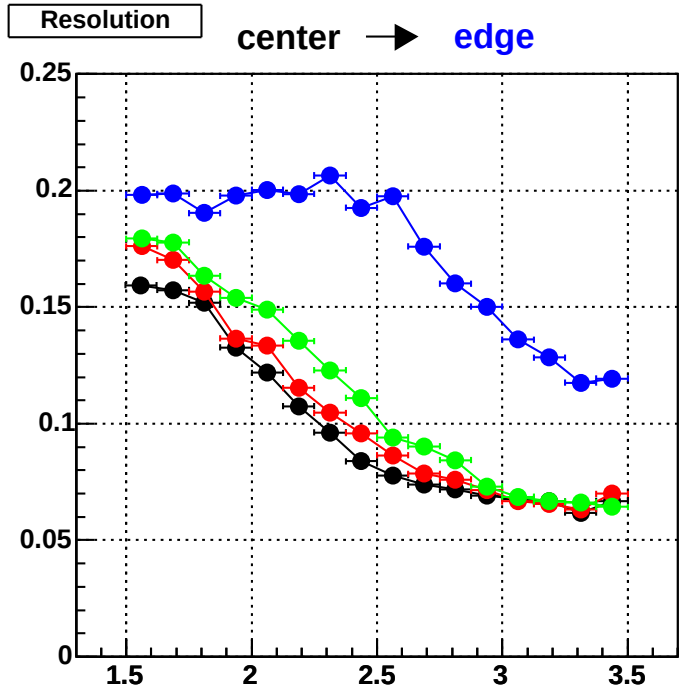
- beamtest06 + Gleam with CU geometry
- 2500 MeV electrons in the center of tower 2
- Tkr1Z0>0 and CalEnergyRaw>5

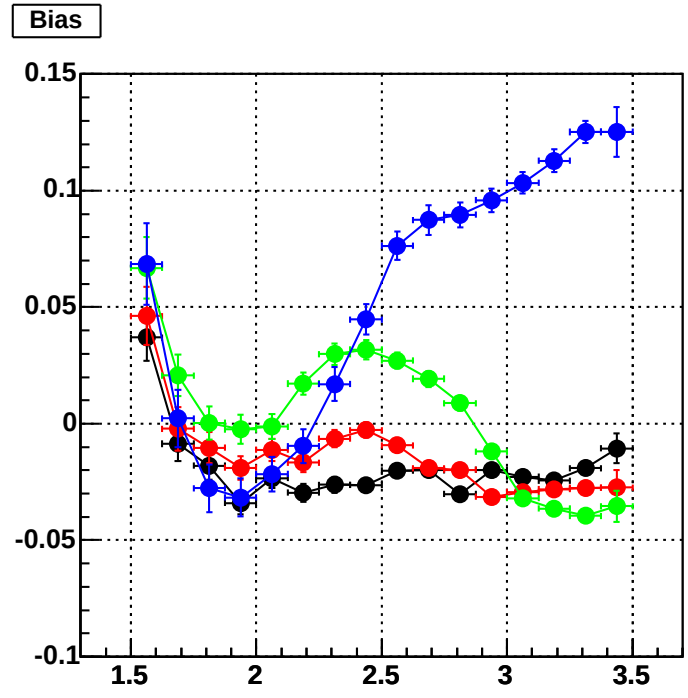




Tagged gammas at PS

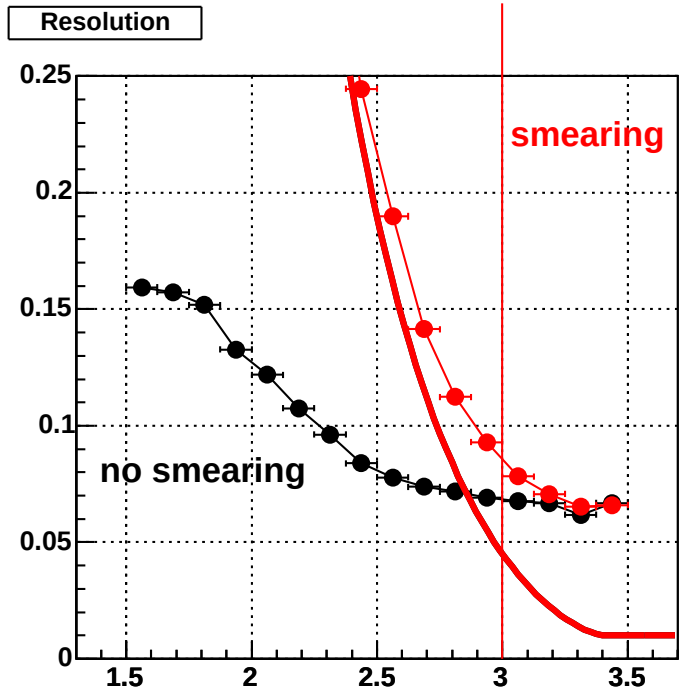
- beamtest06 + Gleam with CU geometry
- 2500 MeV electrons on-axis
- Tkr1Z0>0 and CalEnergyRaw>5

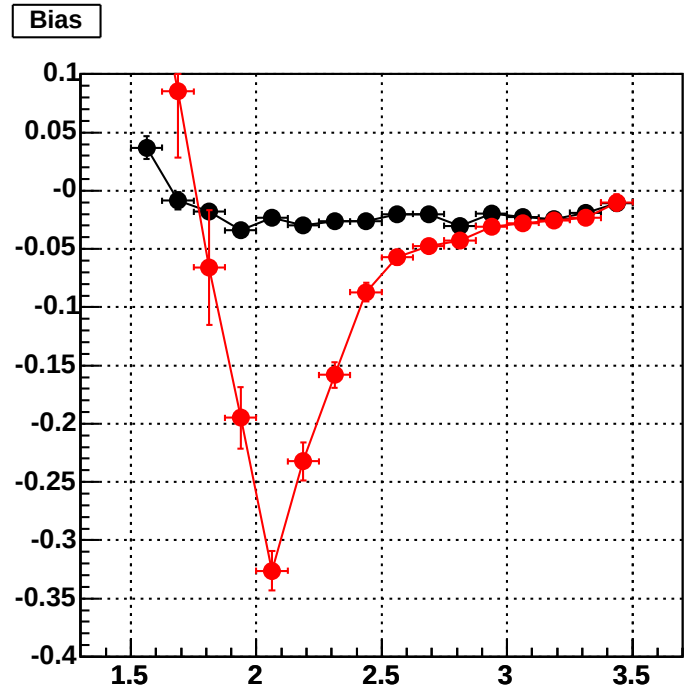




PS : incoming gamma energy uncertainty

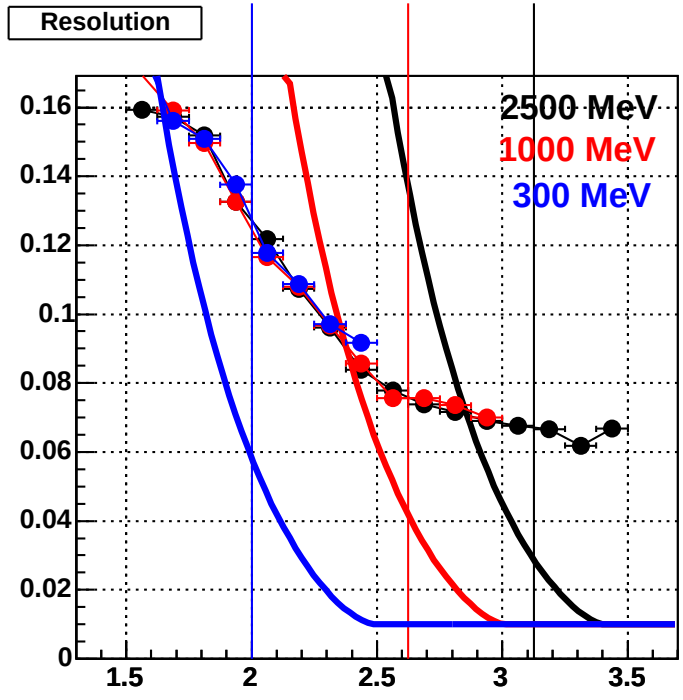
- intial electron (1%) and final electron (2.5%)
- $\frac{\delta E_\gamma}{E_\gamma}|_{beam} = 0.01 \frac{E_{beam}}{E_\gamma} \oplus 0.025(\frac{E_{beam}}{E_\gamma} - 1)$
- limited range : $\frac{\delta E_\gamma}{E_\gamma}|_{beam} < 0.5 \times \frac{\delta E_\gamma}{E_\gamma}|_{CU}$
- 2500 MeV electrons on-axis in the center of tower 2

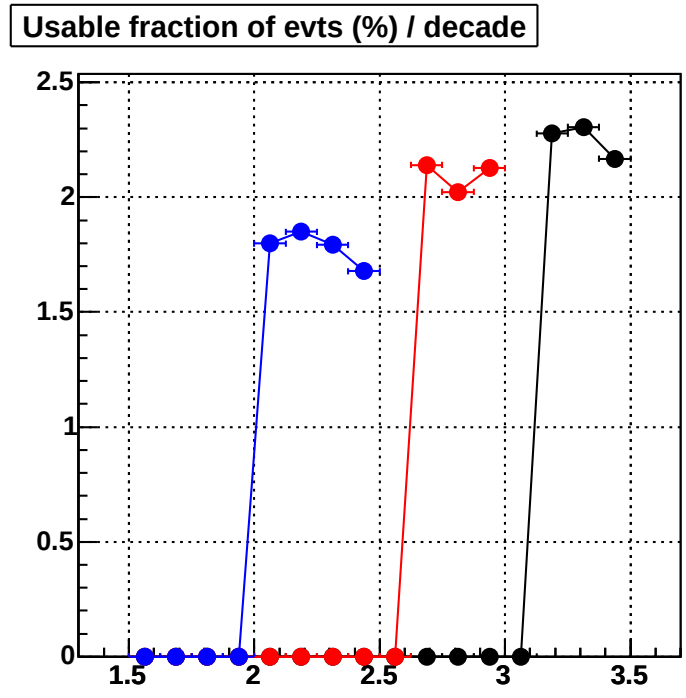




PS : electron beam energies and statistics

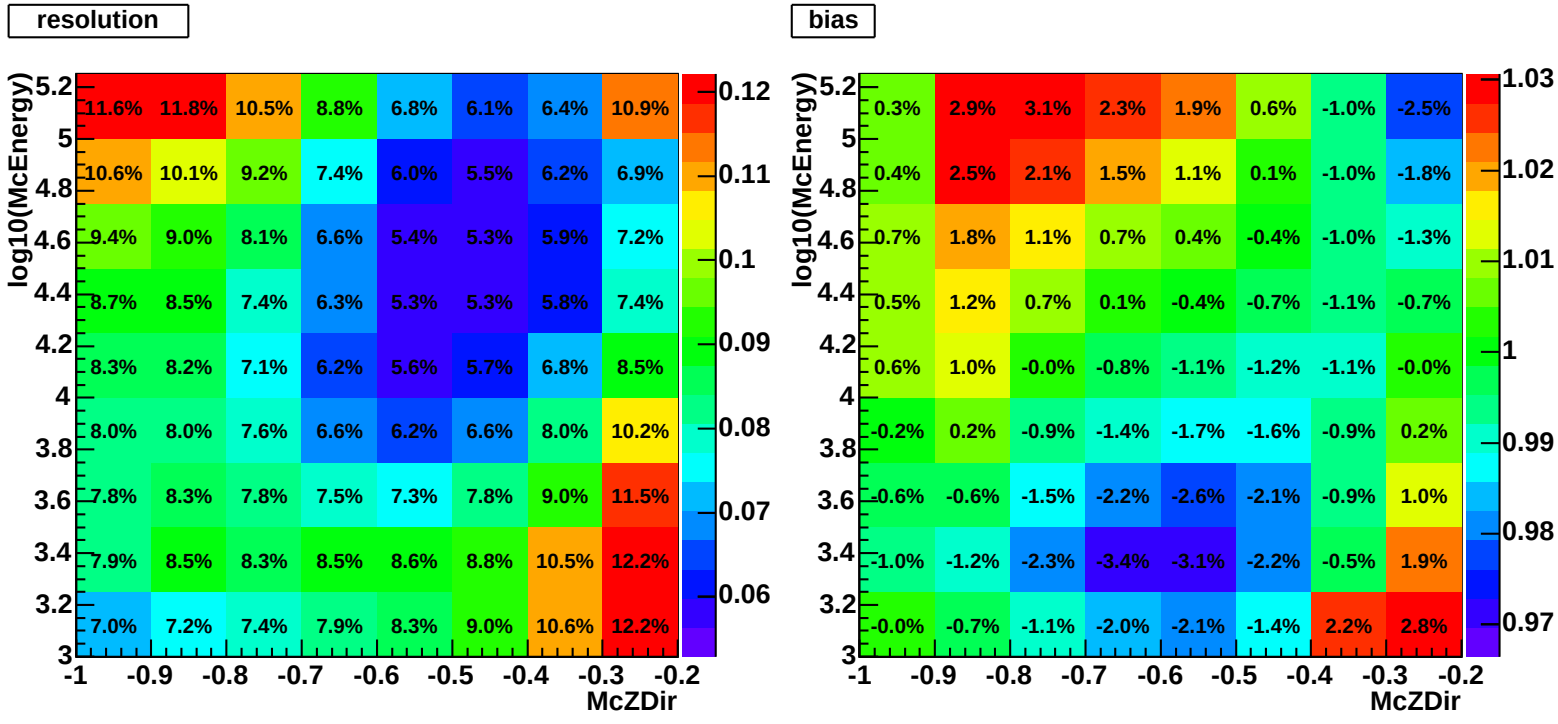
- 300, 1000 and 2500 MeV electron beams
- usable gamma energy ranges
- statistics estimation : $\frac{\delta\sigma}{\sigma} < \frac{\delta\mu}{\mu} = 1/\sqrt{N}$
- 1% on $\mu \rightarrow 10^4$ γ / 0.25 decade $\rightarrow 2 \times 10^6$ electrons



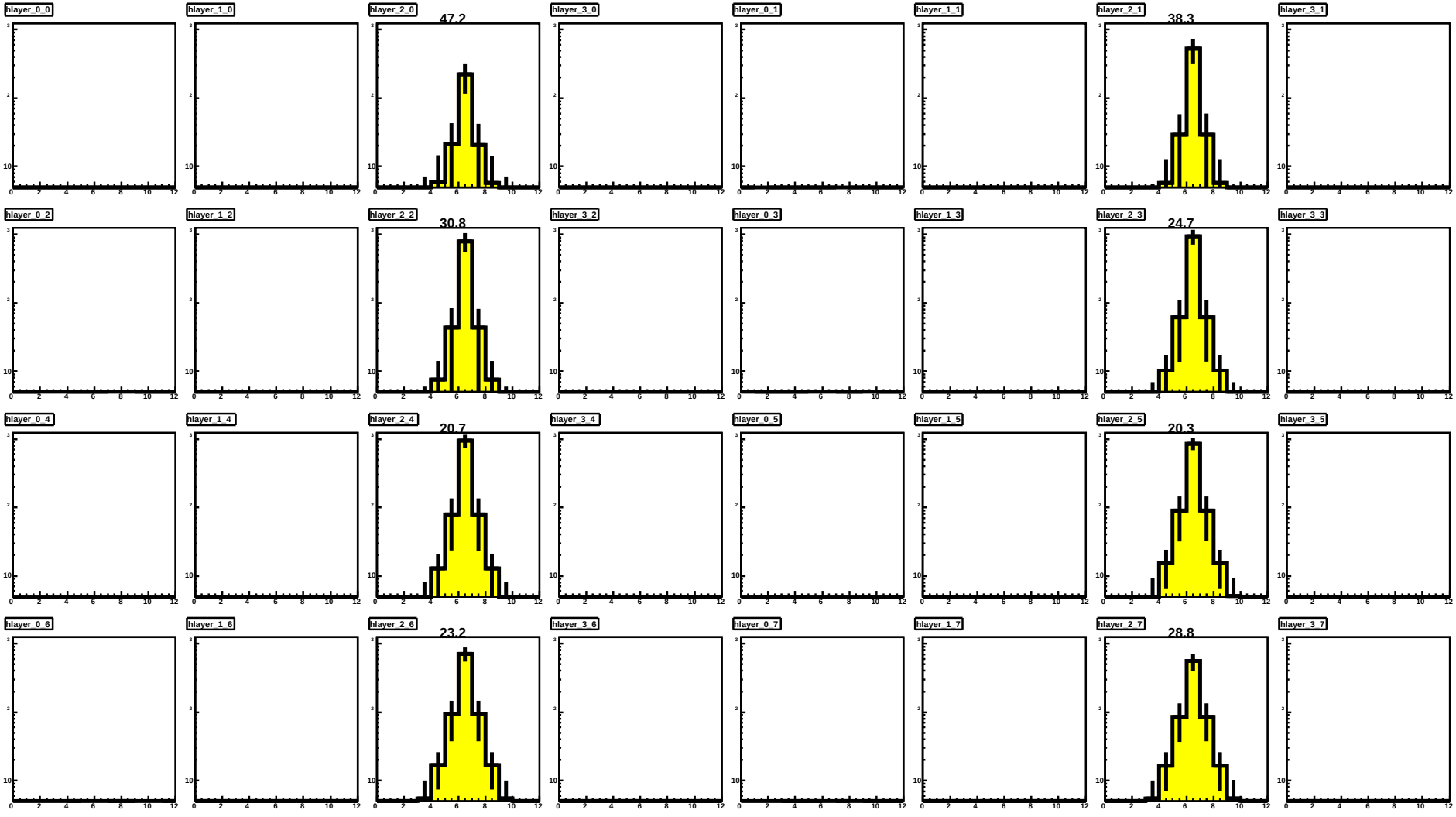


Electrons at SPS

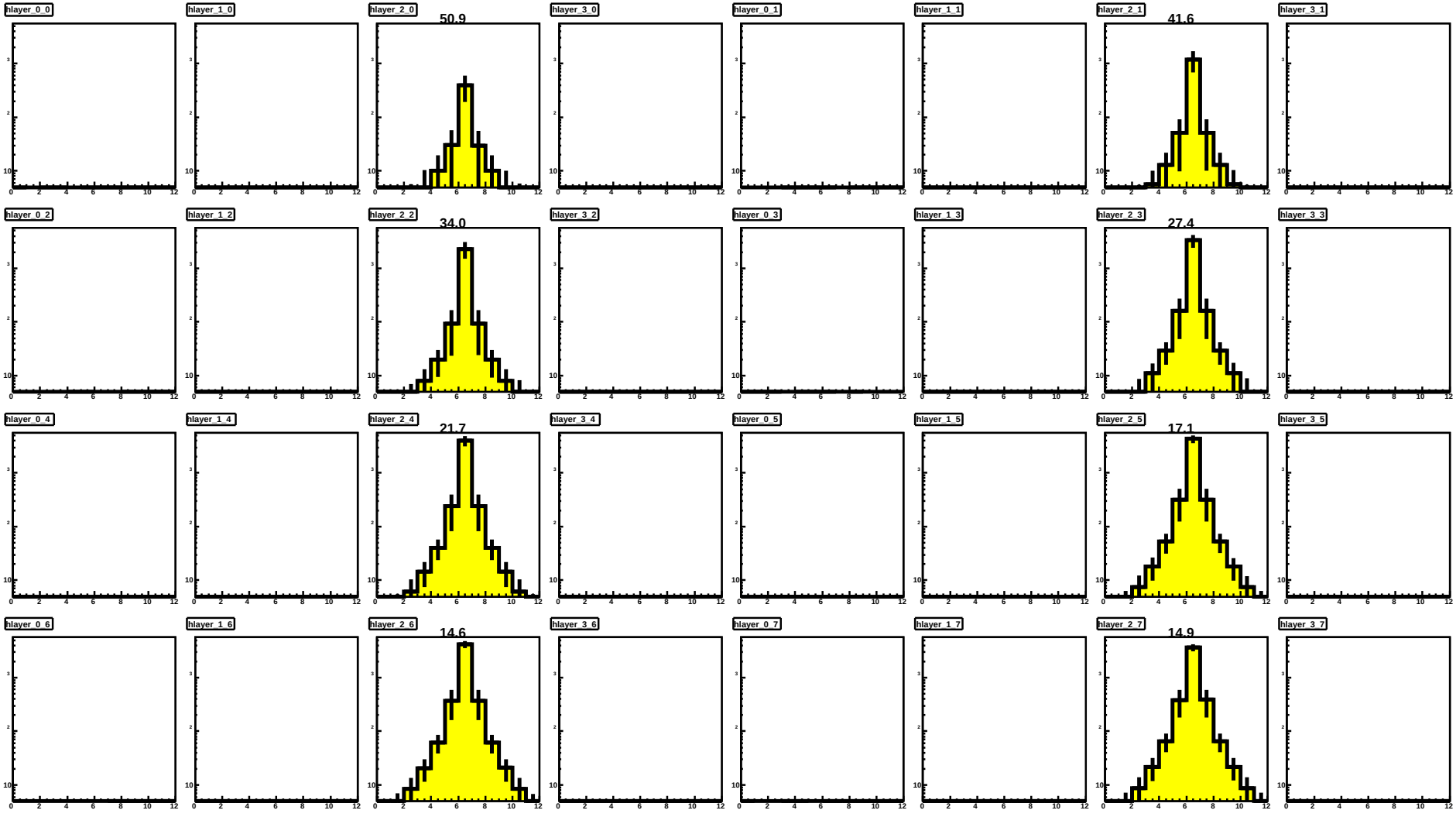
- high energy measurement based on calo information but needs direction and shower start
- check energy deposition in cal : longitudinal and transverse profi le, centroid position
- check cracks effects, leakage



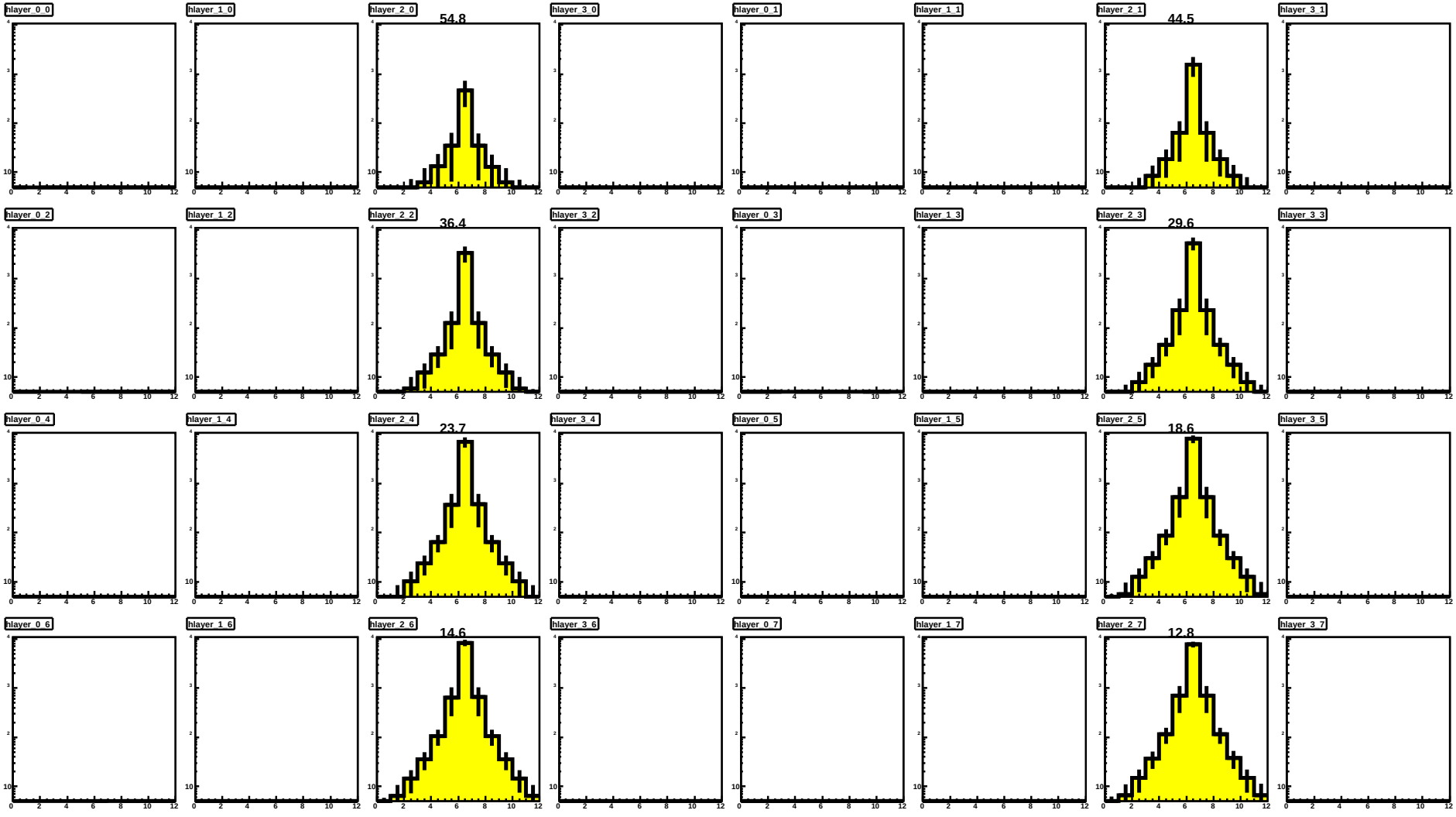
10 GeV (X = 0.5,Y = 0.5) 0 deg.



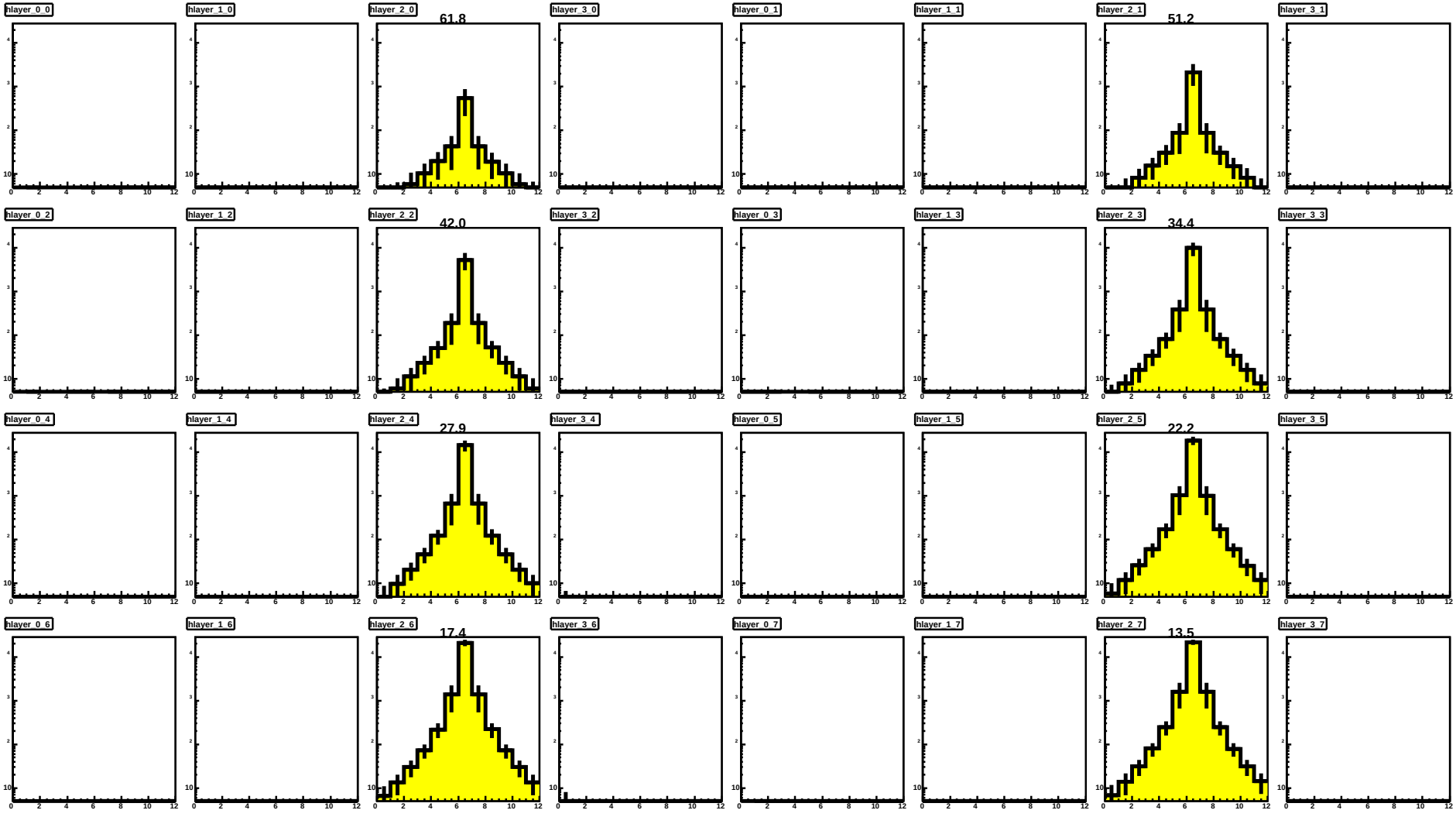
50 GeV (0.5,0.5) 0 deg.



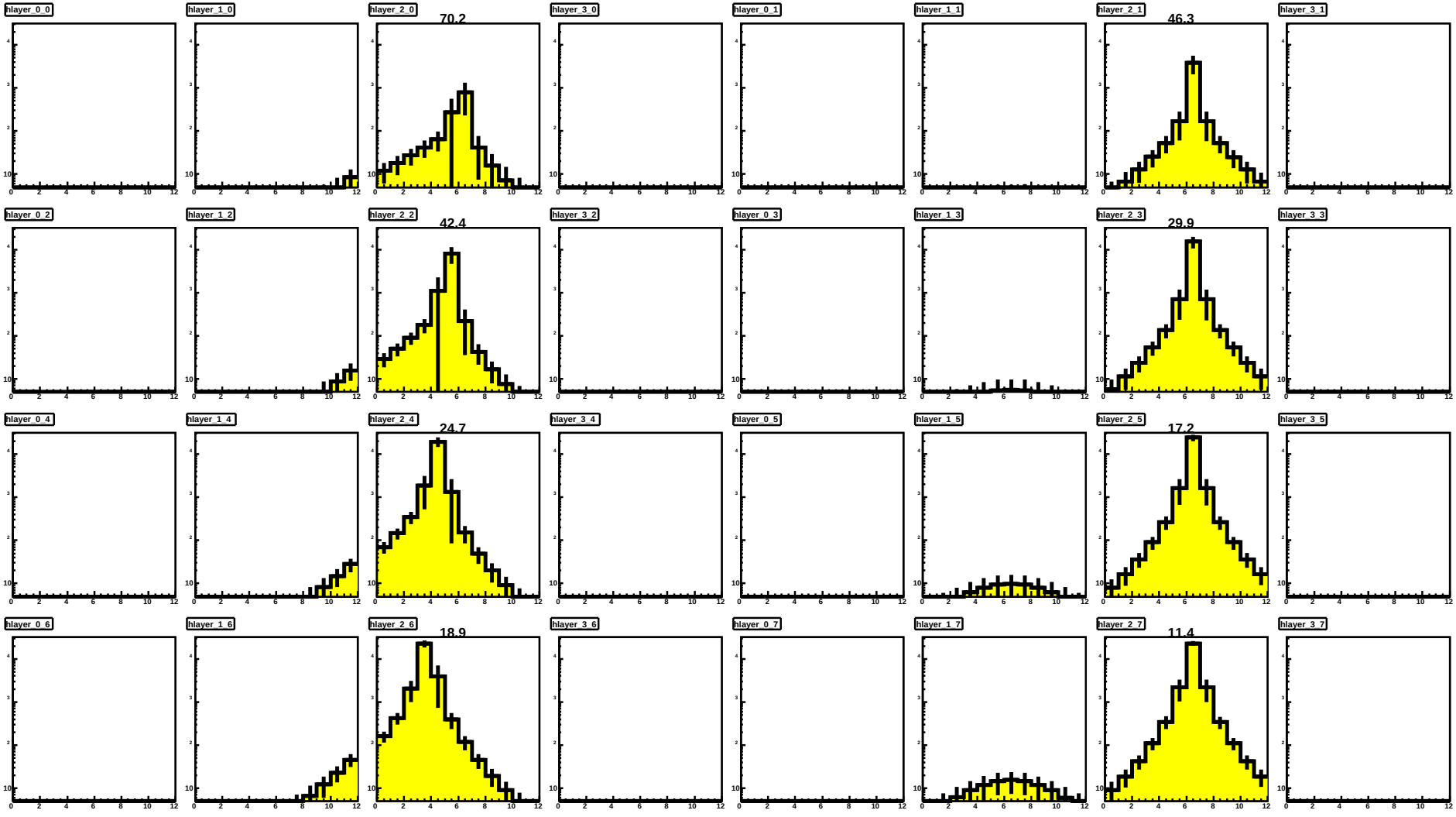
100 GeV (0.5,0.5) 0 deg.



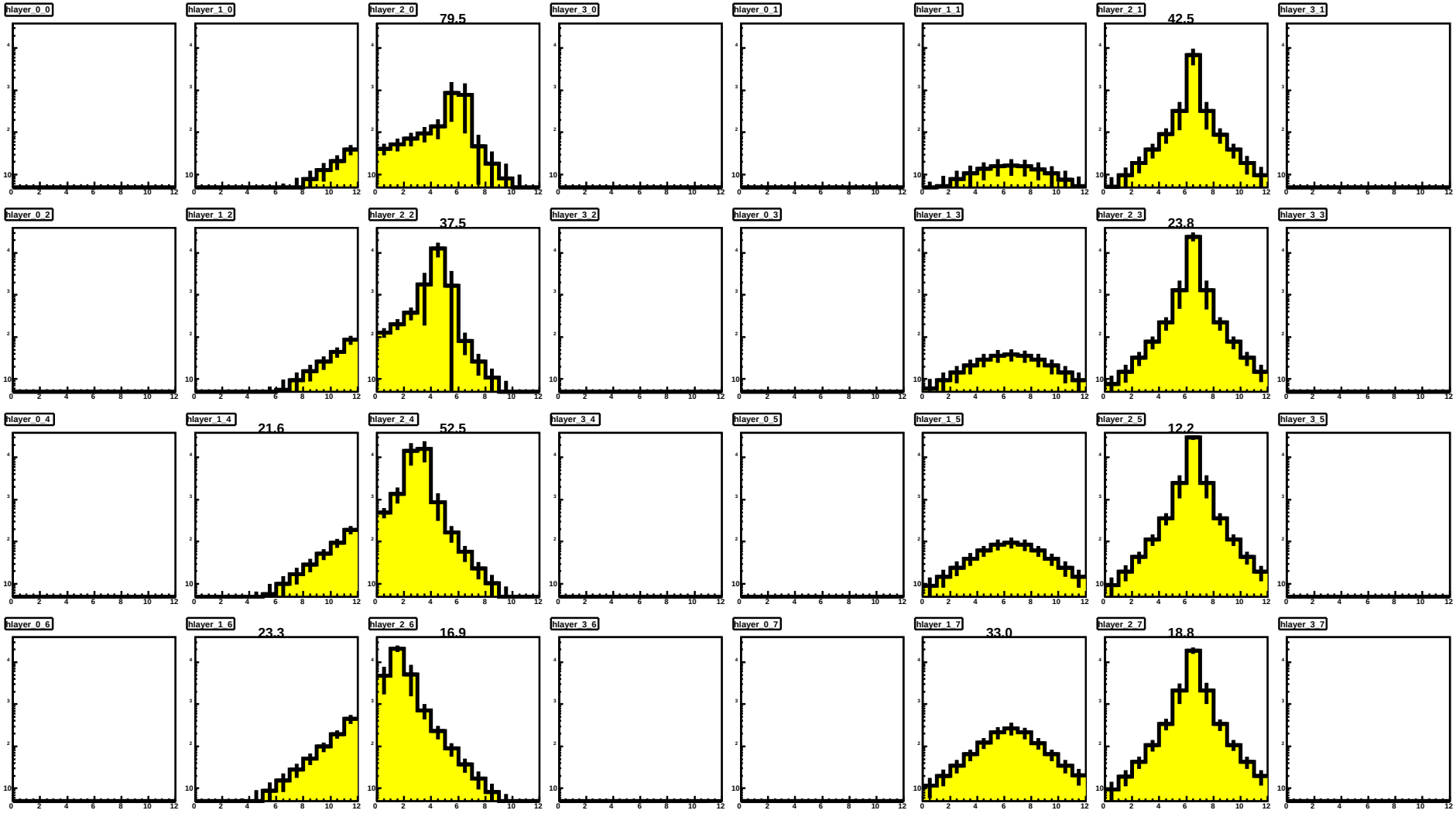
280 GeV (0.5,0.5) 0 deg.



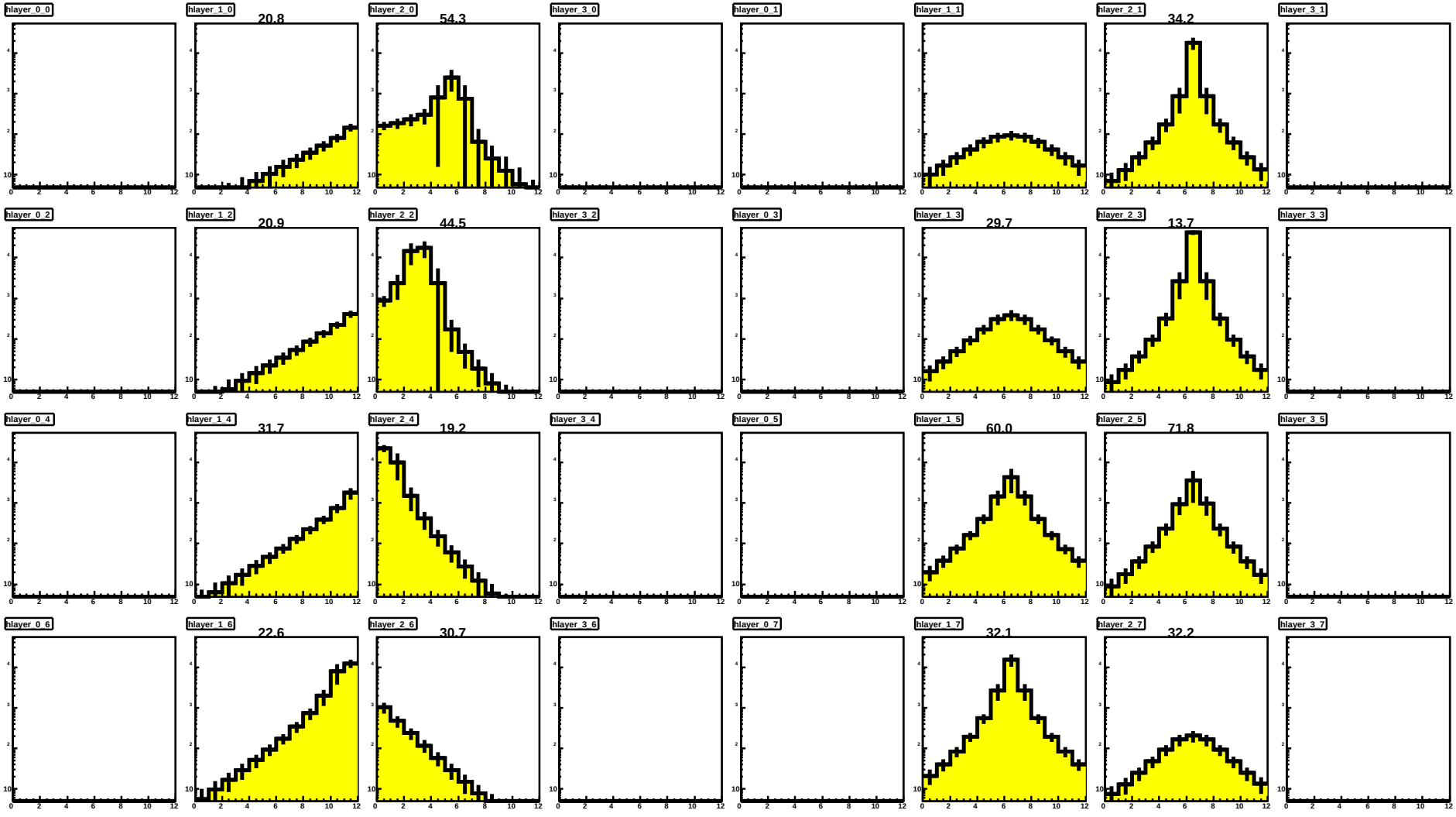
280 GeV (0.5,0.5) 30 deg.



280 GeV (0.5,0.5) 45 deg.



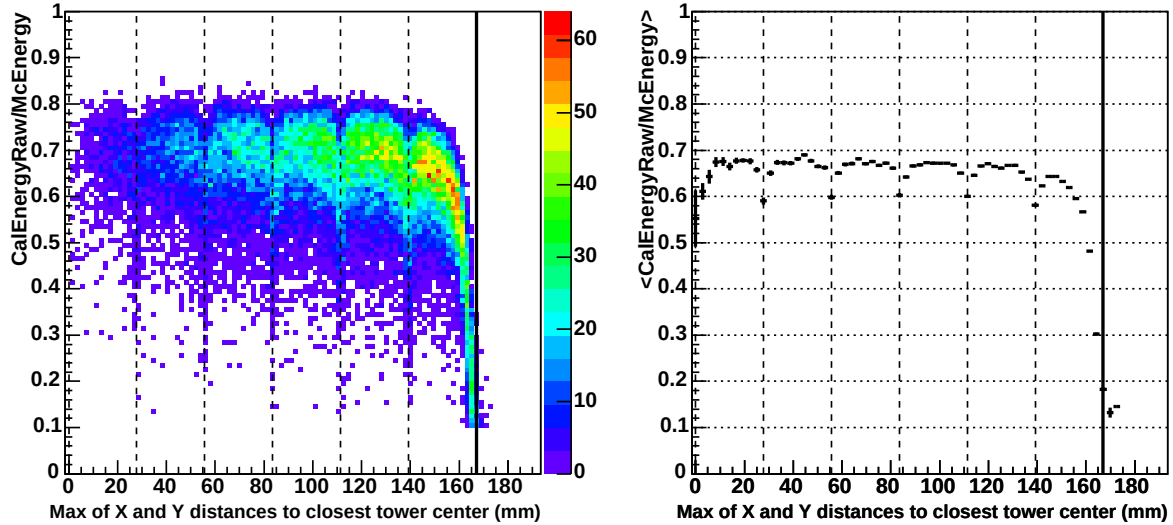
280 GeV (0.5,0.5) 60 deg.

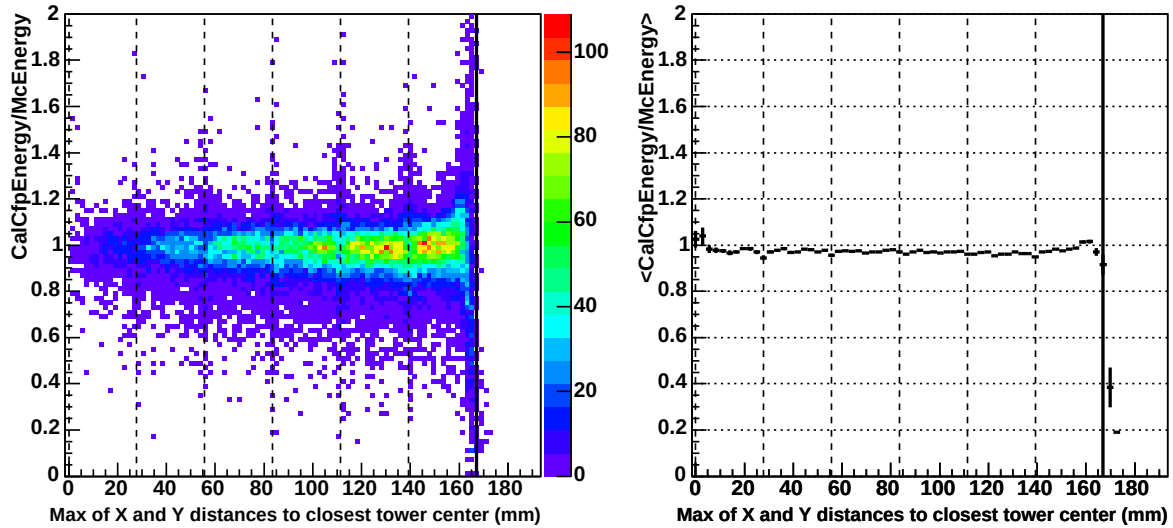


Beam energy choice

- the important scale is T = position of the shower maximum in X_0
- choose the energies to have equal steps in T between :
  - 10 GeV $\rightarrow T \sim 5.6\ X_0$
  - 280 GeV $\rightarrow T \sim 9.2\ X_0$

Cracks effect and transverse size



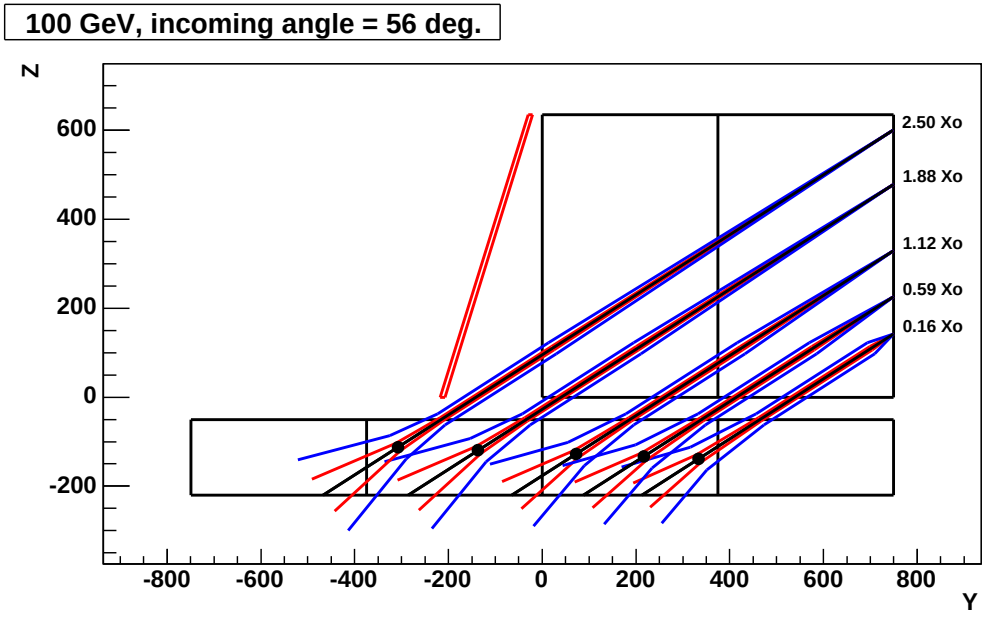


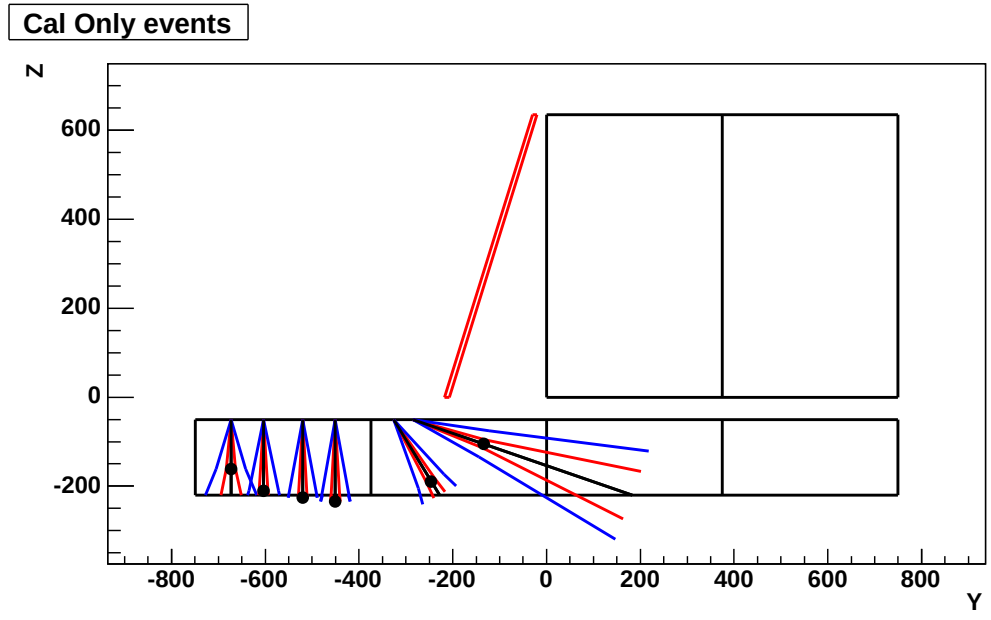
CalCfpEffRLn>6

CalCfpEffRLn>6

Radiation length in tracker

- the shower start is not available
- check the effect of increasing the radiation length in the tracker





Conclusions

We should :

- still look for energy reconstruction features and interesting confi gurations
- implement realistic beamtest conditions (tagged gammas, contamination, etc...)