Miscellanea on TBs

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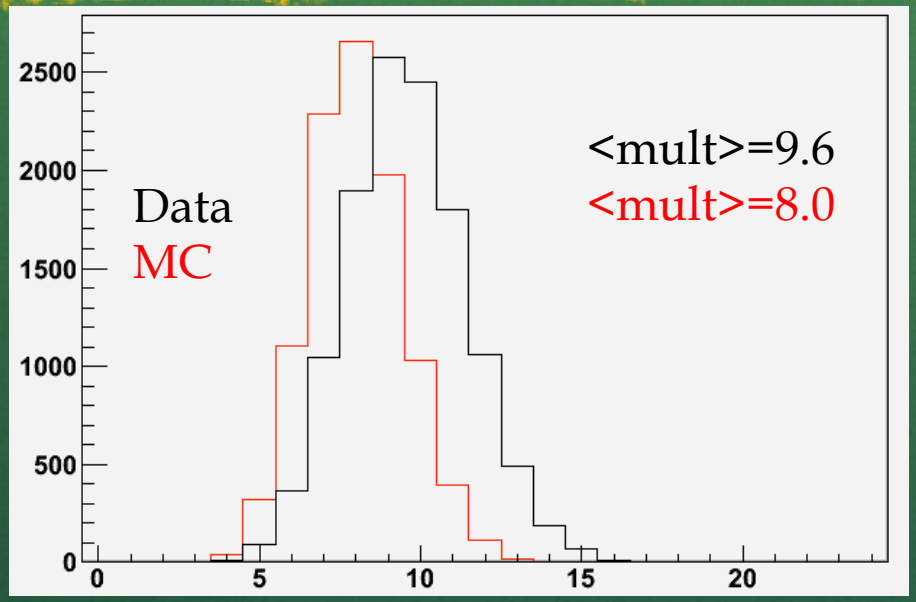
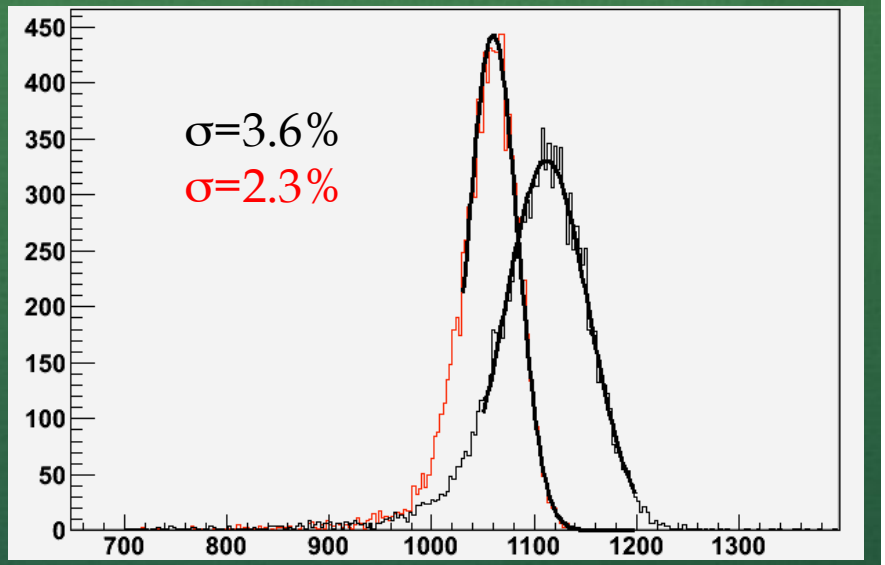
CERN Test Beam

Starting point

CERN TB



Multiplicity



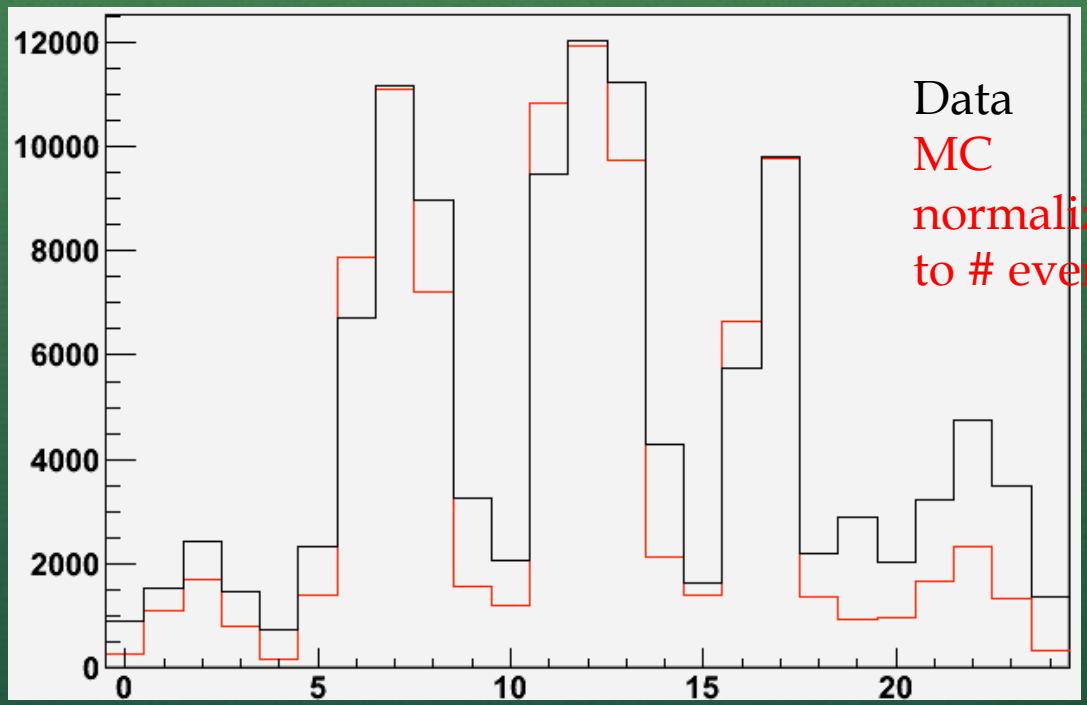
E[MeV]

My reconstruction:

- Energy determined by summing +/- 50 bins around the peak (Pinci)
- Channel dependent threshold at 2 sigma (determined on pedestal data ~6counts)
- Temperature correction and intercalibration from Elisa

Noisy crystal?

CERN TB



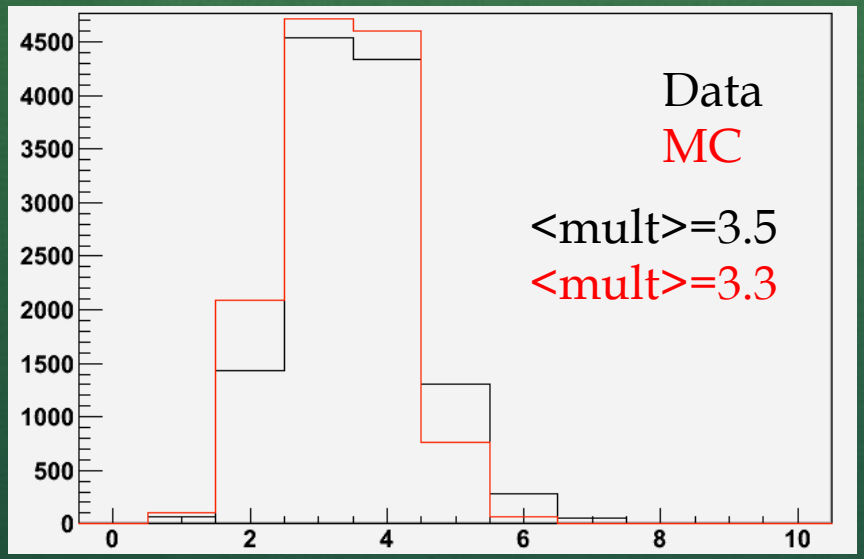
Crystal occupancy

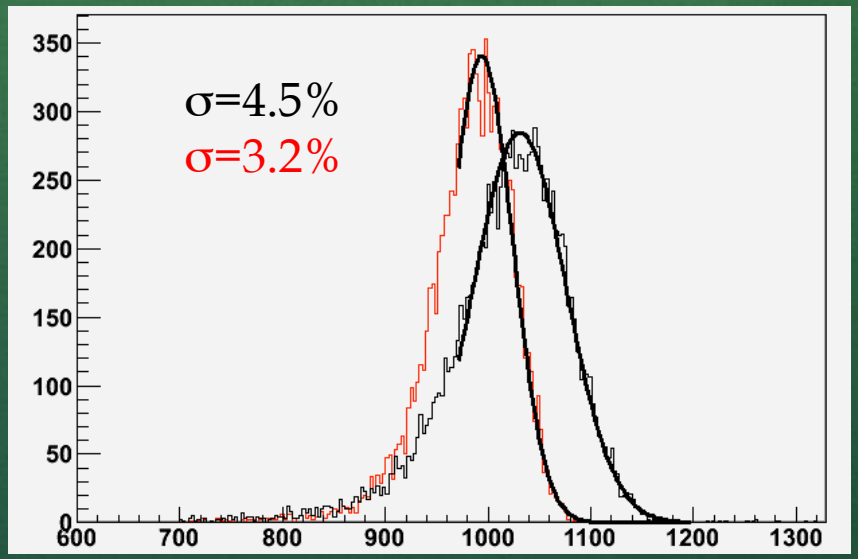
- Excess in last row (20-24)
- Small offset wrt xtal center

Noise rejection

CERN TB

- After requesting signal in a crystal > 10 sigma (instead of 2)





Good Data-MC agreement on multiplicity

Agreement on resolution does not improve

Shower Shape Vars

LAT

$$LAT = \frac{\sum_{i=3}^{n} E_i r_i^2}{\sum_{i=3}^{n} E_i r_i^2 + E_1 r_0^2 + E_2 r_0^2}, \qquad E_1 \geq E_2 \geq \ldots \geq E_n$$

r0=1 crystal

Zernike moments

$$A_{nm} = \sum_{r_i \leq R_0}^{n} \frac{E_i}{E} \cdot f_{nm}(\frac{r_i}{R_0}) \cdot e^{-im\phi_i}, \qquad \text{R0=3 crystals}$$

$$f_{nm}(\rho_i \equiv \frac{r_i}{R_0}) = \sum_{s=0}^{(n-m)/2} \frac{(-1)^s (n-s)! \rho_i^{n-2s}}{s!((n+m)/2-s)!((n-m)/2-s)!},$$

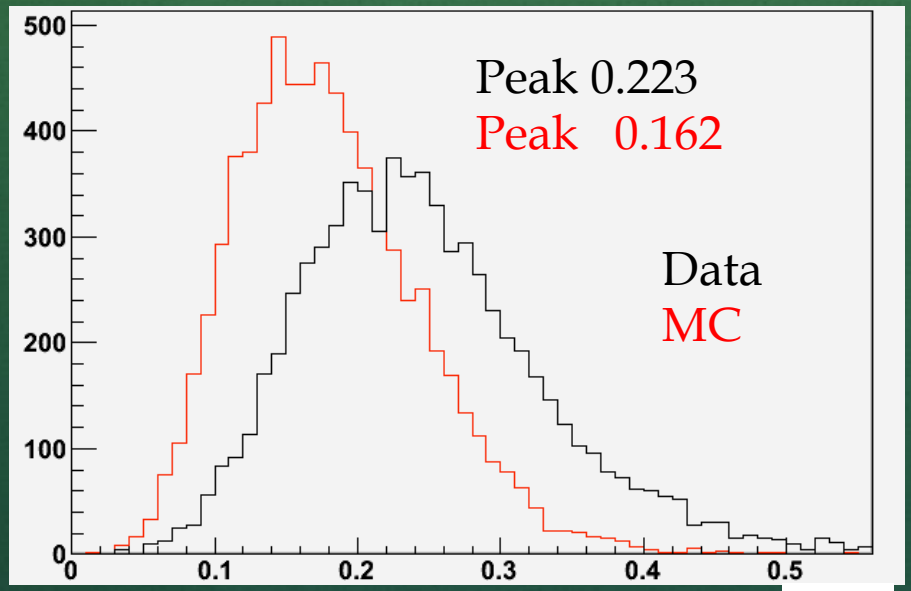
Sum ratios

$$S9S25 = \frac{\sum_{i=1,9} E_i}{E_{tot}}$$

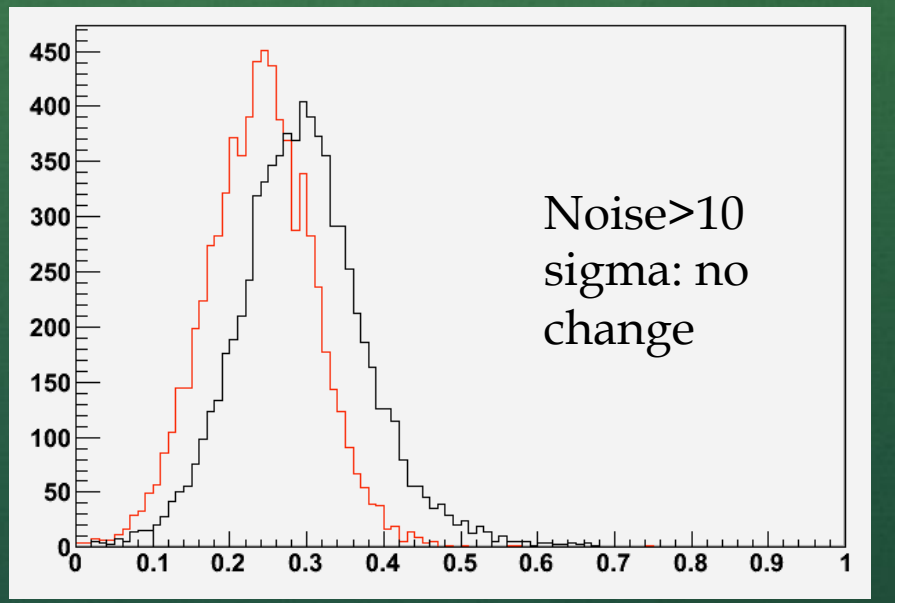
$$S1S9 = \frac{E_{\max}}{\sum_{i=1,9} E_i}$$

LAT

CERN TB



LAT



LAT

Reweighting

CERN TB

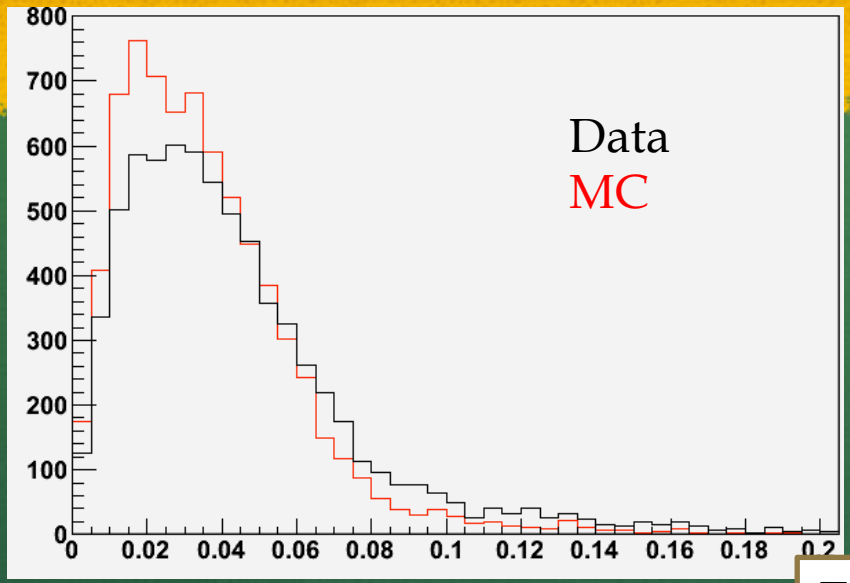
- Fitting LAT distributions with a gaussian and assigning to each event a weight

$$W(LAT)=g_{data}(LAT)/g_{MC}(LAT)$$

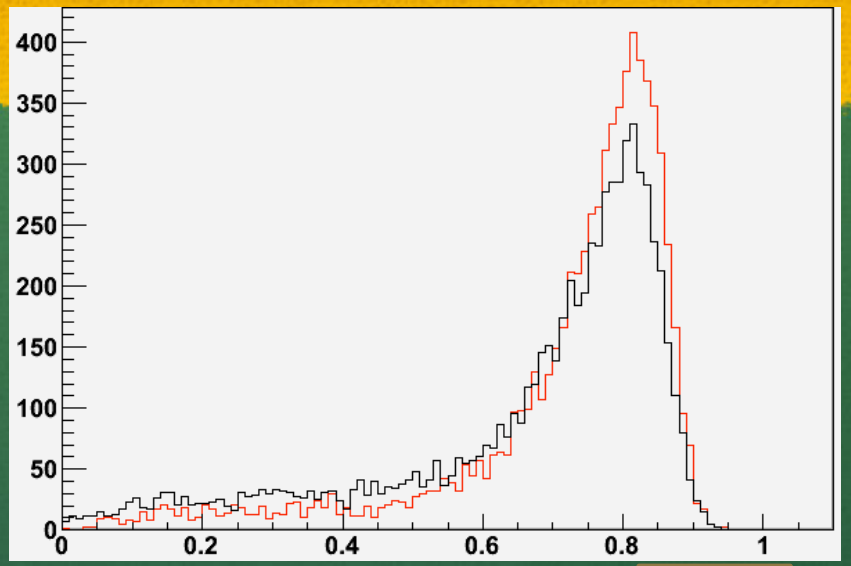
➔ MC resolution still low (2.6% wrt 2.3% without reweighting and cfr data 3.6%)

CERN TB

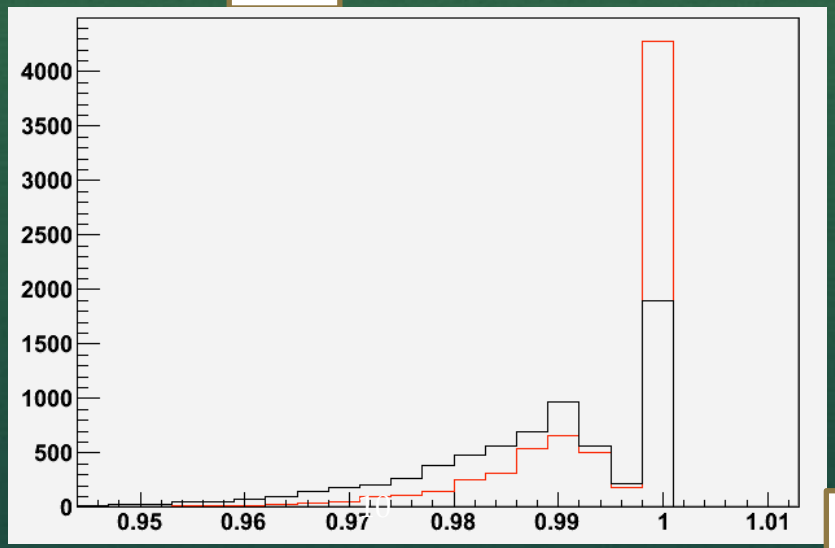
Other Moments



Z42



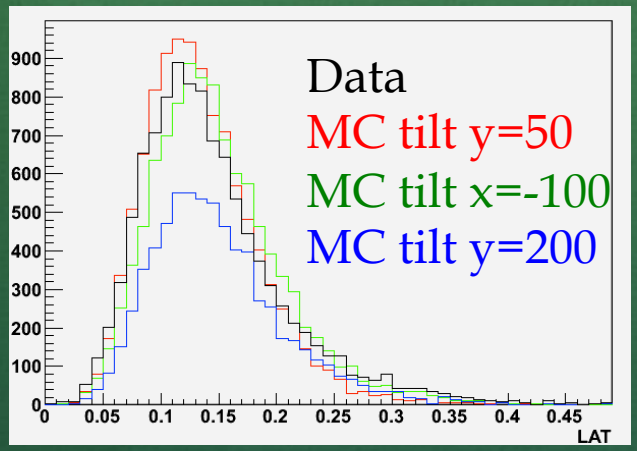
S1/S9



S9/S25

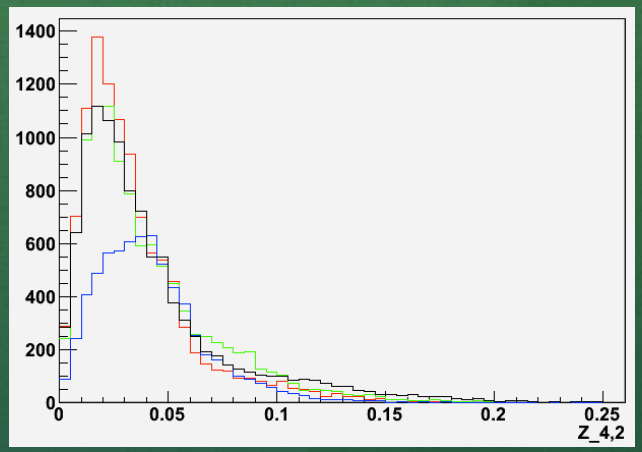
Impact of the tilt on shape vars

CERN TB

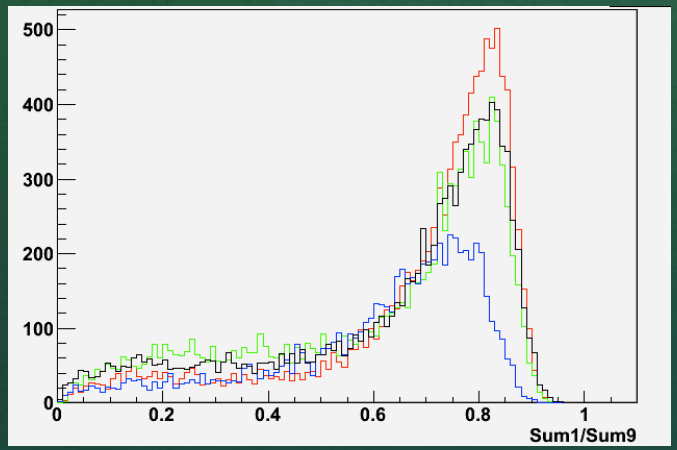


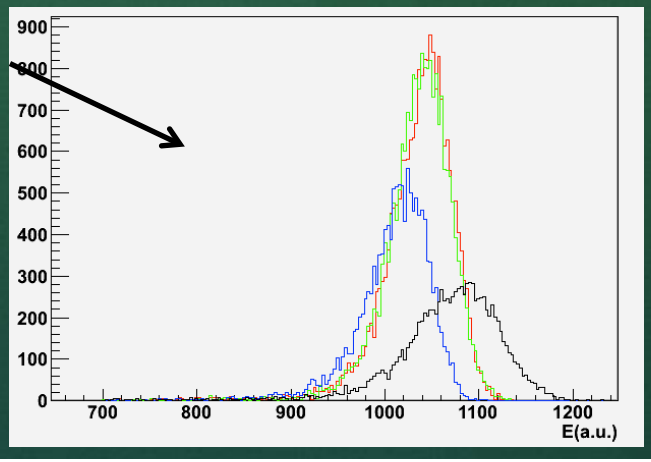
Most likely tilts

Exagerate tilt



X=-100 best tilt
But no impact on resolution





File with tilt in both directions needed to finalize study

LNF Test Beam

Intercalibration with electrons

For each possible configuration of calibration constants plot the total energy and minimize the relative resolution

Use MIP intercalibration as starting point.

Using runs with E=485 MeV and centered in bins 12,8, and 16

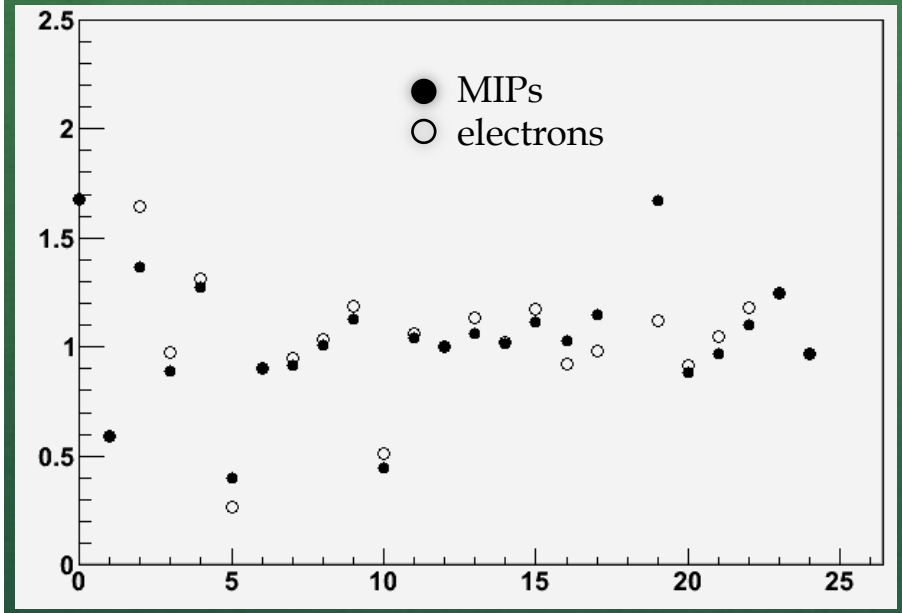
Minimizing RMS/Mean of the distribution

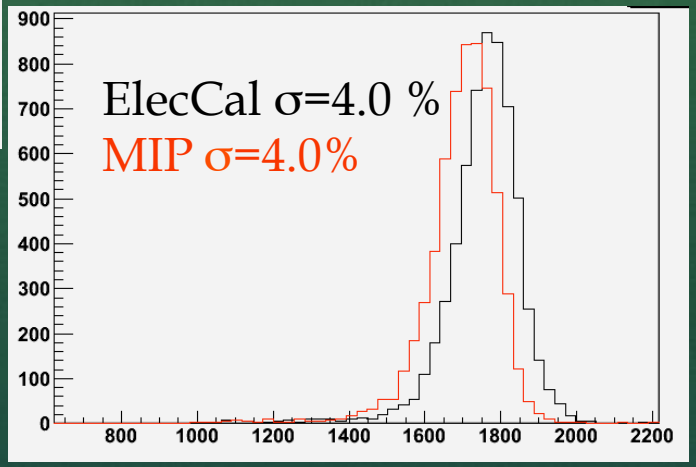
Minimizing in steps, starting from most to the less sensitive channel (pink, gree, orange and white)

4	3	2	1	0
9	8	7	6	5
14	13	12	11	10
19	18	17	16	15
24	23	22	21	20

Channels 6 & 18 determined on Run 803 (first with all on, but beam between 12 and 13)

Comparison between intercalibrations

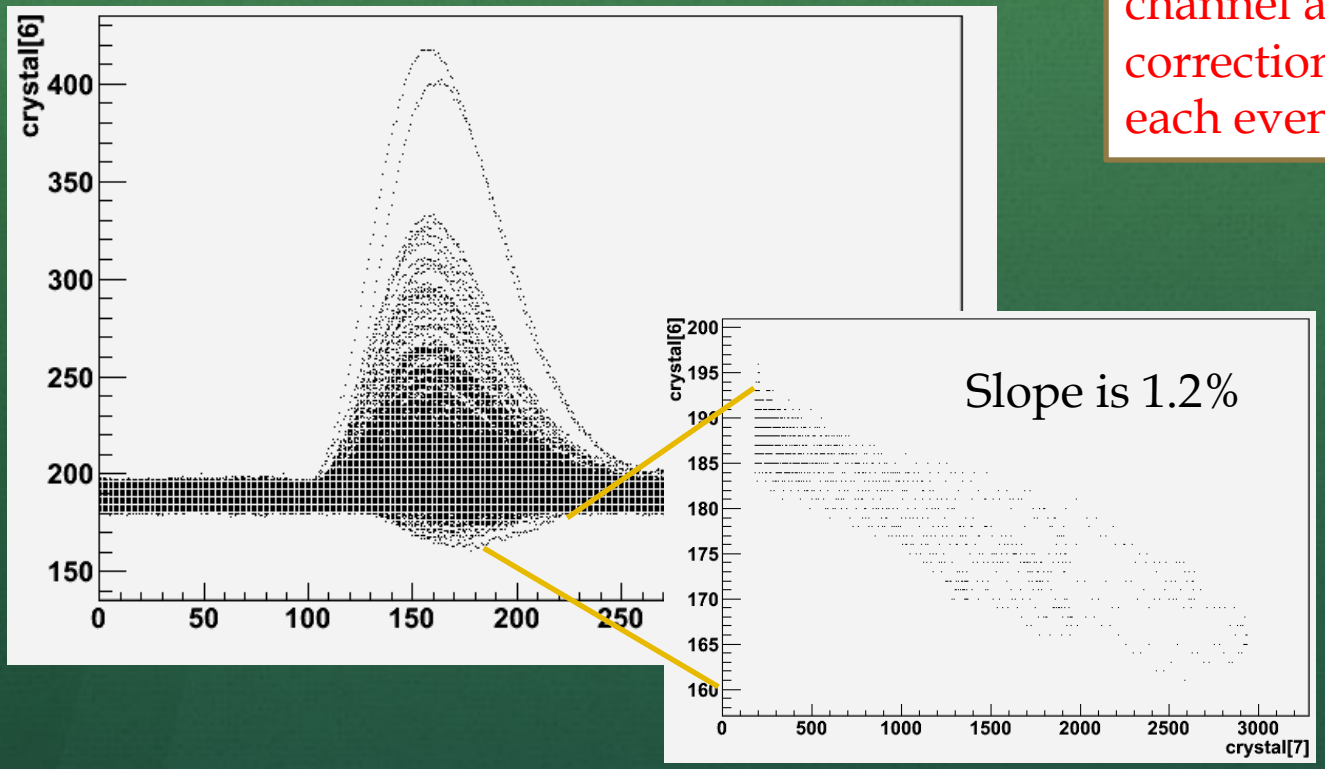




Xtalk

How to estimate Xtalk?
When Xtalk n has signal Xtalk n-1 should have a signal → biased estimate

Is it the same for each channel and should the correction be applied to each event?



Similarly (7,8), (8,9), (2,3), (3,4),(20,21)
Difficult to estimate because you need to have no signal on a crystal when there is a large one in the neighbouring one

Full Matrix

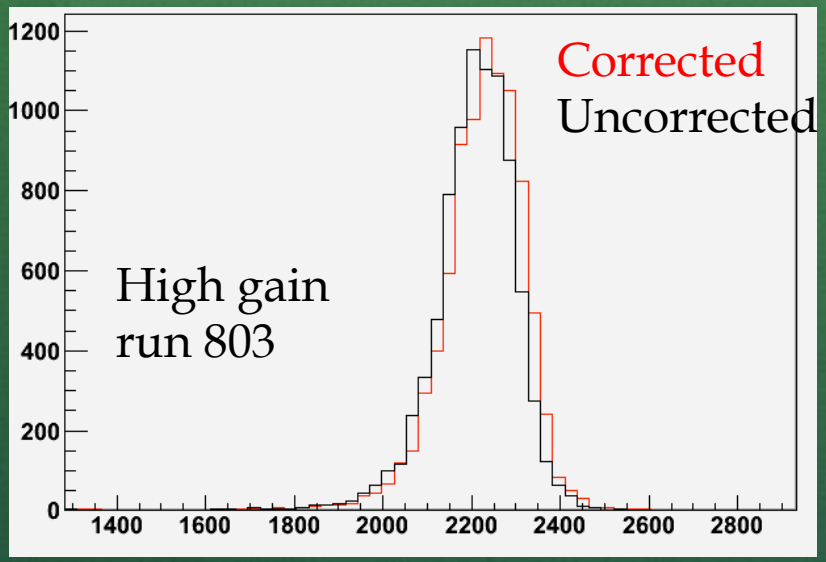
Percent of the signal on channel on the left that is subtracted to the channel

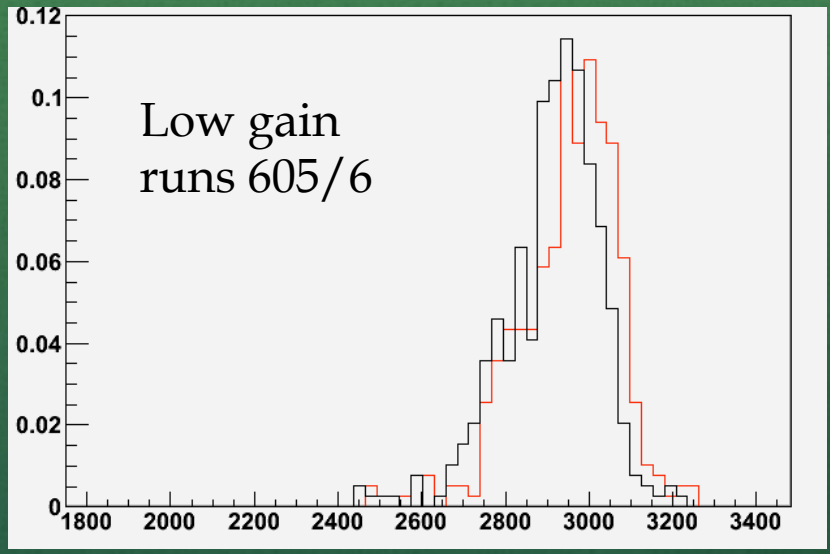
	2.2%	2.0%	1.7%	1.7%
	2.2%	2.0%	2.0%	2.0%
	1.2%	1.2%	1.1%	1.0%
	0.5%	0.5%	0.5%	0.5%
	2.2%	2.0%	2.4%	1.7%

Ch 0

Ch 24

Xtalk correction





No improvement in the worse resolution run
Marginal improvement in the best run (605/6): from 2.55% to 2.44% on same sample and same calibration → a 0.7% contribution? Hard to estimate an error, but could be relevant only at higher energies: keep an eye on the effect.

Summary

- DATA-MC agreement on shower shape distributions and electronic Xtalk don't have a significant impact on resolution in the current TBs, although they need to be kept under control in particular in view of higher energy applications.
- Intercalibration at LNF has been finalized
- TODO:
  - Repeat Shower Shape studies on LNF data – "final" MC needed
  - Define a beam quality estimator to rank the LNF TB data: it could be based on
    - Beam parameters, Beam size, mean number of electrons/bunch, multiplicity (additional photons?),…
  - Finalize the collection of material for the note/paper … deadlines?