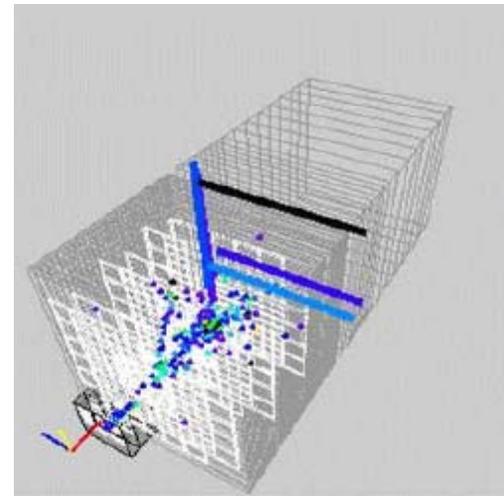




Analysis of electromagnetic showers in CALICE Analog Hadron Calorimeter prototype (AHCAL)

Sergey Morozov

DESY, Hamburg



Changes since last analysis review:

Data:

temperature correction → common T slope for all channels instead of single channel measured value

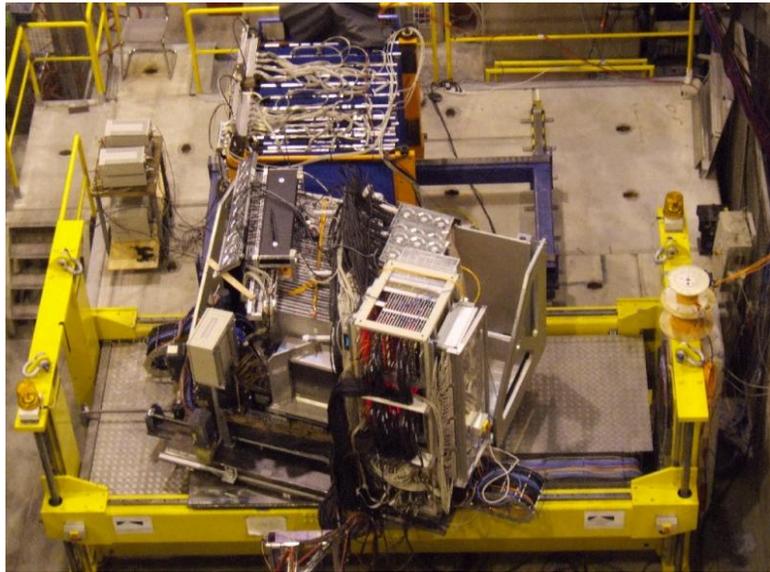
saturation correction → fixes for single curves in shower maximum

MC:

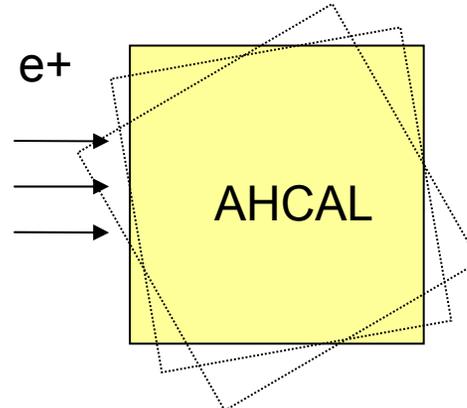
Geometry change → thickness of absorber updated according to measurements

Optical crosstalk between tiles → bug in the digitization code identified

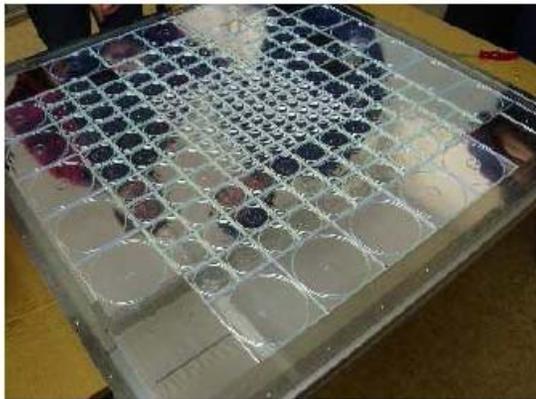
CALICE tile AHCAL prototype at CERN 2007 test beam facility



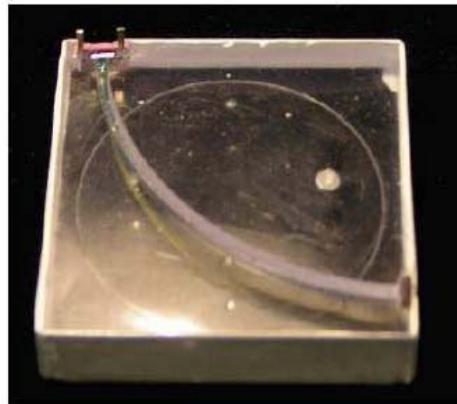
- AHCAL prototype:
- 38 layers (30 with high granularity at central region)
 - each layer has 2cm of absorber (steel) and 0.5cm of active scintillator layer
 - length: 114.57 cm, hadronic: $5 \lambda_0$, e/m: $43.7 X_0$



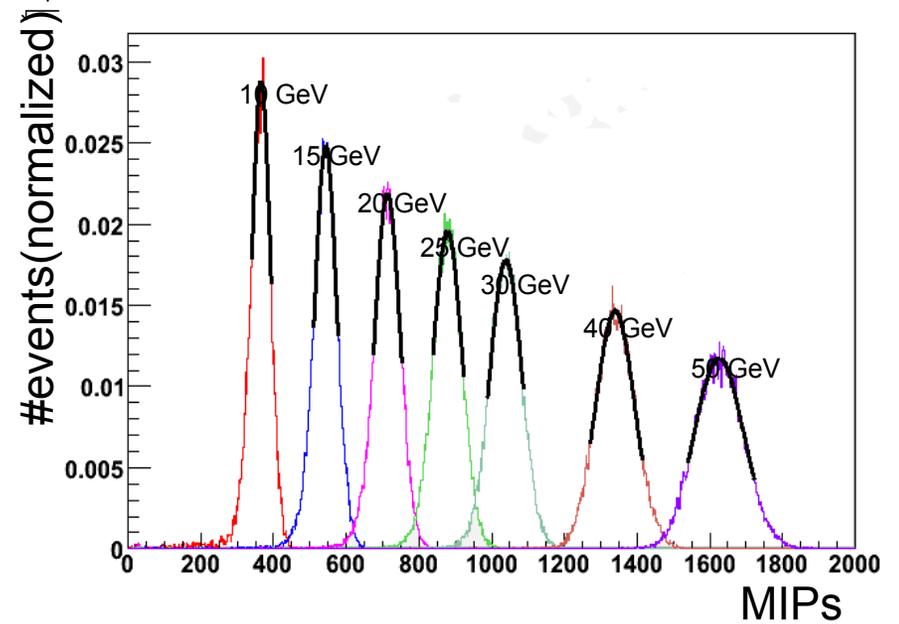
Positron runs collected:
 Energy: 10 - 50 GeV
 Position of beam: 0, +6cm, -6cm
 Angles: 0, 10, 20, 30 degrees



HCAL layer with 216 tiles
(3x3, 6x6, 12x12 cm)



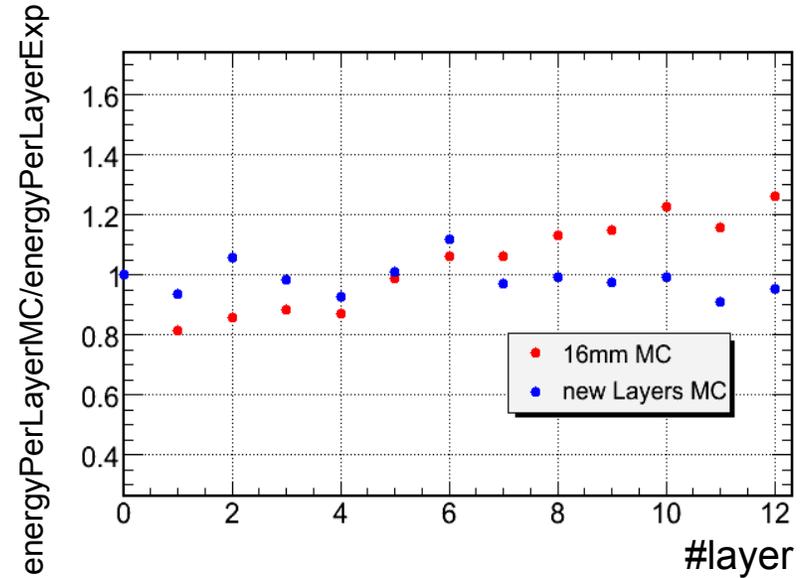
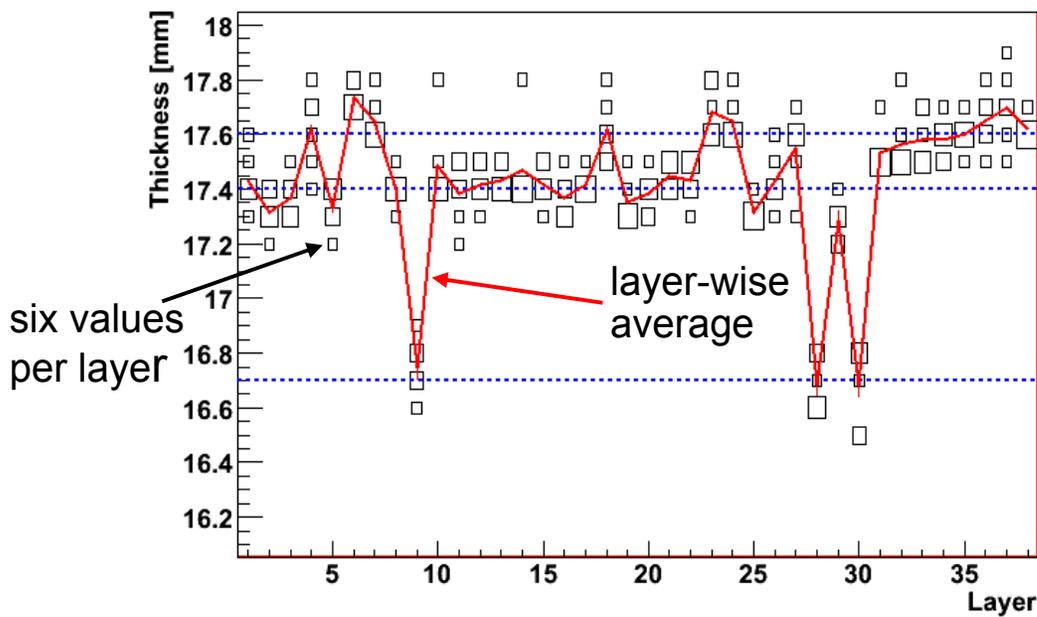
3x3 scintillator tile with
WLS fiber and SiPM



e+ energy reconstructed spectrum in
Minimum Ionizing Particle (MIP) scale

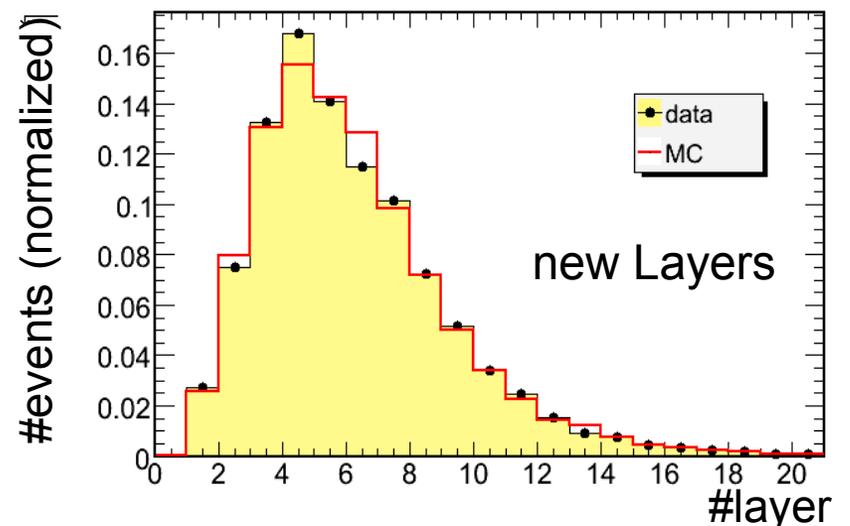
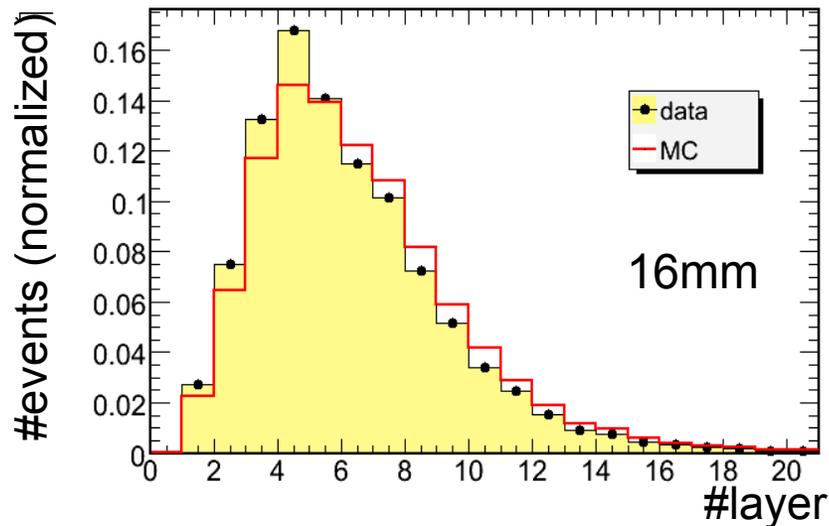
A precision measurements of the absorber's thickness.

Significant improvement of a longitudinal shower profile.



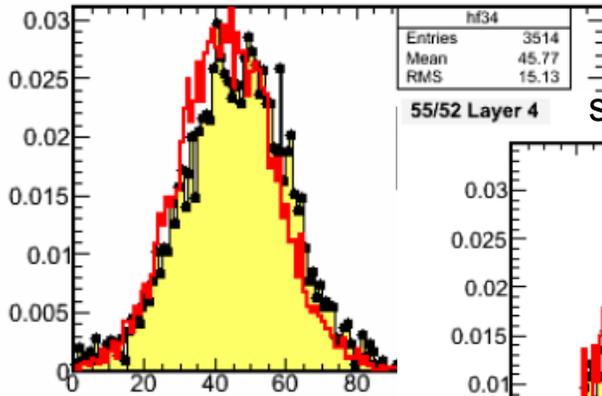
energy profile of a shower

energy profile of a shower



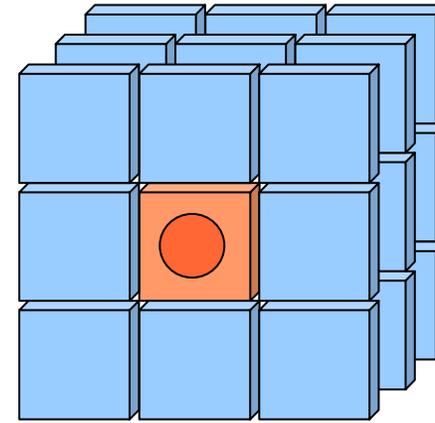
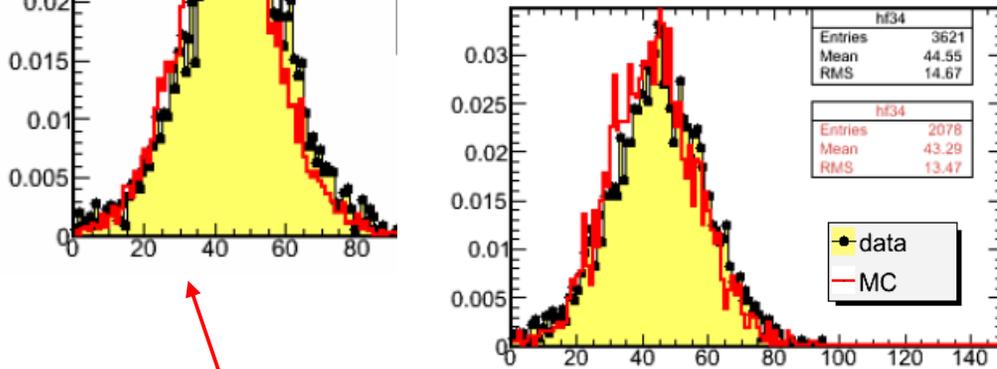
Temperature correction validation. Search for a disagreement in single tile spectra.

49/52 Layer 4 single tile spectrum

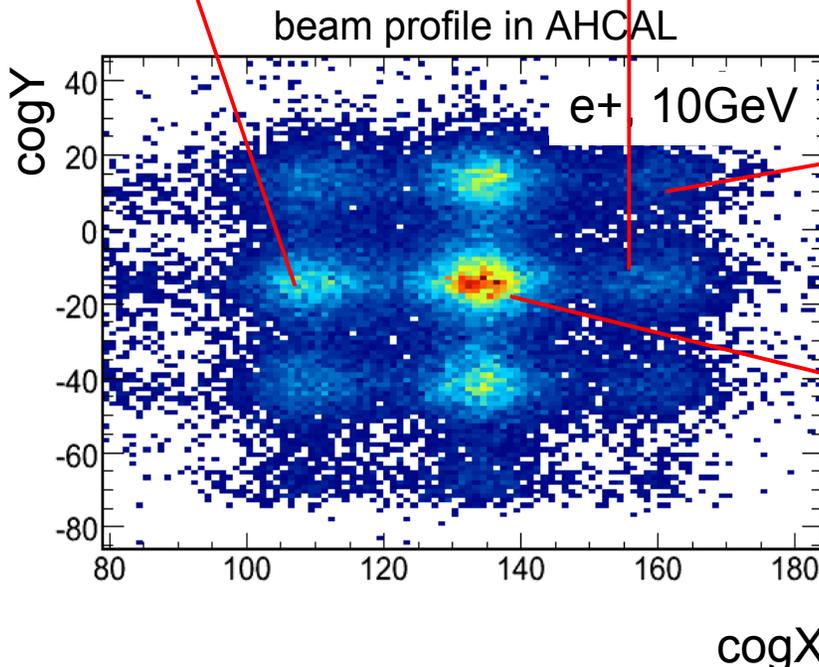


Good agreement!

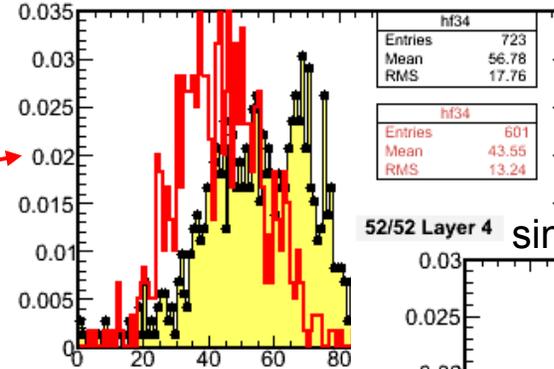
55/52 Layer 4 single tile spectrum



3x3 tile tower study: beam spot of 1cm radius in the center of tile

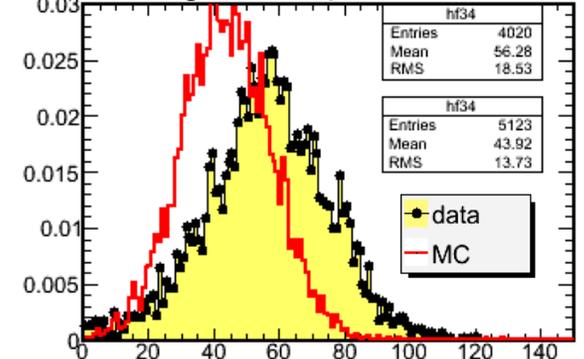


55/55 Layer 4 single tile spectrum

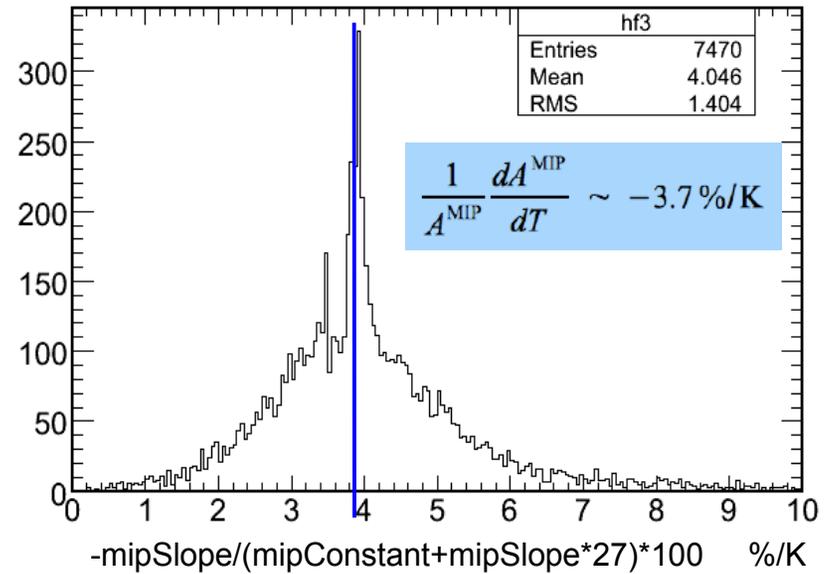
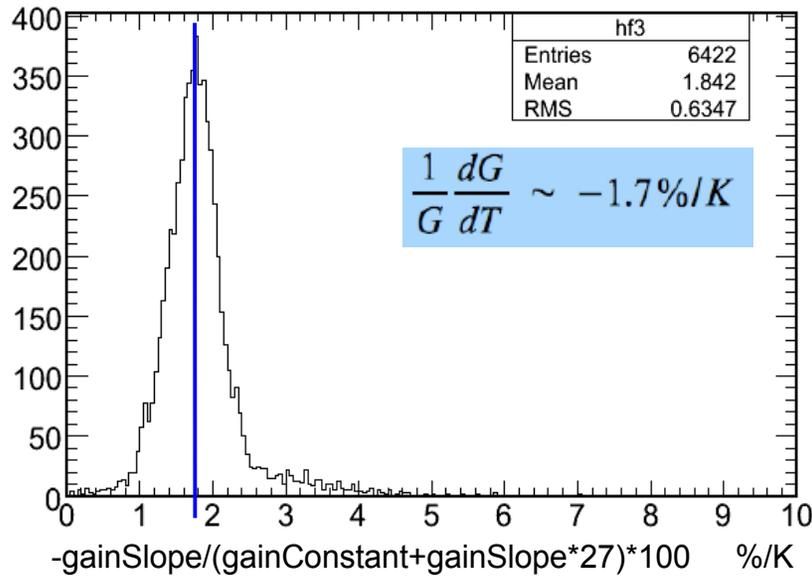


Bad agreement

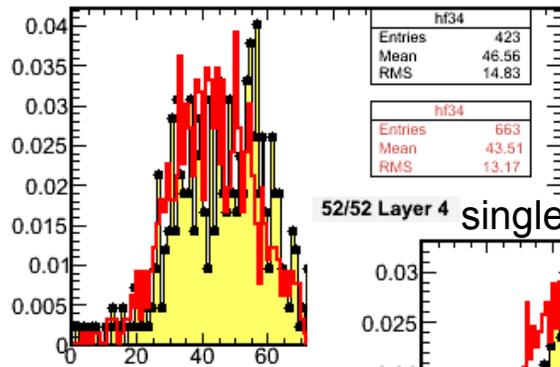
52/52 Layer 4 single tile spectrum



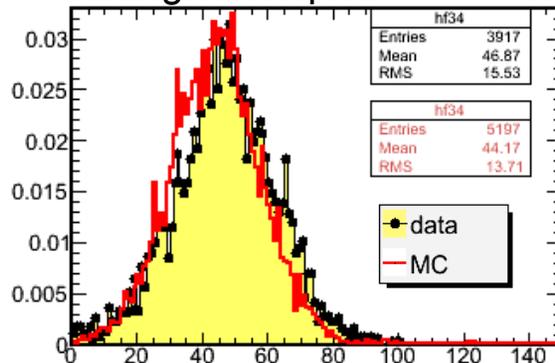
Temperature correction validation.. BIG uncertainties! Let's come back to old fixed value correction



55/55 Layer 4 single tile spectrum

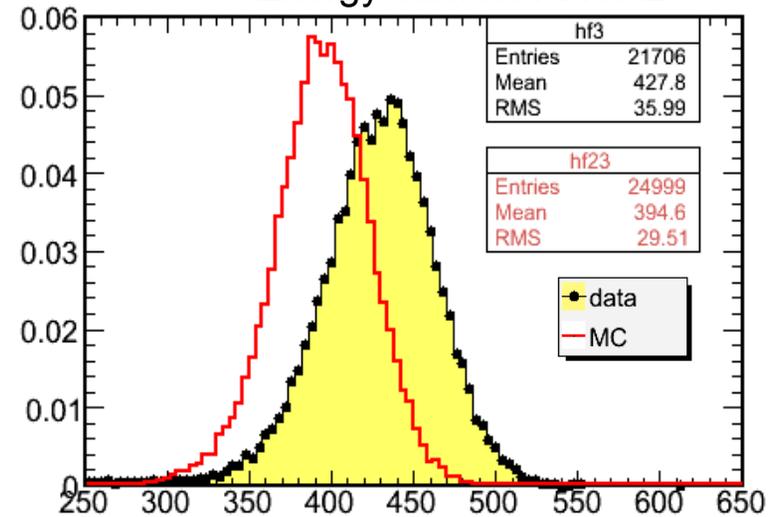


52/52 Layer 4 single tile spectrum



Agreement is better now!

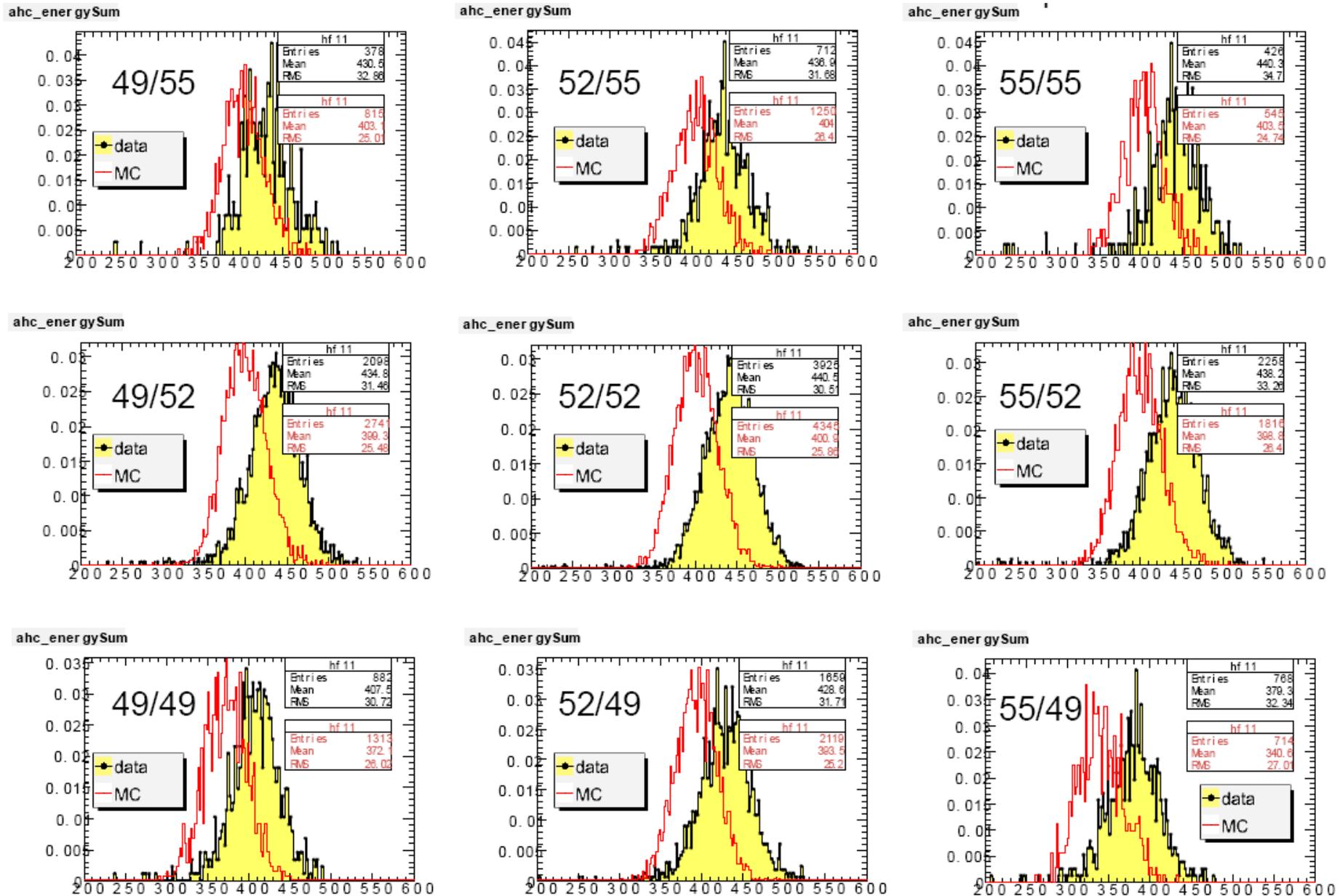
ahc_energySum_data Energy sum for AHCAL



We still have a 10% lower energy in MC.

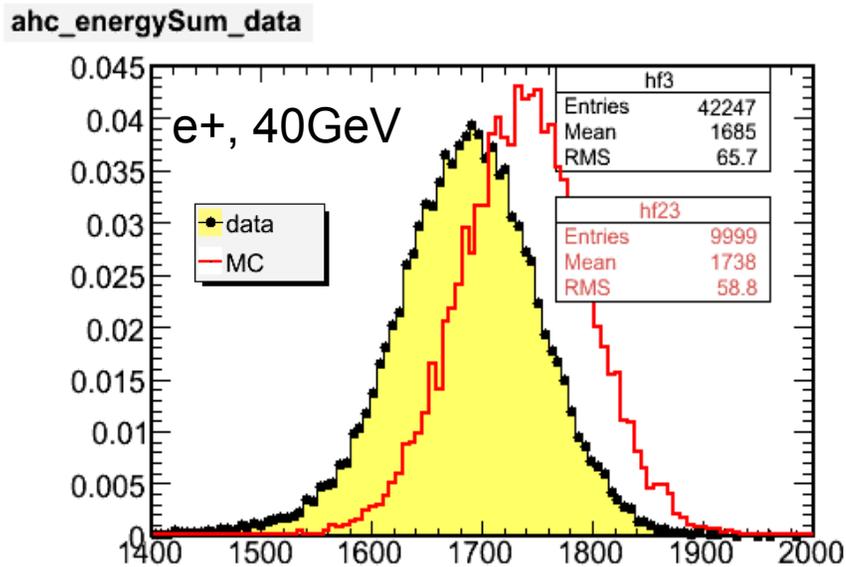
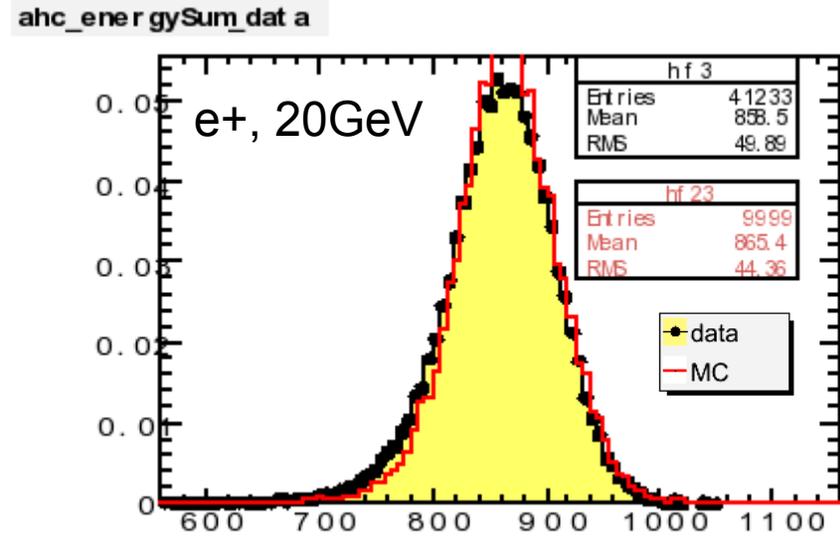
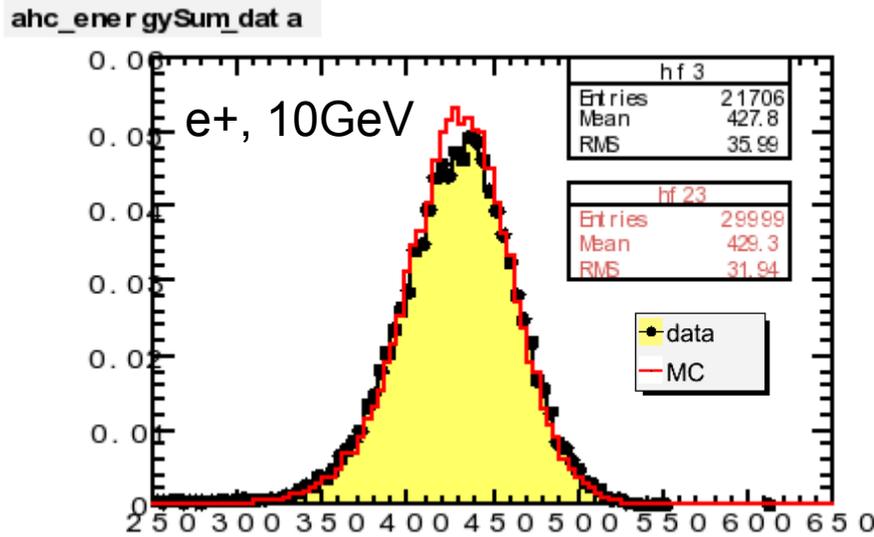
Check beam position dependence of energy reconstruction.

Consistently 10% lower MC independent on beam position.

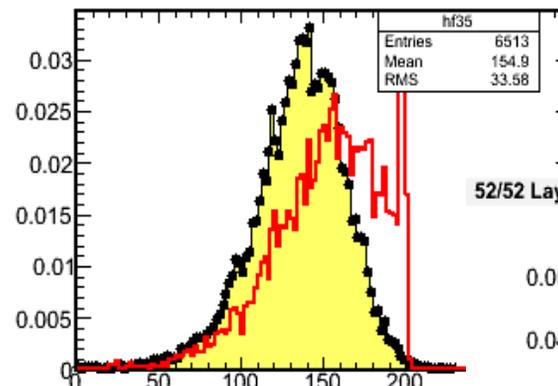


After investigation of code the bug in x-talk implementation was found (exactly 10% effect).

After applying x-talk implementation correction → better agreement at low energy but still problems at high energy scale.

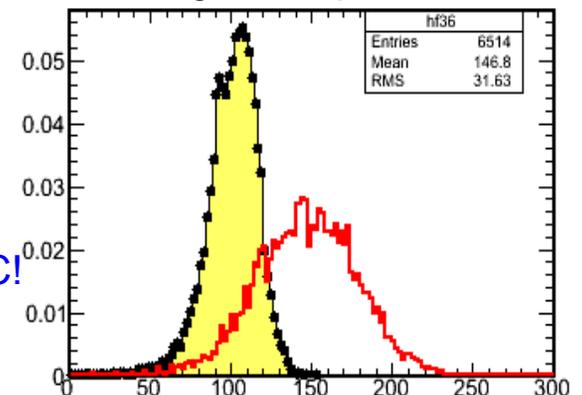


52/52 Layer 5 single tile spectrum



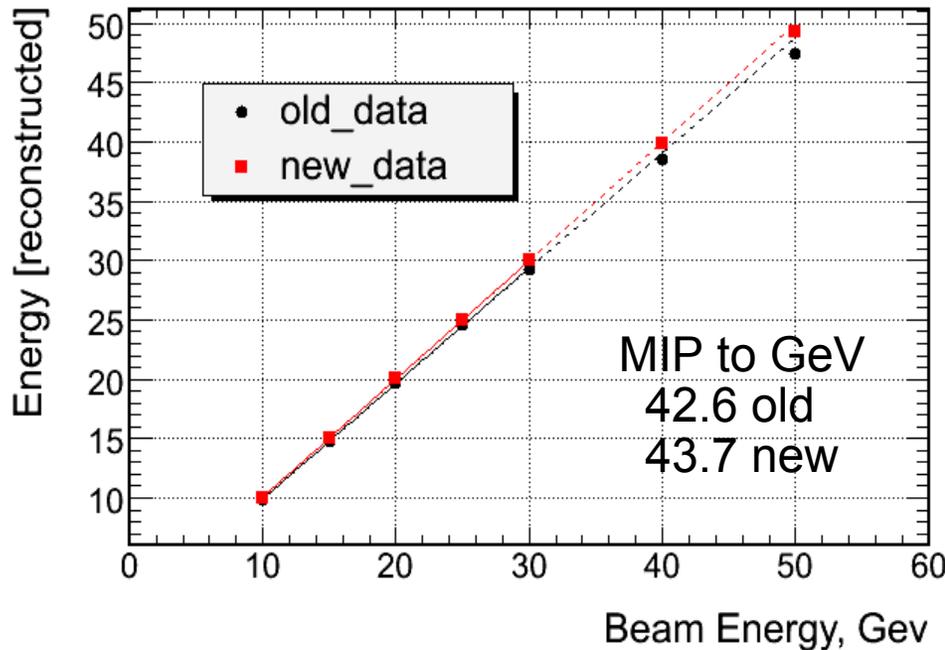
Now the uncertainties in the saturation correction curves are playing the role!

52/52 Layer 6 single tile spectrum

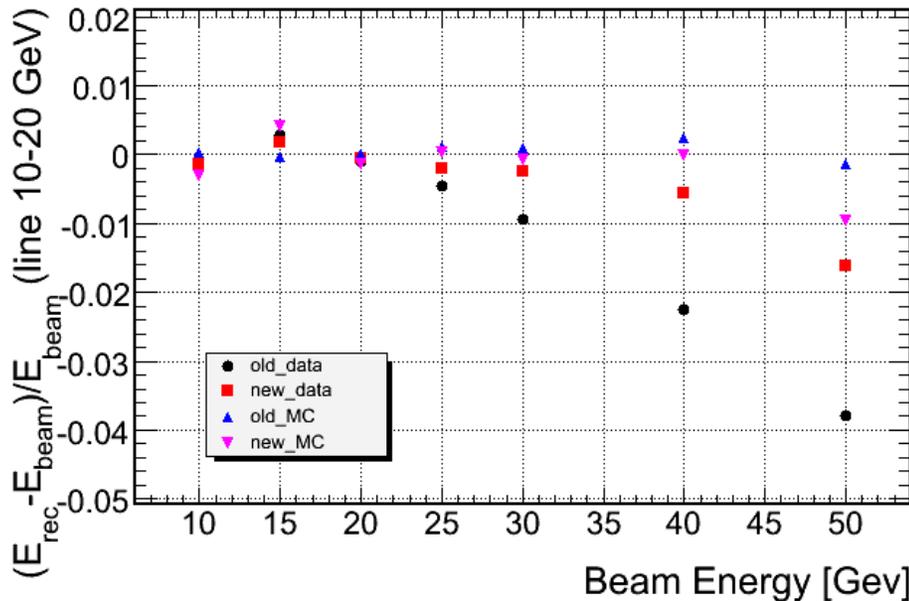
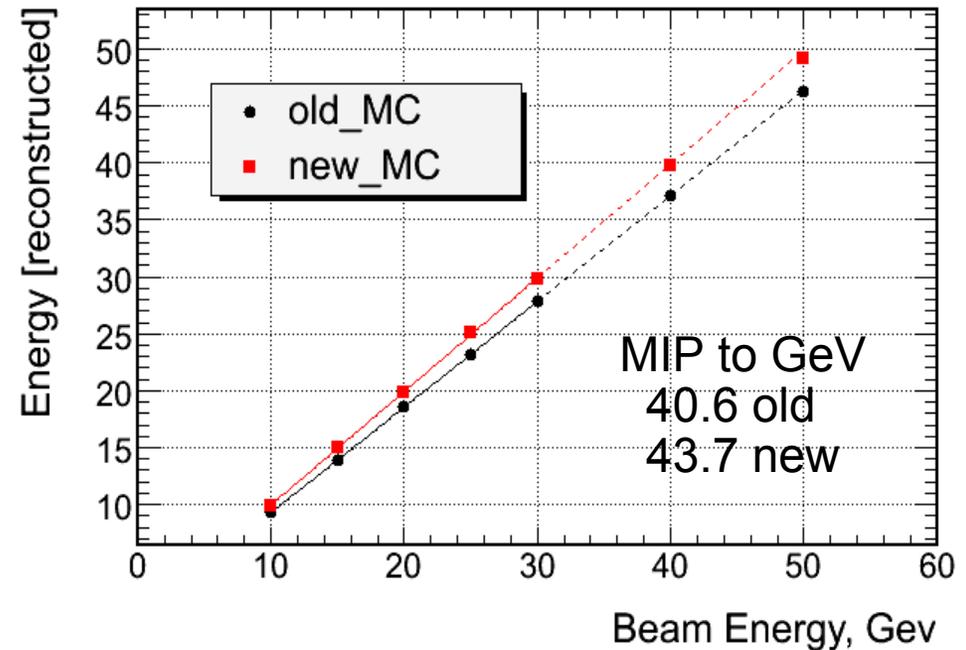


Decision: correct these 2 tiles' curves to match the MC!

All new changes included.



Significant improvement in linearity!



- the energy scale in data and MC now is **the same!**
- the linearity is now better than **2% at 50 GeV**
- the saturated tiles effect is now visible at high energy in MC

Summary & Outlook

Identified corrections:

data

- back to old “fixed values” temperature correction implementation (need to be carefully added to the code and cross-checked!)
- fixed some saturation correction curves using rescaling factors
Significant improvement of linearity (better than 2% at 50 GeV)
Need to be accurately stored in DB to be used in future reconstruction

Monte Carlo

- new Mokka model (new individual absorber thickness measurements) has been validated
- optical x-talk has been corrected in digitization algorithm (need to be carefully added to the code and cross-checked!)

The next final step will be an additional smearing to simulate the constant term in energy resolution curve.

Backup slides

Preliminary energy resolution curves for old data and MC and after we have applied the valid “fixed value” temperature correction, 10% change of effective MIP treatment in MC and individual re-scaling of saturatin curves for 52/52/5 and 52/52/6 tiles in data and MC as well.

The noise term is not fixed here! The constant term is need to be simulated with addition smearing (in plans)..

