Digitization and electron data

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Outline

Two parts:

1. Closer look at MC used for CALICE Analysis Note: Electron data with the CALICE tile AHCAL prototype at the CERN testbeam (Sebastian Richter)

2. Single cell studies (Sergey Morozov)

Analysed positron runs

CERN August 2007 (hcal only):

beam energy	run number	particle
10 GeV	350118	e+
15 GeV	350117	e+
20 GeV	350114	e+
25 GeV	350113	e+
30 GeV	350111	e+
40 GeV	350110	e+
50 GeV	350128	e+

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MC digitization

Basic data:

- Mokka detector model: TBCern07
- beam position adjusted

Brief reminder of effects simulated so far:

- optical crosstalk: light leaks to direct neighbours
- SiPM saturation simulation and correction
- SiPM pixel statistics
- noise: pedestal substracted random trigger events overlayed

Next slides will show impact of (some of) these effects.

red = data (10 GeV e+), default reconstruction
blue = MC (10 GeV e+), no optical crosstalk
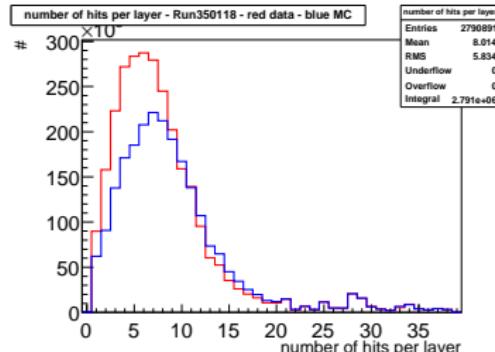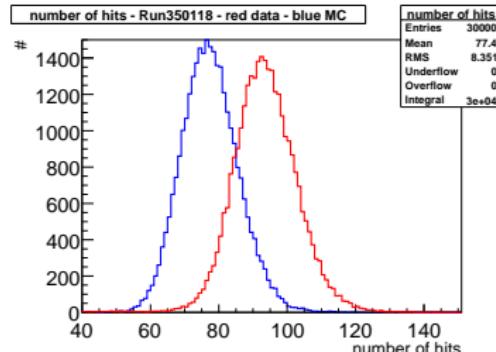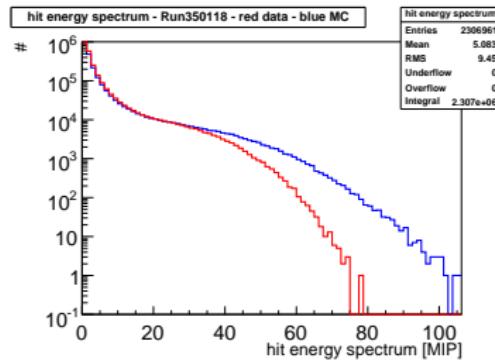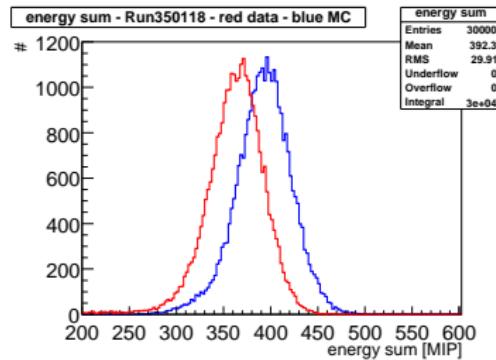
red = data (10 GeV e+), default reconstruction
blue = MC (10 GeV e+), 10% optical crosstalk
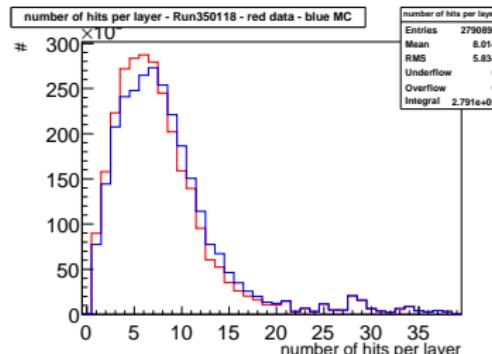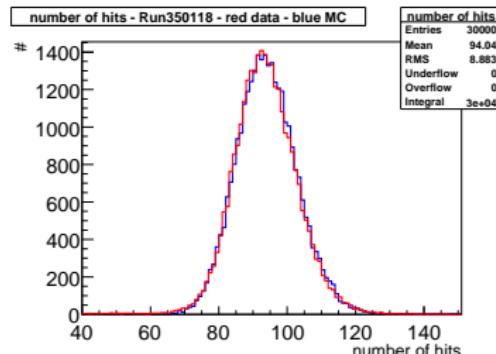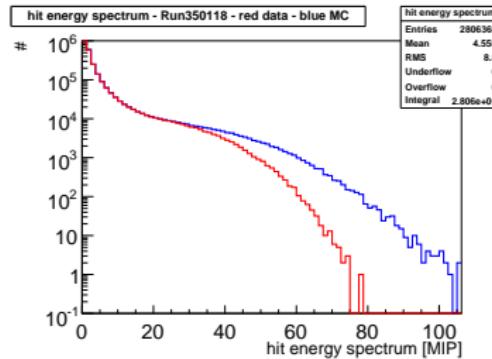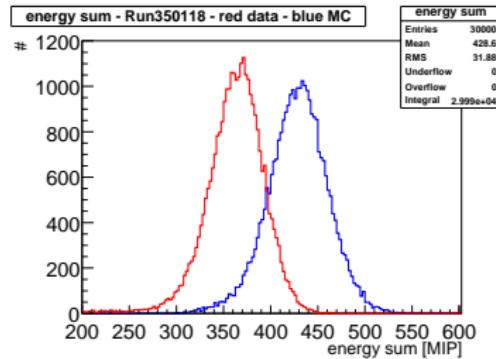
Saturation level
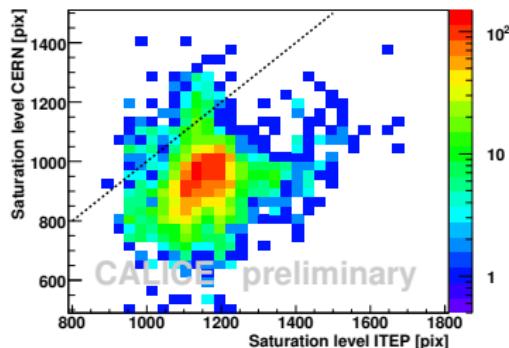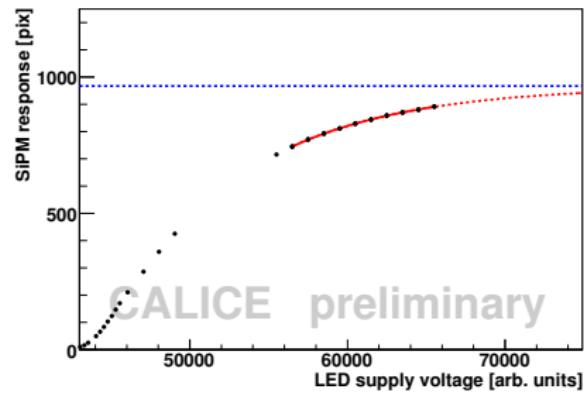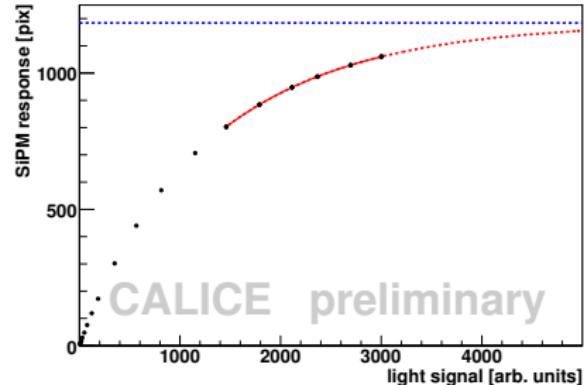
- Saturation level determined using LED runs is $\approx$ 80% of the level obtained from ITEP

- Geometrical mis-alignment of the fibre with respect to the SiPM causes a reduction of available pixels

red = data, blue = MC
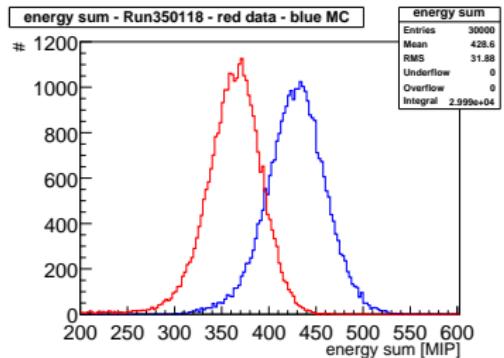
- default ITEP curve
- ITEP curve 80% scaled

e+ '07: reconstructed energy vs. beam energy

Legend:
- MC, 10% optical crosstalk
- Data, 80% scaled curve

y-axis: energy sum [MIP]
x-axis: beam energy [GeV]
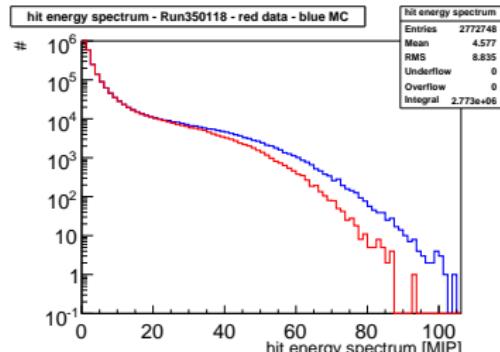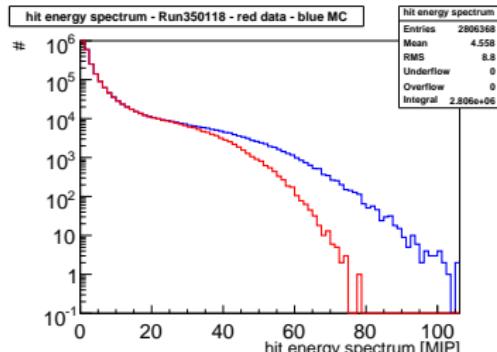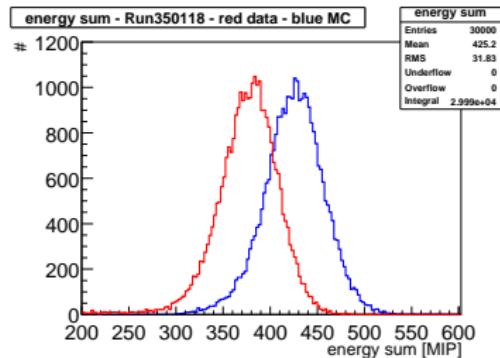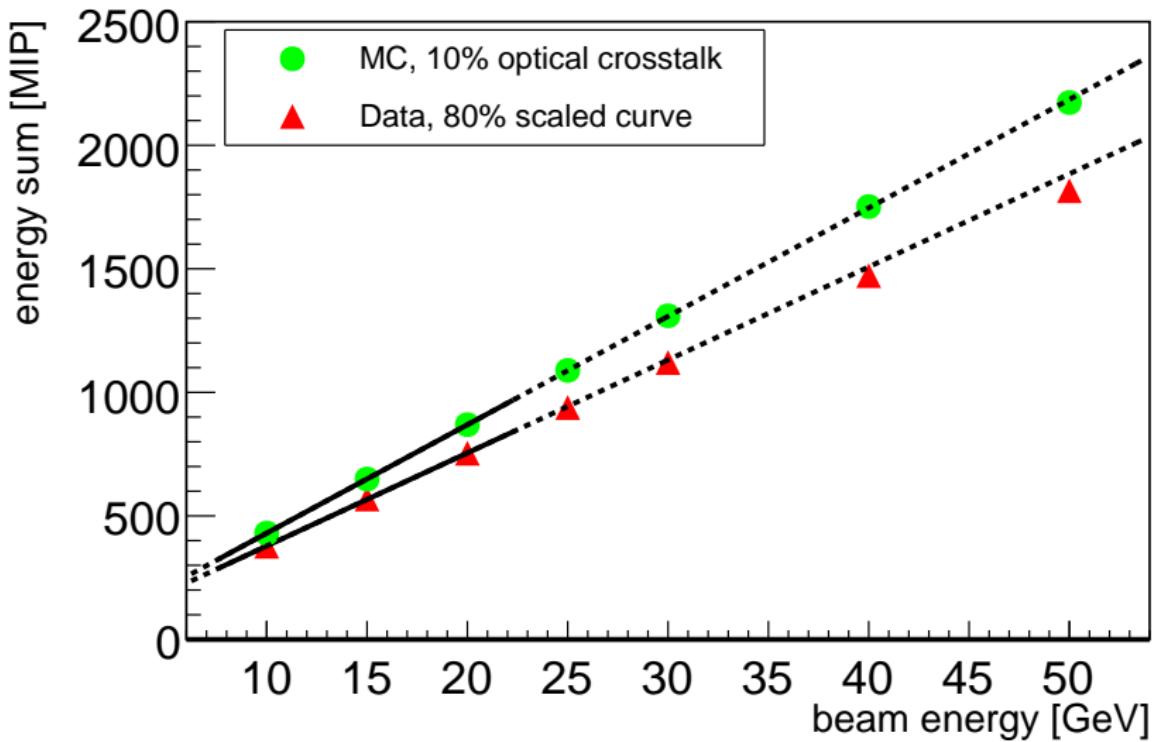
MIP temperature dependence

- MIP ($\frac{ADC}{muon}$) decreases with rising temperature
- Positron runs analysed taken during a hot period
- $\Delta T_{e+} - T_{MIP} \approx +2.4°$
- No temperature correction currently available for data
  - ⇒ simulate the MIP during positron run
- Assume 10% smaller MIP constants during digitization, but calibrate with plain measured MIPs
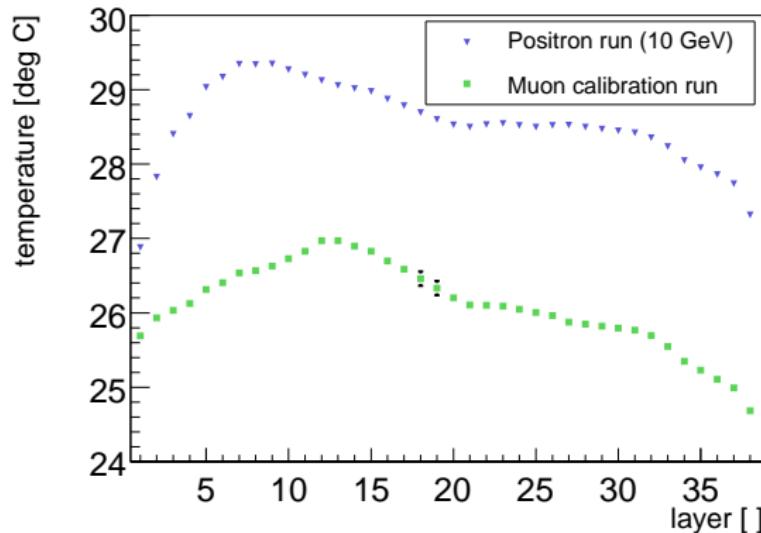

(Temperature extracted by Nils Feege)

red = data, blue = MC

no temperature effects (left), temperature effects simulated (right)
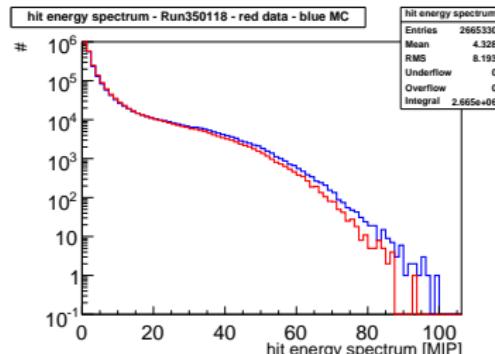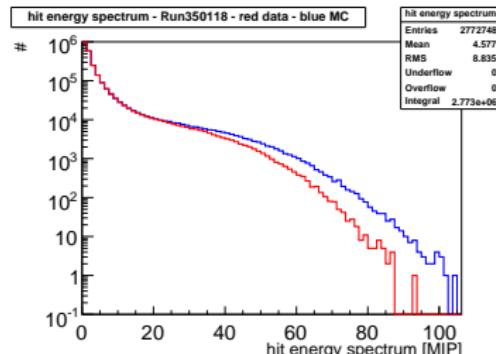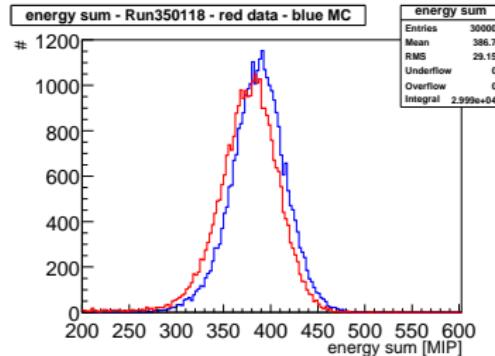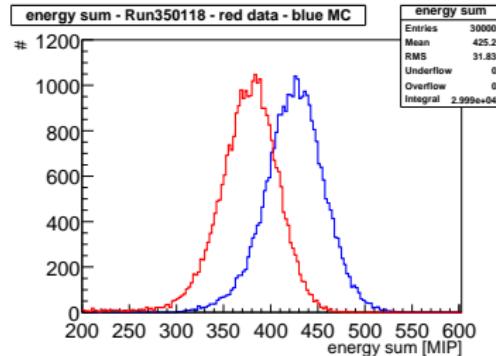
red = data (10 GeV), ITEP curve 80% scaled
blue = MC, 10% optical crosstalk, temperature effects
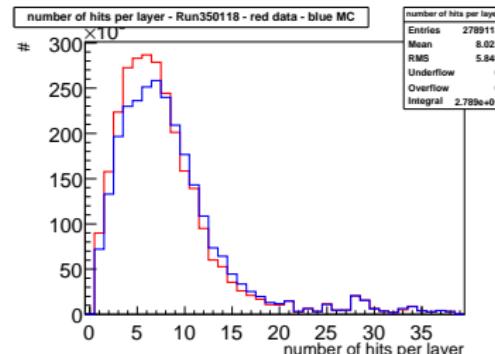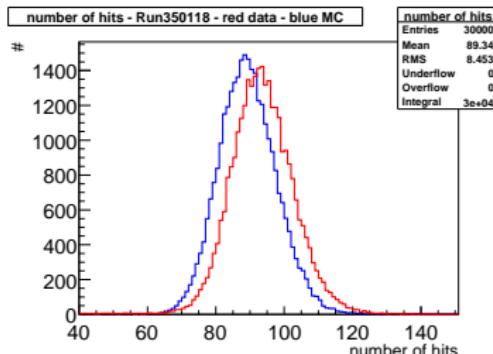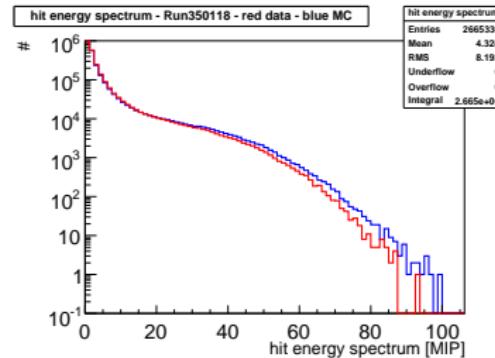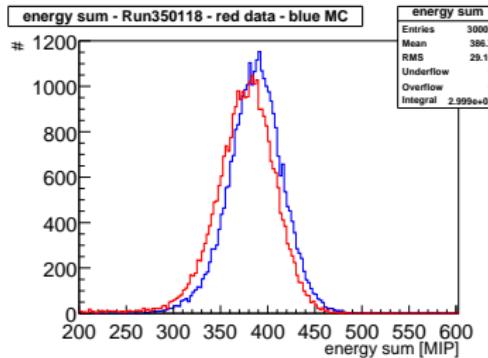
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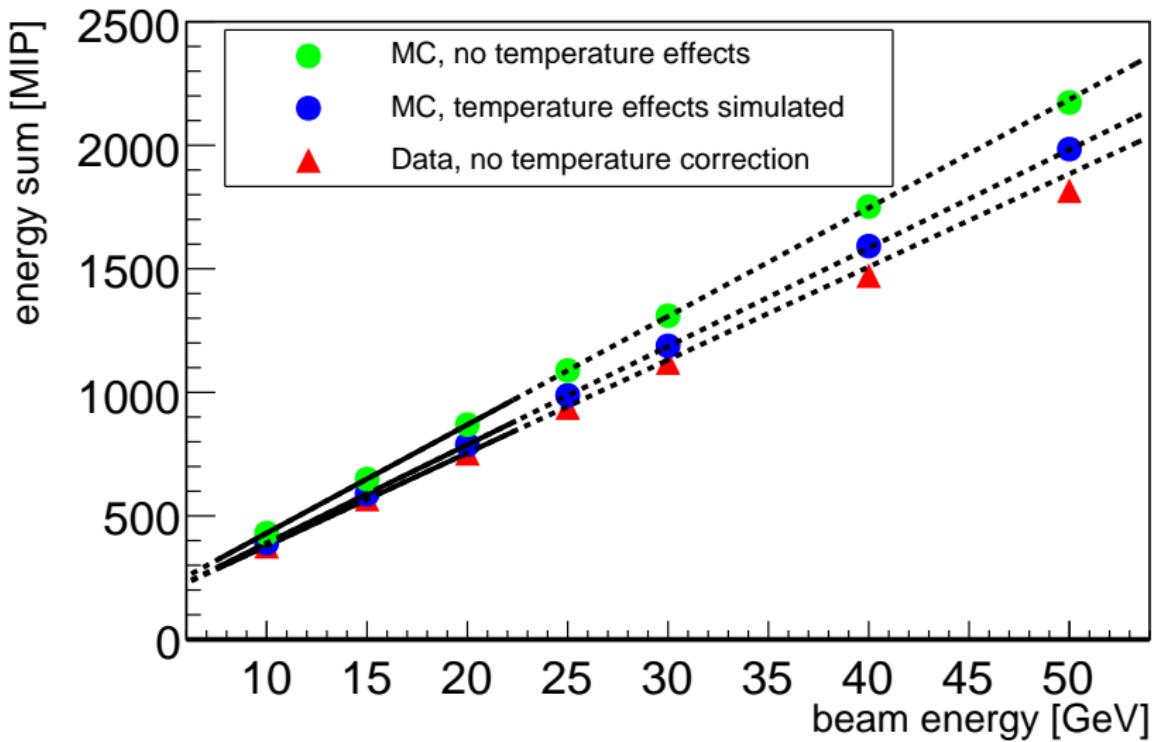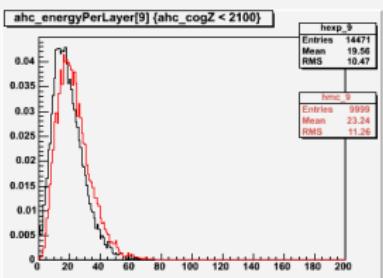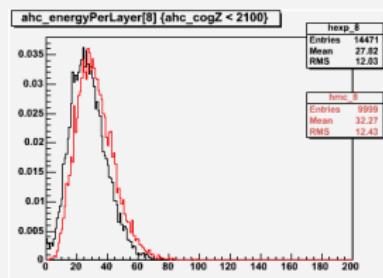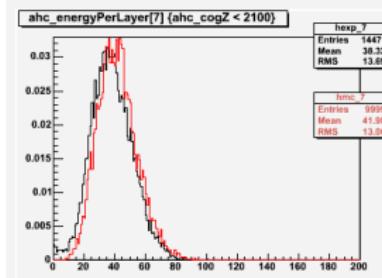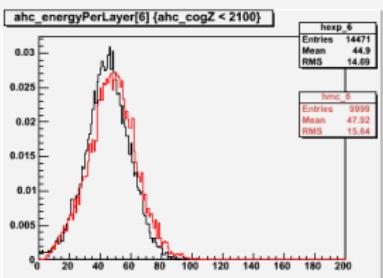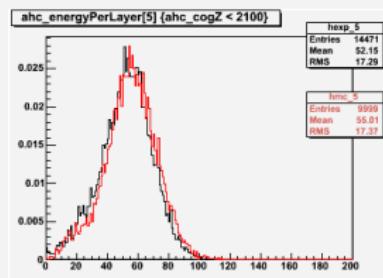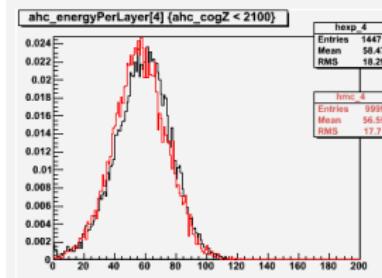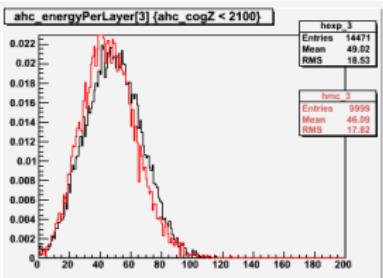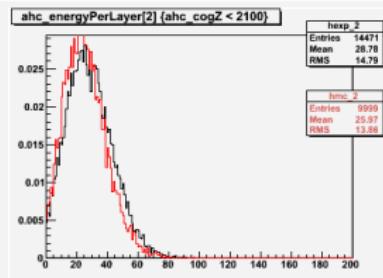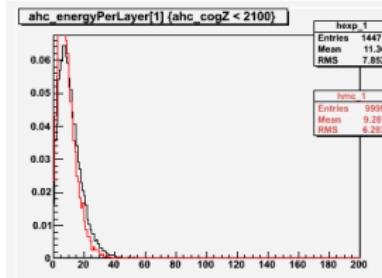
Legend:
- MC, no temperature effects
- MC, temperature effects simulated
- Data, no temperature correction

y-axis: energy sum [MIP]

x-axis: beam energy [GeV]

Energy sum per layer:
red = MC, black = data - all effects

Average energy sum per layer:
red = MC, black = data - all effects
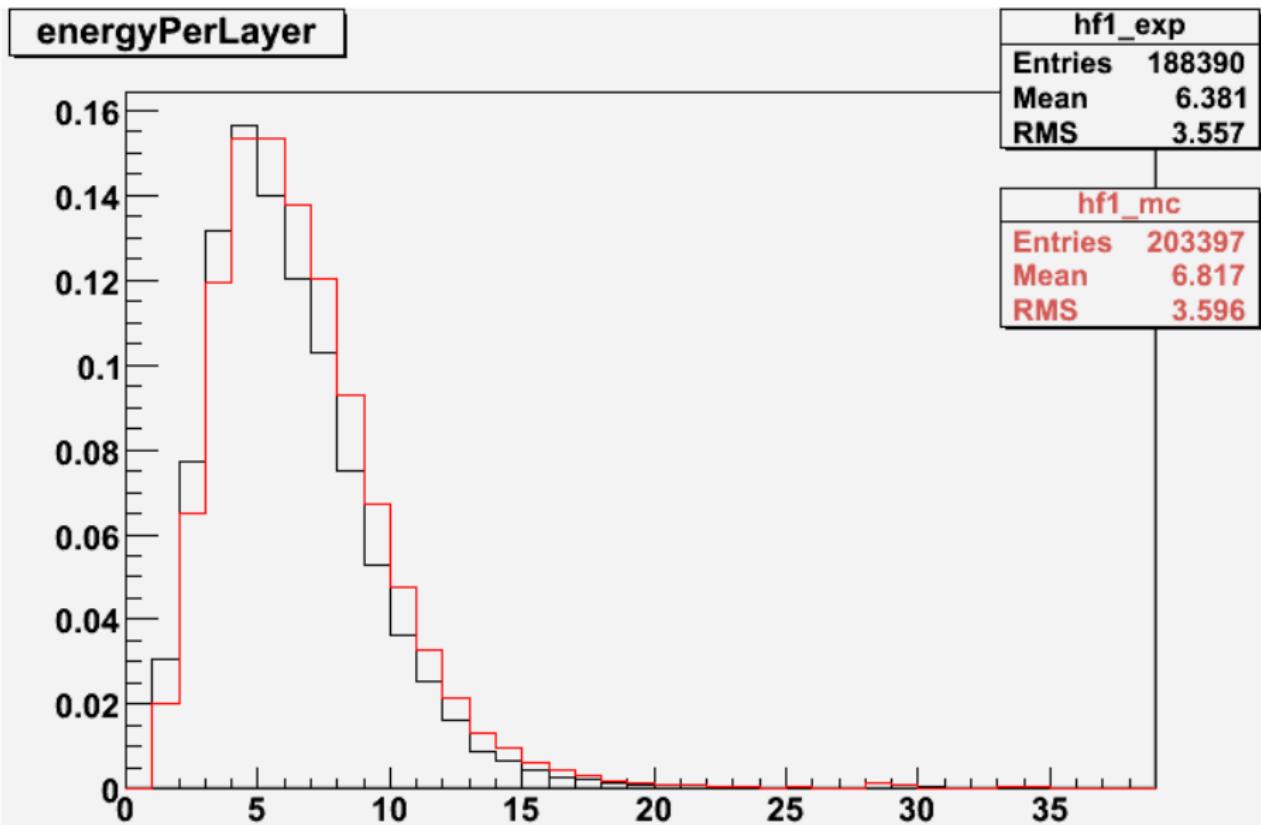
Average energy sum per layer:
red = MC - no temperature effects,
black = data - no saturation adjustment
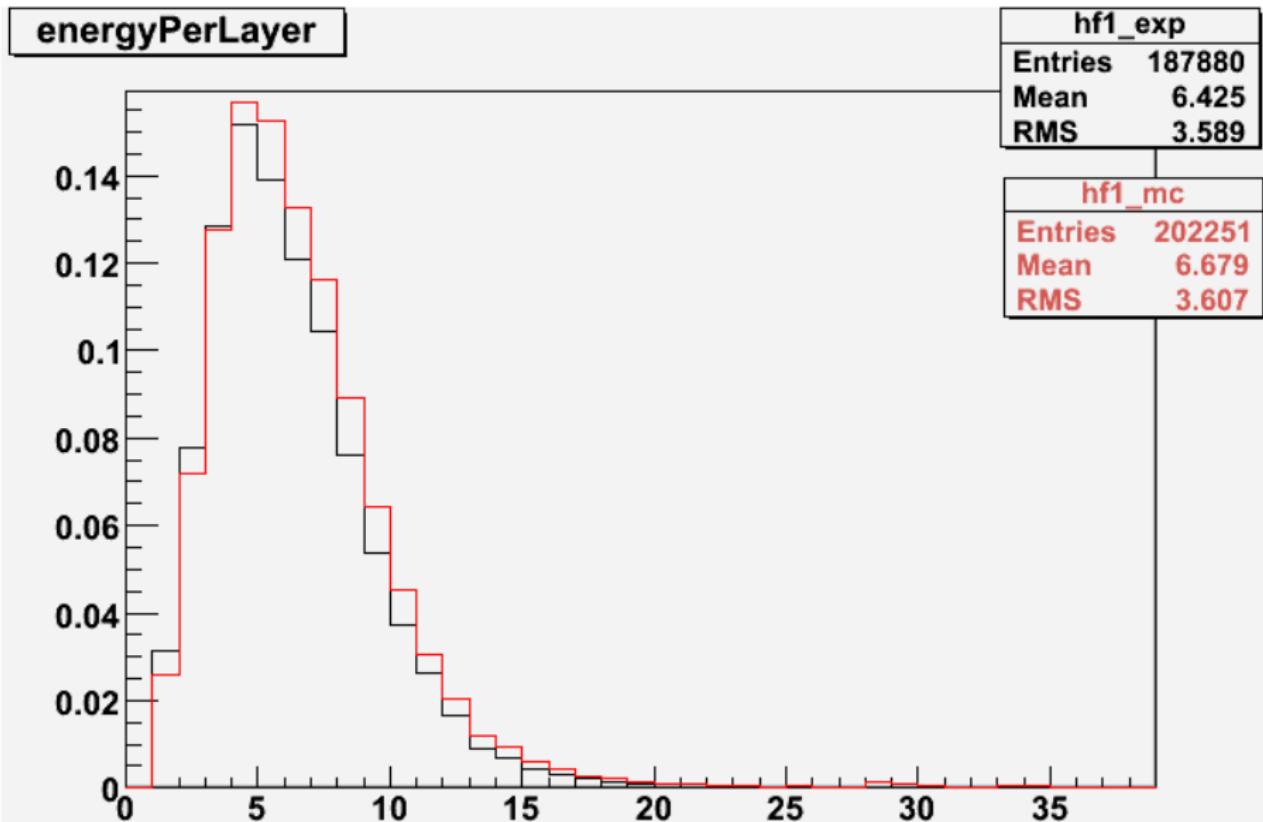
Single cell in shower maximum:
red = MC - no temperature effects,
black = data - no saturation adjustment
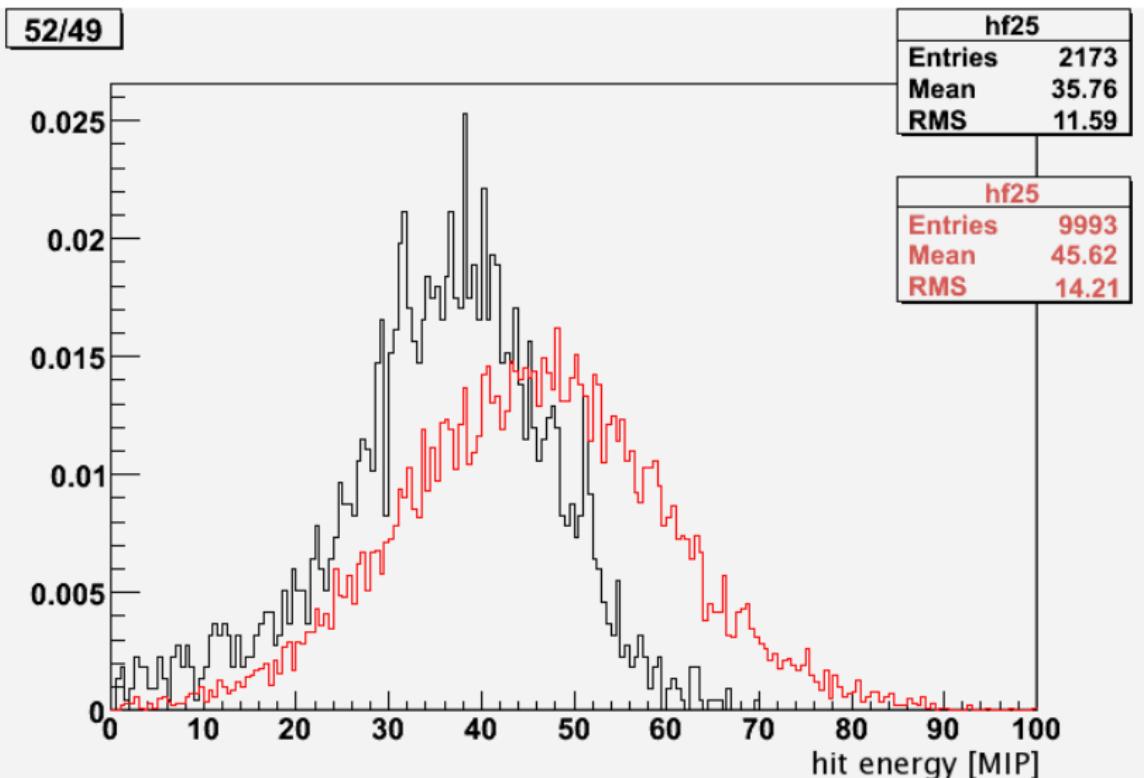
Single cell in shower maximum:
red = MC - with temperature effects,
black = data - with saturation adjustment
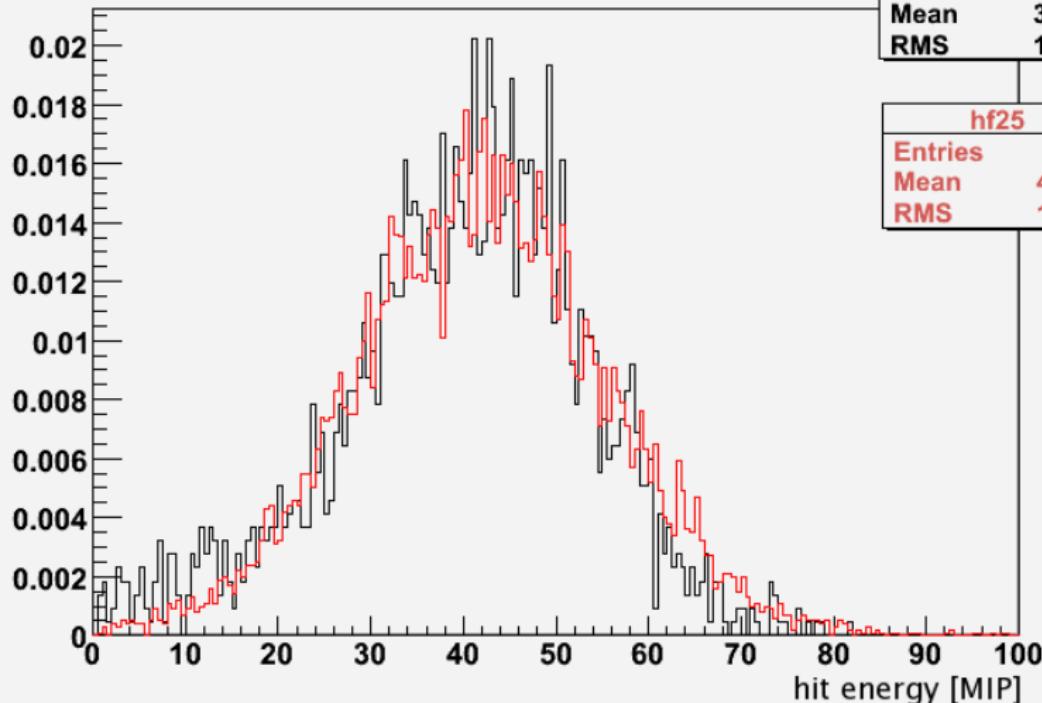
Summary

- Temperature effects have to be taken into account
- $< 6\%$ discrepancy in energy sum and number of hits up to 30 GeV
- $\Rightarrow$ global values agree well
- Analysis on smaller scales started
- $\Rightarrow$ Energy distribution in single cell promising, but further investigation is needed