The University Of Sheffield.

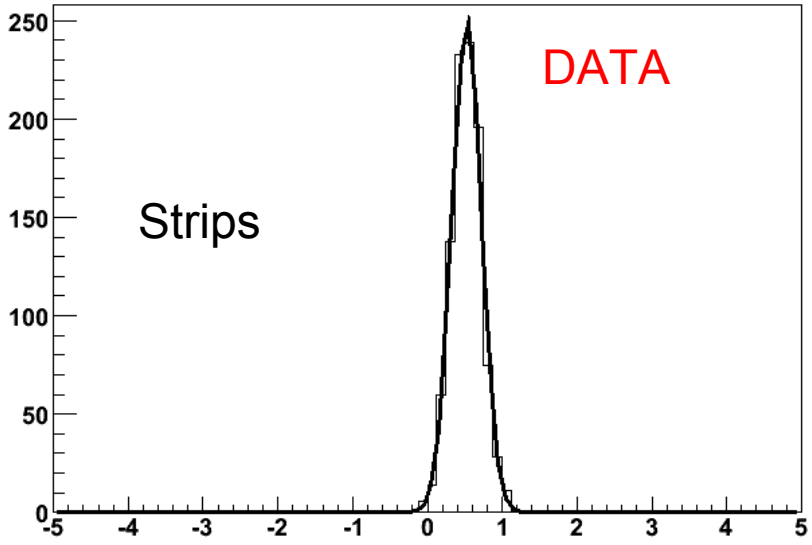
Update on Material Studies

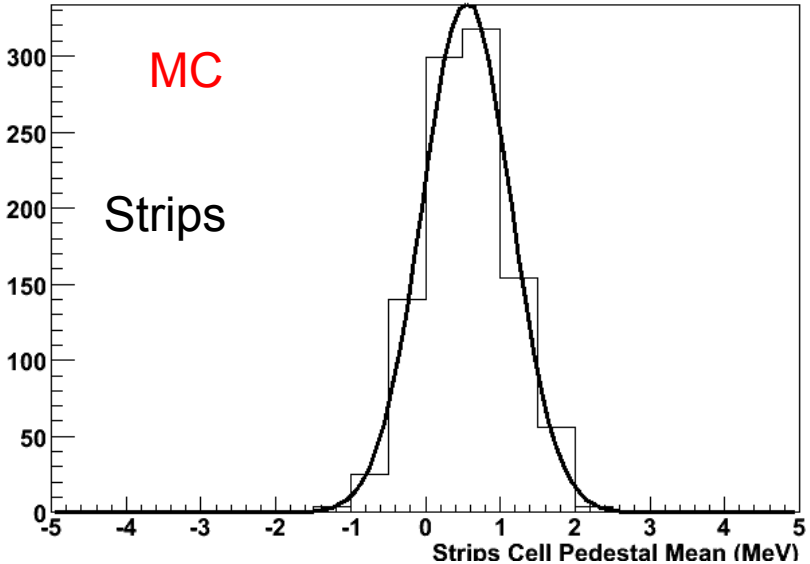
- Progress on Linearity using calib-hits (very brief)
- Revisiting the material problem:
    - a number of alternative scenarios discussed

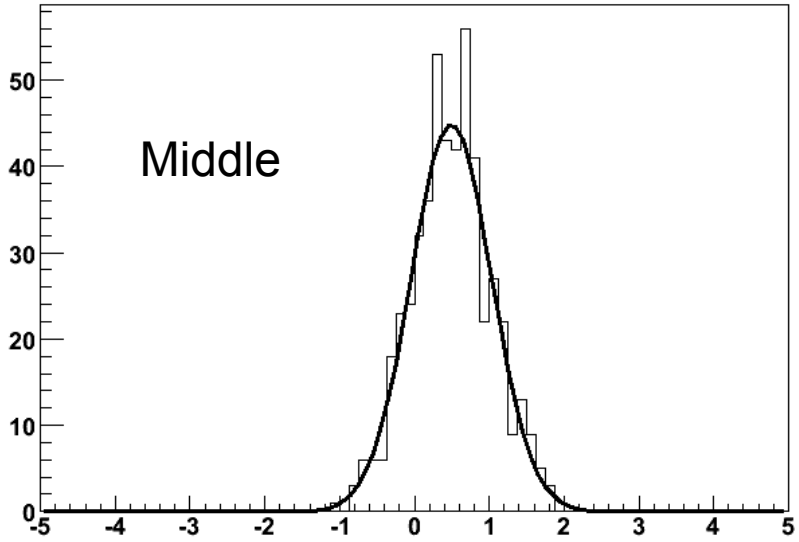
Reminders of MC-setup (periods 5+6)

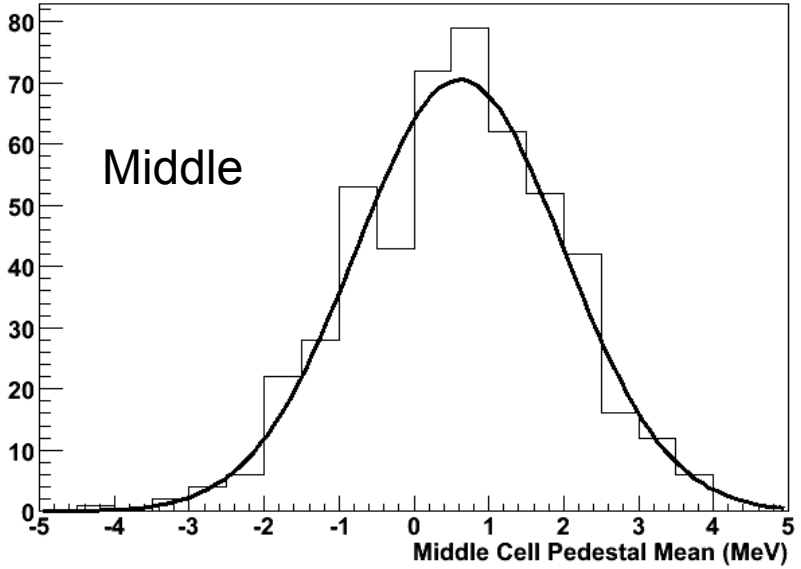
- Athena 10.5.0
  - LArG4TBBarrel-00-00-15
  - CTB-G4Sim-00-02-43
  - RecExTB-00-00-94
- Several configurations in the MC:
  - 13.35mm of Aluminum far upstream +
    - 15mm of Aluminum in front of the calo
    - 0mm of Aluminum in front of the calo
  - Runs with/without charge corrections
  - 6 Energies: 9, 20, 50, 100, 180, 250 GeV
  - Phi position Scans (under production)
  - CBNTs: /castor/cern.ch/user/p/paganis/ctb04/10.5.0/defg4/
  - CalibHIts: /castor/cern.ch/user/p/paganis/ctb04/10.5.0/chits/

Small bias in pedestal <Energy>

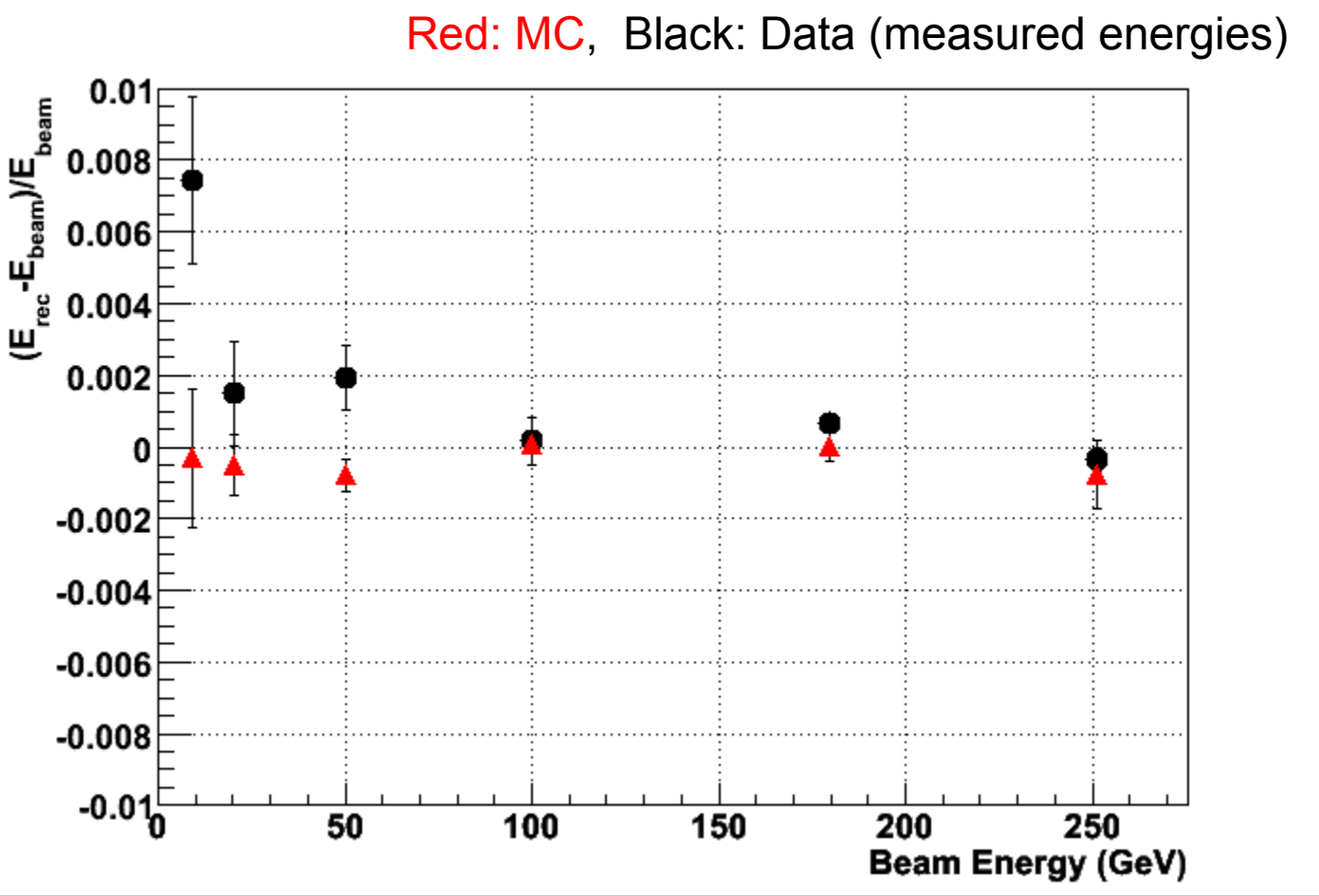








Linearity using calibration hits



MC should have a residual 0.1% systematic due to the procedure.
Data: need to look at all material configurations and study systematics.

Method(s) used:

$$E_{rec} = off + w_0 E_0 + (1+d)\frac{E_{ACC}}{SF_{ACC}}$$

$$E_{rec} = \lambda\left(off + w_0 E_0 + \frac{E_{ACC}}{SF_{ACC}} \right)$$

$$E_{rec} = off + w_0 E_0 + w_{sq}\sqrt{E_1 E_2} + (1+d)\frac{E_{ACC}}{SF_{ACC}}$$

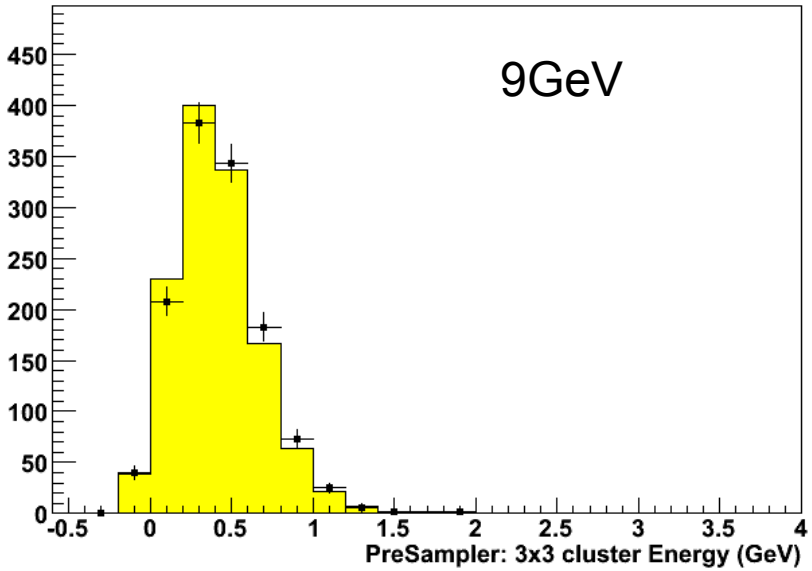
→ Milano group proposed this and will try it for ATLAS

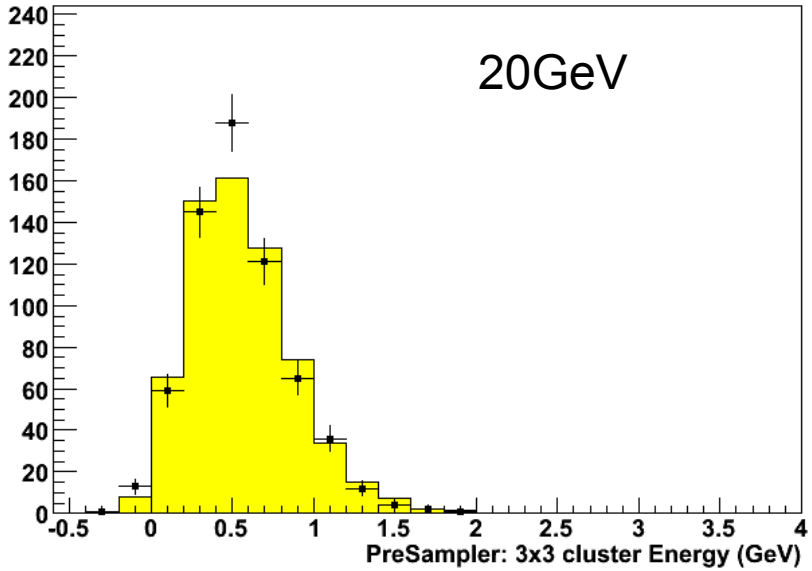
- ✓ Remove any SF factors from data and MC (see Sandrine's talk)
- ✓ Reduce strip energy by 0.92
- ✓ Reduce PS in the MC by 0.8*11/13 (11/13 due to the Efield extent, 0.8 is a puzzle)
- ✓ Correct relative beam by beam phi energy modulation (using MC)
  - This is done on average instead of using a function.
- ✓ Apply the weights obtained from calib. Hits with the above formulae
- ✓ Normalize everything to one beam energy (say 100GeV)

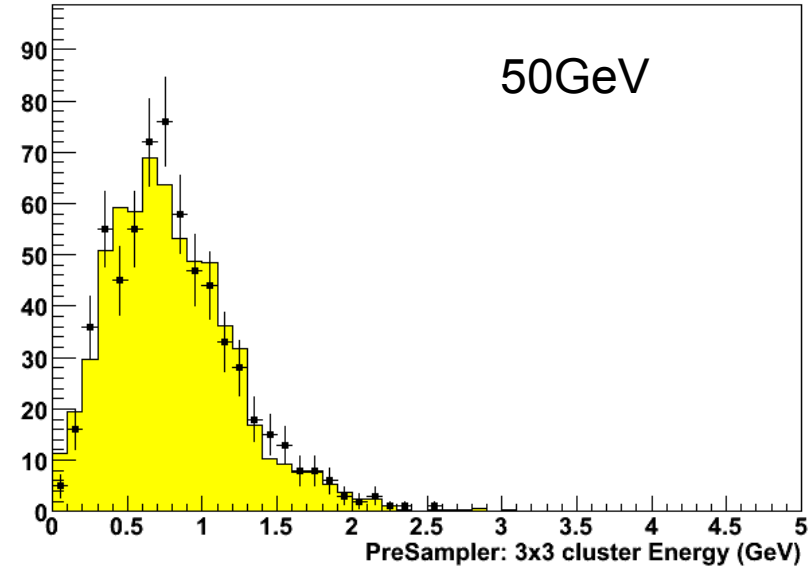
Material problem revisited

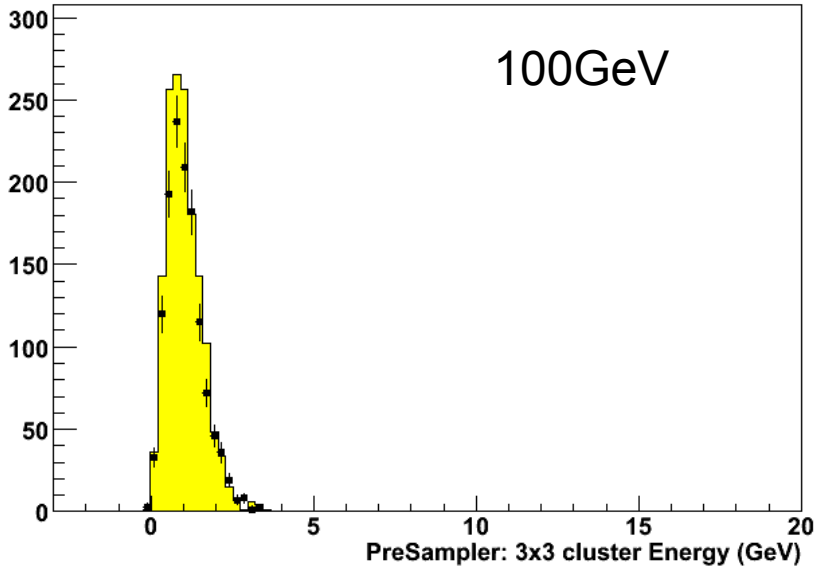
- Our calibration depends on the MC description of the CTB and LAr layouts.
- Any extra material changes the long. Weights.
  - Example, the PS mean response changes by ... +20% when we add 15mm of Aluminum.
- We generated runs without any close upstream material (only the far upstream was kept) and looked at S1 and S2 comparison with data

The PS puzzle: with E=11/13Eps, good agreement

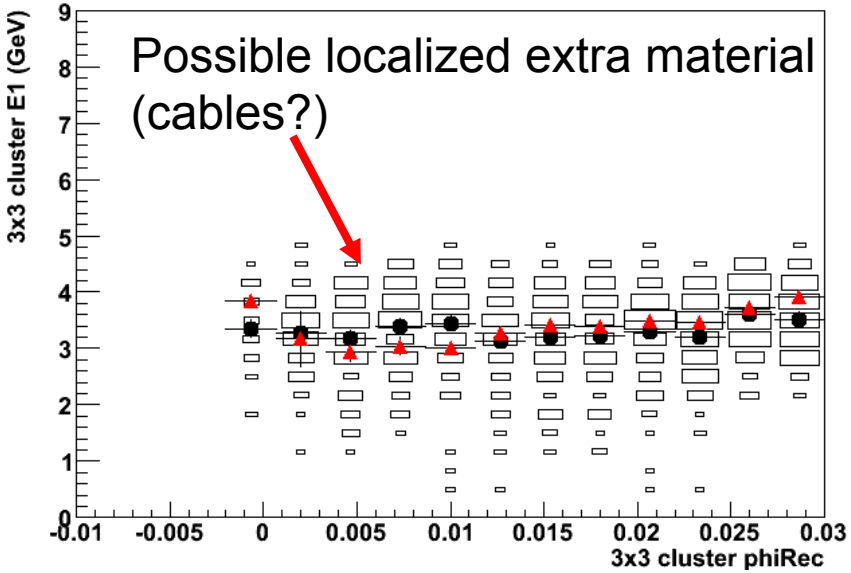




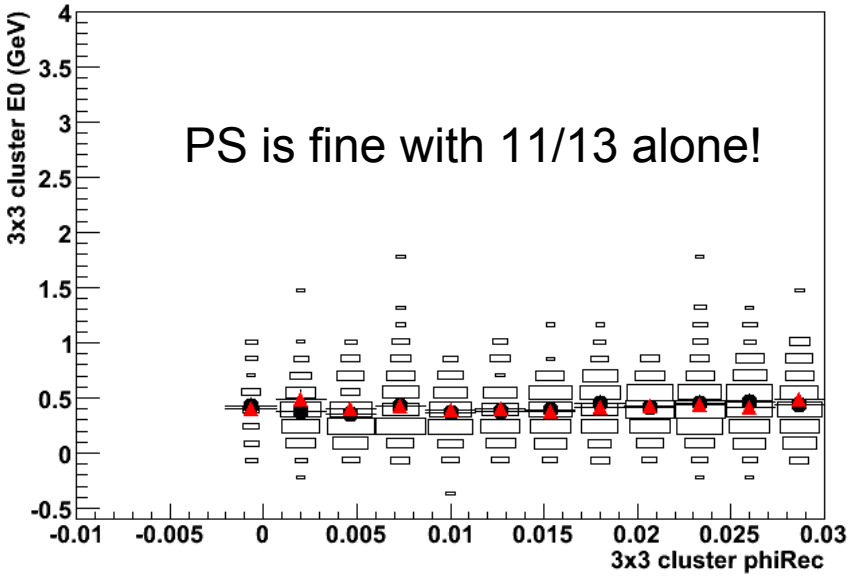


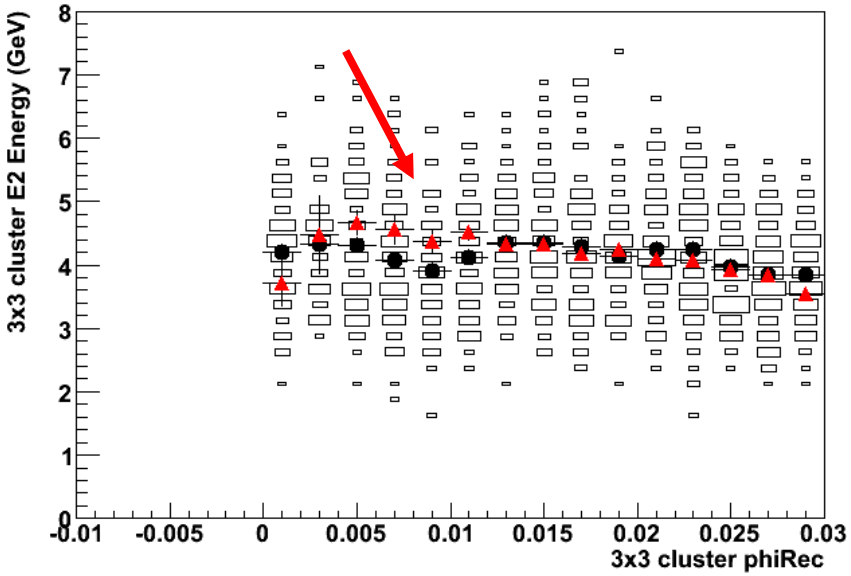


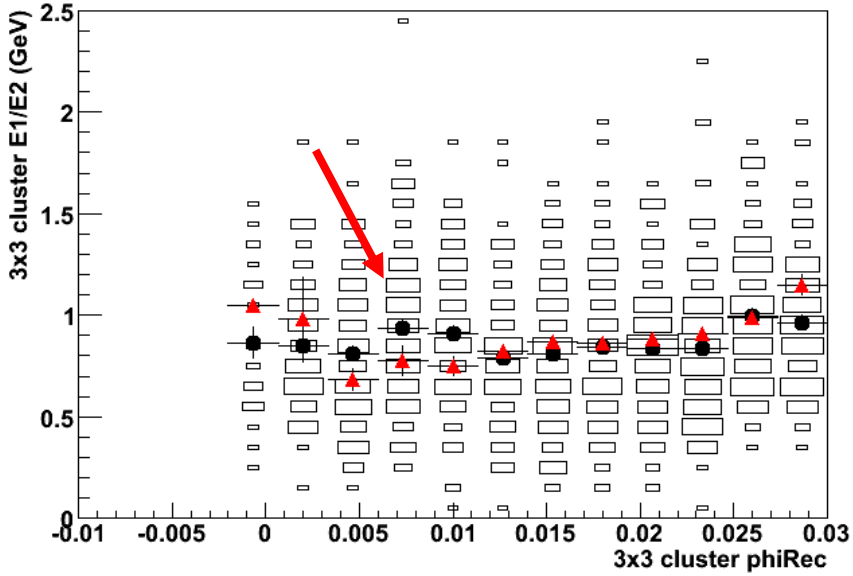
Energies vs phi (E_2 reduced by 4% in MC)



Red: MC Black: Data







Edata/Emc without extra material

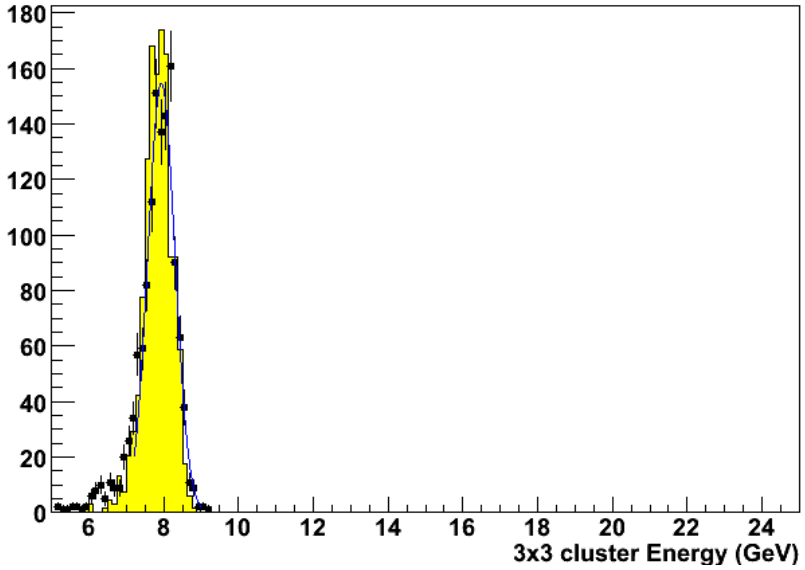
Energy (GeV)	S1data/S1mc	S2data/S2mc
9	0.991	0.962
20	1.007	0.973
50	1.0	0.985
100	1.004	0.983

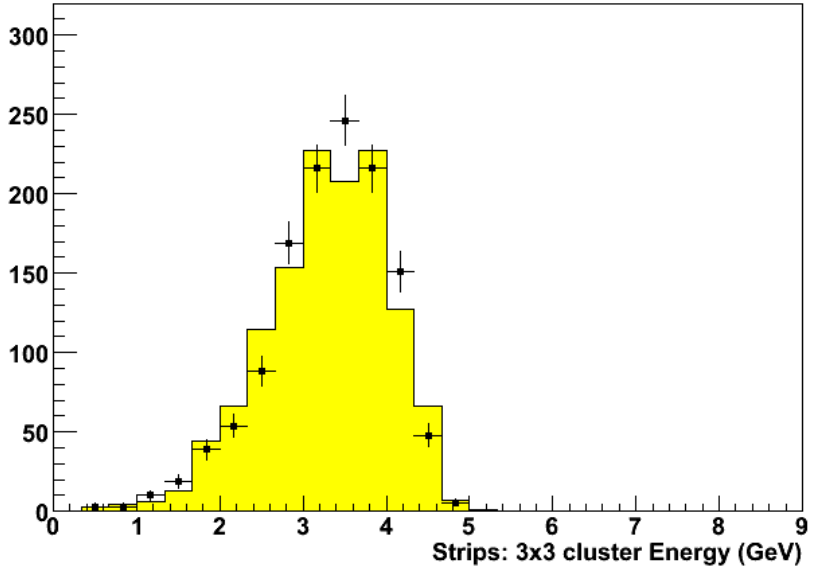
How many different scenarios can explain the data without destroying the agreement of the PS with the data?

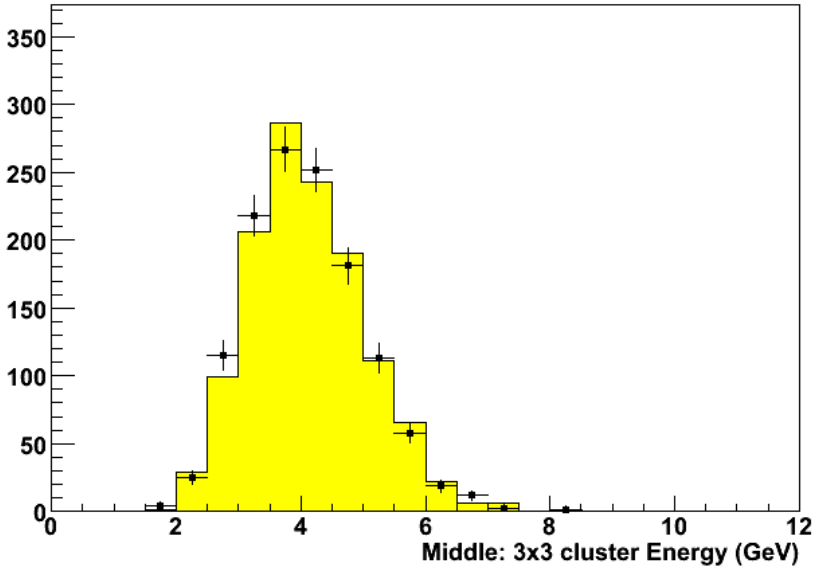
Scenarios

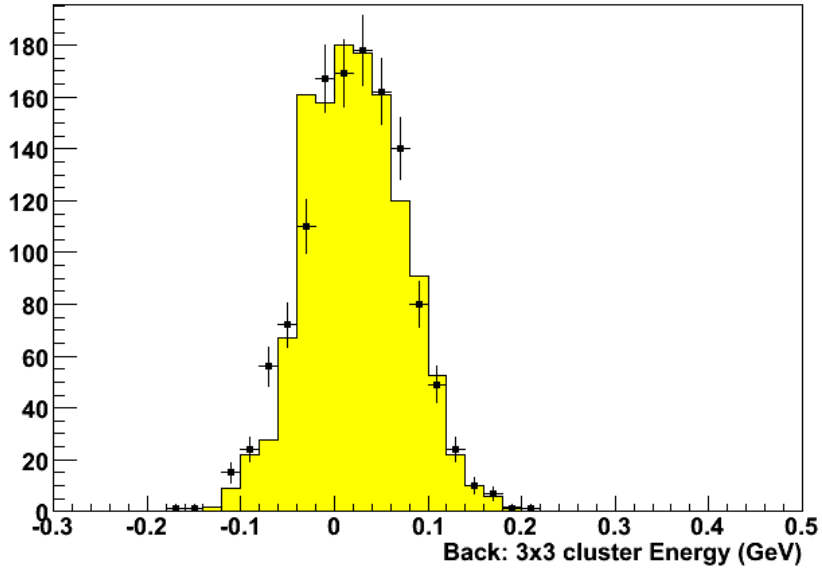
- There is extra material after the PS and before the S1
  - Problem: hard to imagine 0.15X0 missing in this region
- Extra Losses in the middle energy wrt strips due to charge losses
  - Problem: it seems like a large effect on top of 7% loss in the sim
- Extra losses in the middle due to wider EM showers in real data
  - Problem: it looks like a big effect
- The strips have more xtalk: if we apply a 0.9 factor (now 0.92) and adjust the overall MC by 0.965 (now 0.98) we can still get reasonable agreement
  - It would be nice if this could work at all energies...

Scenarios: a look at #4 9GeV

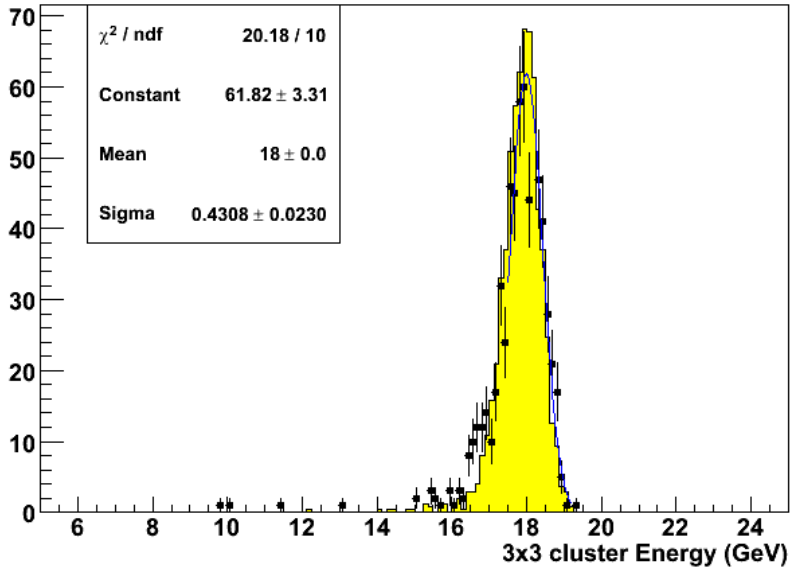


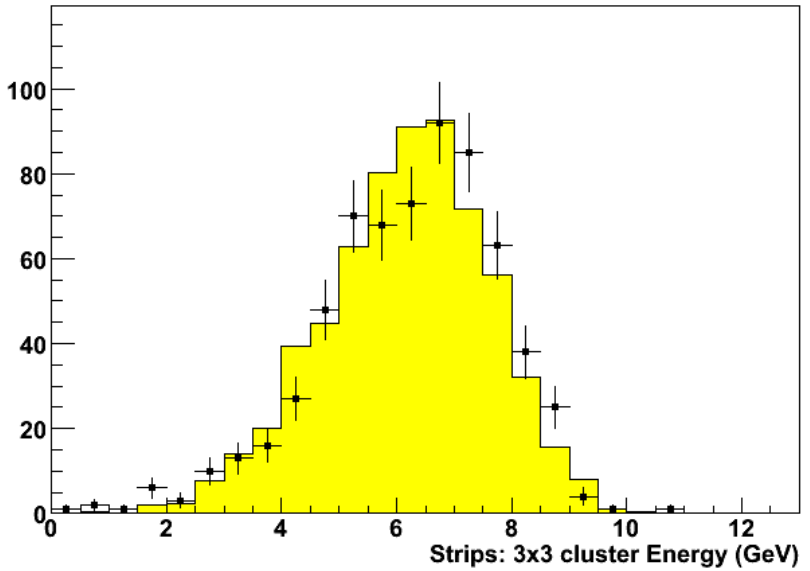


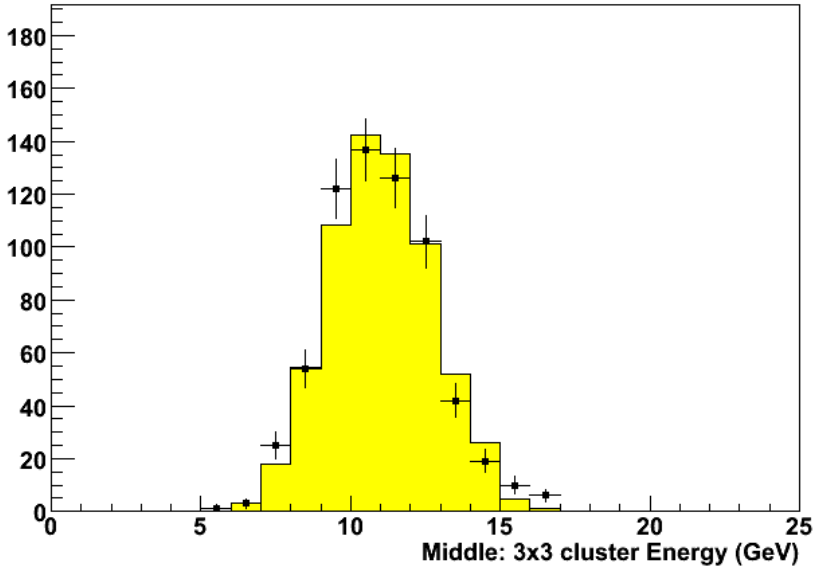


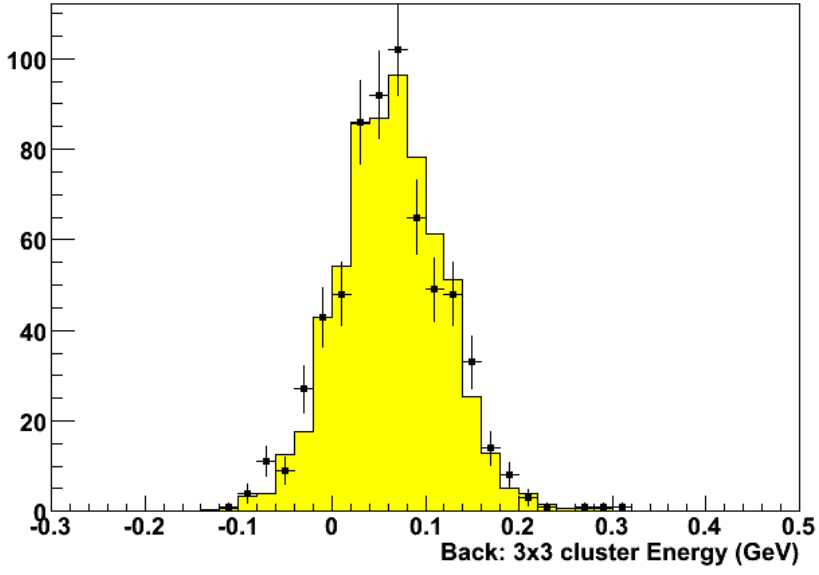


20GeV

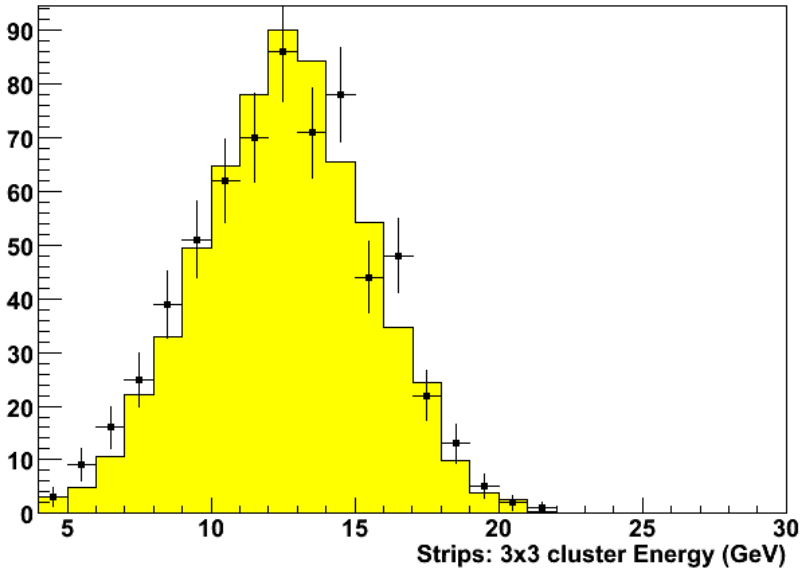

χ^2 / ndf 20.18 / 10
Constant 61.82 ± 3.31
Mean 18 ± 0.0
Sigma 0.4308 ± 0.0230
3x3 cluster Energy (GeV)

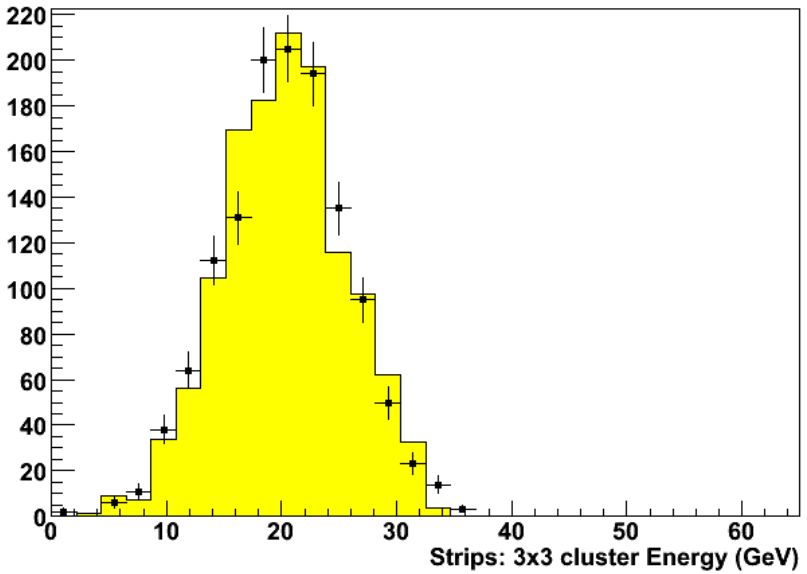

Strips: 3x3 cluster Energy (GeV)

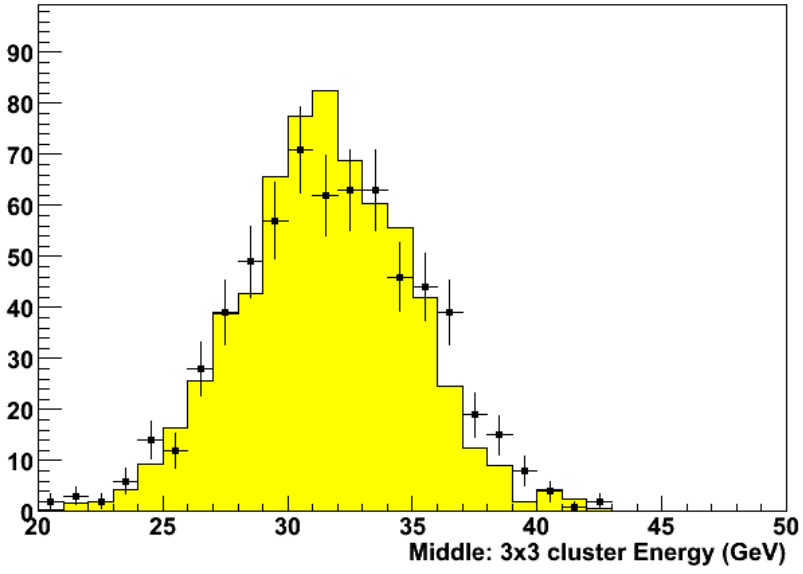

Middle: 3x3 cluster Energy (GeV)

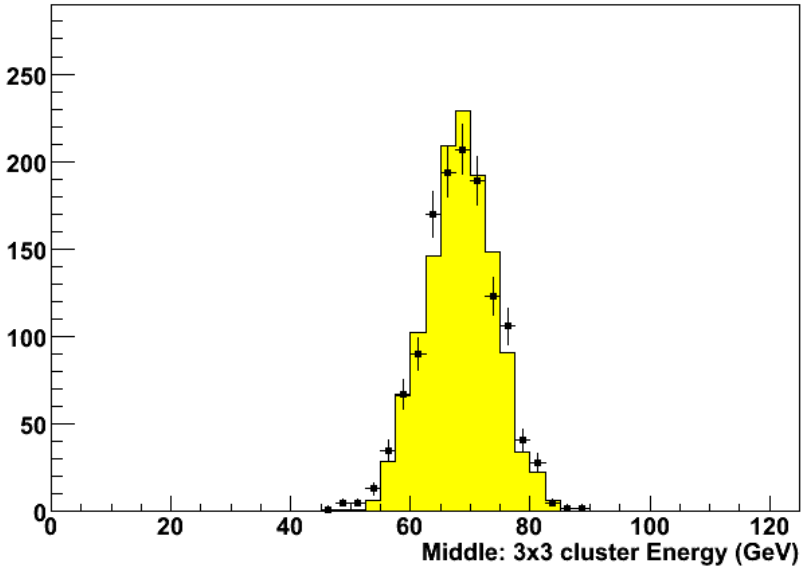

Back: 3x3 cluster Energy (GeV)

50GeV and 100GeV









Summary

- Excellent linearity for the MC was obtained:
  - We used MC-truth, (calib hits) to extract the weights and apply it on the fully reconstructed clusters
  - For the data is premature to conclude (system. Error studies needed)
- Revisited the material problem
  - For extra material in MC the PS response is 20% too high
  - For no material the PS is fine, but the S1/S2 does not match
  - Several hypotheses, each one with its own problems, were discussed.
  - Is it possible to use all of our data to constrain the problem?