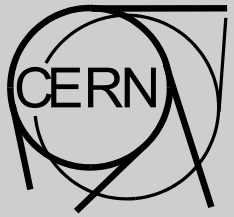


LAr Response to pions: Data vs MC (work in progress)

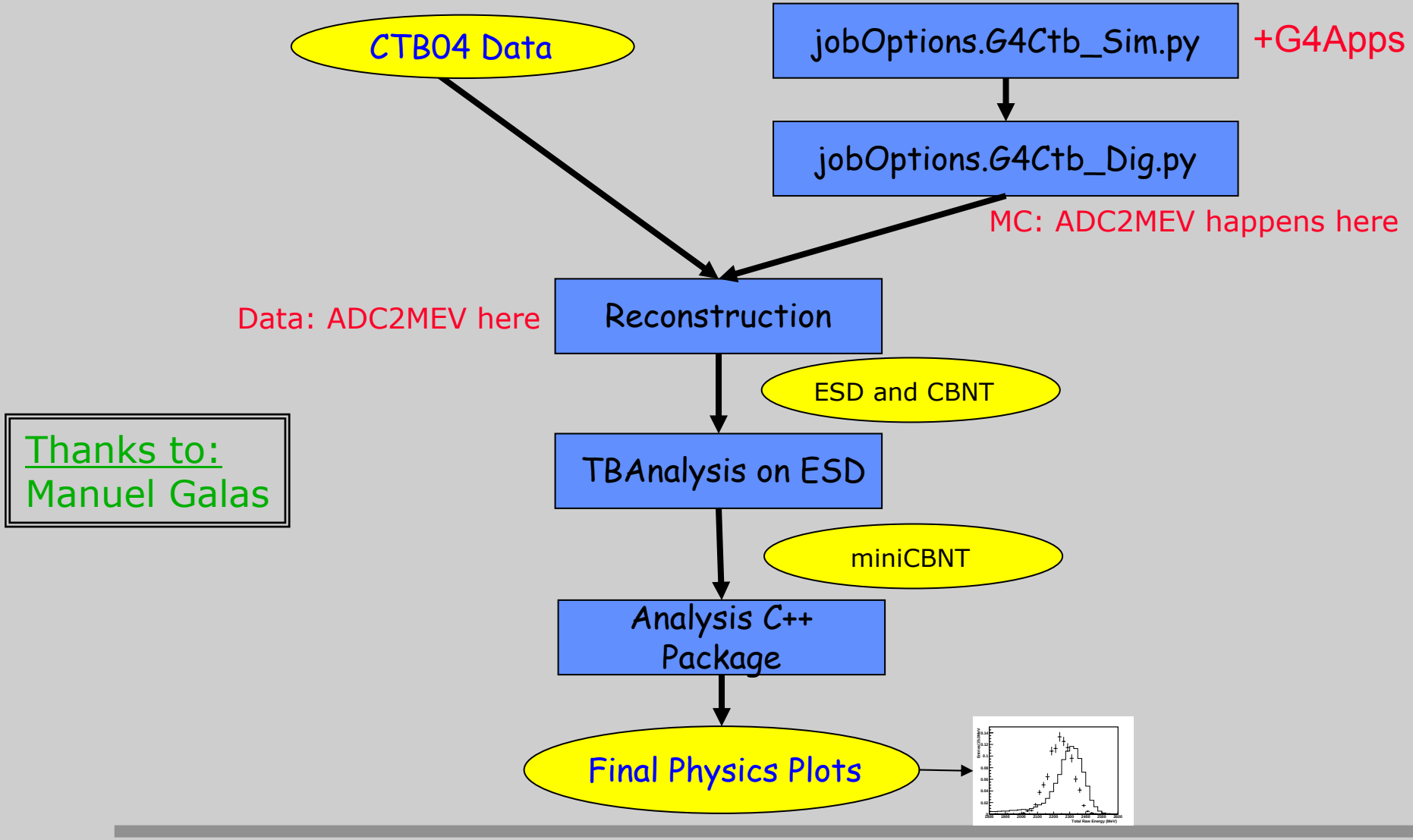
S.Paganis (Wisconsin)
with
Isabelle,Martin

LAr+Tile H8 pion CTB Meeting,
CERN, 19-April-2005

Analysis (10.0.2 data+MC)

- Run: 2100482 20GeV pions
  - Fully combined, have shown previously problems in LAr rec. energy
- Parabola Energy reconstruction
  - 50MeV "cubicADCcut" in LArRawChannelSimpleBuilder.cxx
  - μA2MEV numbers from EMTB
- EMTB 3x3 clustering
- No cluster corrections, No Long. weigths
- No shower cuts yet.
- MC
  - New "pythonized" version (powerful)
  - Charge collection corrections
  - Tried to get "correct" beam profile …
  - ADC2MEV in Digitization step (parabola is the default)

Program Flow (release 10.0.1):



Thanks to:
Manuel Galas

ADC -> MeV for MC and Data (10.0.2)

Monte Carlo

$$ADC = \frac{E_{Geant}}{ADC2MEV_{mc} \times SF_{mc}} + Noise(ADC)$$

$$E_{rec} = ADC2MEV_{mc} \times ADC$$

Data

$$E_{rec} = ADC2MEV \cdot \left[ADCpeak - \overline{PEDESTAL}\right]$$

$$ADC2MEV = ADC2DAC \times DAC2uA \times uA2MEV_{visi} \times (1/SF_{data})$$

Differences at present:

1. Difference in the Sampling Fractions
2. Different noise normalization due to ADC2MeV (small)

ADC2MEV (Data vs MC)

$$E_{rec} = \mathrm{ADC2MEV} \cdot \left[\mathrm{ADCpeak} - \overline{\mathrm{PEDESTAL}}\right]$$

	ADC2DAC	DAC2Volt	Volts2μA	μA2MeV
How:	Ramps	38.147 uA/Volt	Injection Resistor	$(t_{drift}*W)/e$ * 1/SF
PS (EMB1)		38.147/R=0.114 nA		1250
S1 (EMB1)		12.62 nA		370.3703
S2 (EMB1)		37.58 nA		370.3703
S3 (EMB1)		37.58 nA		370.3703

MC ADC2MEV(PS) = 7.0
MC ADC2MEV(S1) = 2.5
MC ADC2MEV(S2) = 12.0

Data ADC2MEV(PS) ~ 7.2
Data ADC2MEV(S1) ~ 2.4
Data ADC2MEV(S2) ~ vary 10.0,12.0,16.0

How to get the SF for Data (an example)

$$\mathrm{uA2MEV} = \mathrm{uA2MEV}_{\mathrm{visi}} \times (1/\mathrm{SF}) \Rightarrow \mathrm{SF} = \mathrm{uA2MEV}_{\mathrm{visi}} / \mathrm{uA2MEV}$$

EMTBeam Reconstruction :

$|\eta| < 0.8$

1250 MeV/μA Presampler

370.37 MeV/μA Accordion

$|\eta| > 0.8$

1176.47 MeV/μA Presampler

328.947 MeV/μA Accordion

Presampler :

$\mathrm{MeVper}\,\mu\mathrm{A} = 420ns \cdot 23.6eV / 1.6 \cdot 10^{-19} C$

Accordion :

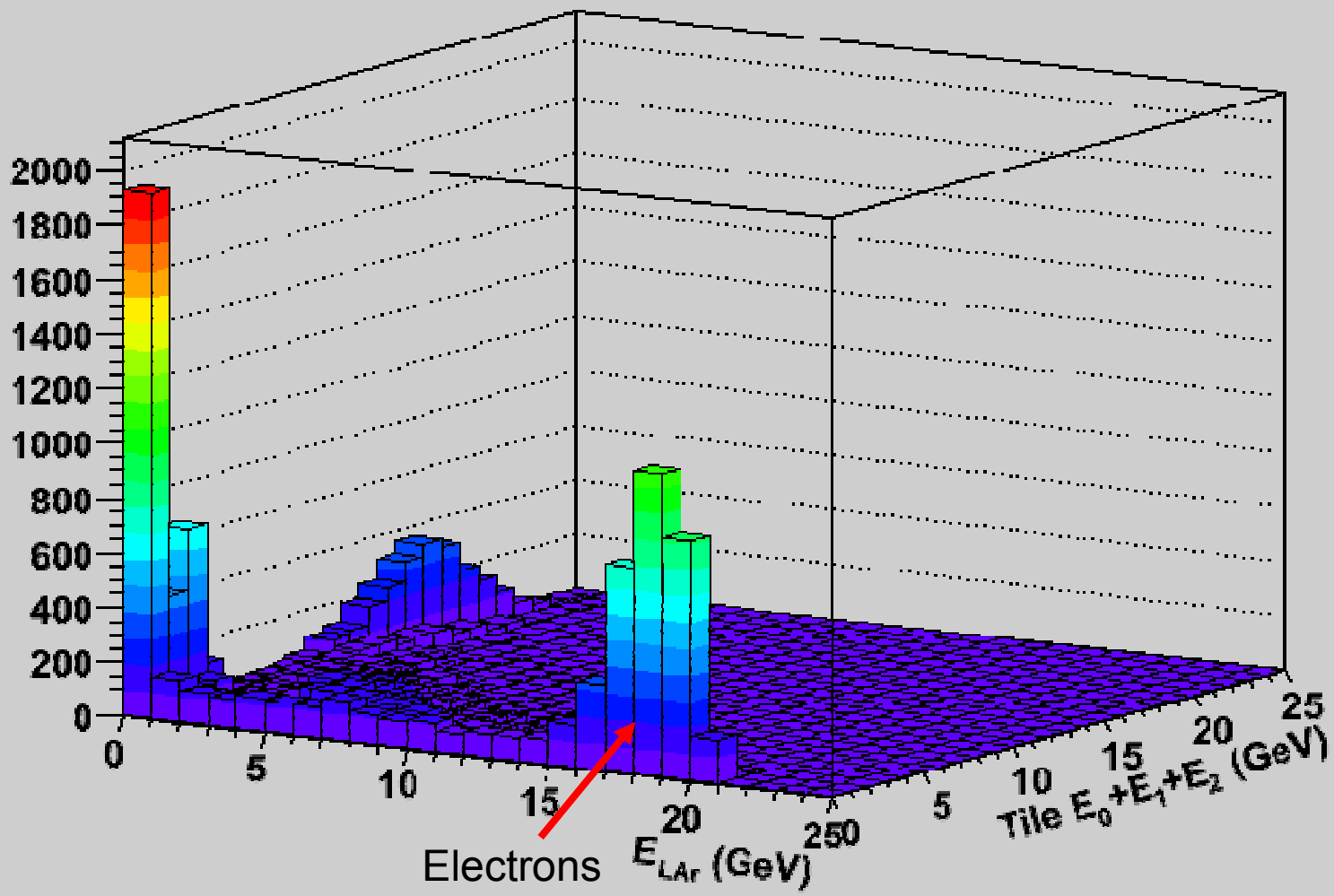
$\mathrm{MeVper}\,\mu\mathrm{A} = 470ns \cdot 23.6eV / 1.6 \cdot 10^{-19} C$

SF(Presampler η<0.8)=t*W/e/1250 = 0.0496
SF(Accordion η<0.8)=t*W/e/370.37 = 0.18718

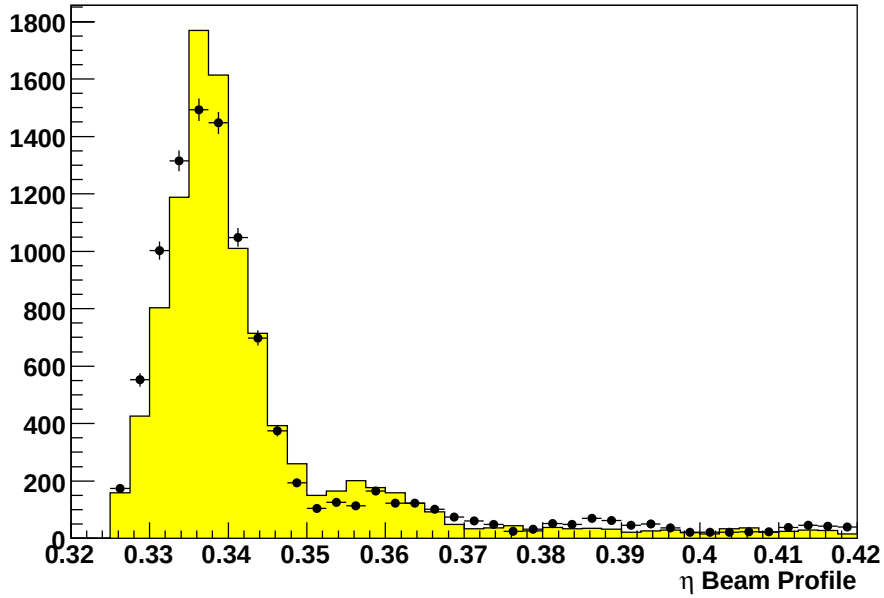
How to get the SF for MC

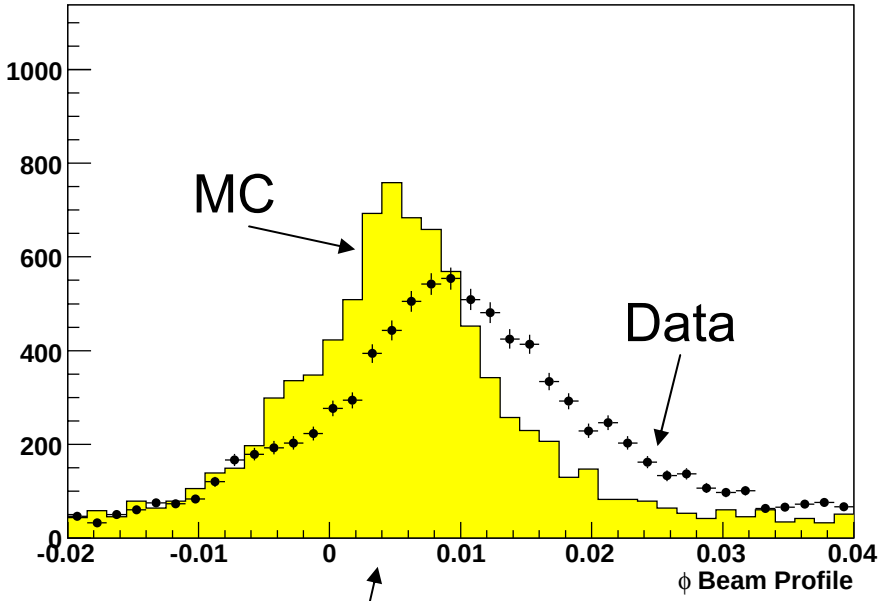
- Since 10.0.2 the Sampling Fractions are the same as for ATLAS
  - Example, for Accordion eta<0.8, SF=0.1667
- They are calculated (Geant4) assuming no upstream material and compensating for charge collection effects (ON by default)
  - Eventually we must port them to the data stream, as part of the ADC2MEV factor

Data: 3x3 LAr vs Total tile Energy



Beam Profiles





Can do better

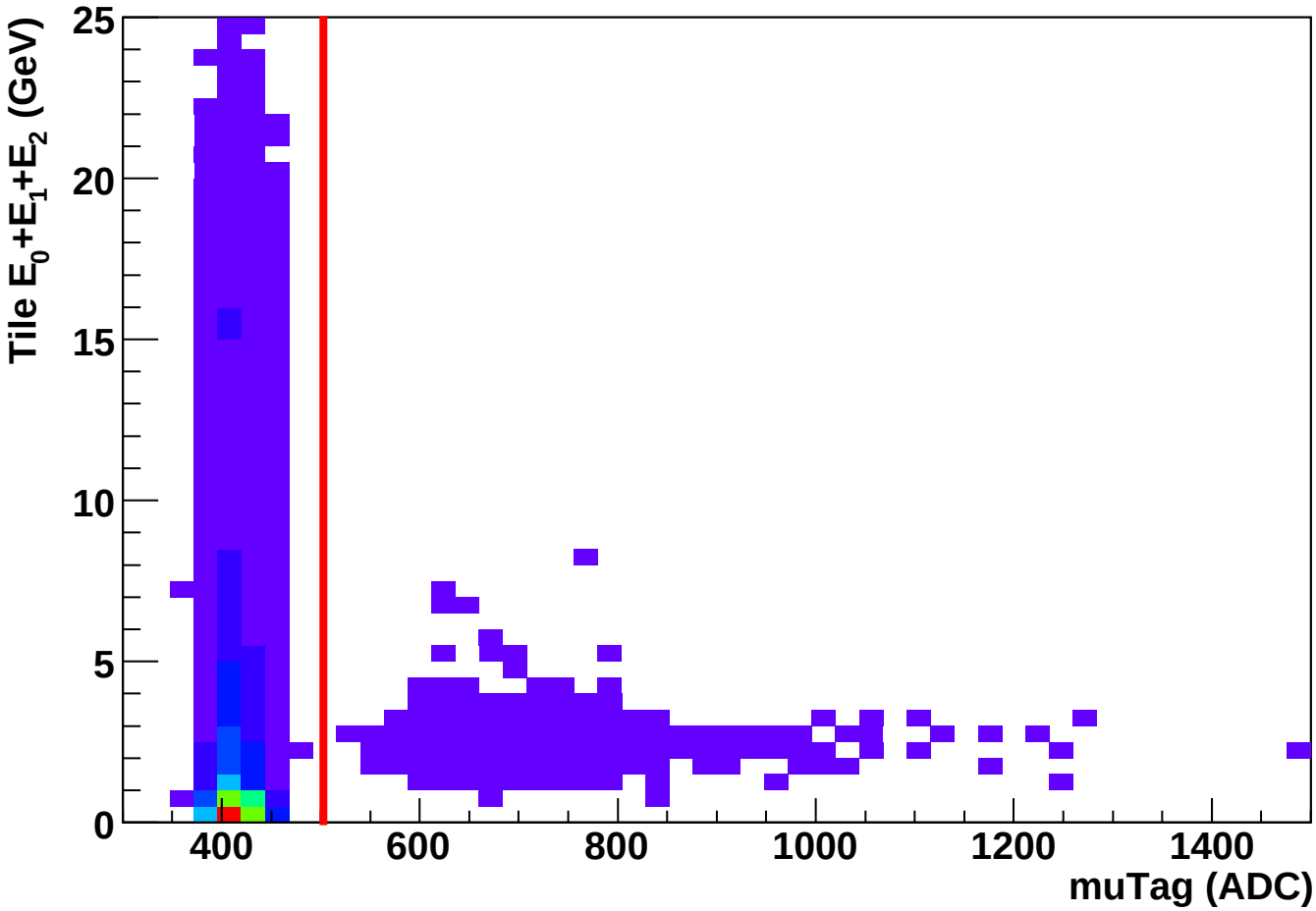
Cleaning cuts: any biases?

- For reconstructed energy comparisons:
  - E(MC) = Erec * SFmc/SFdata
- For visible energy comparisons:
  - E(MC) = Erec * SFmc
  - E(data) = Erec * SFdata
- muTag to remove muons
- Etile+ELAr MIP cuts to remove muons
- Etile>2GeV, to remove electrons (crude)
  - Don't want to use shower shape cuts yet (under study)
  - Possible Long electron tail
  - I studied the region Etile<2GeV and ELar<14GeV and I see small discrepancies (checking also with electrons)

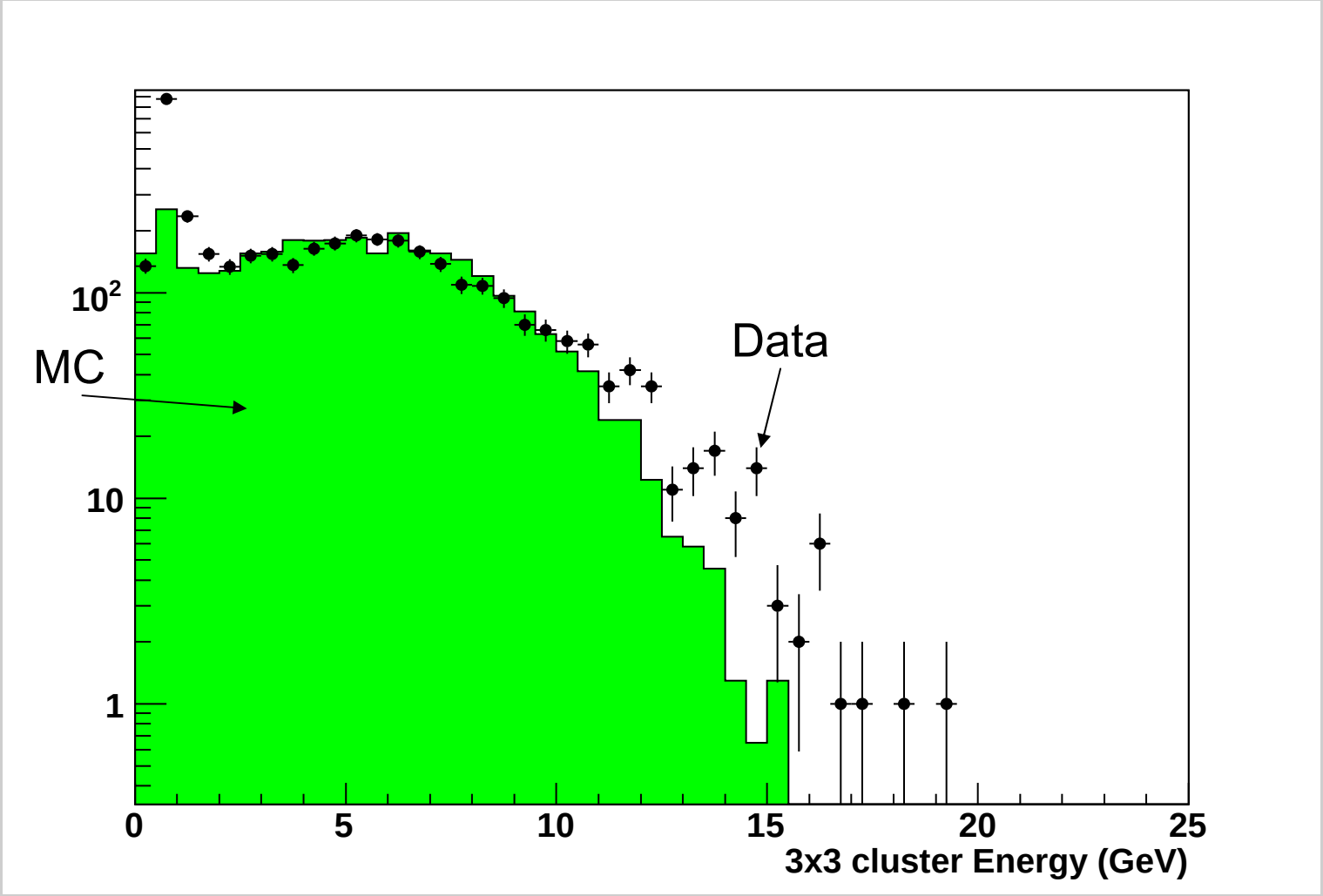
Known biases:

- Tile MC has no noise.
- For data a LAr drift time assumption is made to get the SF
- LAr MC has noise but I haven't checked how representative is of the data
- Cuts on LAr energy cause a bias when scale and shape are different
- Parabolic fit at low energies?
- ...

MuTag: removes a portion of muons

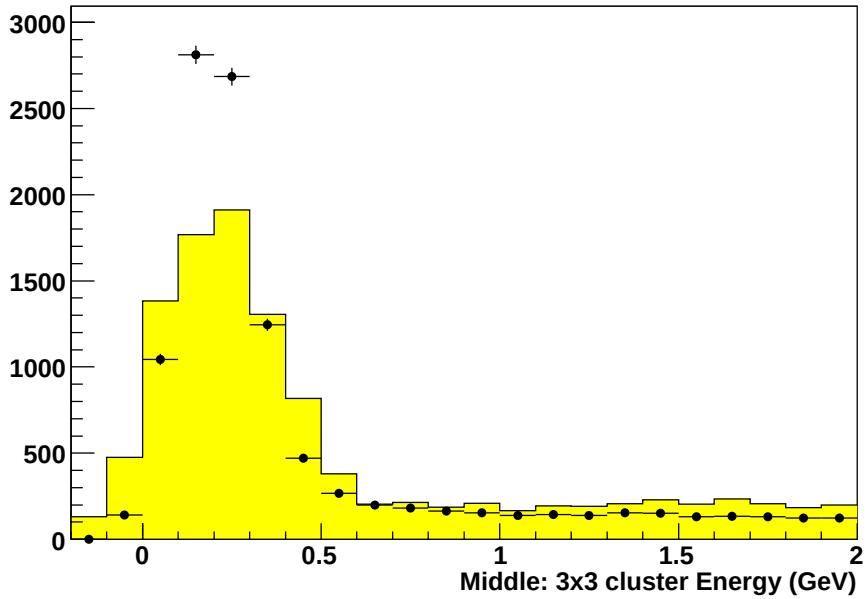


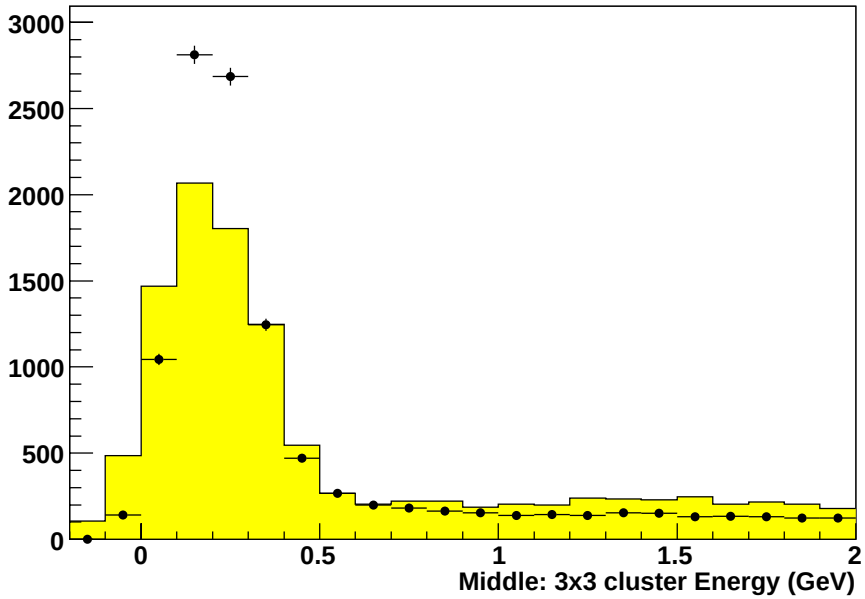
LAr Energy after simple cuts



Zoom in the MIP region (before cuts)

(Rear situation that data looks better than MC!)

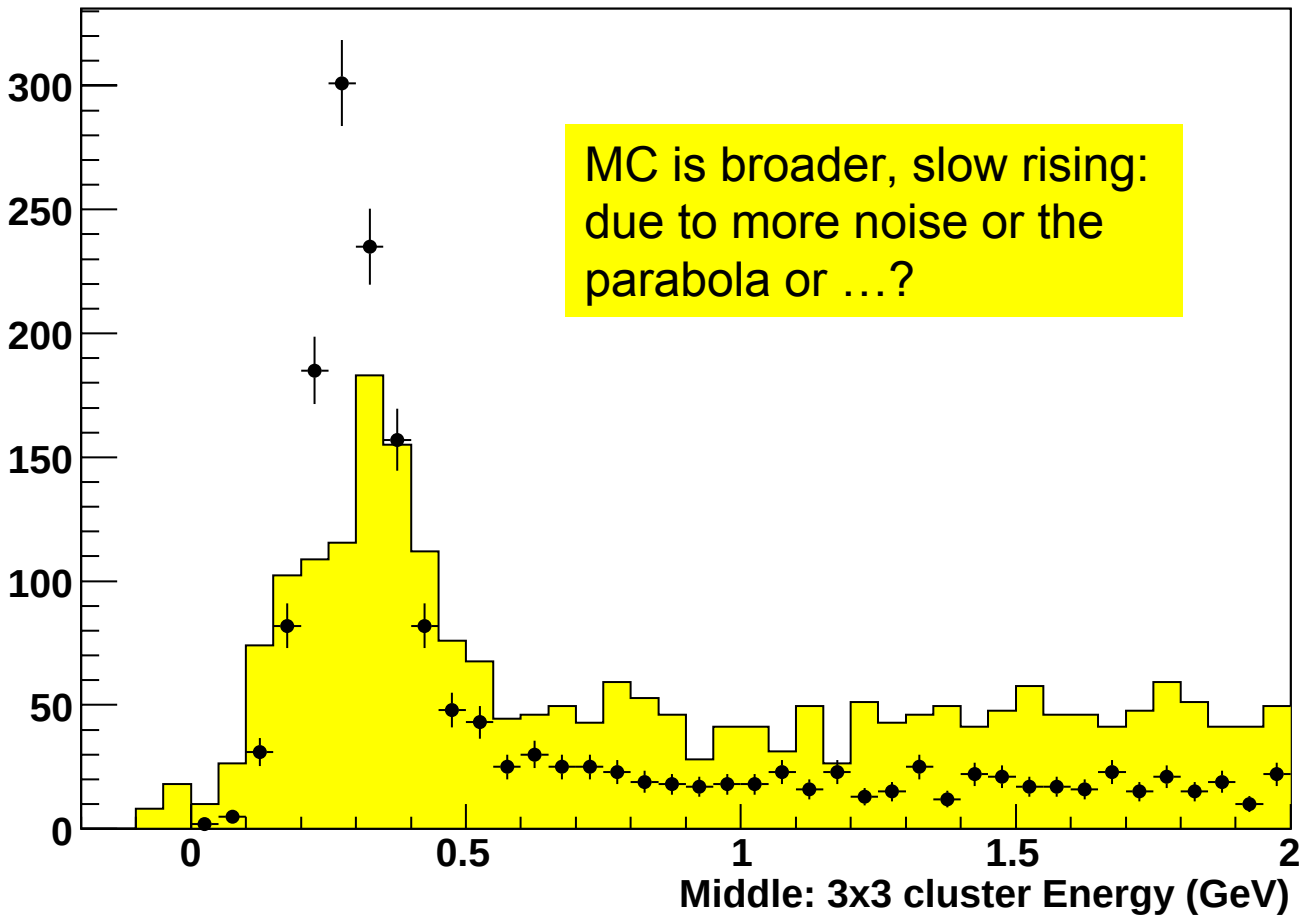




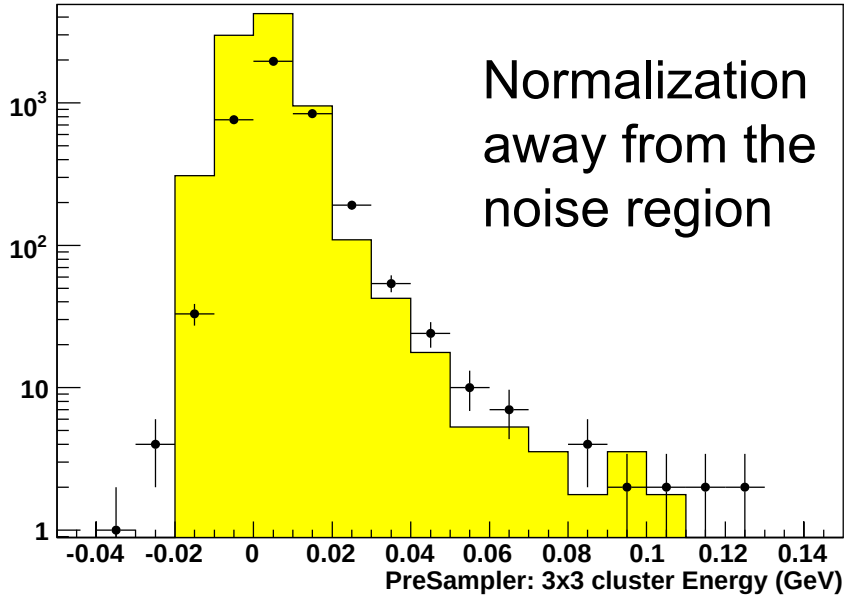
Uncorrected MC

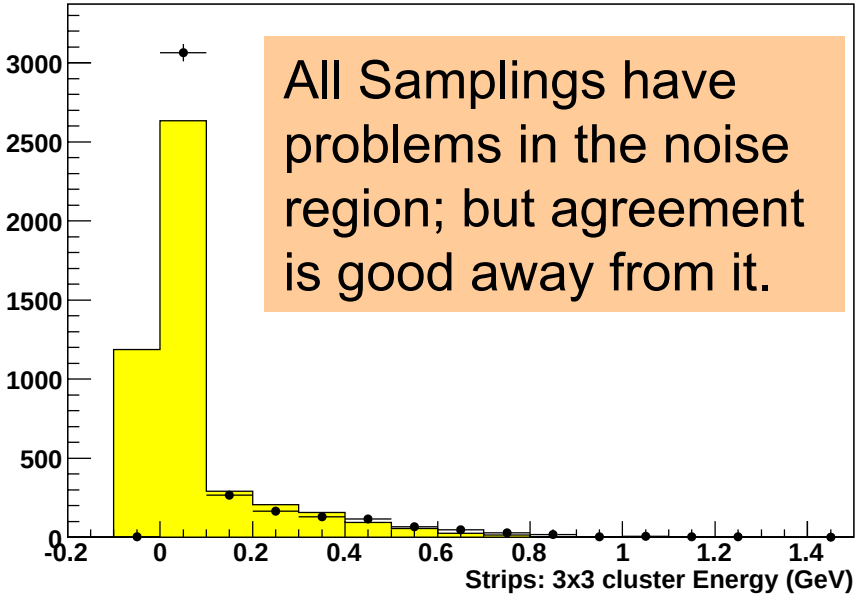
Corrected MC for Sampling Fraction

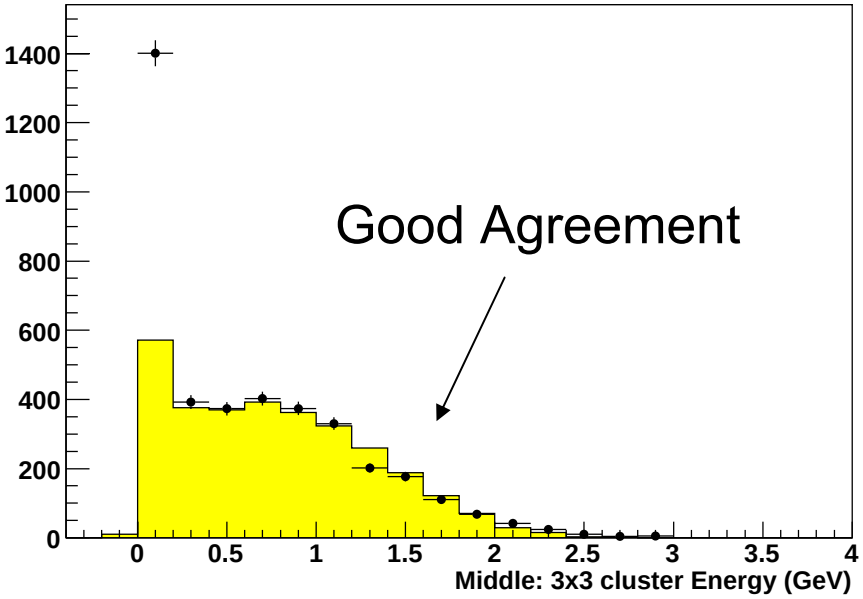
Zoom in the "MIP" region (after cuts)

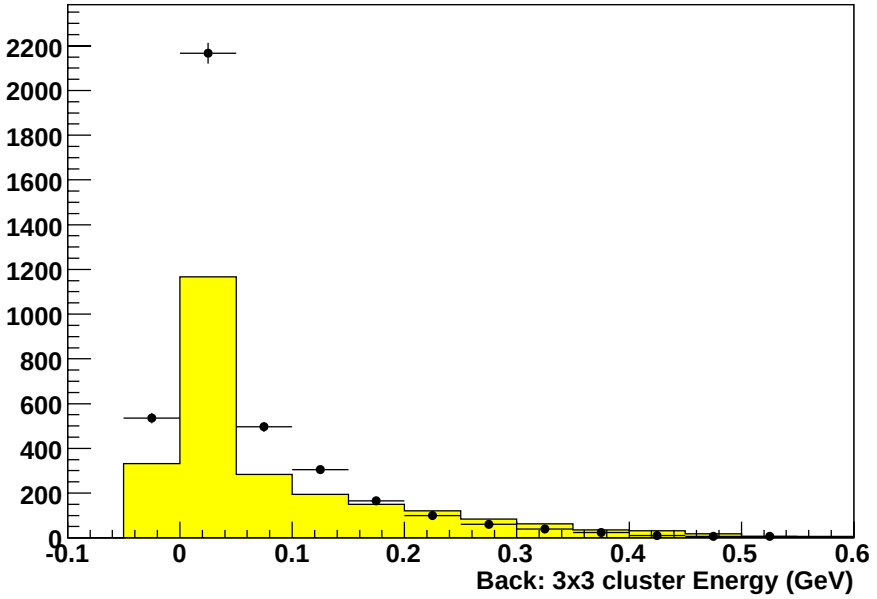


Visible Energy per LAr Sampling

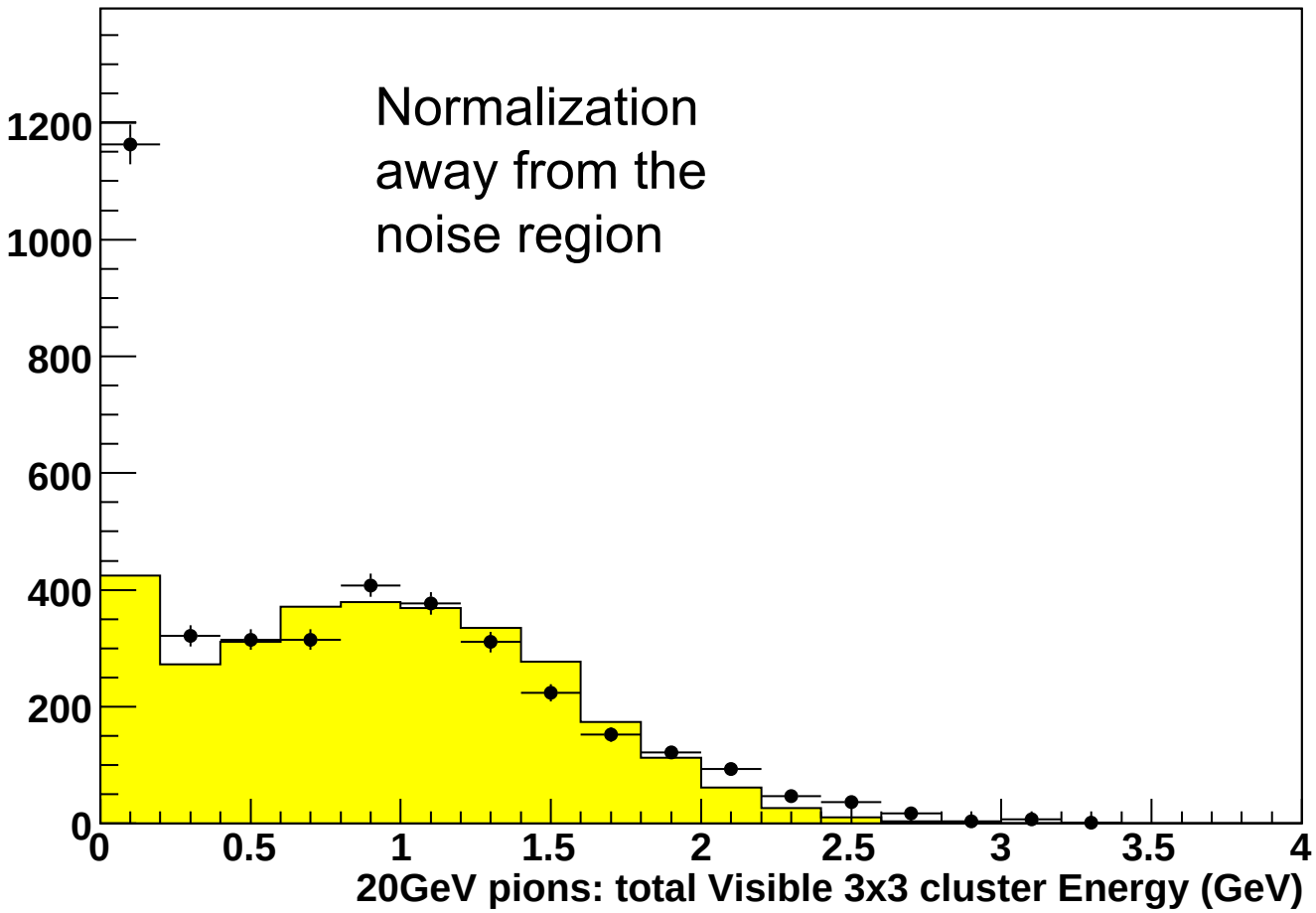








Total visible Energy (LAr)



Summary

- Reasonable agreement between Data and MC:
  - Away from the noise/MIP region
  - After properly correcting MC for Sampling Fraction difference (however it is data SF that needs to changed in ATHENA !)
- Discrepancy between DATA and MC for very small depositions. Distributions around 0 Energy look different. It is possible that MC noise is larger (at least for the middle).
- Fully contained pions are being checked together with electrons
  - I am seeing a discrepancy in this run but I'm still checking