Towards MET certification
&
Unclustered Energy studies

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Outlines

- I- Towards MET certification
  - $Z\mu\mu$ (μ's p_T>25GeV/c, |η|<2, μ isolated, 80<M_Z<100)
  - Zee (e's p_T>25GeV/c, |η|<1.1 or 1.5<|η|<2.5, 80<M_Z<100)
  - Wev (e's p_T>25GeV/c and in CC)
- II – Unclustered Energy (UE) Studies
  - Calibration of UE
  - Correlation between UE and bad jets

- Analysis done in p16.05.02 (d0correct v8.2) [bug on muons smearing fixed]
- MC: pythia
- MC in solide line, data with crosses

All the details will be given in the d0-note 4927

Reminder

- METD is the MET computed from EM, FH, ICD and MG
- METBCorrCALO is the MET computed from METD and corrected from EM scale, JES, and CH fraction of the jets
- METBCorrCALOMU is the MET computed from METBCorrCALO and the muons' pT

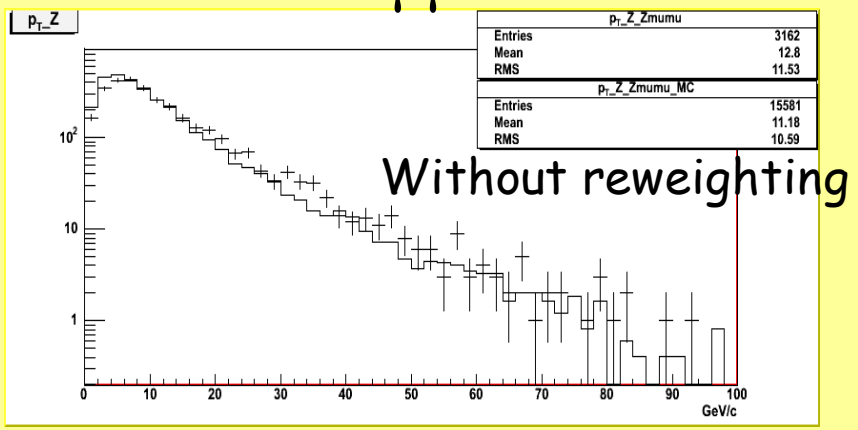
Z samples

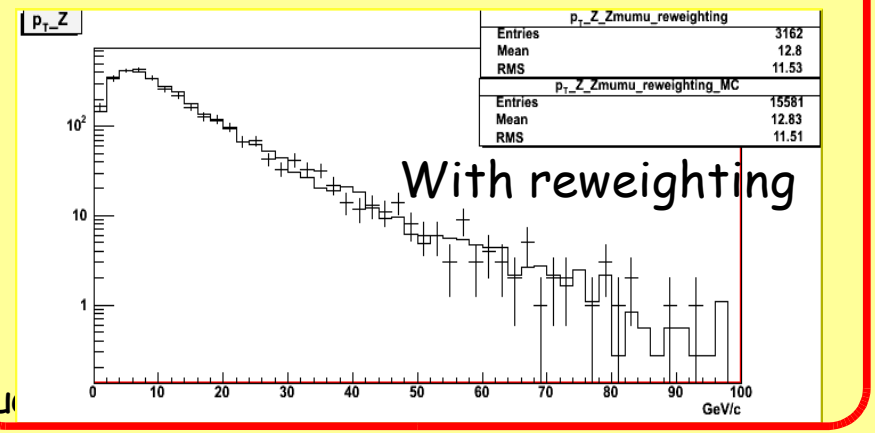
Corrections on the Z samples' MC

- Smearing by d0correct
- Reweighting with the Z's pT (for Zμμ and Zee samples)

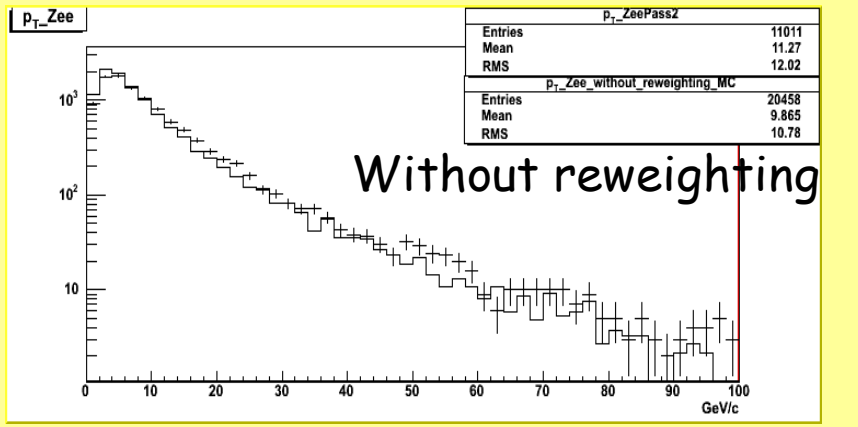
[d0-note 4660]

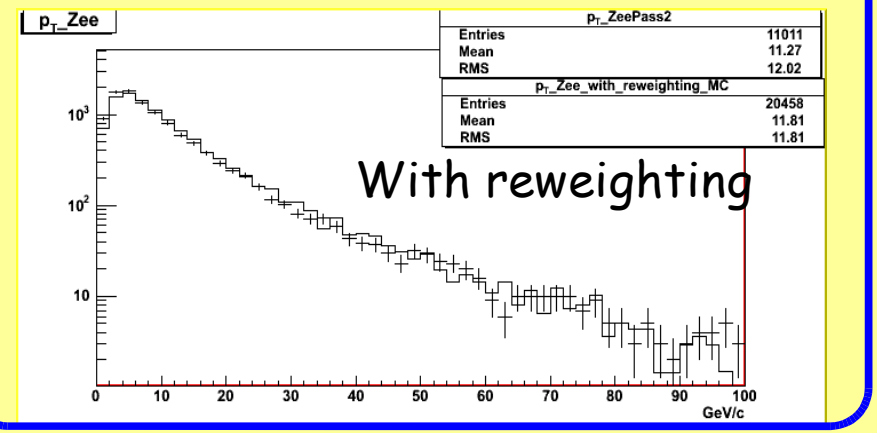
Zμμ





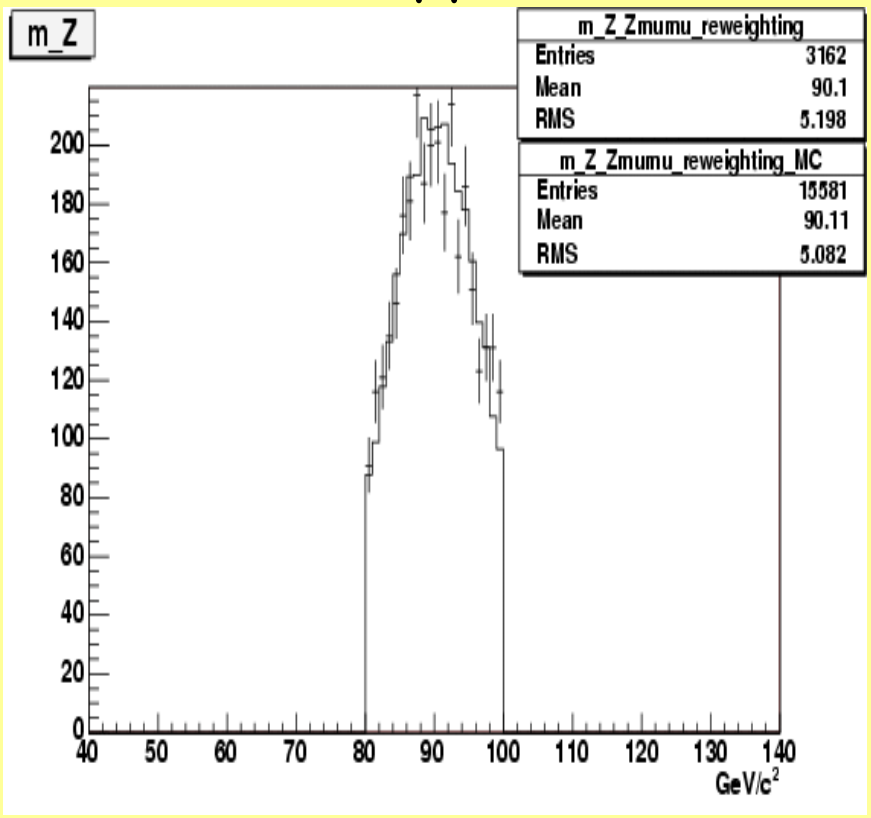
Zee



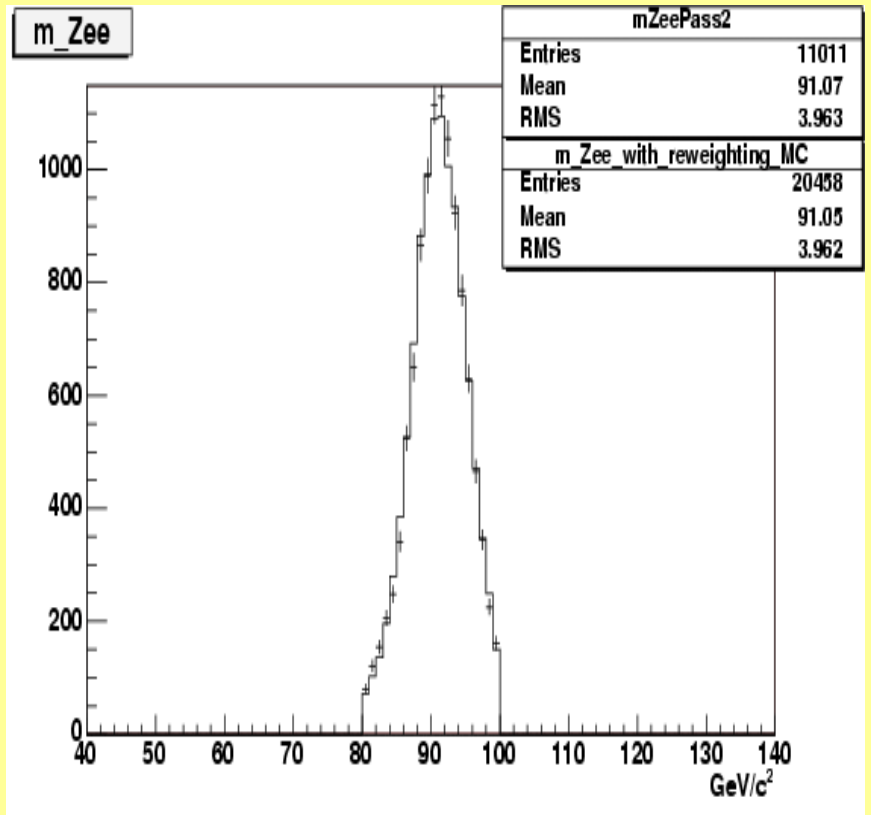


Invariant mass

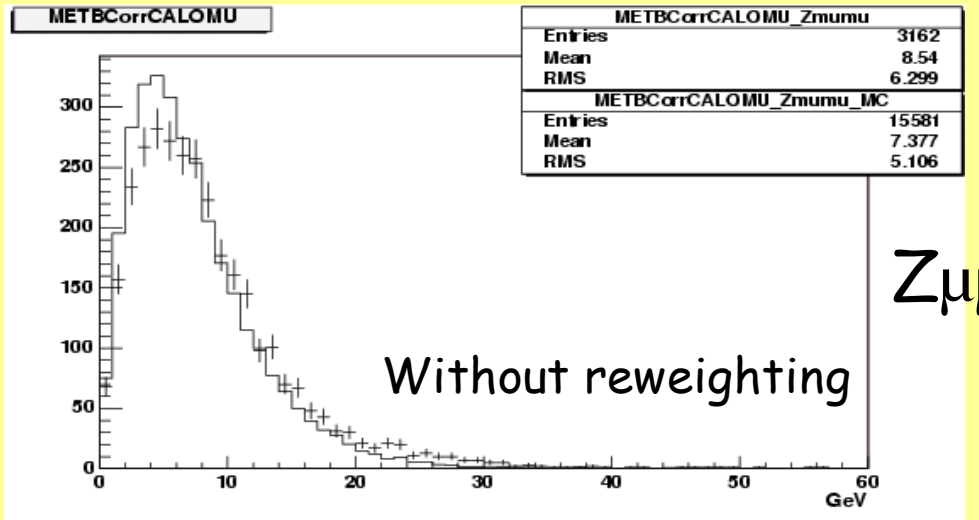
Zμμ



Zee

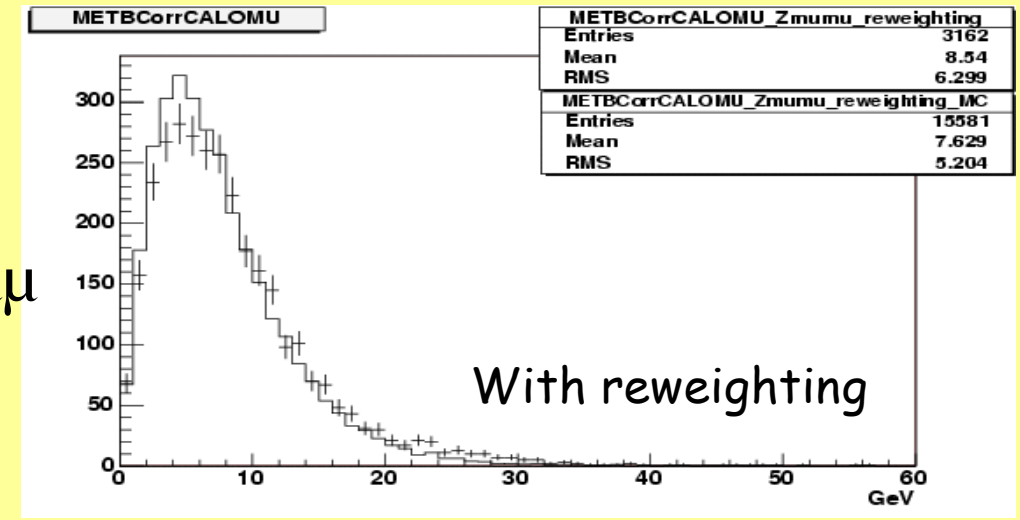


Results

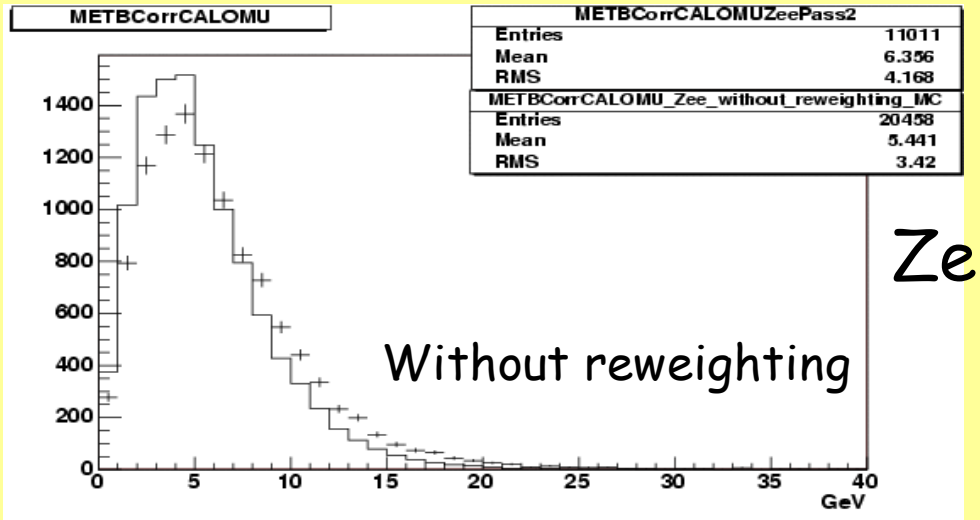


Without reweighting

Zμμ

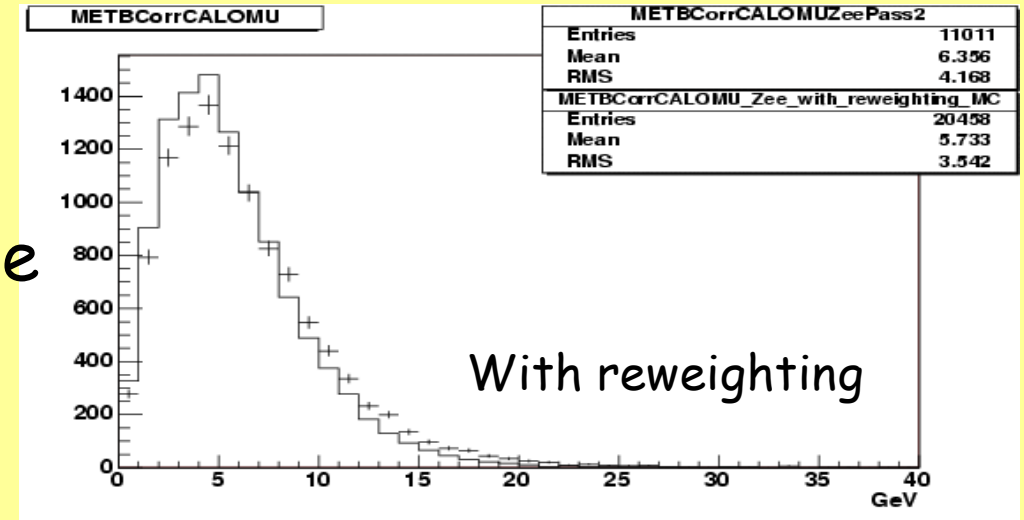


With reweighting



Without reweighting

Zee



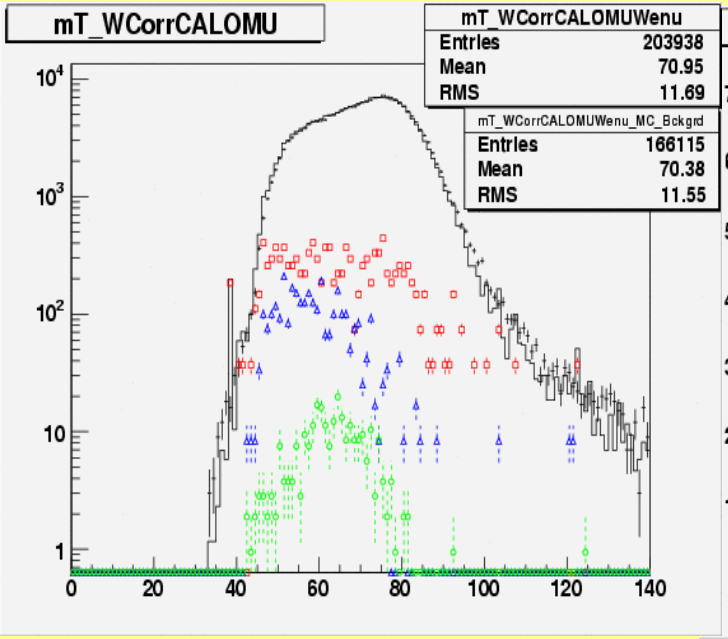
With reweighting

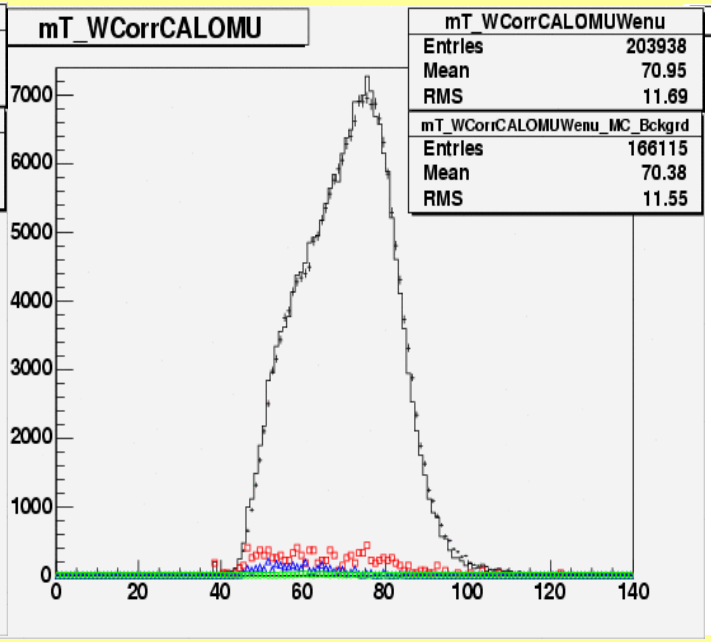
Wev sample

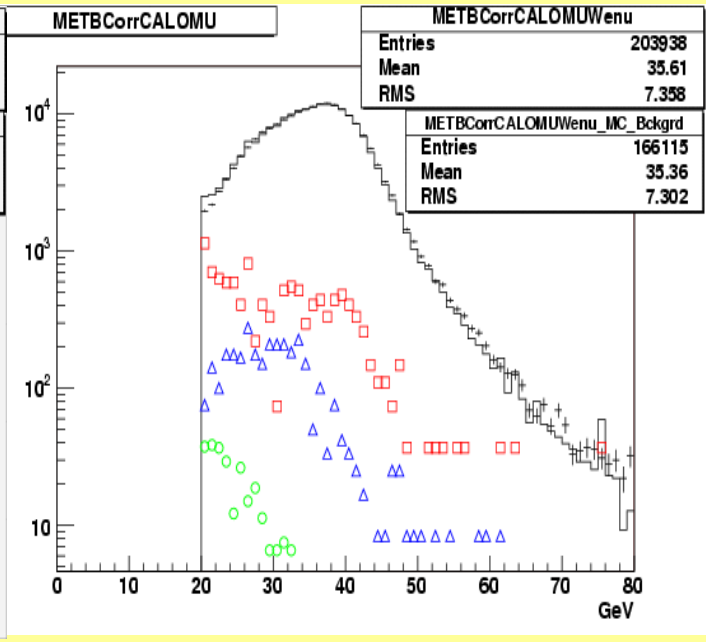
Corrections on the Wev sample' MC

- Smearing
- Bakgrounds: - QCD (estimated from the data) [red square]

  - $Z \rightarrow ee$ (from MC) [green triangle]
  - $W \rightarrow \tau\nu$ (from MC) [blue circle]







Conclusion

- Z studies : - done with pyhtia MC

  - MET agreement between data and MC, once the reweighting is done

  - need of simulation with a good Z's p_T

- Wenu study : the MET is almost well simulated

II.1 – Calibration of the UE

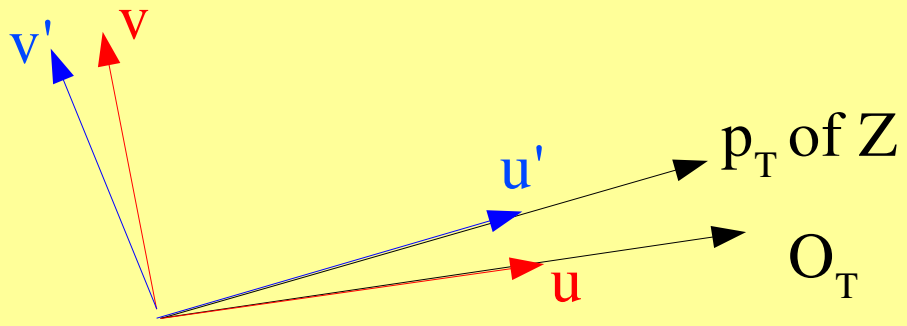
Goal: to reduce the fake MET

We call UE the contribution of the unclustered energy to MET

Need of new variable O_T:

$$\overrightarrow{O_T} = \sum_{jet} \overrightarrow{p_T} + \sum_{EM} \overrightarrow{p_T} + \sum_{muon} \overrightarrow{p_T}$$

New systems of coordinate:



II.1 – Calibration of the UE

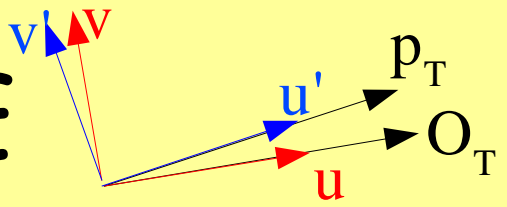
Sources of unclustered energy (UE):

- minimum bias (MB)
- "bad" EM's and jets which are not identified and so not corrected. There would be no problem whether their energies were true, but actually they introduce fake MET
- "bad" muons which are not identified, are not taken into account in MET calculation

if bad EM's, jets and muons were taken into account:

$$\sum_{bad\ EM} \overrightarrow{p_T}_{corrected} + \sum_{bad\ jet} \overrightarrow{p_T}_{corrected} + \sum_{bad\ muon} \overrightarrow{p_T} = -\overrightarrow{O_T}$$

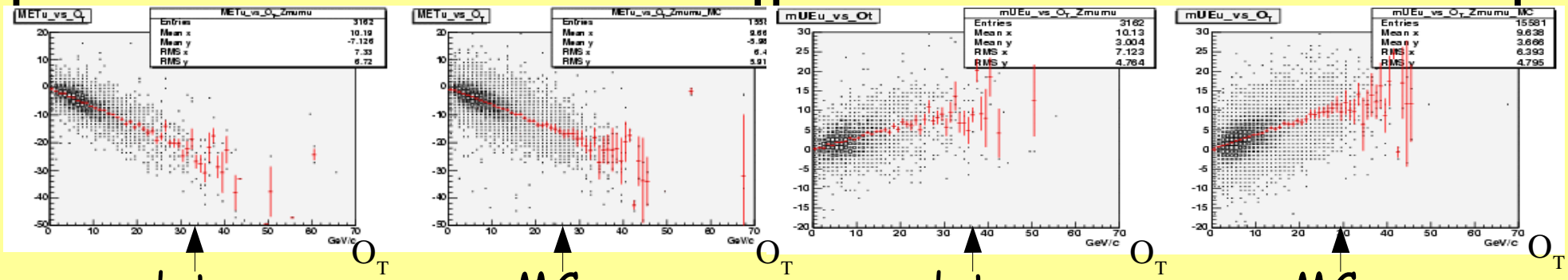
II.1 – Calibration of the UE



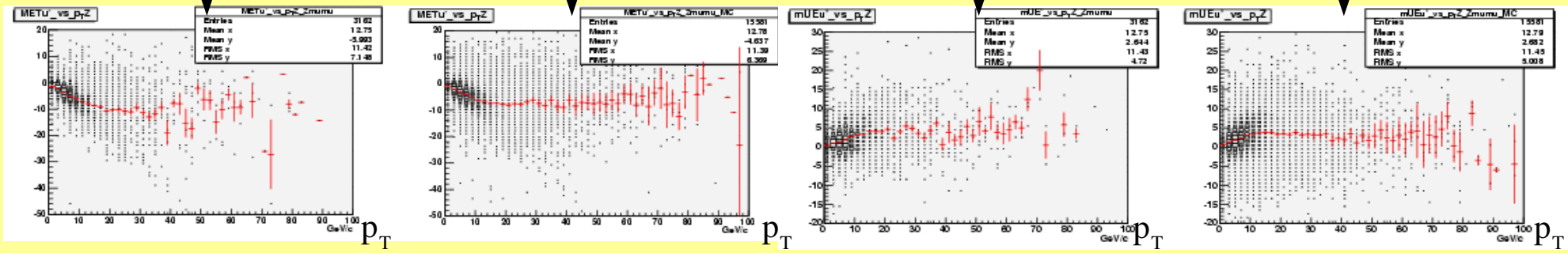
Study done on Zμμ samples (MC smeared)

MET_u(') vs O_T or p_T | -UE_u(') vs O_T or p_T

u

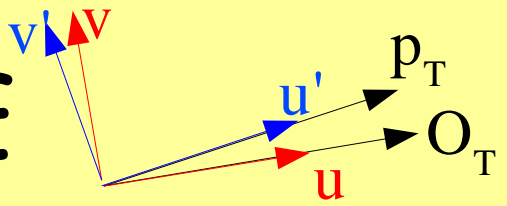


u'



Clean correlations in O_T coordinates

II.1 – Calibration of the UE



MET_v(') vs O_T or p_T

-UE_v(') vs O_T or p_T

v

v'

data

MC

data

MC

O_T

p_T

No correlation in the "v" direction

II.1 – Calibration of the UE

Let's suppose: $\overrightarrow{UE} = \overrightarrow{MB} - a \times \overrightarrow{O_T}$

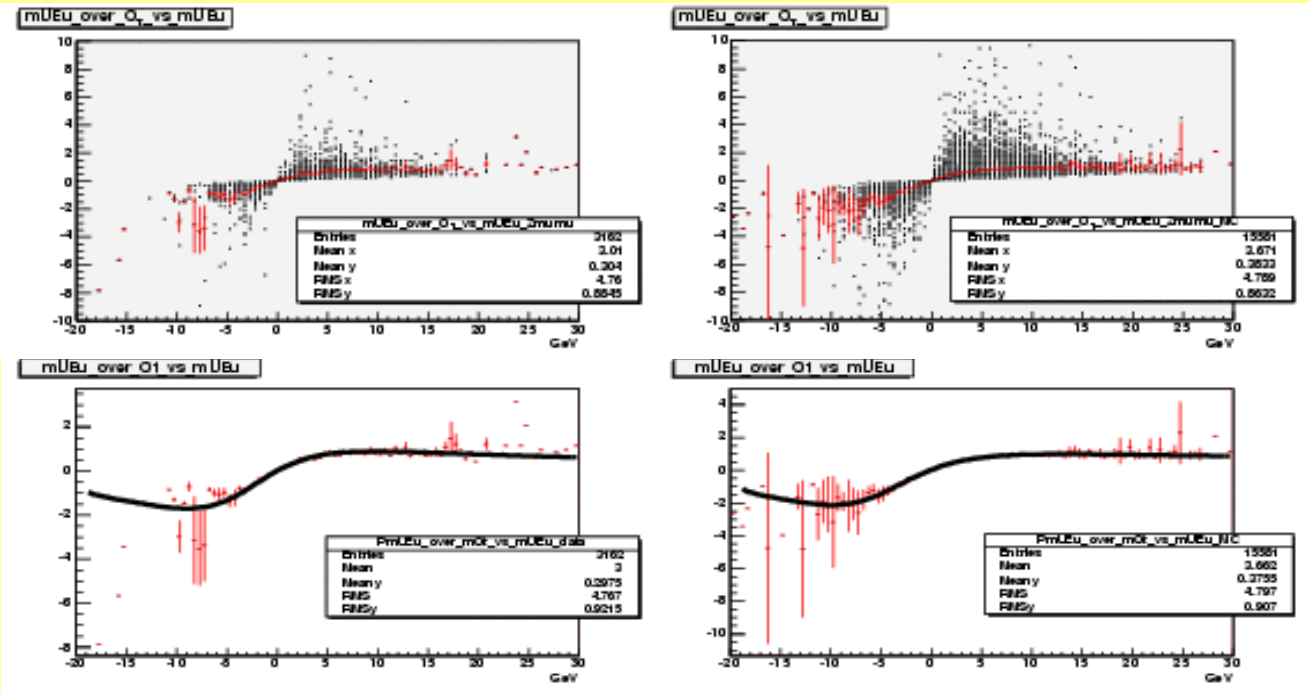
→for a given O_T: <UE>=a.O_T=<UE_u> and <UE_v>=0

because there is no calibration, a≠1 :

UE_u/O_T versus UE_u:

fitted by:

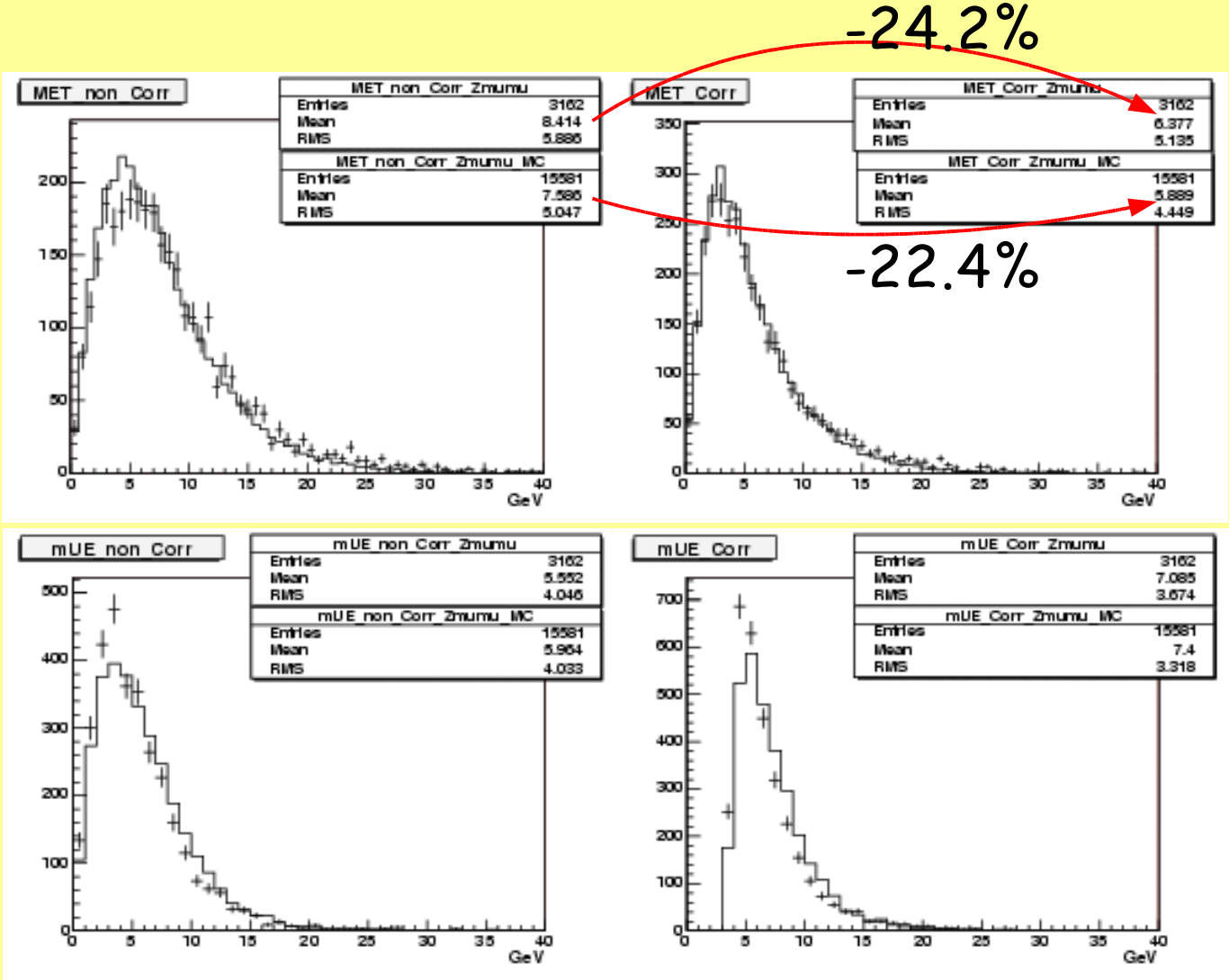
$$f(x) = \frac{u_1 \times x + u_2 \times x^2 + u_3 \times x^3}{1 + d_1 \times x + d_2 \times x^2 + d_3 \times x^3}$$



II.1 – Calibration of the UE

$UE_{cal}=UE/f(UE)$

- Disagreement in the mean of MET between data and MC goes down from 9.8% to 7.7%
- But bad shappe of UE
- This calibration apply to Zee with succes



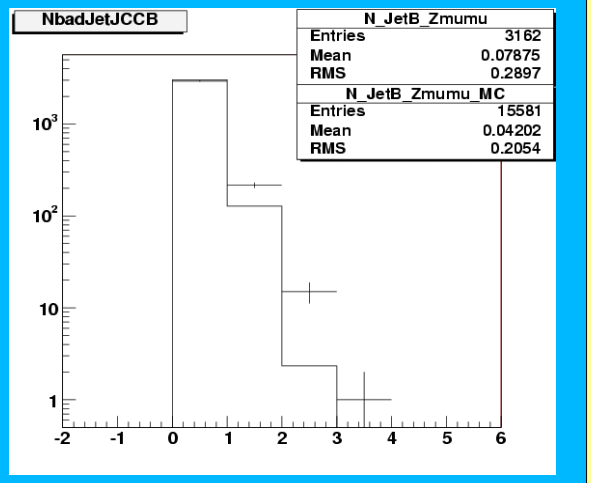
II.2 – Correlation between UE and bad jets

Study in Zμμ sample:

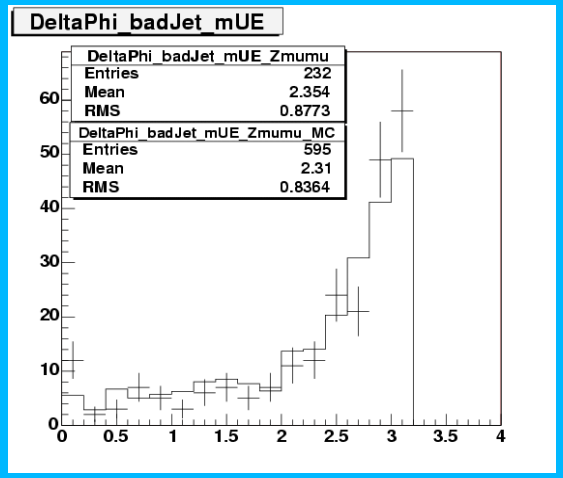
"bad" jet: a jet who do not pass the cuts to be a good jet

→ no JES correction, no MET correction

≈10% of the events with bad jets



$\Delta\varphi(\Sigma pT_{\text{bad jet}}, UE)$ (in events with bad jets)



Note: the "real" proportion of events with bad jets should be bigger than 10% because of reconstruction inefficiency

Conclusions about UE studies

- The rudimantary UE calibration decreases fake MET of more than 20%.
- There is a strong link between bad jets, UE and fake MET

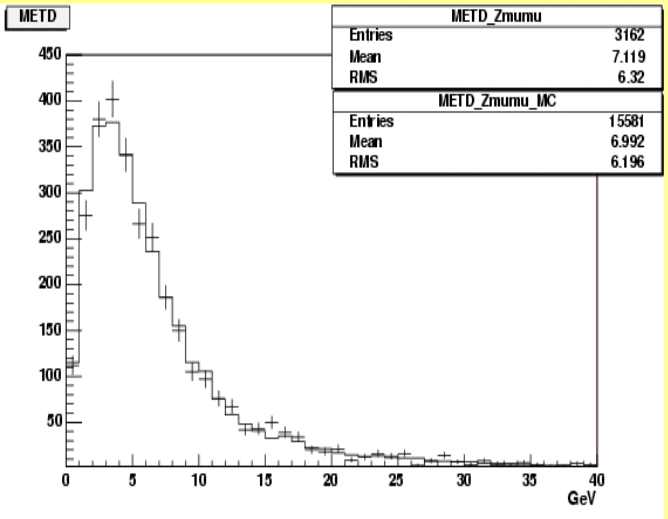
→ a calibration of bad jets (for example in Zμμ) should have a really good impact on fake MET and so on MET resolution

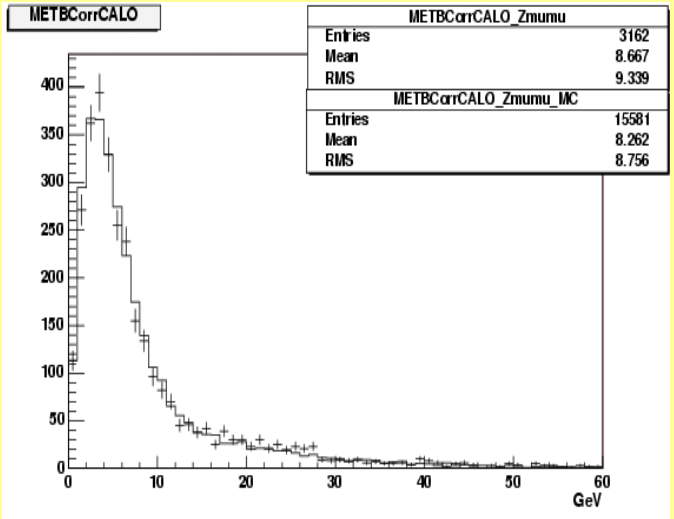
We could lower the reconstruction level (so increase the number of bad jets) -> better impact of the bad jet calibration. But how much would it cost?

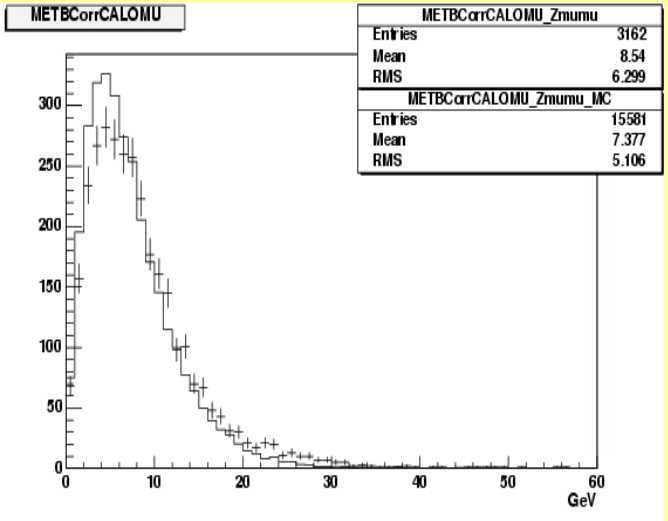
Back up

I - Zμμ

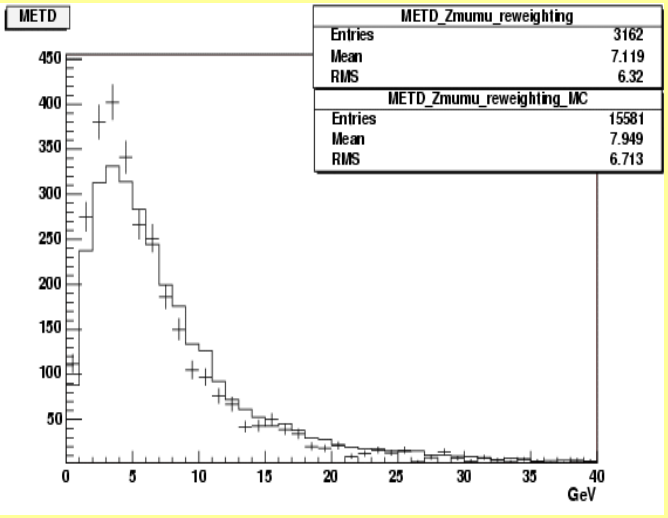
Before reweighting

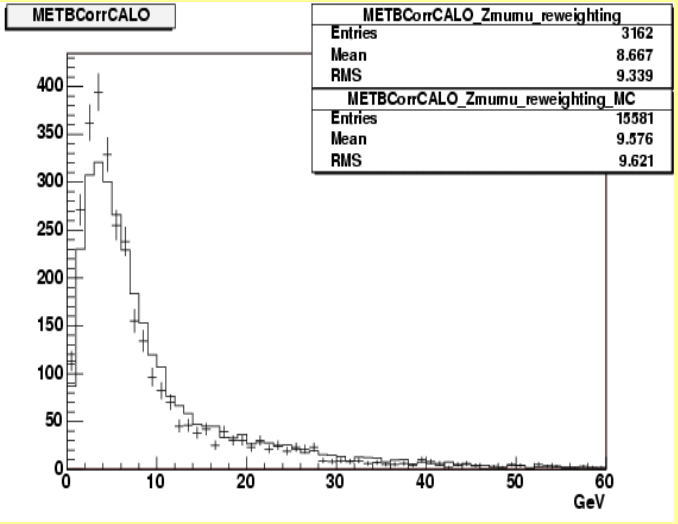


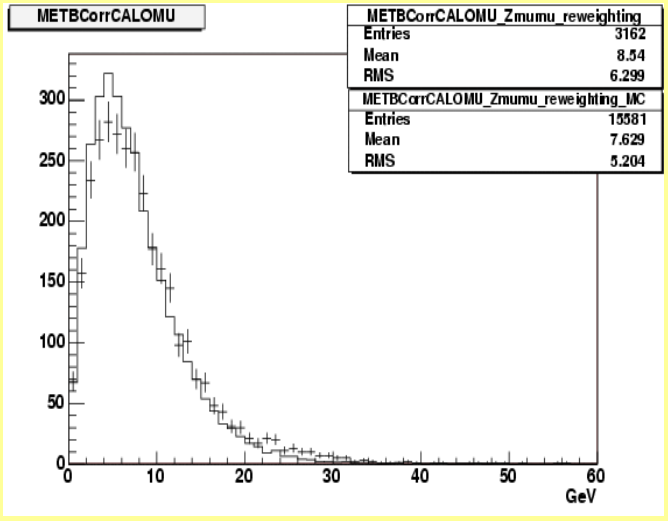




After reweighting

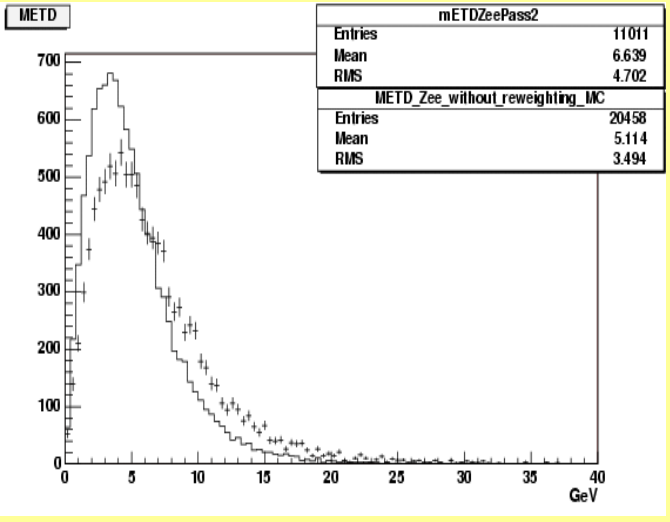


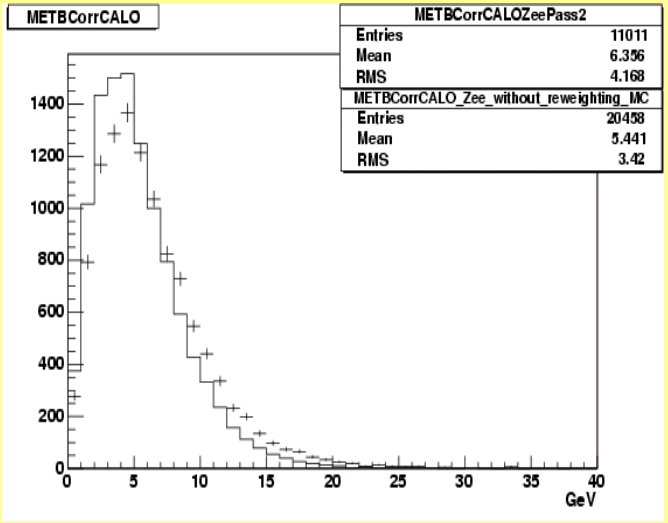


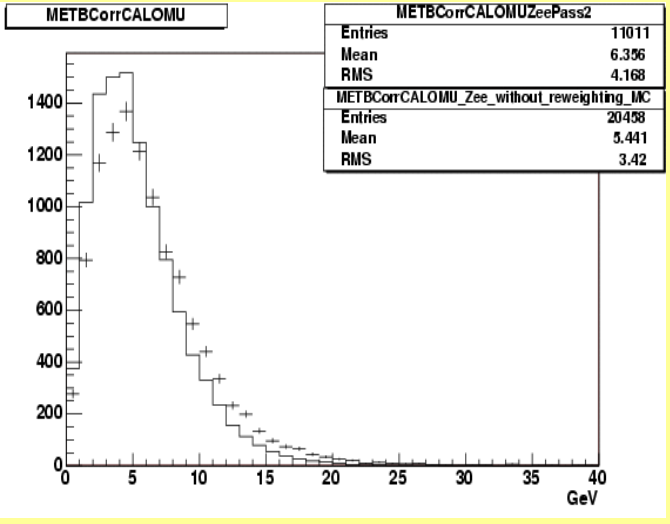


I - Zee

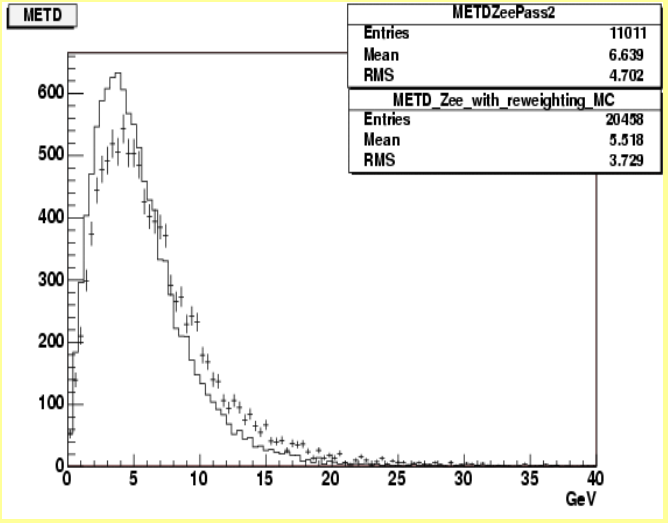
Before reweighting

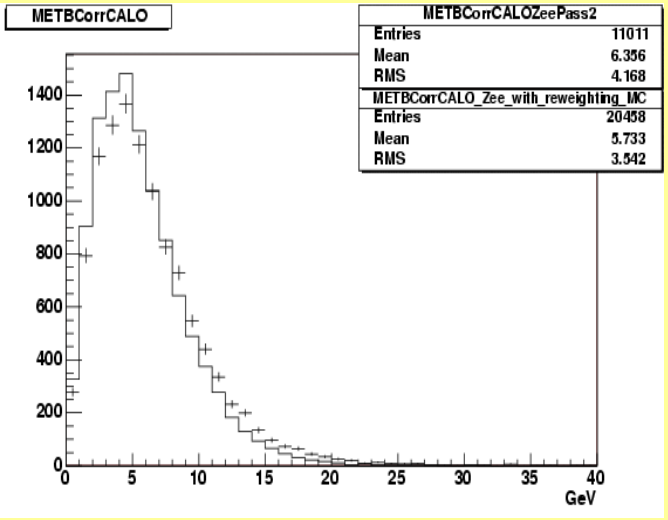


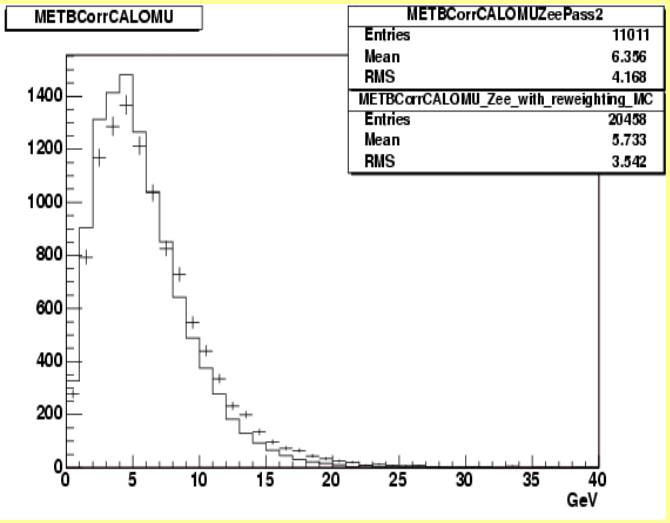




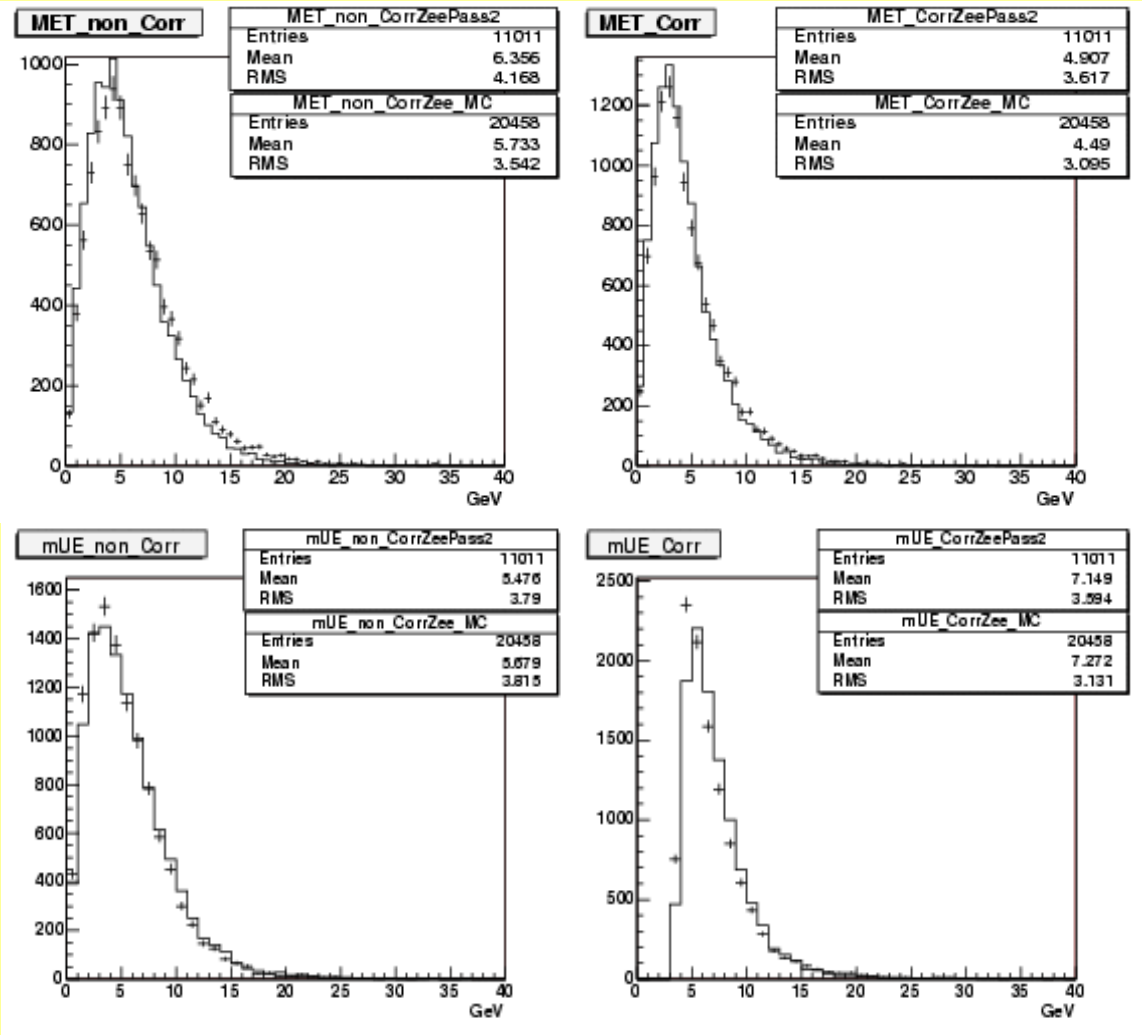
After reweighting







UE calibration (from $Z\mu\mu$) applied to Zee



Good jet

- 0.05<EMfrac<0.95
- CHfrac<0.40
- HotCellRatio<1000
- f90<0.5
- (L1_Energy*JES_factor)/{jet_pT(1-CH_E_frac)}>0.4