EtMiss: the ‘phi swing’ explained?

- are there additional effects (biases) than the displaced BeamSpot hypotheses ?-

- What is the ‘phi swing’ problem
- Where does it originate from
- Can we correct MC and data

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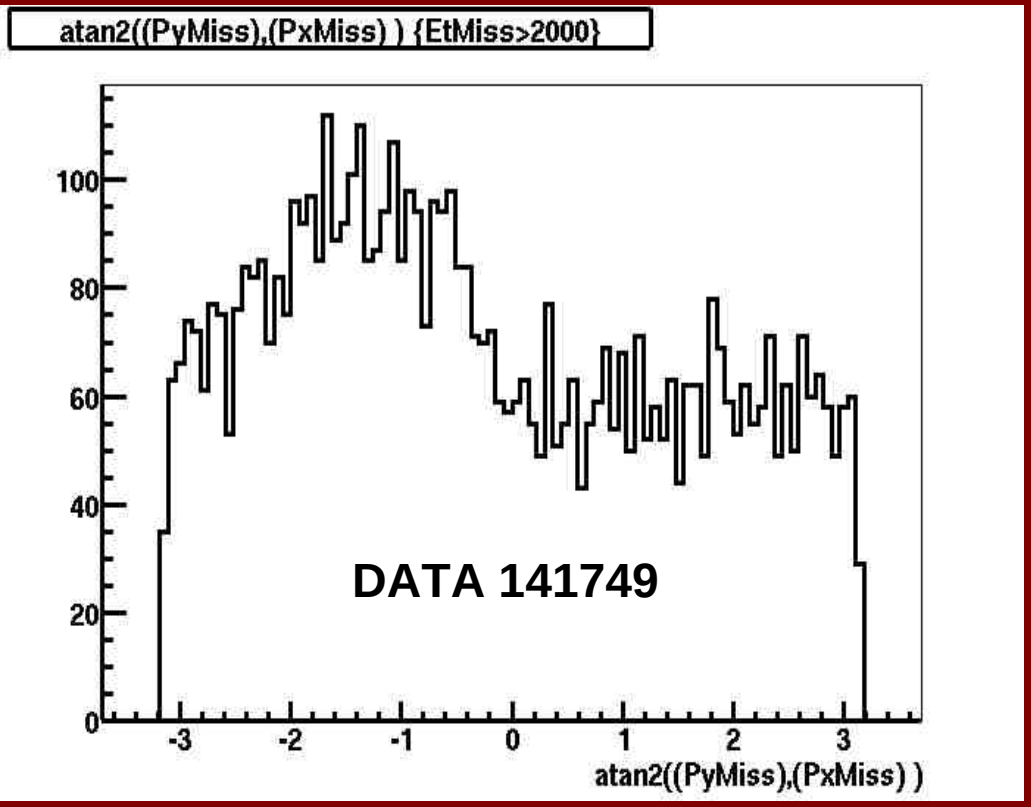
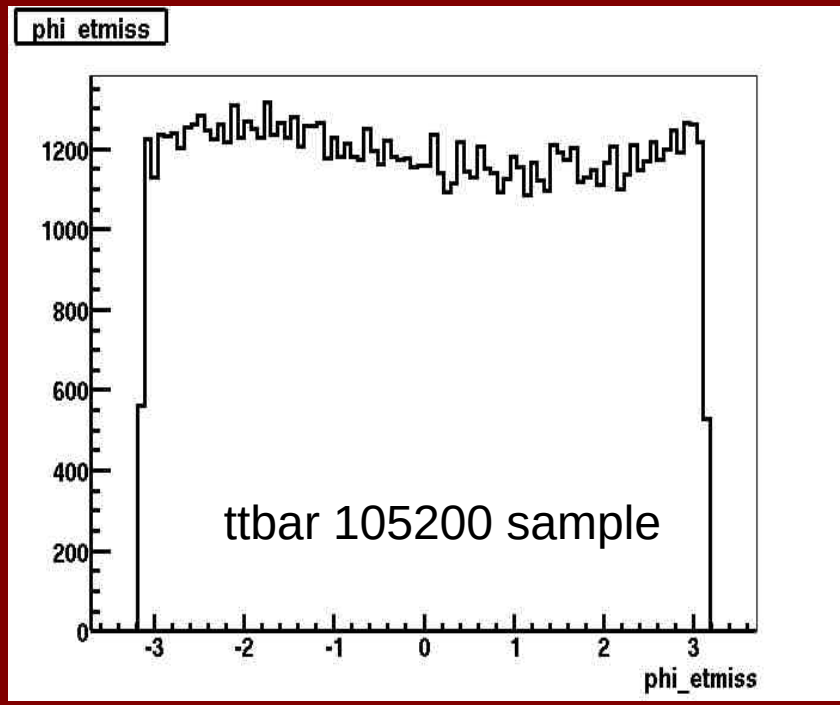
What is the ‘phi swing’ problem

- → not understood modulation in the phi of EtMiss





Using METref_Final, see backup for many other MET approaches.

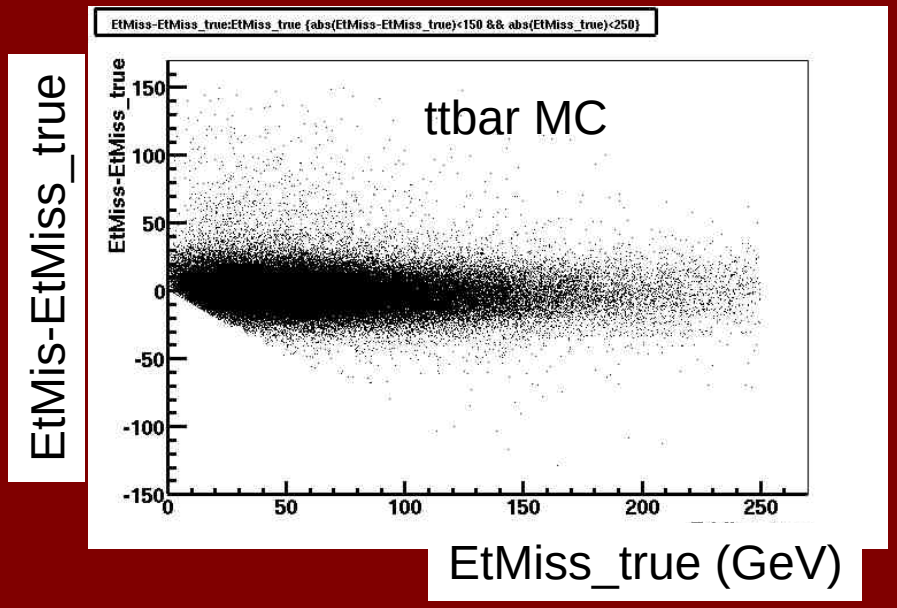
problem > 2 years old.
Seen in Data, MC-900GeV (not shown) and ttbar 105200 sample

Hypotheses

1. BeamSpot Disp. → it is the displaced beam position.

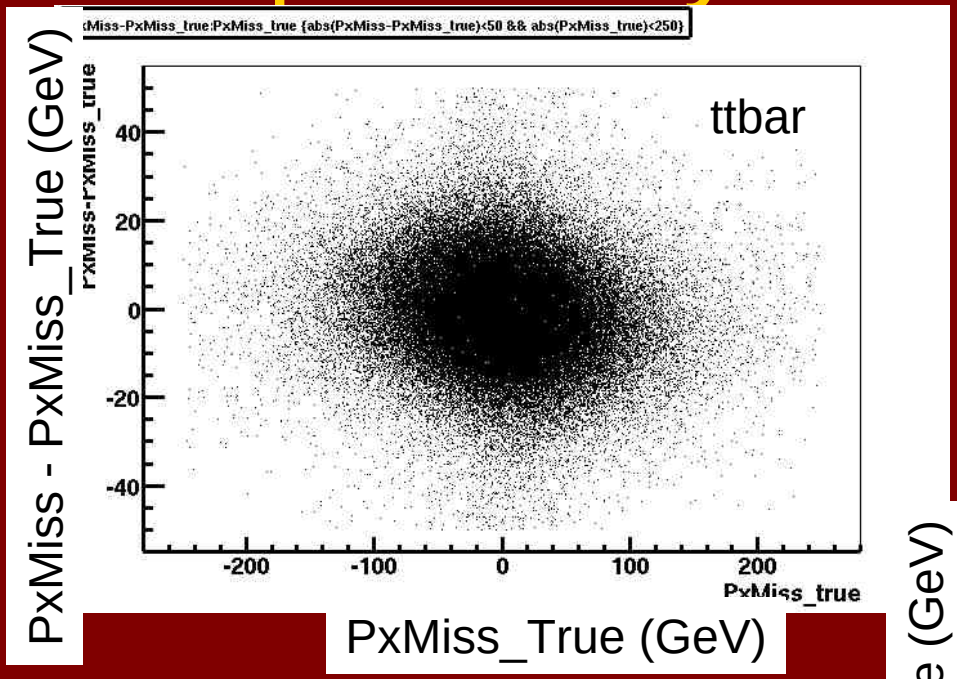
   Do the math, or make toy MC, effect is order 1mm/1m~0.001 not ~0.1. (Not further discussed in this talk). However: see Margars plot.

2. EtMiss calibration → seems unlikely because in MC we know it is calibrated to ~1% level and thus phi_etmiss=atan(pymiss/pxmiss) is hardly affected ←→ this statement will appear to be wrong (This talk!)

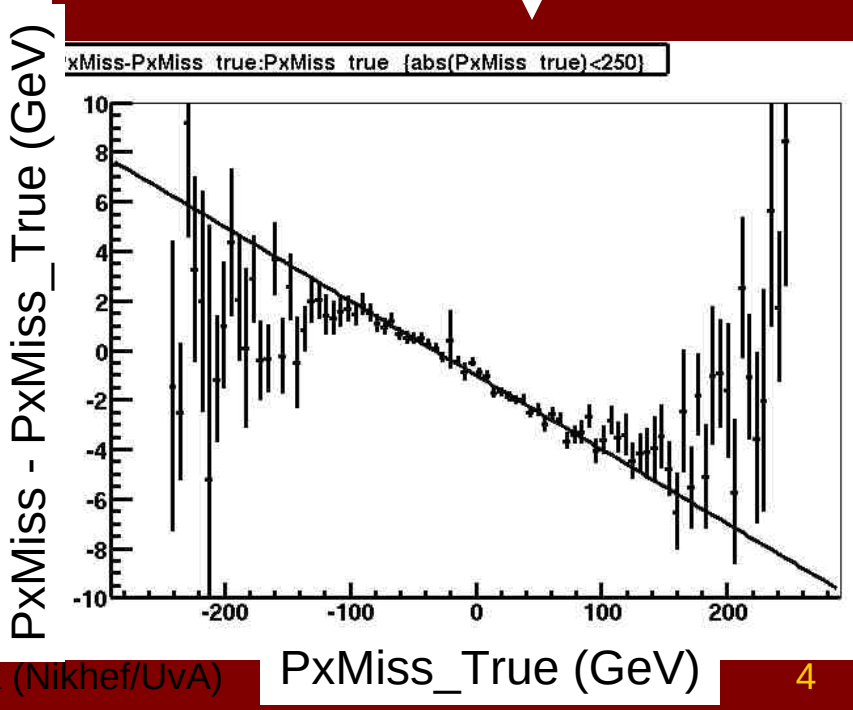


→ nicely calibrated.... Remark: in the CSC-note there are plots showing residual calibration effects (or sample dependences) of order percents. Hence, some deviation may be expected. (see also www.nikhef.nl/~h73/biases.pdf)

Component by component: PxMiss



→ seems ok, but
let's have a closer look.....



line fit (shown here):

$$\Delta PxMiss = -1.0 - 0.03 \cdot PxMiss\_true$$

line fit (not shown, see backup):

$$\Delta PyMiss = -1.6 - 0.03 \cdot PyMiss\_true$$

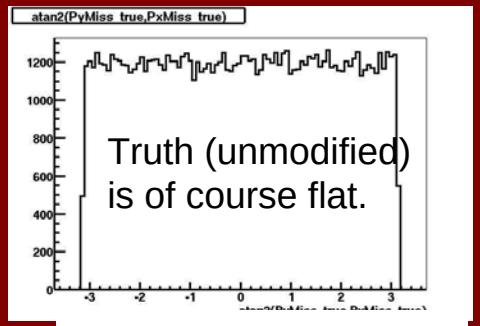
~1 GeV bias and 3% off → So what?!

Does small bias explain 'swing'?

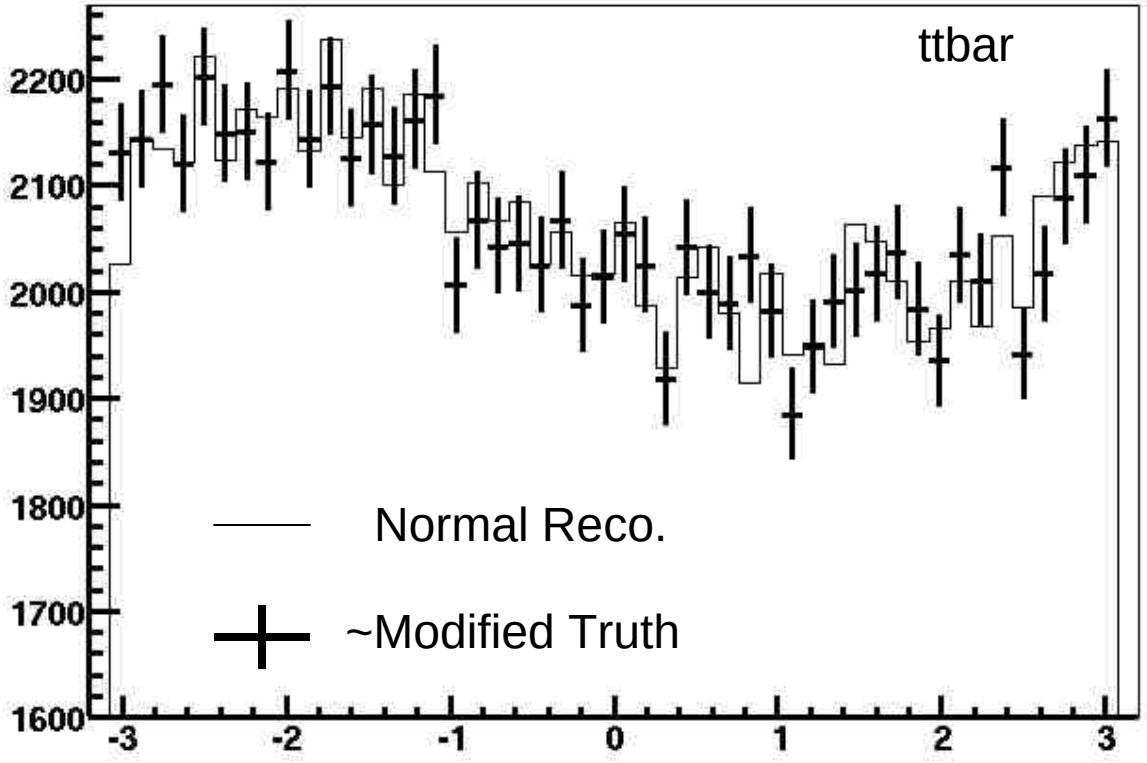
Modify true quantities with the small bias to see the effect:

$$PxMiss\_true \rightarrow PxMiss\_true + (-1.0 - 0.03 \cdot PxMiss\_true)$$

$$PyMiss\_true \rightarrow PyMiss\_true + (-1.6 - 0.03 \cdot PyMiss\_true)$$



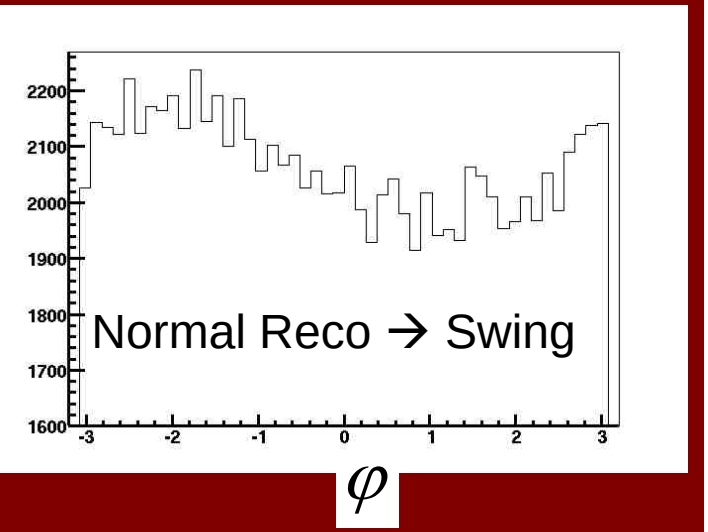
phi_EtMiss_Truth

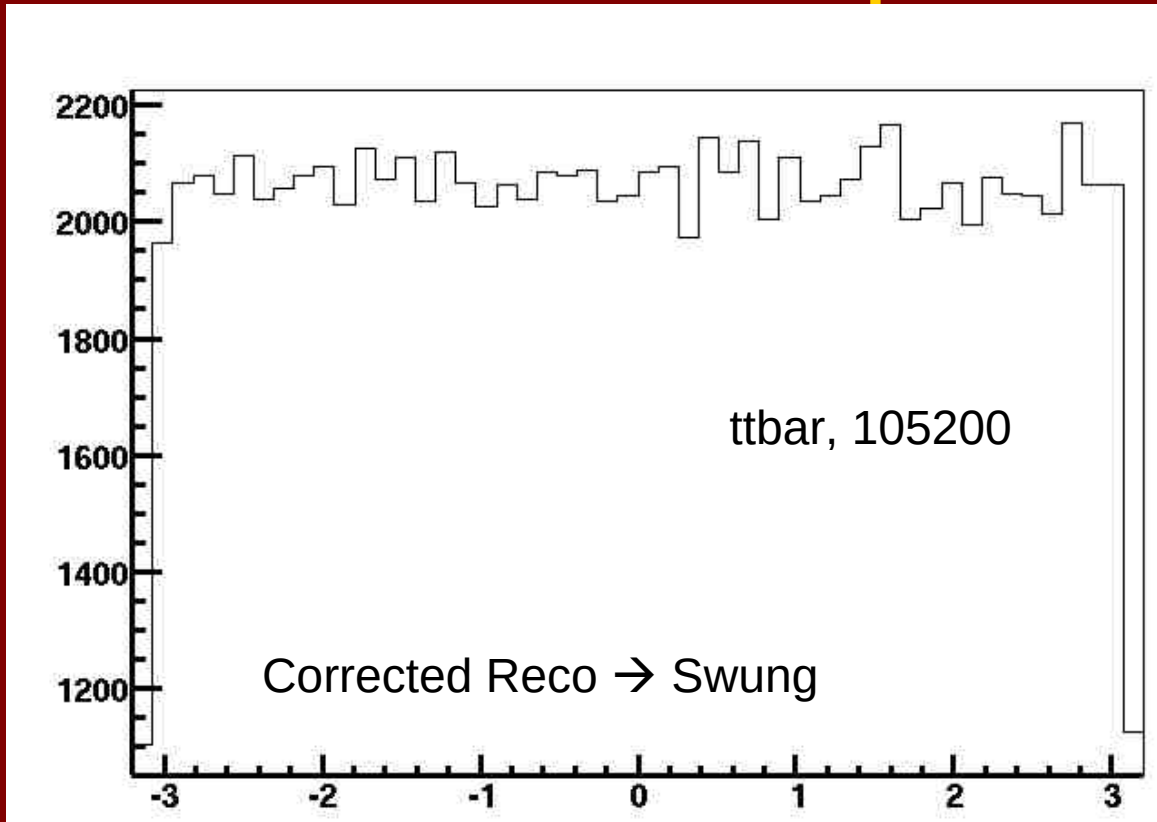


Conclusion:
Small bias in the PxMiss and PyMiss explains all.
→ No BS needed.

$$\varphi = \arctan\left(\frac{PyMissTrue - 1.6 - 0.03 \cdot PyMiss\_true}{PxMissTrue - 1.0 - 0.03 \cdot PxMiss\_true}\right)$$

Correct the reconstructed phi





$$\varphi = \arctan\left(\frac{PyMiss + 1.6}{PxMiss + 1.0}\right)$$

So simple, so effective
→ What about data?

To find correction function, invert:

$$PxMiss\_true \rightarrow PxMiss\_true + (-1.0 - 0.03 \cdot PxMiss\_true)$$
$$PyMiss\_true \rightarrow PyMiss\_true + (-1.6 - 0.03 \cdot PyMiss\_true)$$

Then slope drops out in φ

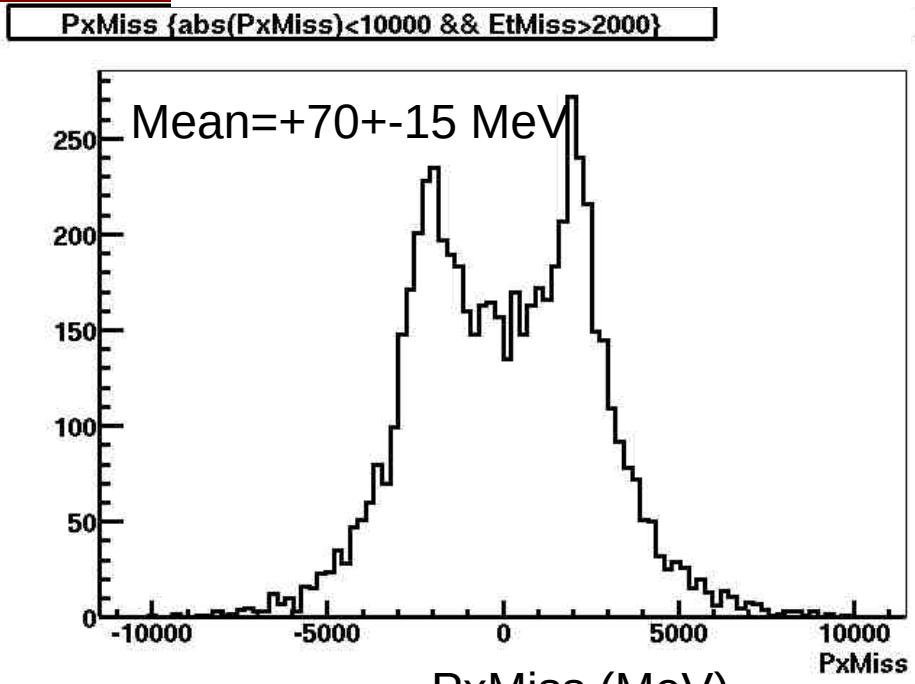
Correct Data (141749)

→ Note: to correct phi, only bias (not slope) is needed.

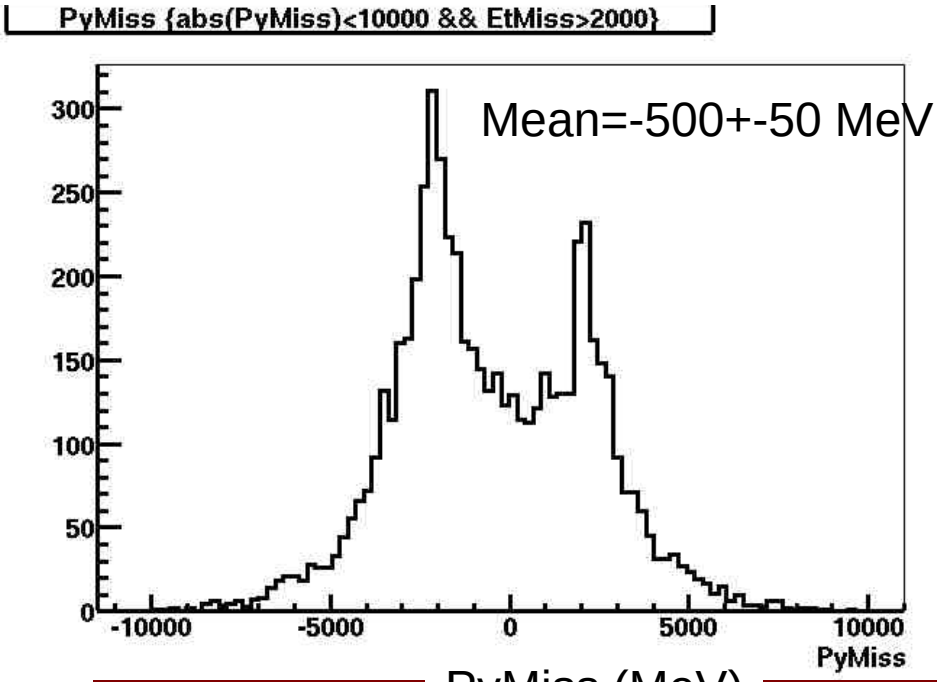
→ bias=Px,yMiss – Px,yMissTrue

→ assume Px,yMissTrue in data ~ zero.→ Bias=<Px,yMiss>

run 141749, for EtMiss>2000MeV (otherwhise phi is really random)



PxMiss (MeV)

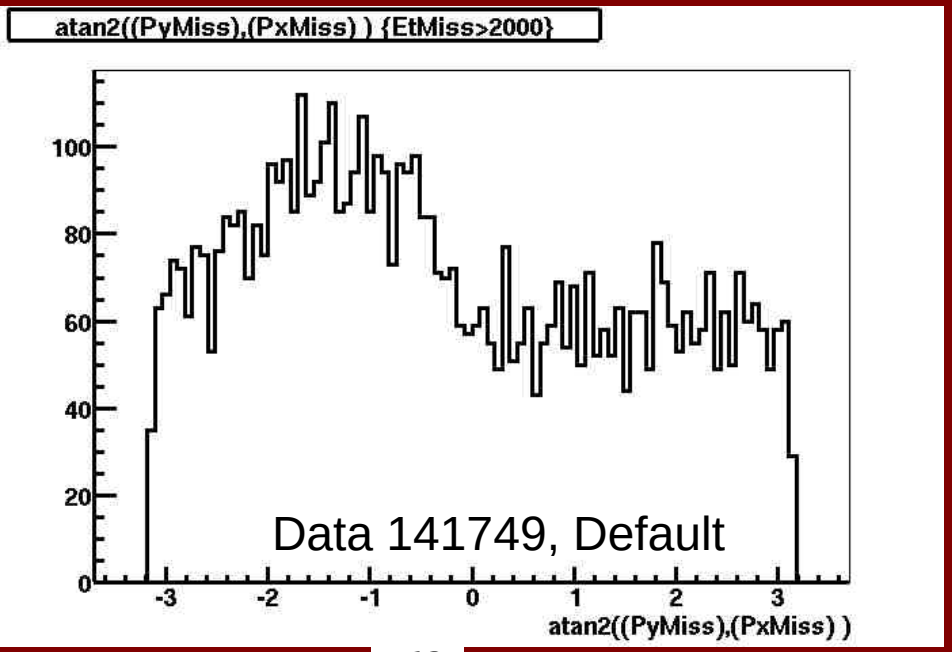


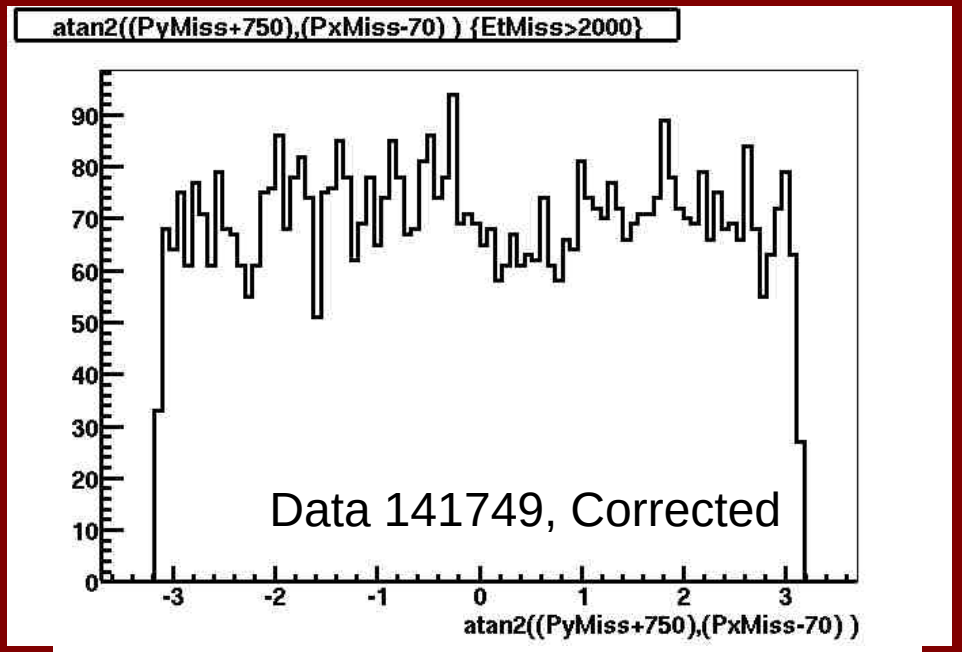
PyMiss (MeV)

Correct Data (141749)

→ thus bias found of +70, -500MeV

→ nice results with bias of 70,-750MeV





φ

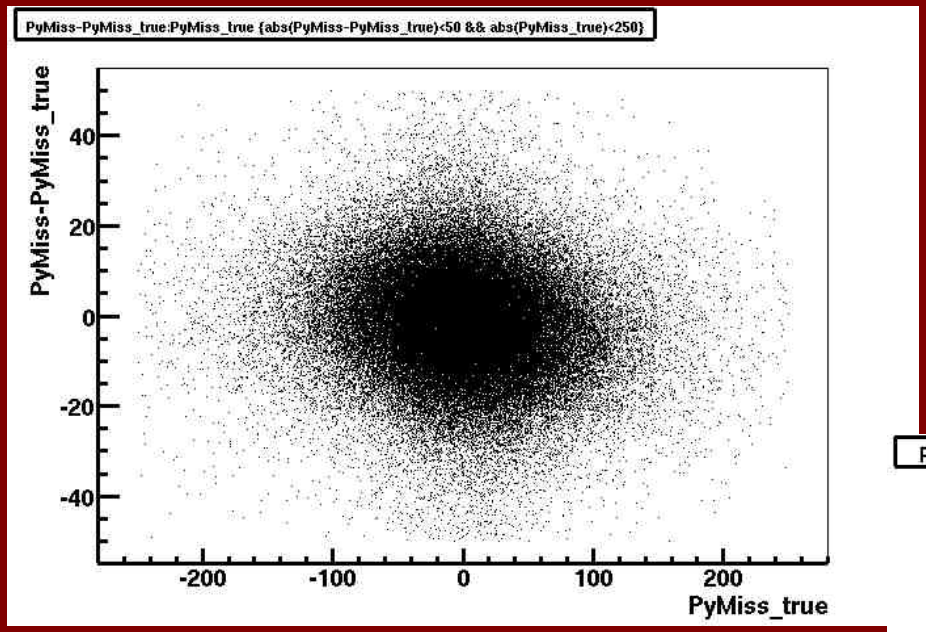
$$\varphi = \arctan\left(\frac{PyMiss + 750MeV}{PxMiss - 70MeV}\right)$$

Conclusion: a small bias leads to a (statistically) flat phi distribution

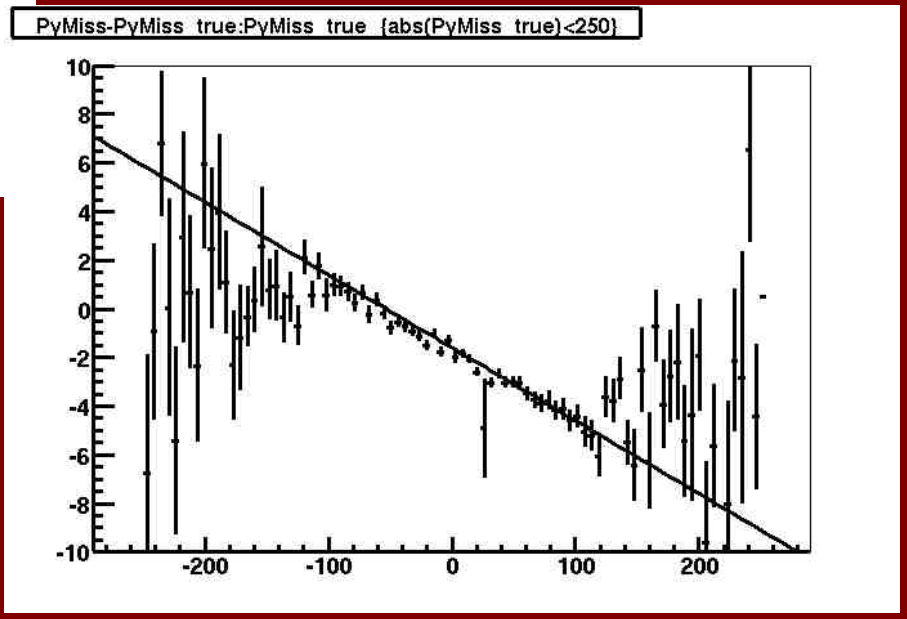
Conclusion

- The phi_etmiss distribution is not flat in data and MC.
- A small bias in Px,yMiss explains this behaviour.
- (Small biases in Etmissing are also seen in the CSC-note. These can be due to imperfection in the calibration/sample dependences.)
- For data, a bias of (only) Px,yMiss=70, -750MeV leads to a flat phi_etmiss
- Hence, the displaced BeamSpot hypotheses is not the only hypotheses.
- For experts: See the Backup Slides for other METs (Topo, Base, etc) → bias changes.
- → Question: what is the exact origin of these biases?

Back-up: PyMiss

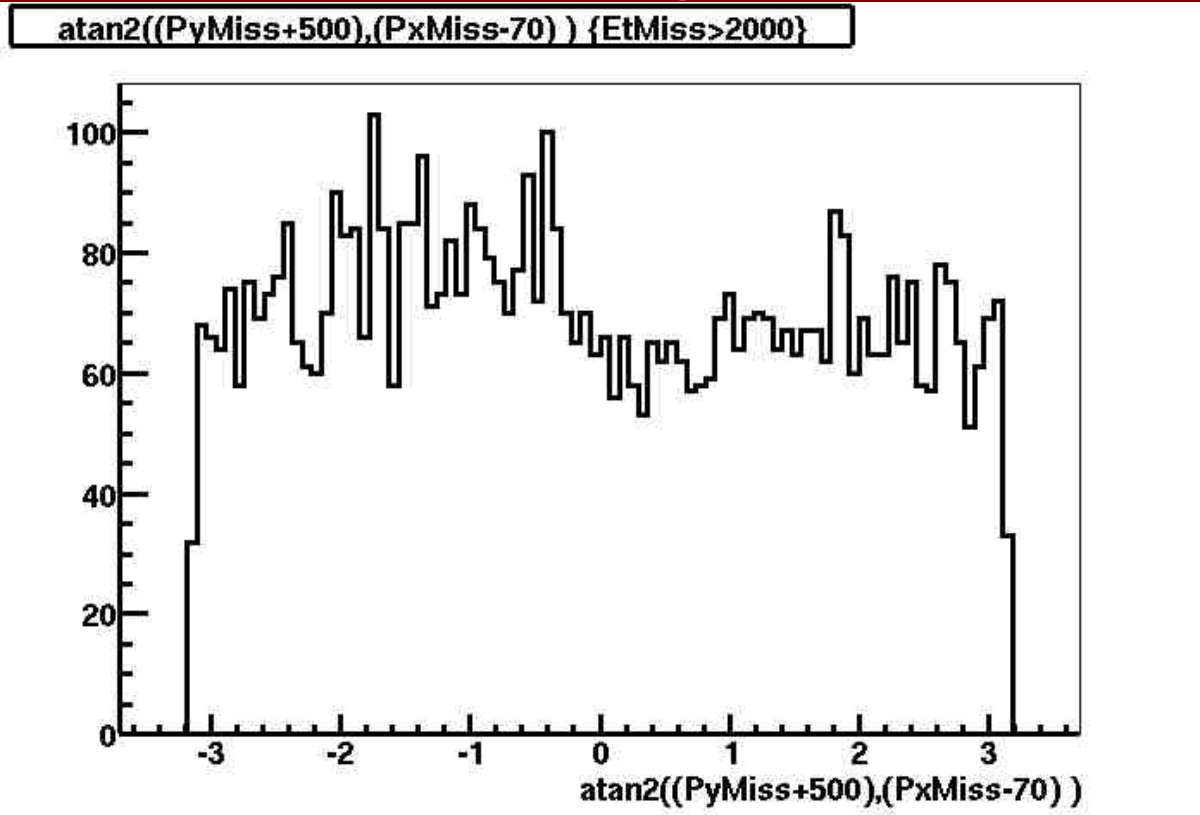


ttbar 105200 , units GeV.

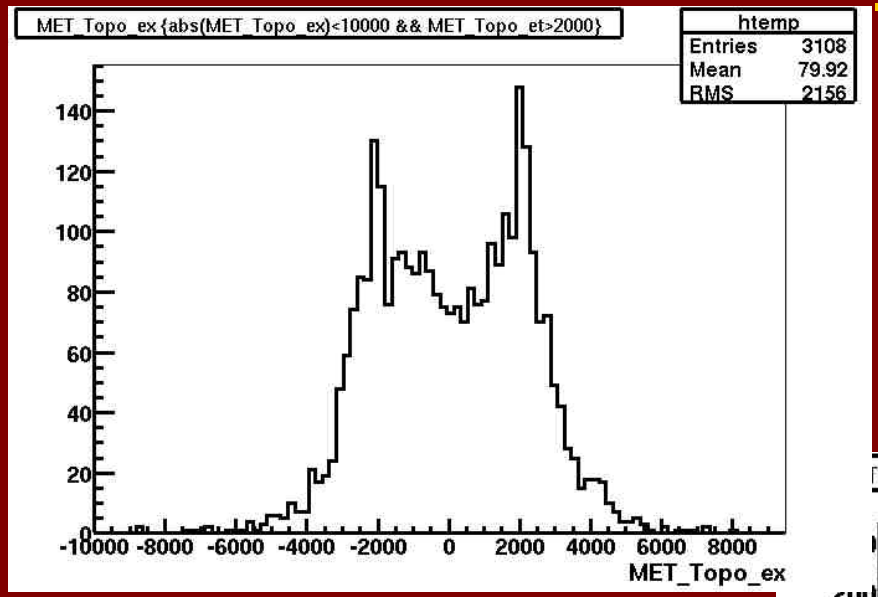


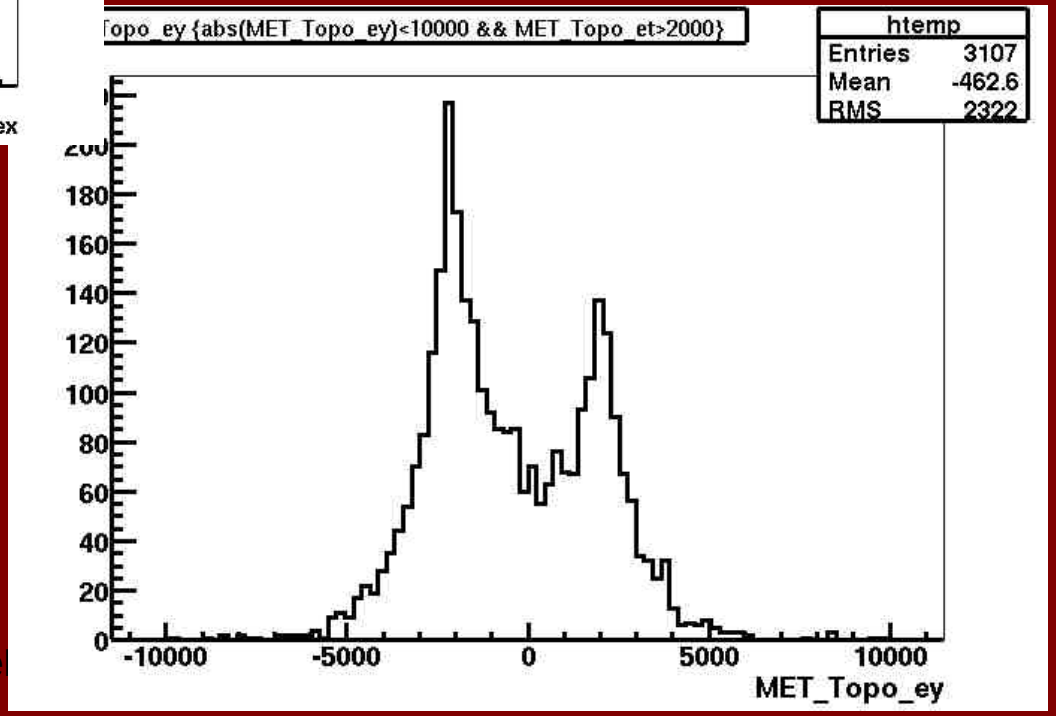
Back-Up

- Correct data with the original 70, -500MeV bias

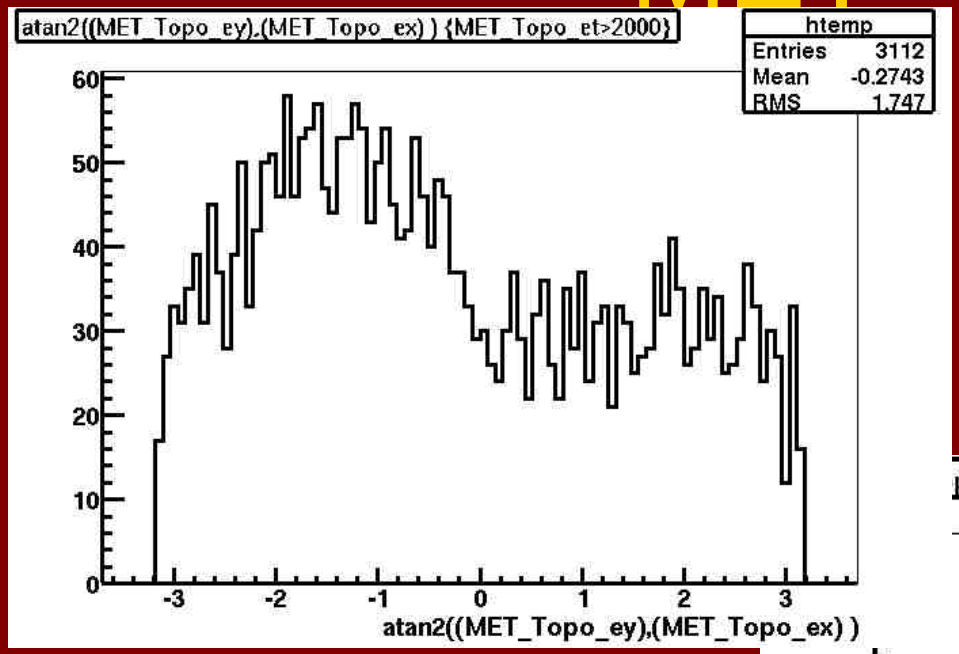


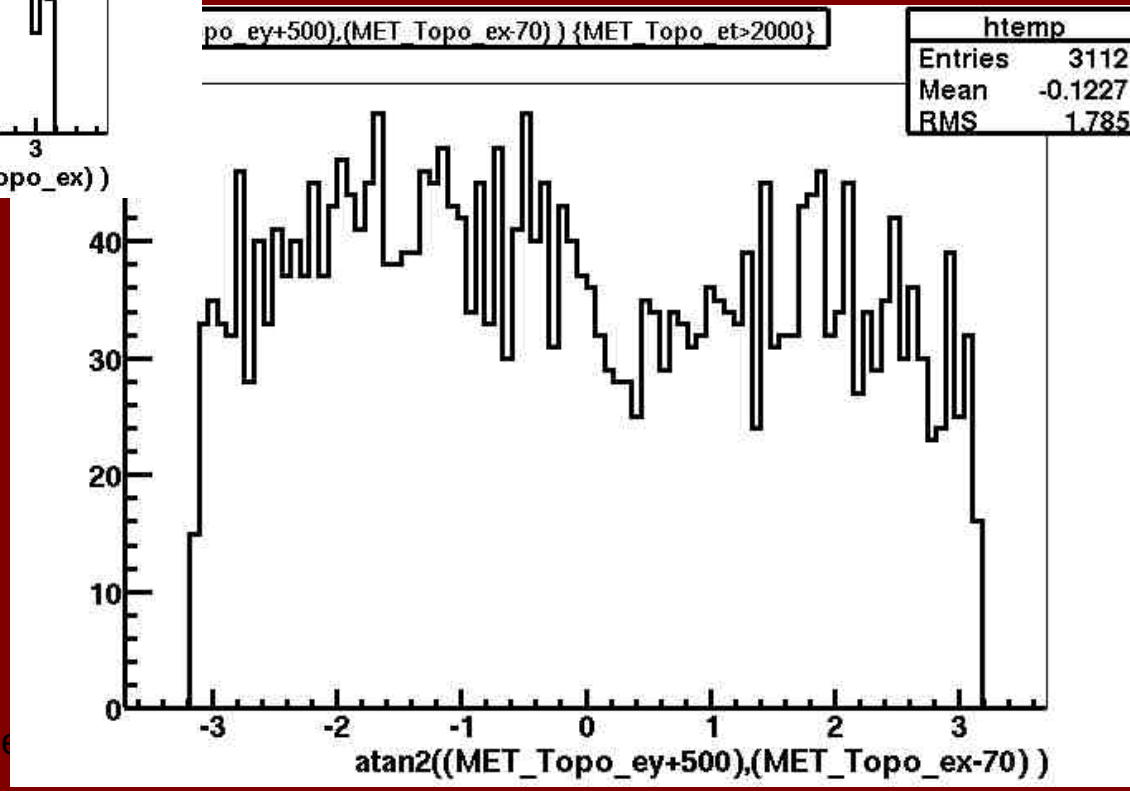
MET_Topo


MET_Topo_ex{abs(MET_Topo_ex)<10000 && MET_Topo_et>2000}
htemp
Entries 3108
Mean 79.92
RMS 2156
140
120
100
80
60
40
20
0
-10000 -8000 -6000 -4000 -2000 0 2000 4000 6000 8000
MET_Topo_ex

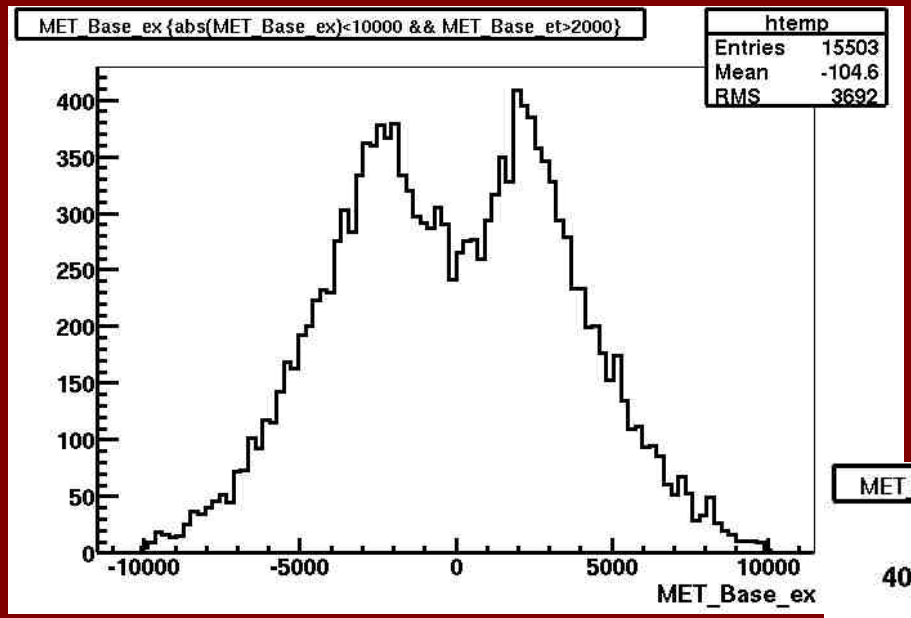

opo_ey{abs(MET_Topo_ey)<10000 && MET_Topo_et>2000}
htemp
Entries 3107
Mean -462.6
RMS 2322
180
160
140
120
100
80
60
40
20
0
-10000 -5000 0 5000 10000
MET_Topo_ey

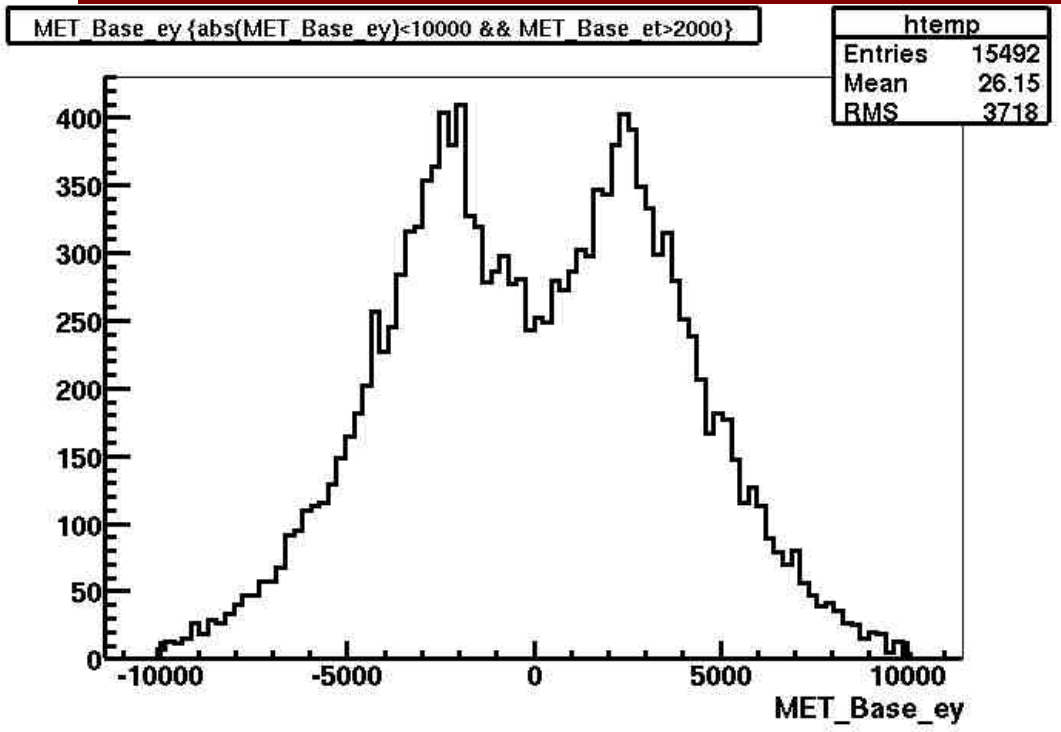
MET_Topo


atan2((MET_Topo_ey),(MET_Topo_ex)) {MET_Topo_et>2000}
htemp
Entries 3112
Mean -0.2743
RMS 1.747
60
50
40
30
20
10
0
-3
-2
-1
0
1
2
3
atan2((MET_Topo_ey),(MET_Topo_ex))

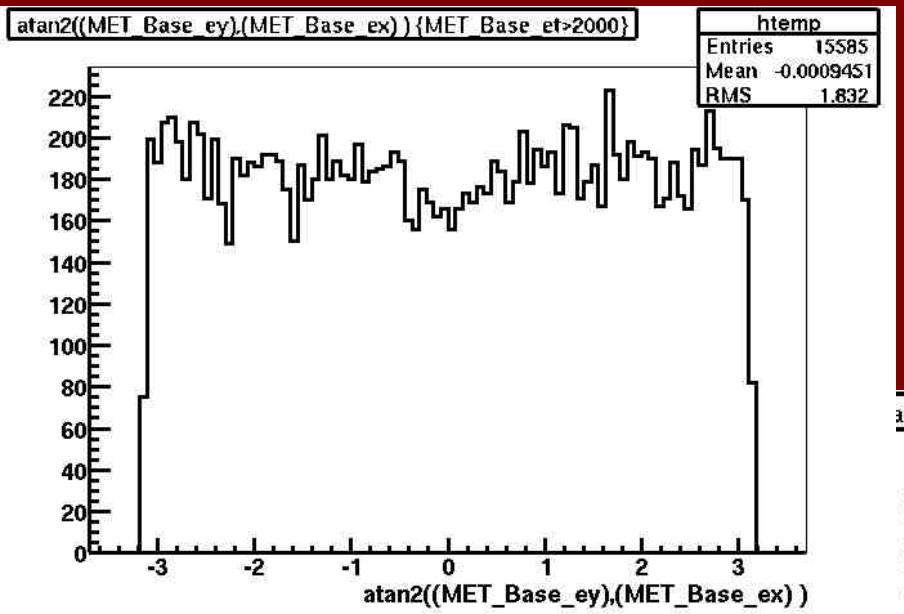

po_ey+500),(MET_Topo_ex-70)) {MET_Topo_et>2000}
htemp
Entries 3112
Mean -0.1227
RMS 1.785
40
30
20
10
0
-3
-2
-1
0
1
2
3
atan2((MET_Topo_ey+500),(MET_Topo_ex-70))

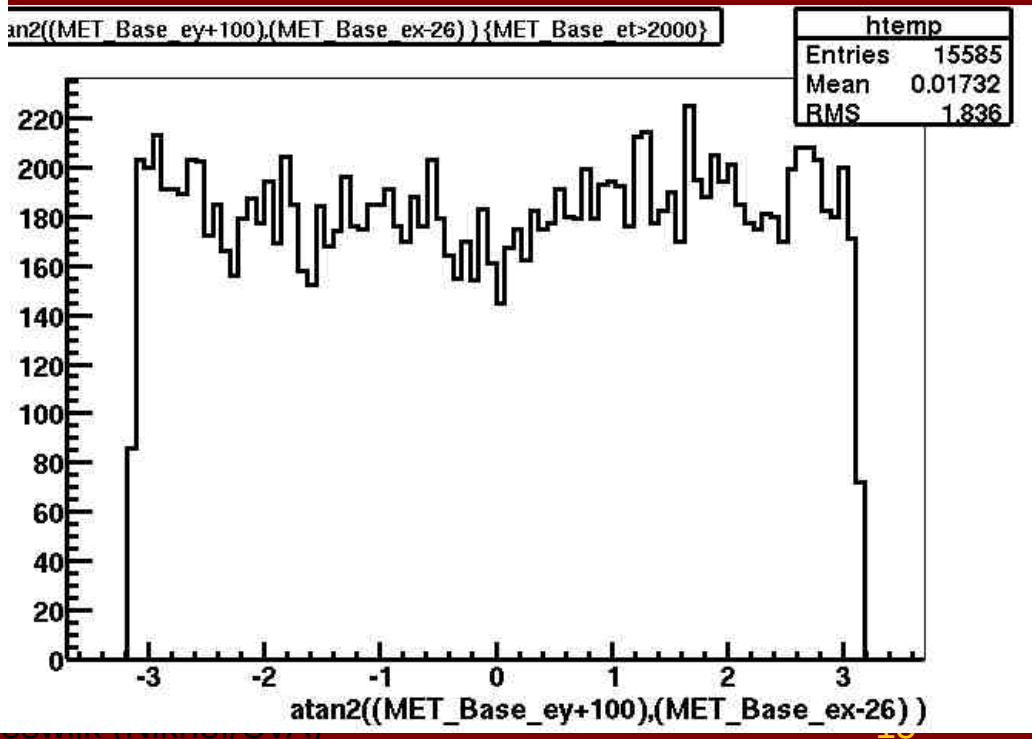
MET_Base


MET_Base_ex{abs(MET_Base_ex)<10000 && MET_Base_et>2000}
htemp
Entries 15503
Mean -104.6
RMS 3692
400
350
300
250
200
150
100
50
0
-10000
-5000
0
5000
10000
MET_Base_ex

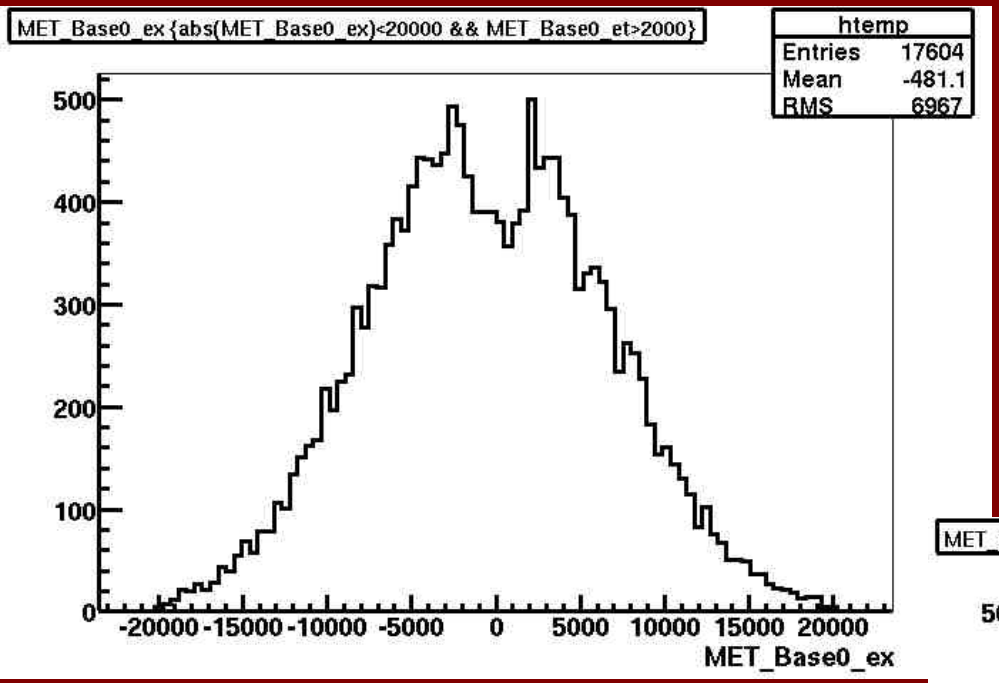

MET_Base_ey{abs(MET_Base_ey)<10000 && MET_Base_et>2000}
htemp
Entries 15492
Mean 26.15
RMS 3718
400
350
300
250
200
150
100
50
0
-10000
-5000
0
5000
10000
MET_Base_ey

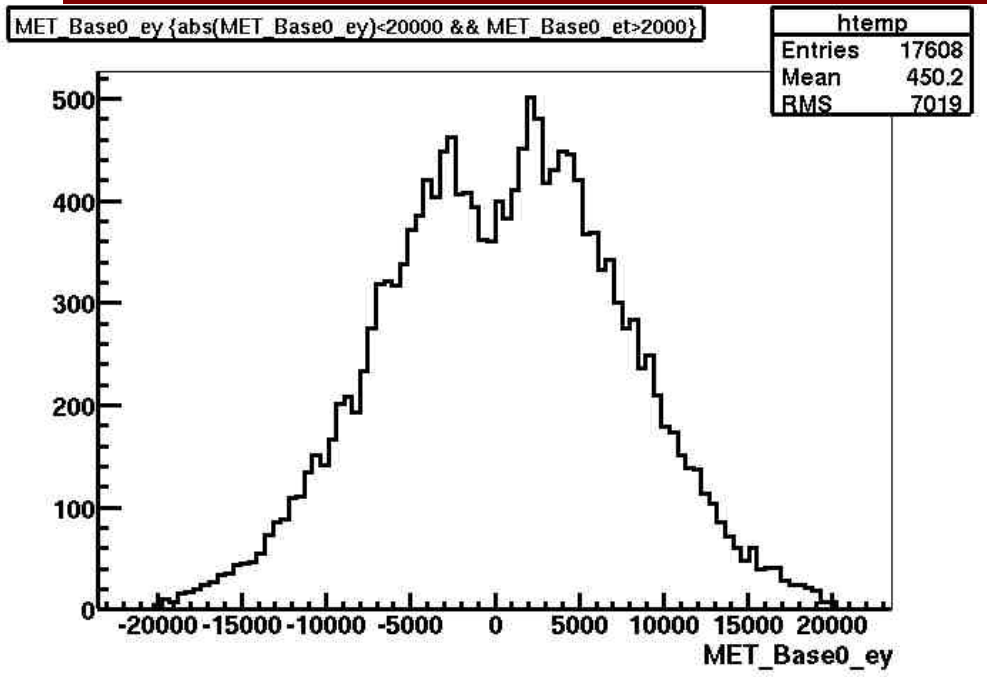
MET_Base


atan2((MET_Base_ey),(MET_Base_ex)) {MET_Base_et>2000}
htemp
Entries 15585
Mean -0.0009451
RMS 1.832
atan2((MET_Base_ey),(MET_Base_ex))

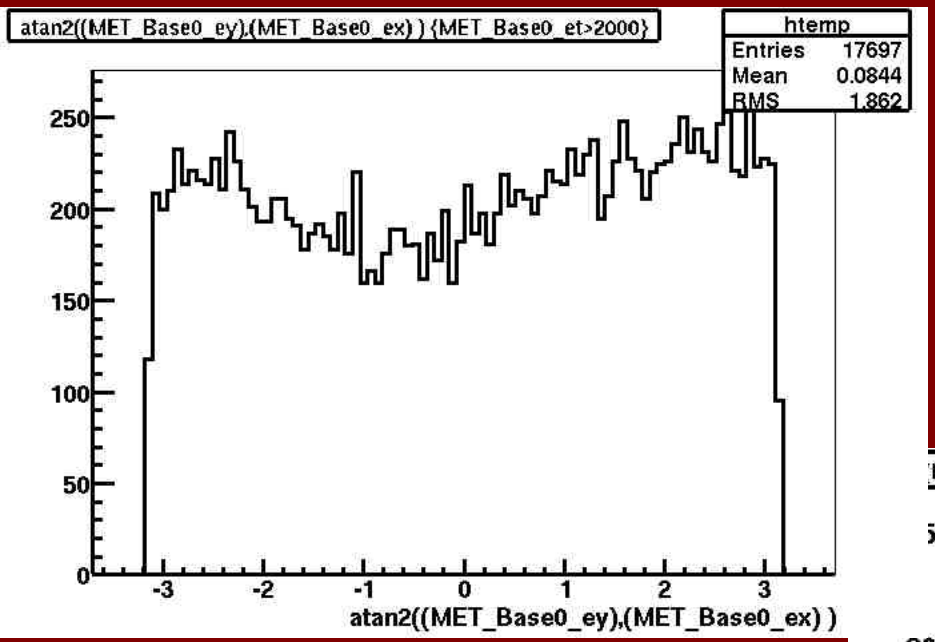

an2((MET_Base_ey+100),(MET_Base_ex-26)) {MET_Base_et>2000}
htemp
Entries 15585
Mean 0.01732
RMS 1.836
atan2((MET_Base_ey+100),(MET_Base_ex-26))

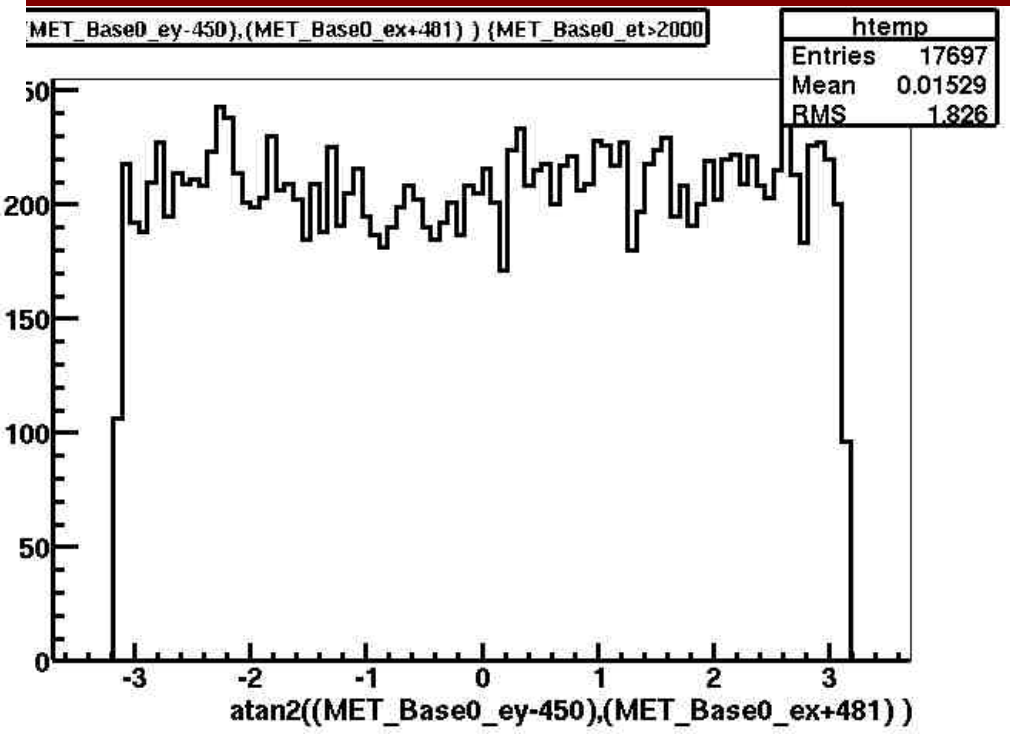
MET_Base0


MET_Base0_ex{abs(MET_Base0_ex)<20000 && MET_Base0_et>2000}
htemp
Entries 17604
Mean -481.1
RMS 6967
500
400
300
200
100
0
-20000 -15000 -10000 -5000 0 5000 10000 15000 20000
MET_Base0_ex

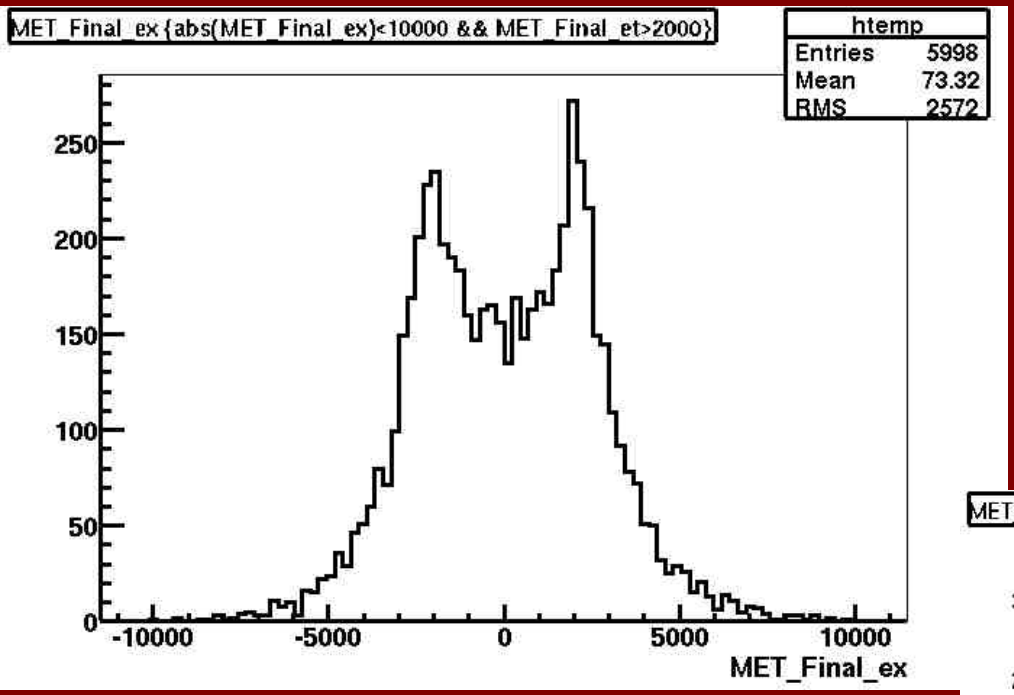

MET_Base0_ey{abs(MET_Base0_ey)<20000 && MET_Base0_et>2000}
htemp
Entries 17608
Mean 450.2
RMS 7019
500
400
300
200
100
0
-20000 -15000 -10000 -5000 0 5000 10000 15000 20000
MET_Base0_ey

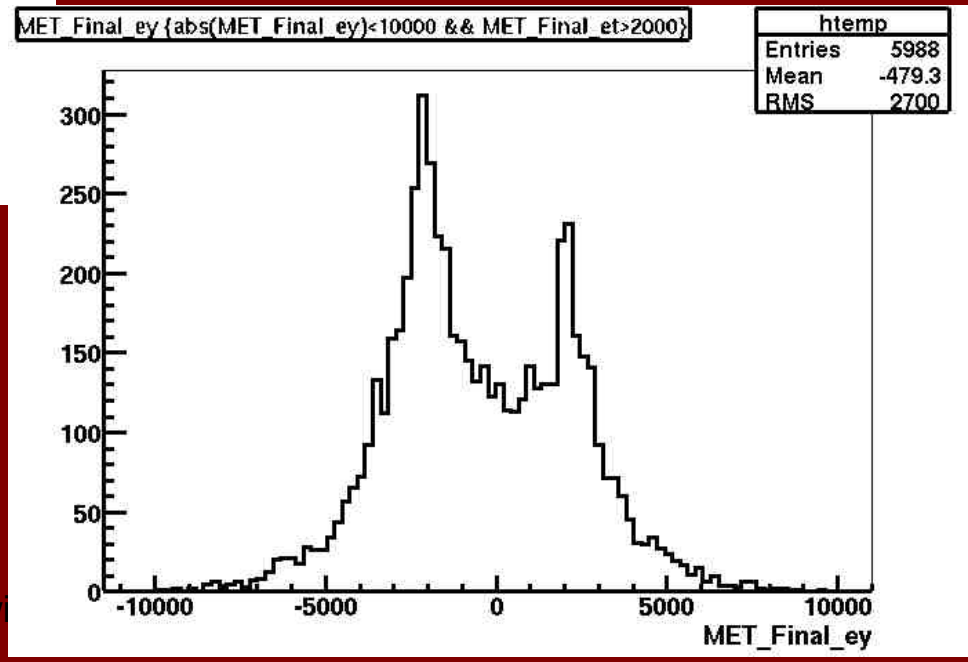
MET_Base0


atan2((MET_Base0_ey),(MET_Base0_ex)) {MET_Base0_et>2000}
htemp
Entries 17697
Mean 0.0844
RMS 1.862
250
200
150
100
50
0
-3
-2
-1
0
1
2
3
atan2((MET_Base0_ey),(MET_Base0_ex))

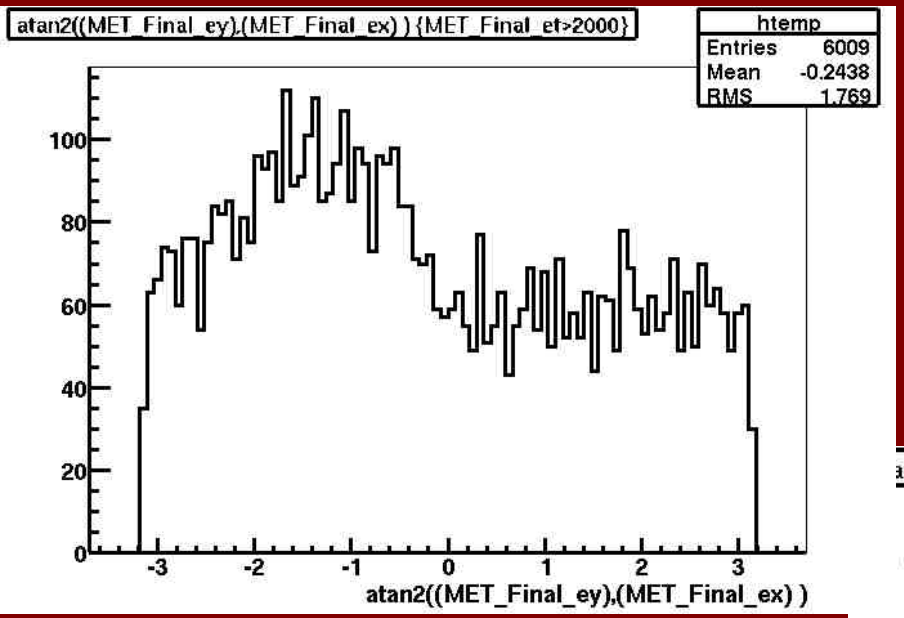

MET_Base0_ey-450),(MET_Base0_ex+481)) {MET_Base0_et>2000
htemp
Entries 17697
Mean 0.01529
RMS 1.826
200
150
100
50
0
-3
-2
-1
0
1
2
3
atan2((MET_Base0_ey-450),(MET_Base0_ex+481))

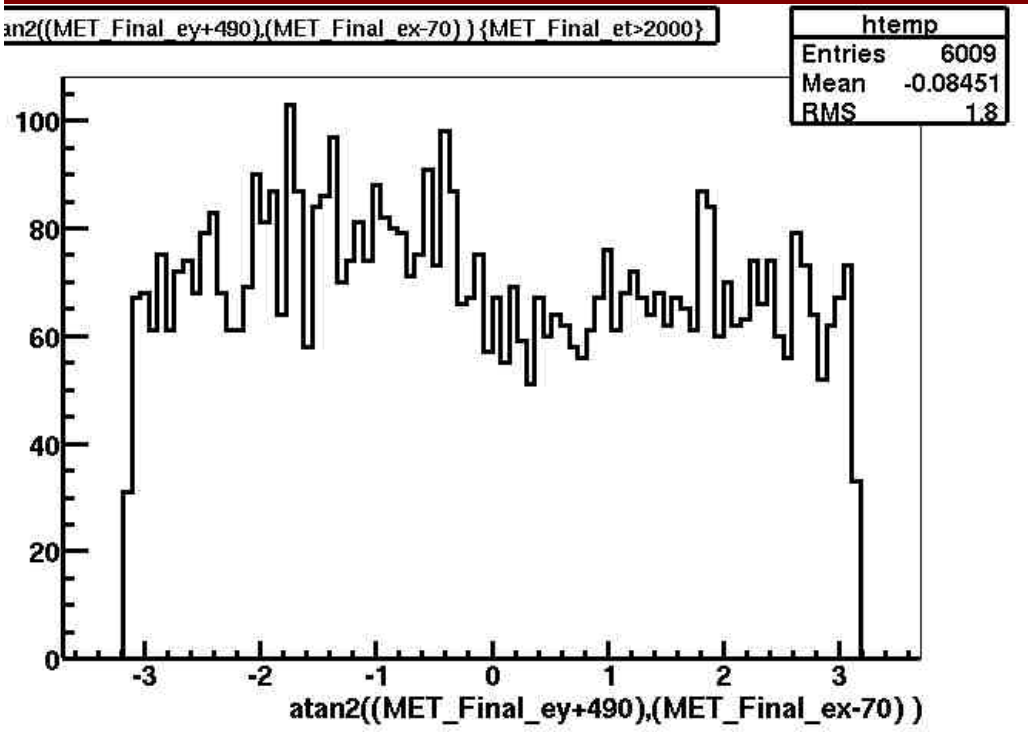
MET_Final


MET_Final_ex{abs(MET_Final_ex)<10000 && MET_Final_et>2000}
htemp
Entries 5998
Mean 73.32
RMS 2572
250
200
150
100
50
0
-10000
-5000
0
5000
10000
MET_Final_ex


MET_Final_ey{abs(MET_Final_ey)<10000 && MET_Final_et>2000}
htemp
Entries 5988
Mean -479.3
RMS 2700
300
250
200
150
100
50
0
-10000
-5000
0
5000
10000
MET_Final_ey

MET_Final


atan2((MET_Final_ey),(MET_Final_ex)) {MET_Final_et>2000}
htemp
Entries 6009
Mean -0.2438
RMS 1.769
100
80
60
40
20
0
-3
-2
-1
0
1
2
3
atan2((MET_Final_ey),(MET_Final_ex))


an2((MET_Final_ey+490),(MET_Final_ex-70)) {MET_Final_et>2000}
htemp
Entries 6009
Mean -0.08451
RMS 1.8
100
80
60
40
20
0
-3
-2
-1
0
1
2
3
atan2((MET_Final_ey+490),(MET_Final_ex-70))

Margars Plot