

Missing E_T Tutorial

An Example: $W \rightarrow \mu\nu$

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ATLAS Analysis Tutorial, TAU 11/02/07

Outline

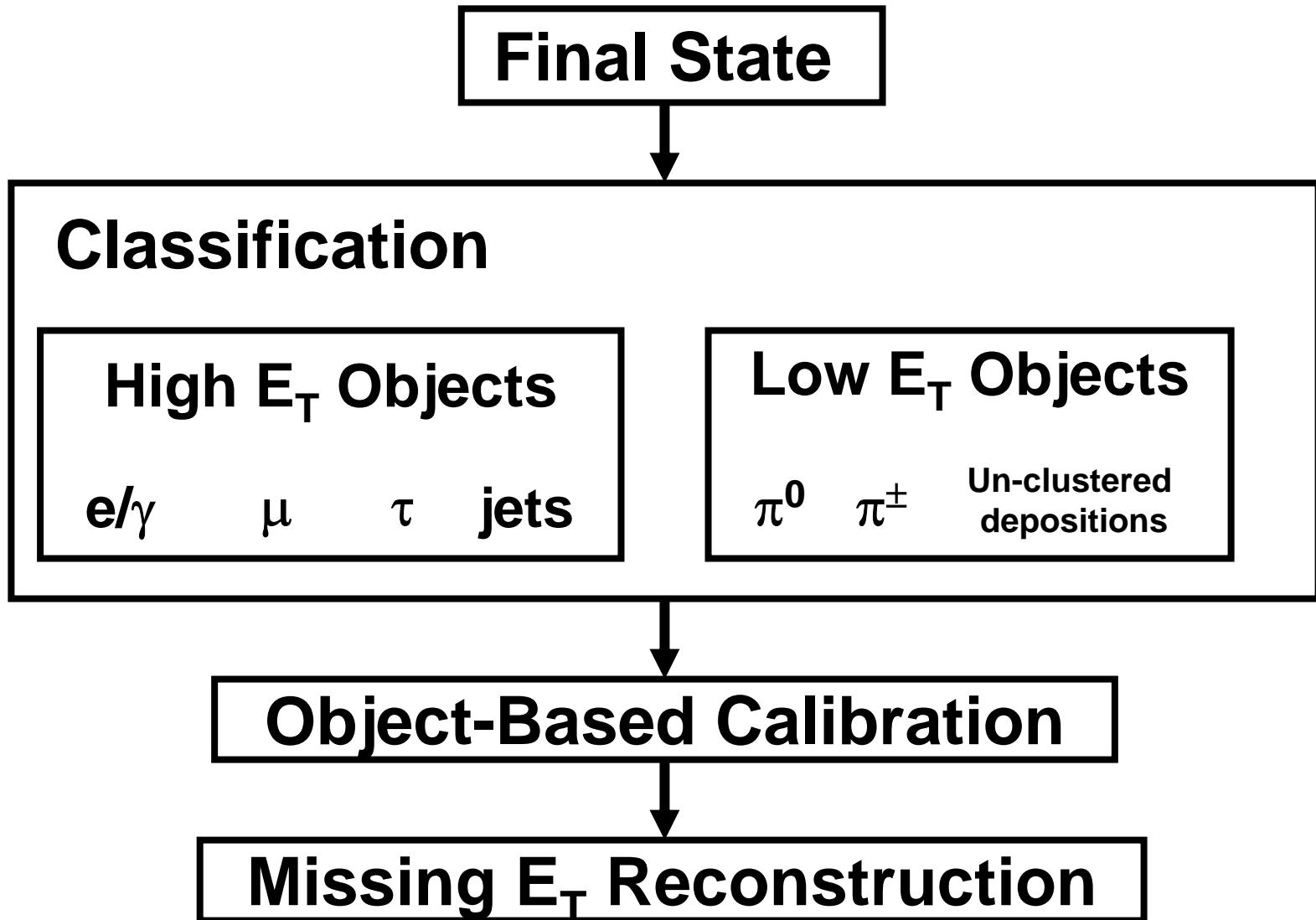
 Package Structure

 ObjMissingET Tools

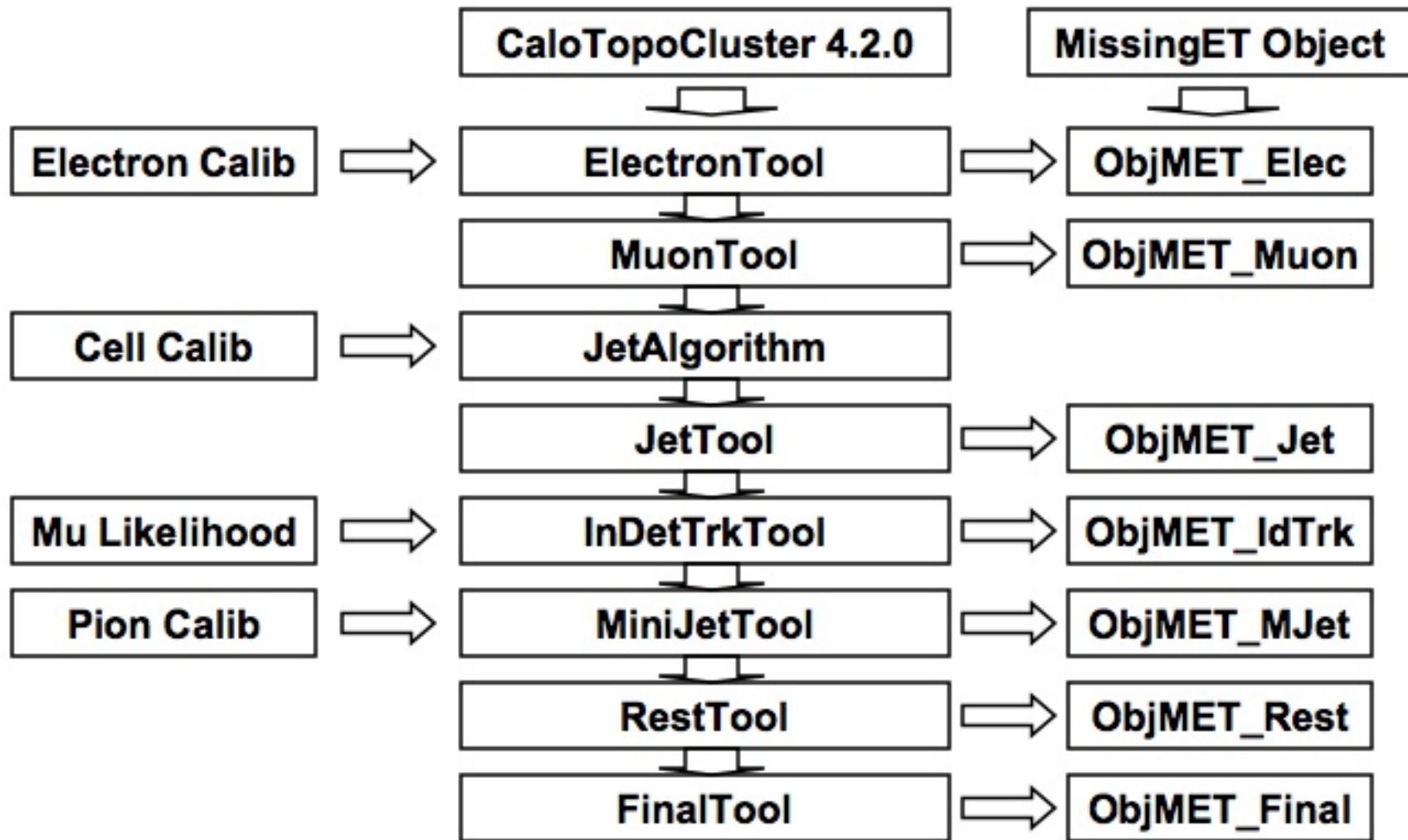
 Looking into Variables

 Looking into $W \rightarrow \mu\nu$

Object-Based Missing E_T

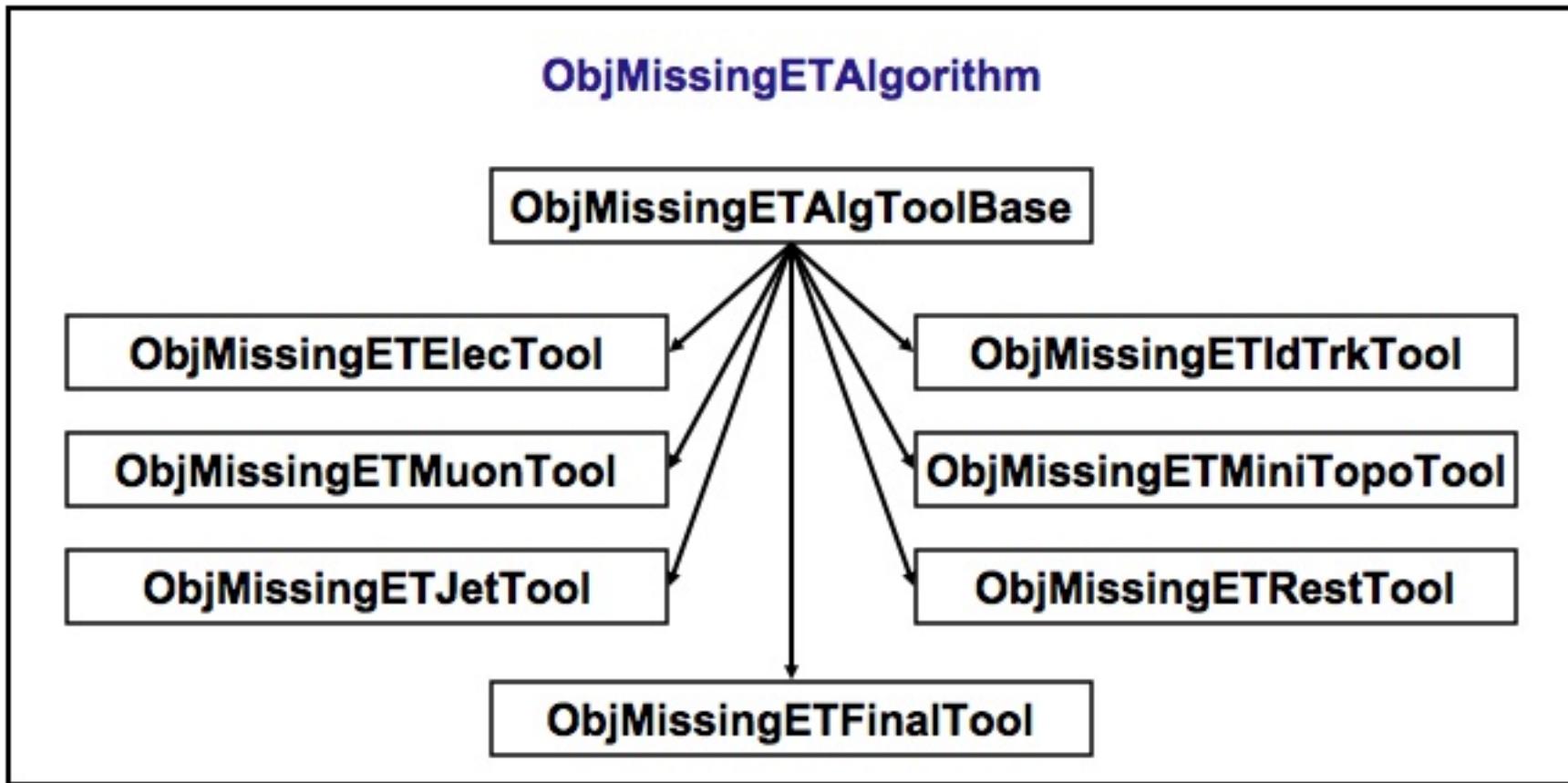


Package Structure



ObjMissingET Tools

■ A single algorithm invokes several tools



Electron Tool

1) Electron Selection:

- take electrons from <egammaCollection>
- apply IsEM calorimeter based cuts
- require track match
- require electron $p_T > 8\text{GeV}$

2) Perform sampling based electron energy calibration (L. Flores)

3) Compute the electron contribution to ObjMissingET

4) Mask out the topoclusters around the electron within a cone of 0.15

Muon Tool

1) Muon Selection:

- take muons from <StacoCombinedMuonContainer>
- require muon $p_T > 6\text{GeV}$

2) If calorimeter energy around the muon within a cone of 0.2 is greater than 20GeV, compute muon contribution to ObjMissingET using $E_{\text{muon}} - E_{\text{loss}}$ and do not mask out any topoclusters (this is important for a high energy muon in a jet). The muon energy loss in calorimeter E_{loss} is standard parameterization based

3) Otherwise mask out topos inside the cone of 0.2

Jet Tool

1) Jet Selection:

- Jets are obtained from remaining topoclusters running standard cone 0.7 jet algorithm on them with PseudoH1 weights (S. Padhi) applied for calorimeter compensation
- require jet $p_T > 20\text{GeV}$

- 2) Jet clusterization correction is applied in bins of η and E_T (very simple and crude currently, will evolve with new iterations)
- 3) Jet contribution to ObjMissingET is calculated and associated topos within a cone of 0.7 masked out

Id Track Tool

1) Id Track Selection:

- take tracks from <TrackParticleCandidate>
- require minimum track energy 2GeV
- apply track quality cuts (track fit prob, track hits and holes)
- require track to calorimeter extrapolation successful
- require isolated tracks only in a cone of 0.3
- remove track overlap with electrons, muons and jets
- select tracks with muon LHR > 0.8 and E/p < 0.3

2) Separate tool for muon: ObjMissingETLHMuonTool

3) Track contribution to ObjMissingET calculated and corresponding topos in a cone of 0.3 masked out

MiniTopo Tool

1) MiniTopo Jet Composition:

- simple mini-topo jets from remaining low p_T topos within a cone 0.2 and $|\eta| < 3.0$ with a p_T threshold 0.5GeV for seed
- apply pion calibration constants on those mini-jets
- require $ET > 0.5$ GeV

2) Mini-topo jet with $E_{tot} > 10$ GeV and $E_{had}/E_{tot} < 0.02$ within $|\eta| < 3.2$ are calibrated with π^0 constants (sampling based) and with π^\pm constants (cell based) otherwise (talk by Bruce in previous JetEtMiss meetings)

3) Mini-topo jet contribution to ObjMissingET calculated and constituent topos masked out

Rest Tool, Final Tool, etc.

- 1) All remaining topos contribute to ObjMissingET with a scale factor depending on 3 regions
- 2) Final ObjMissingET for physics are calculated in the FinalTool with sums over all previous ObjMissingET objects stored in TES in each tool
- 3) All calibration routines and other necessary utility functions stored in ObjMissingETUtils.h in a class
- 4) Relies on MissingETEvent for persistency issues
(need to coordinate with the author)
- 5) Currently no truth variables – take from MissingET
- 6) Provide CBNT and CBNTAA in 12 releases

Ntuple Variables

```
ObjMET_ExMissEle;  
ObjMET_EyMissEle;  
ObjMET_EtSumEle;  
ObjMET_ExMissMu;  
ObjMET_EyMissMu;  
ObjMET_EtSumMu;  
ObjMET_ExMissJet;  
ObjMET_EyMissJet;  
ObjMET_EtSumJet;  
ObjMET_ExMissIdTrk;  
ObjMET_EyMissIdTrk;  
ObjMET_EtSumIdTrk;  
ObjMET_ExMissMJet;  
ObjMET_EyMissMJet;  
ObjMET_EtSumMJet;  
ObjMET_ExMissRest;  
ObjMET_EyMissRest;  
ObjMET_EtSumRest;
```



Electrons

Muons (with spectrometer)

Jets

Tracking (calo muons, isolated pions)

Mini-topo-jets

Rest (not classified)

Ntuple Variables (cont.)

```
ObjMET_ExMissMJetB;  
ObjMET_EyMissMJetB;  
ObjMET_EtSumMJetB;  
ObjMET_ExMissMJetE;  
ObjMET_EyMissMJetE;  
ObjMET_EtSumMJetE;  
ObjMET_ExMissMJetF;  
ObjMET_EyMissMJetF;  
  
ObjMET_ExMissRestB;  
ObjMET_EyMissRestB;  
ObjMET_EtSumRestB;  
ObjMET_ExMissRestE;  
ObjMET_EyMissRestE;  
ObjMET_EtSumRestE;  
ObjMET_ExMissRestF;  
ObjMET_EyMissRestF;  
ObjMET_EtSumRestF;
```

Mini-topo-jets
(Barrel, EndCap, FCAL)

Rest (not classified)
(Barrel, EndCap, FCAL)

Ntuple Variables (cont.)

```
ObjMET_ExMissFinal;  
ObjMET_EyMissFinal;  
ObjMET_EtSumFinal;  
ObjMET_EtMissFinal;  
ObjMET_PhiMissFinal;
```

{

Final reconstructed quantities

```
MET_ExTruthInt;  
MET_EyTruthInt;  
MET_EtSumTruthInt;
```

{

P_T of non-interacting particles
in $| \eta | < 5$ (excluding muons)

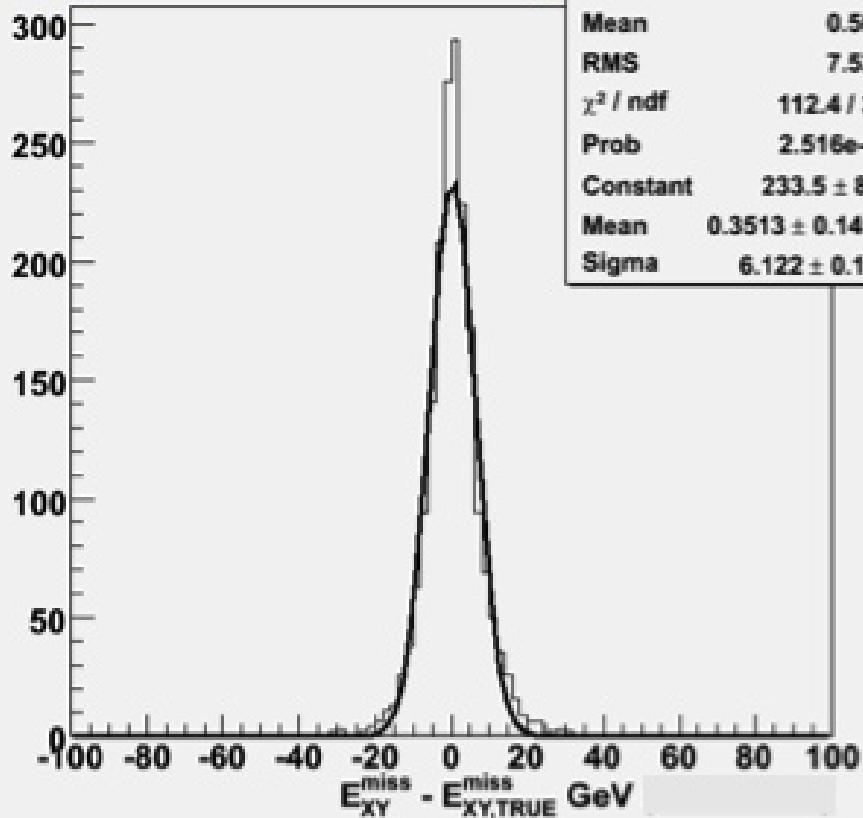
```
MET_ExTruthMuons;  
MET_EyTruthMuons;  
MET_EtSumTruthMuons;
```

{

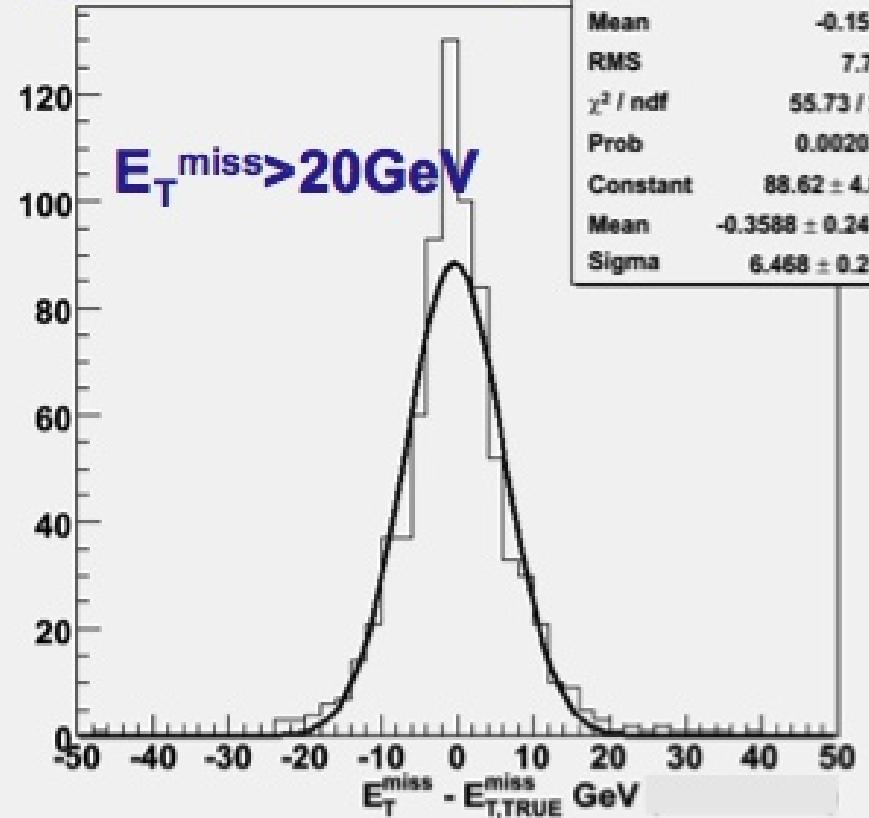
P_T of muons

Missing E_T in $W \rightarrow \mu\nu$

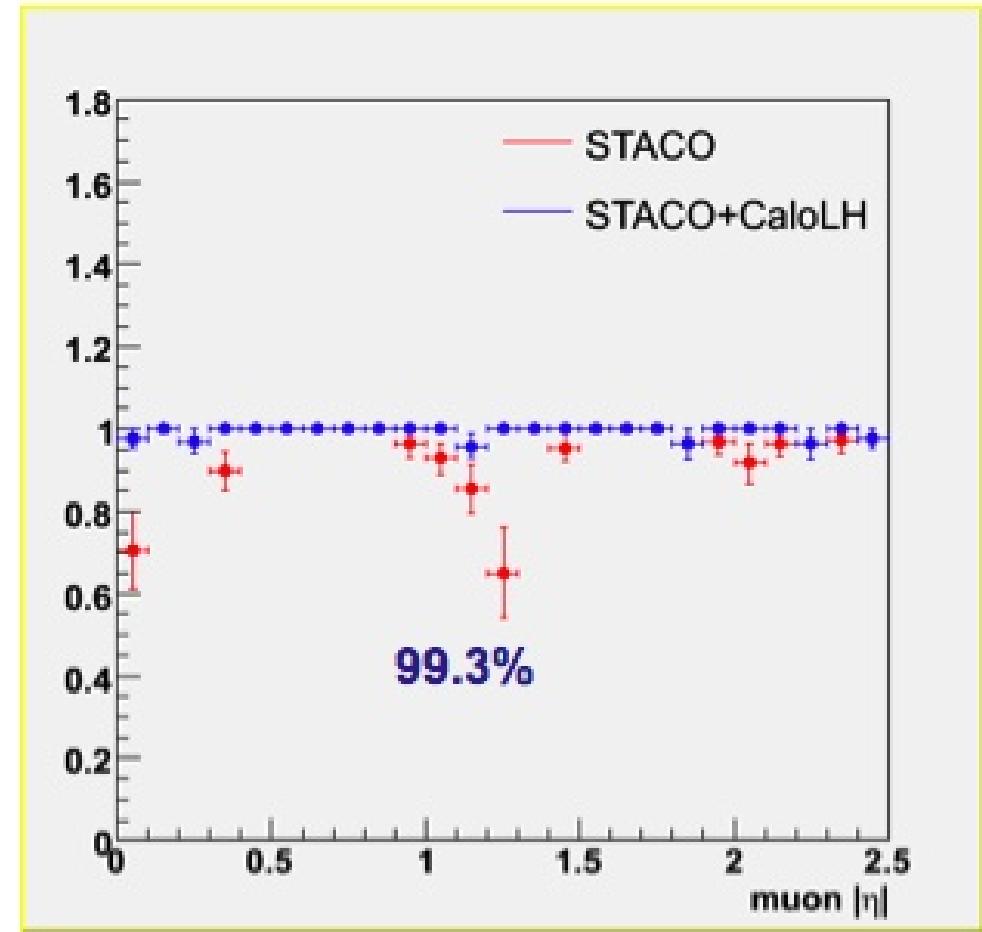
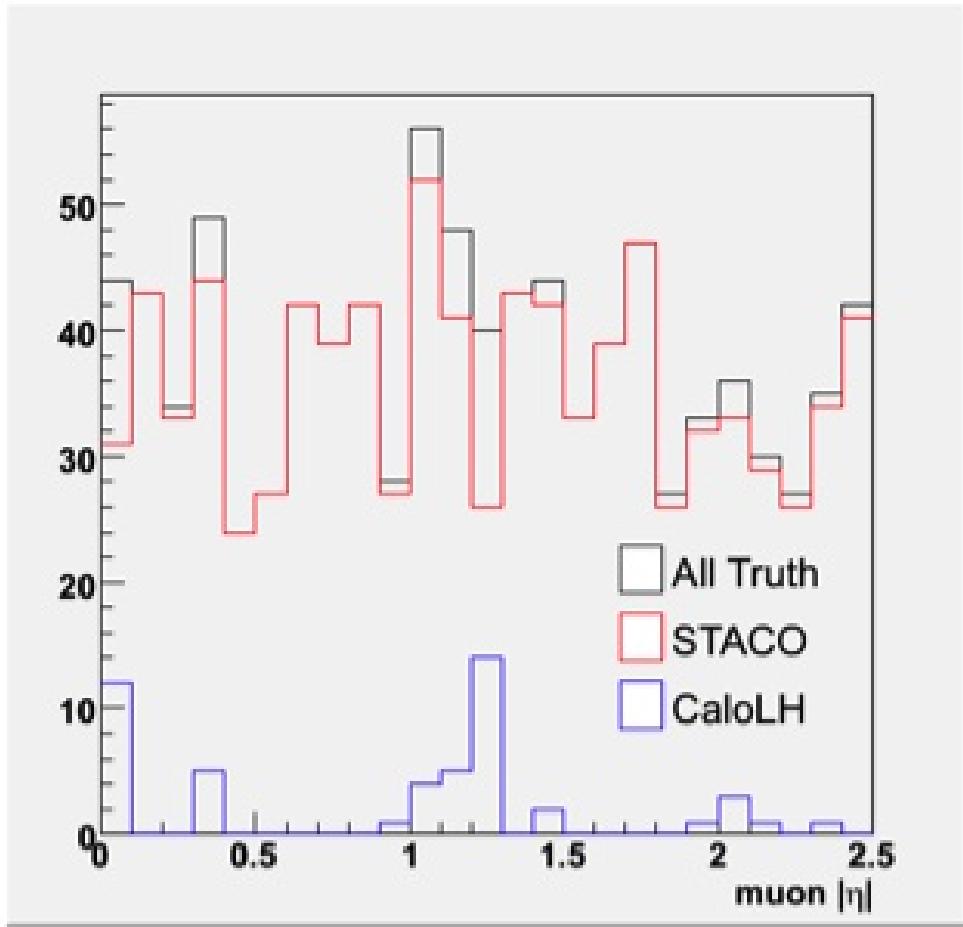
$|\eta| < 2.5$ muons only



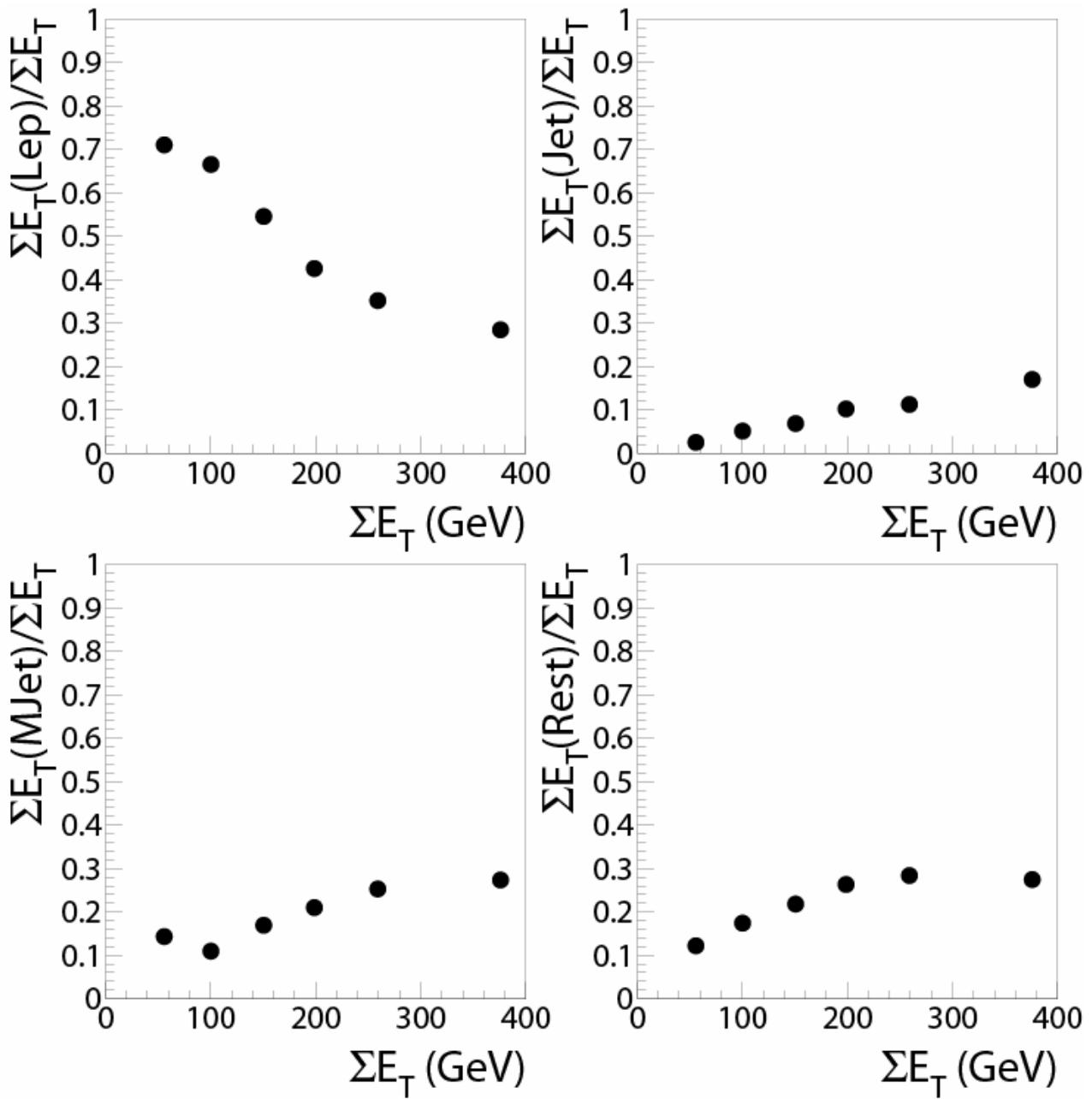
$|\eta| < 2.5$ muons only



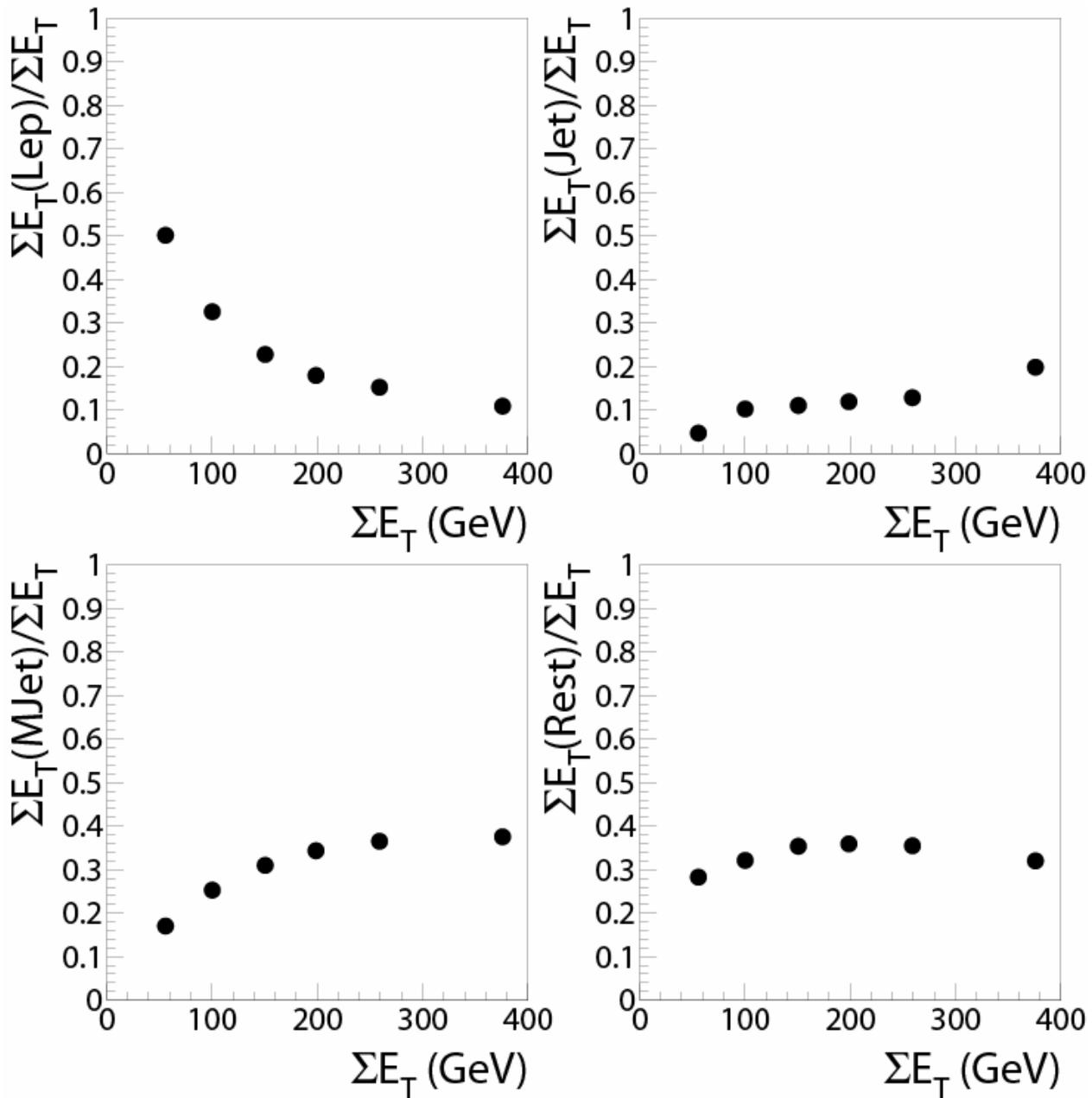
Calo muons in $W \rightarrow \mu\nu$

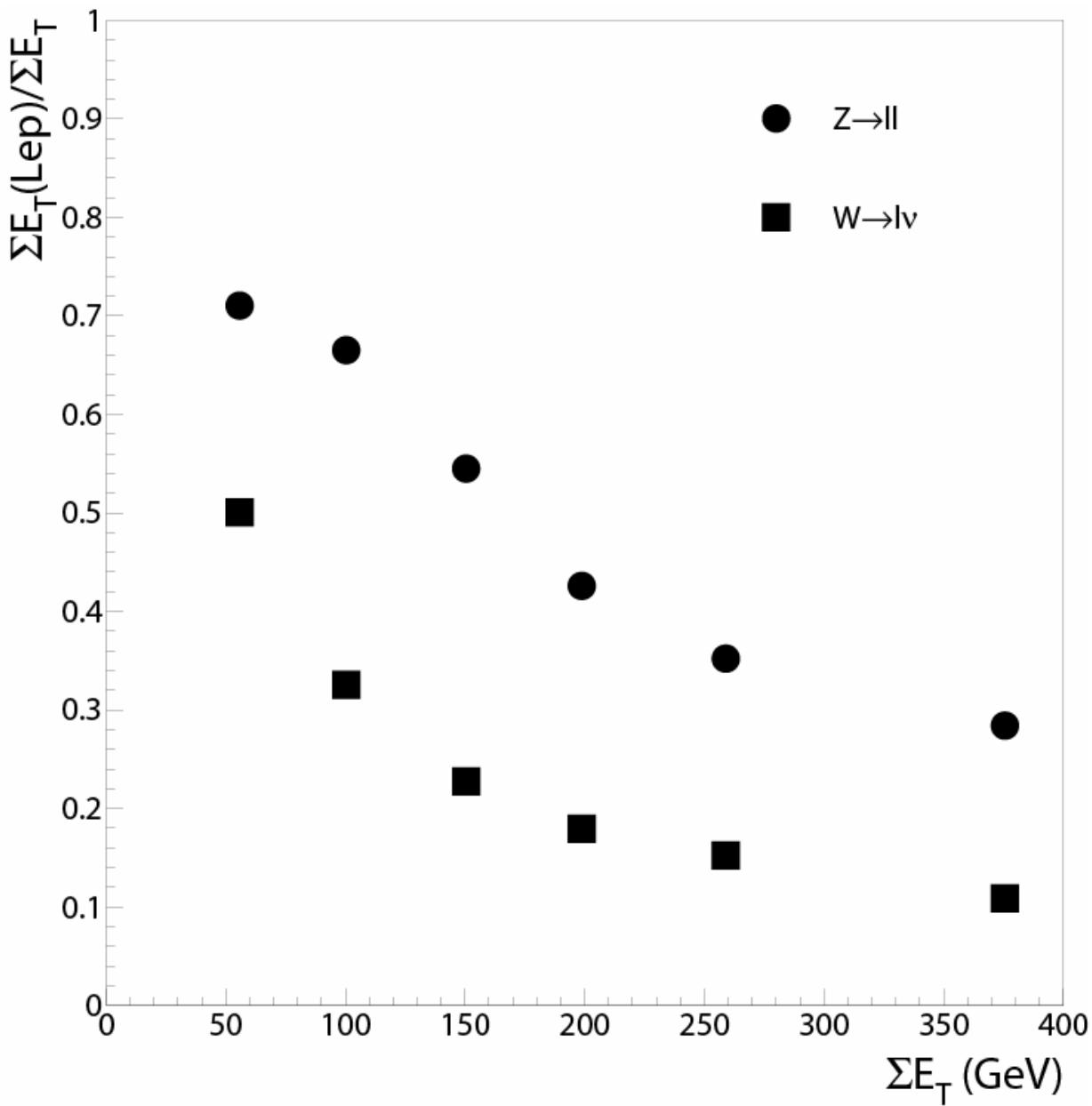


$Z \rightarrow ll$



$W \rightarrow l\nu$





$W \rightarrow l\nu$

Relative
Contribution of
"un-clustered"
energy in Barrel,
EndCap and FCAL

