QCD Background Estimation From Data

Rob Duxfield, Dan Tovey

University of Sheffield

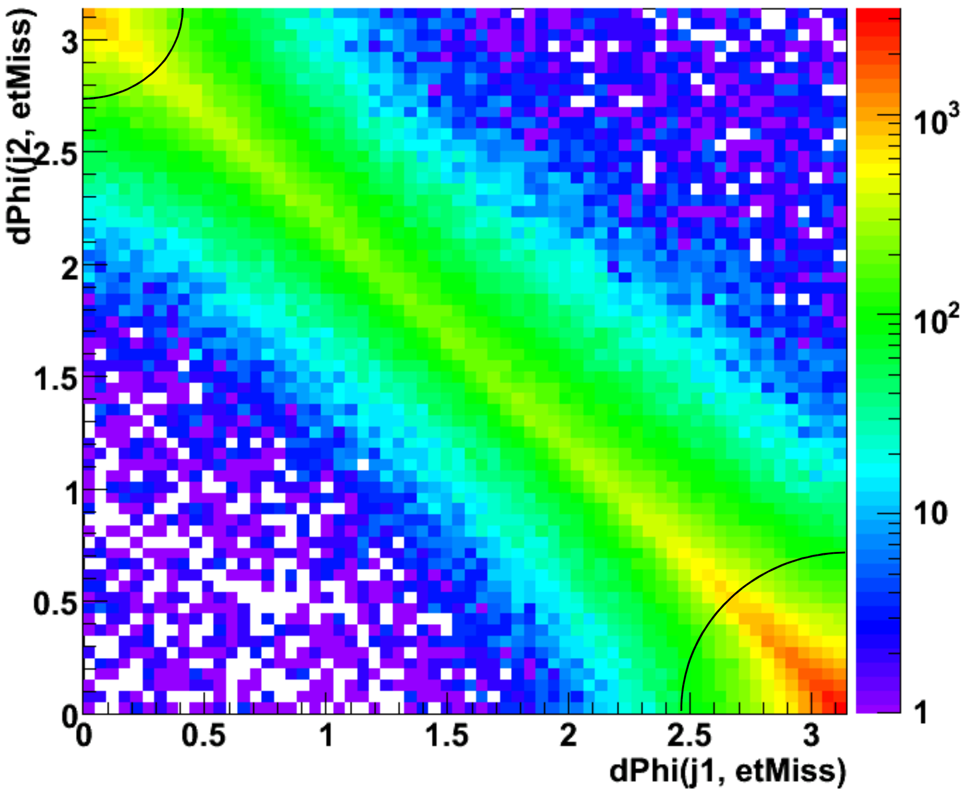
Contents

- Leading jet – EtMiss phi correlations.
- Jet fiducialisation from data.
- QCD background estimation from data.

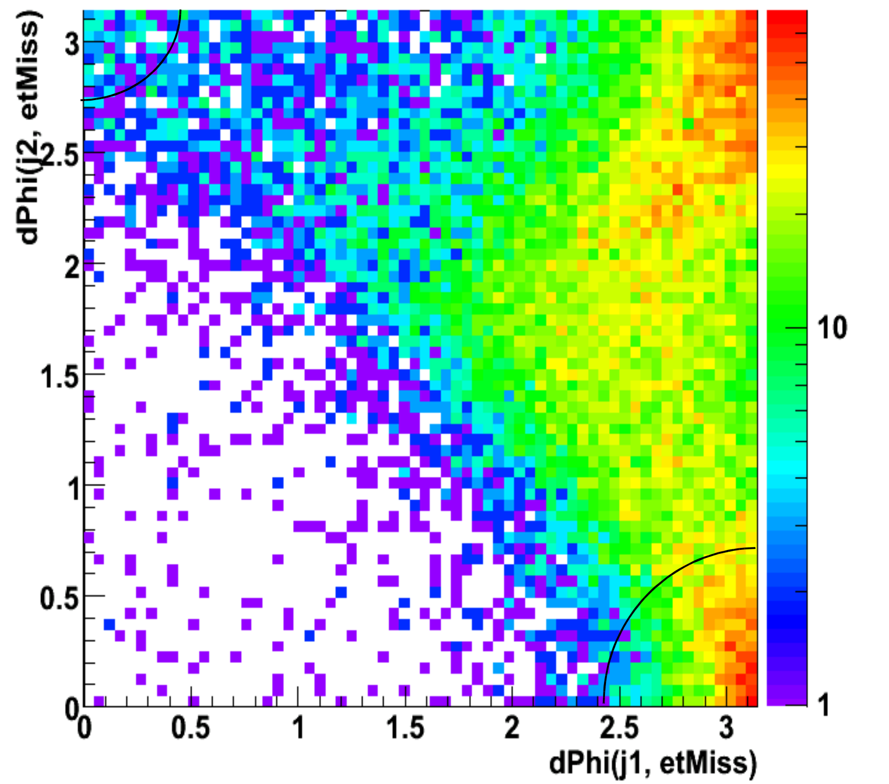
dPhi(j12, EtMiss) - QCD & SU3 (full sim)

csc11.005013.J4_pythia_jetjet.recon.v11004103

csc11.005014.J5_pythia_jetjet.recon.v11004103



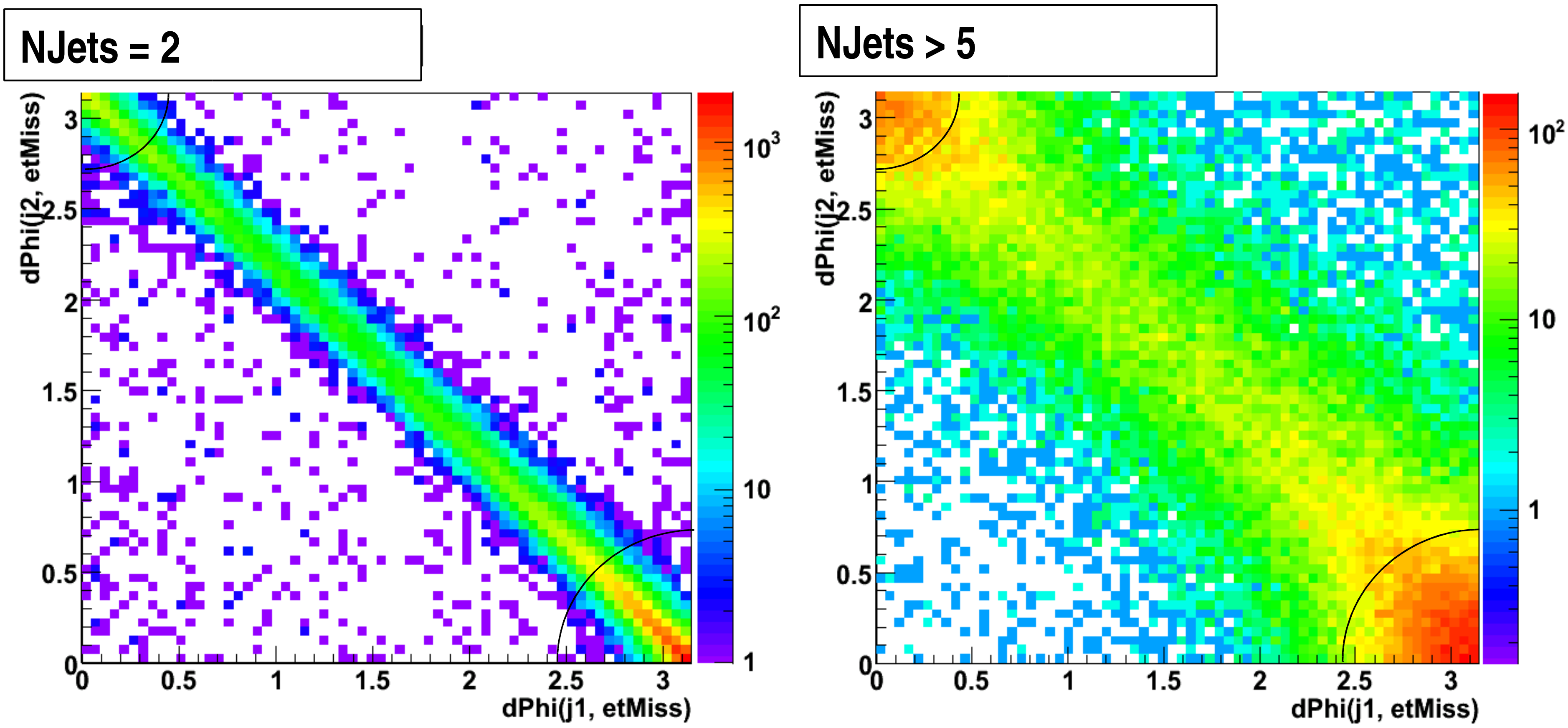
csc11.005403.SU3_jimmy_susy.recon.v11004103



- Good separation, but what about diagonal feature in QCD sample?
- Indicative of 2 jet events?

NJet Dependence

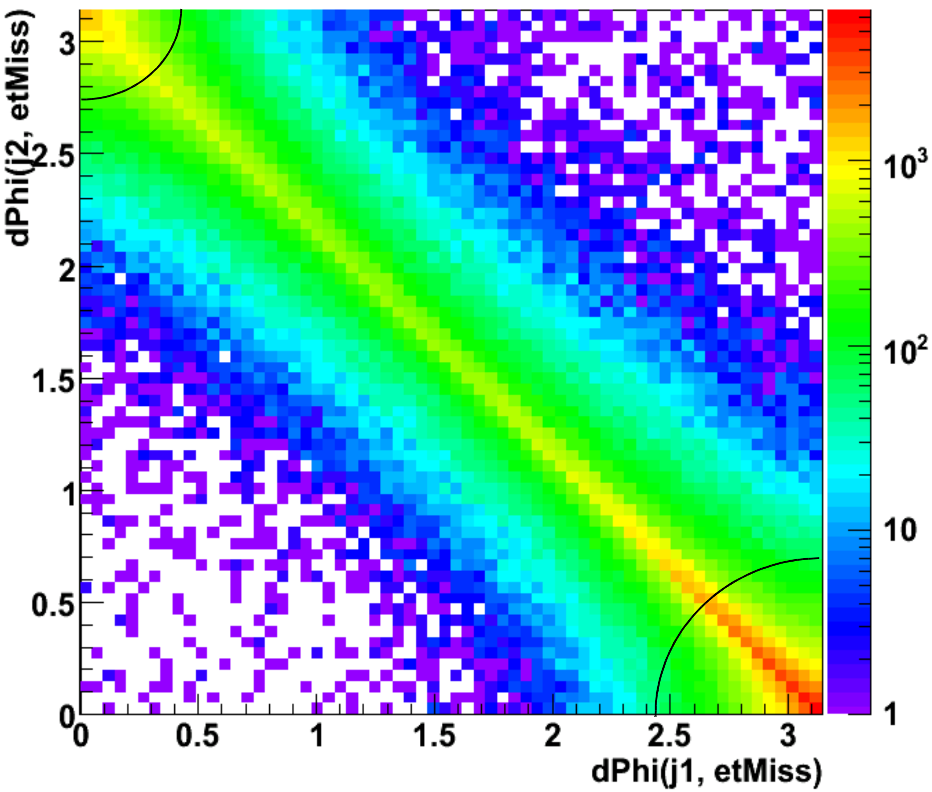
- csc11.005013.J4_pythia_jetjet.recon.v11004103
- csc11.005014.J5_pythia_jetjet.recon.v11004103



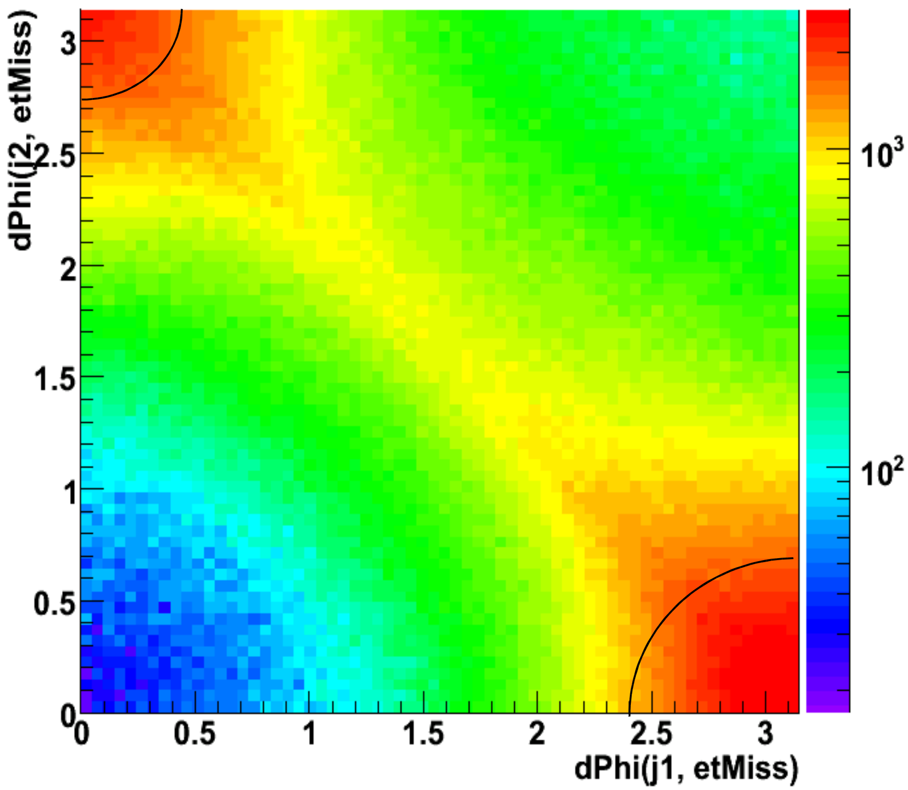
Pythia vs. Alpgen (ATLFAST)

csc11.005013.J4_pythia_jetjet.evgen.v11004103

csc11.005014.J5_pythia_jetjet.evgen.v11004103

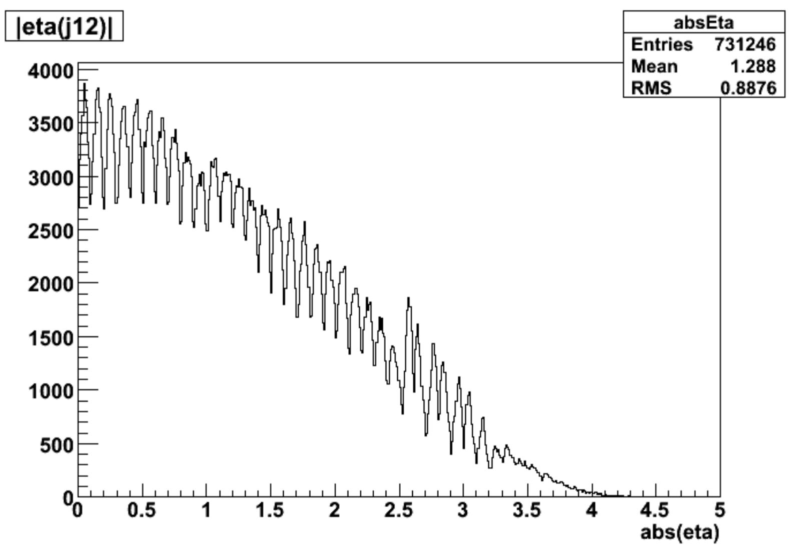


Alpgen QCD Multijet m4jckkw_PT40



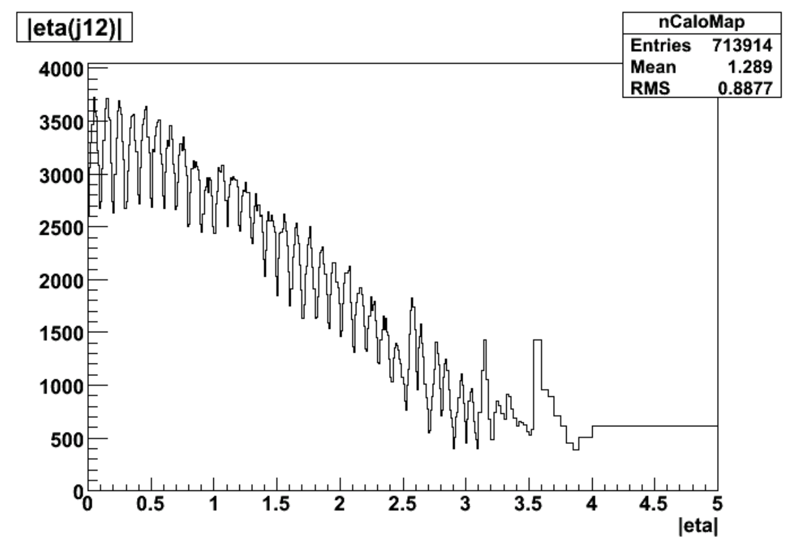
Jet Fiducialisation (1)

- Technique for defining non-fiducial jet regions from data.
  - csc11.005013.J4_pythia_jetjet.recon.v11004103
  - csc11.005014.J5_pythia_jetjet.recon.v11004103

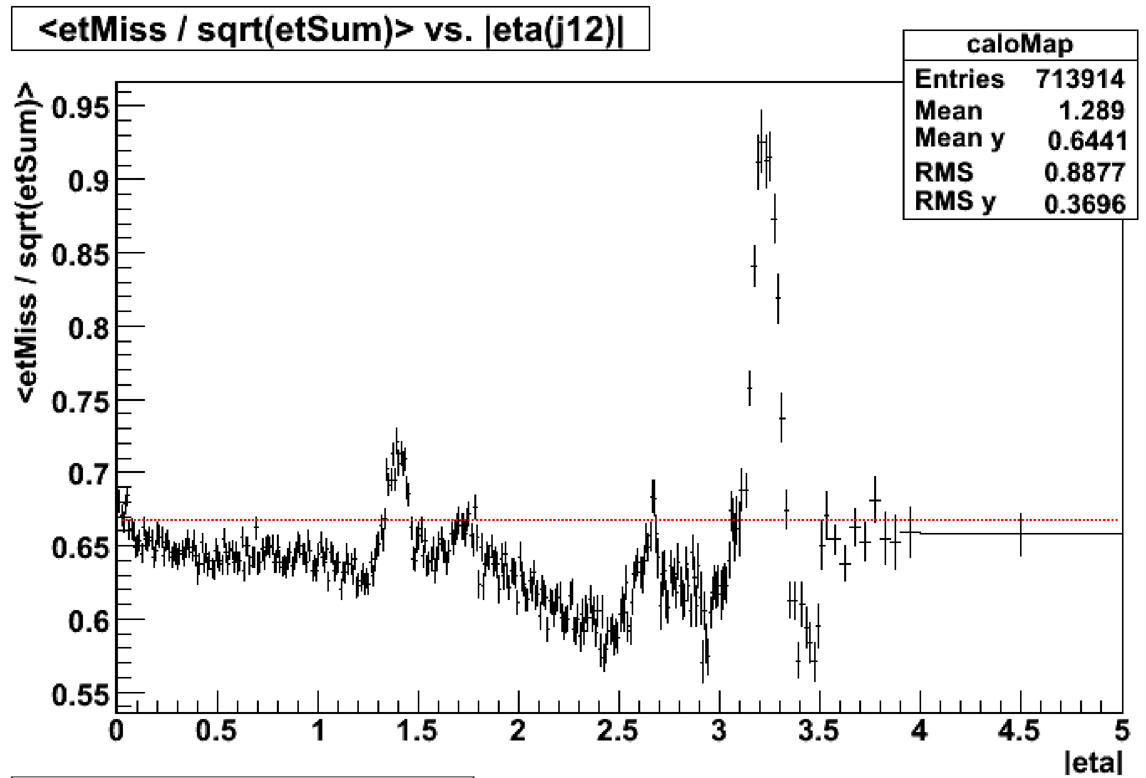


1- Measure |eta(j12)| distribution.

2- Rebin so as to get equal statistics (400 evts.) per bin.



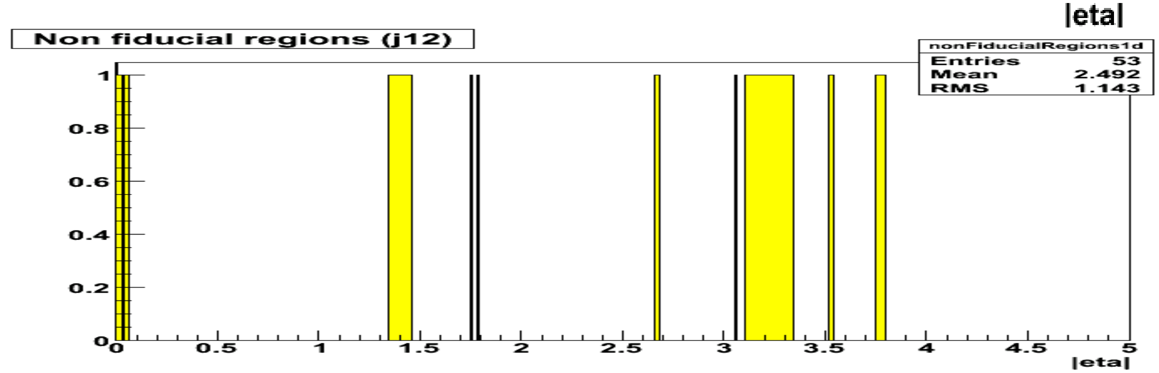
Jet Fiducialisation (2)



3- Plot

$$\frac{\not{E}_T}{\sqrt{\sum E_T}}$$

binned as per previous slide.



4- Define any regions above some value ($0.67\ GeV^{1/2}$) as non-fiducial.

QCD Est. From Data – Why?

- QCD background hard to estimate – a convolution of many detector effects.
- Can use fully simulated data to estimate tails of EtMiss distribution from MC (cpu intensive), but…
- Systematic uncertainties on MC may be large (and unknown), especially with early data.

Use of early data can provide an independent estimate of background contribution.

The Method

- Use Z/gamma + 1 jet calibration samples to measure balance with hadronic products of recoiling parton :

$$R = 1 + \frac{\not{E}_T \cdot p_T^Z}{{p_T^Z}^2}$$

  Assume selection gives Z + 1 parton.
- Select low EtMiss QCD seed events and correct each jet with <p_T(Z) / p_T(j)> from calibration samples.
- Require $$\sum_j p_T^{j,corr} \approx -\not{E}_T$$
- Smear each jet with appropriate distribution.
- Produce N smeared ‘events’ for each seed event to get estimate of EtMiss distribution.

Calibration Data

- Use Z + jets samples for J1 bin (17-35 GeV) :

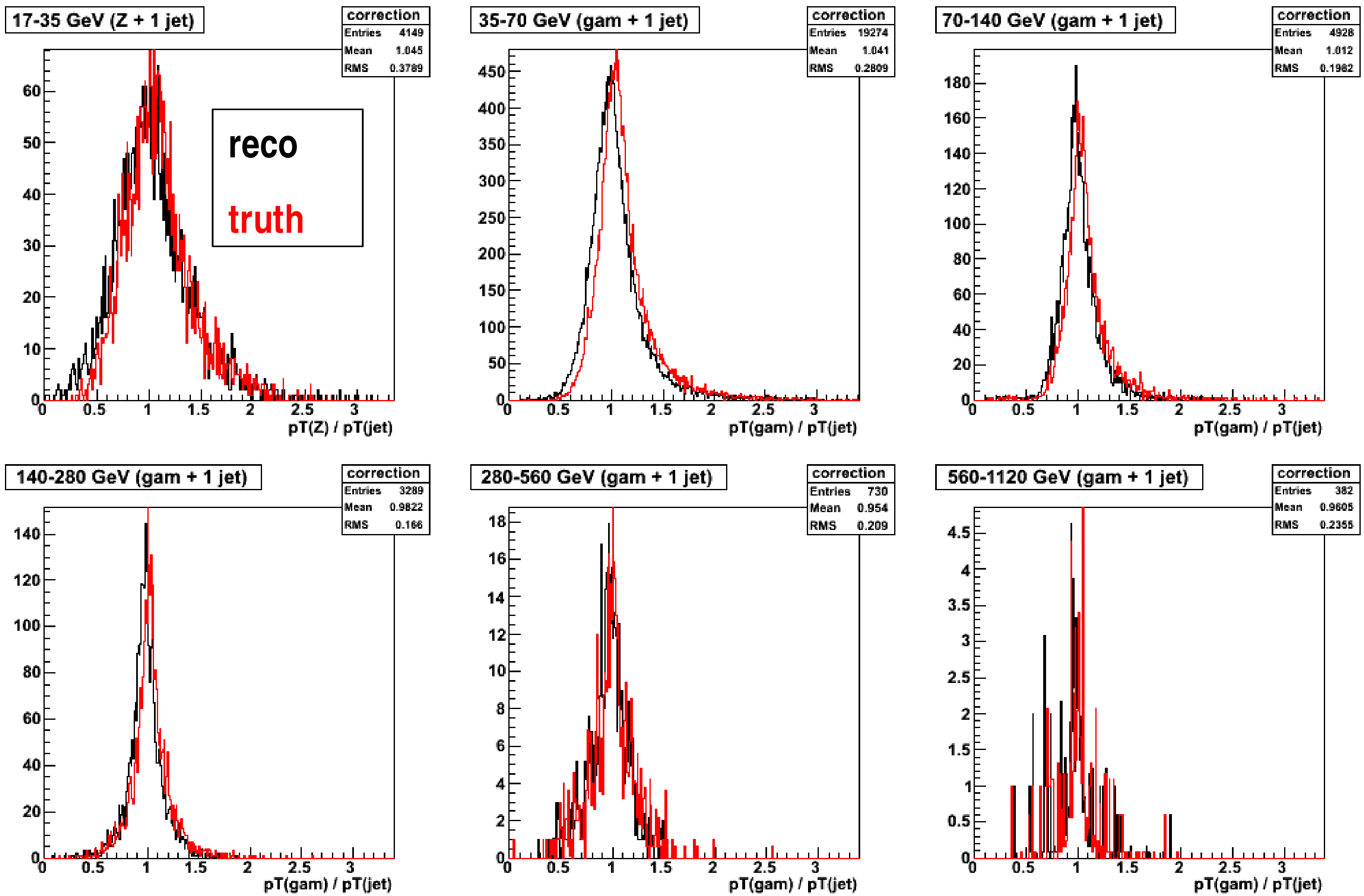
  csc11.005144.PythiaZee.recon.v11004201
  csc11.005145.PythiaZmumu.recon.v11004205

- Use gamma + jets samples for higher p_T bins :

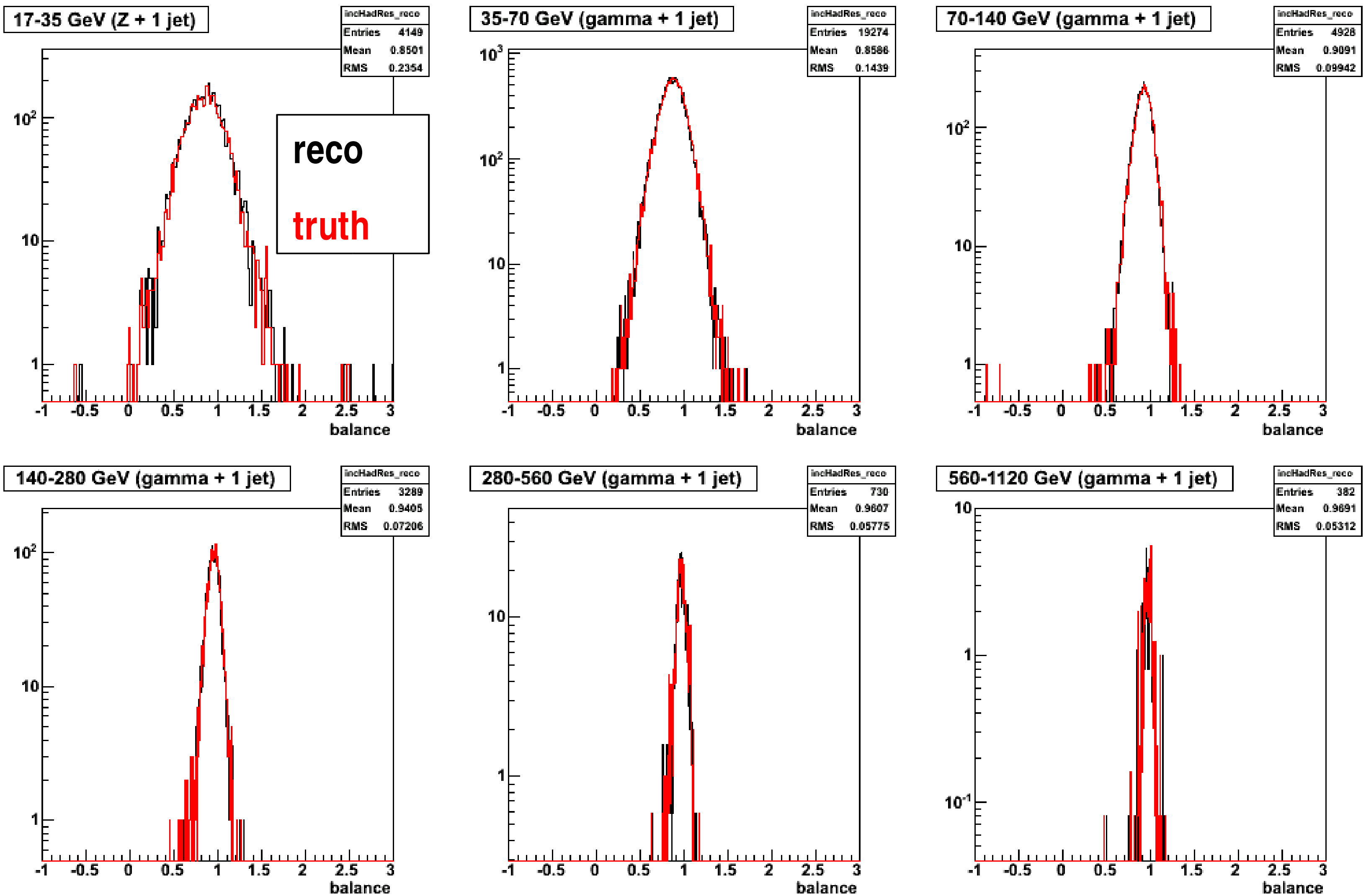
  csc11.005056.PythiaPhotonJet2.recon.v11004107
  csc11.005057.PythiaPhotonJet3.recon.v11004201
  csc11.005058.PythiaPhotonJet4.recon.v11004103
  csc11.005059.PythiaPhotonJet5.recon.v11004103
  csc11.005052.PythiaPhotonJet6.recon.v11004103

- Normalised to 100 pb^{-1}.
- Efficiencies are probably optimistic since Pythia underestimates jet multiplicity and am requiring one and only one jet.

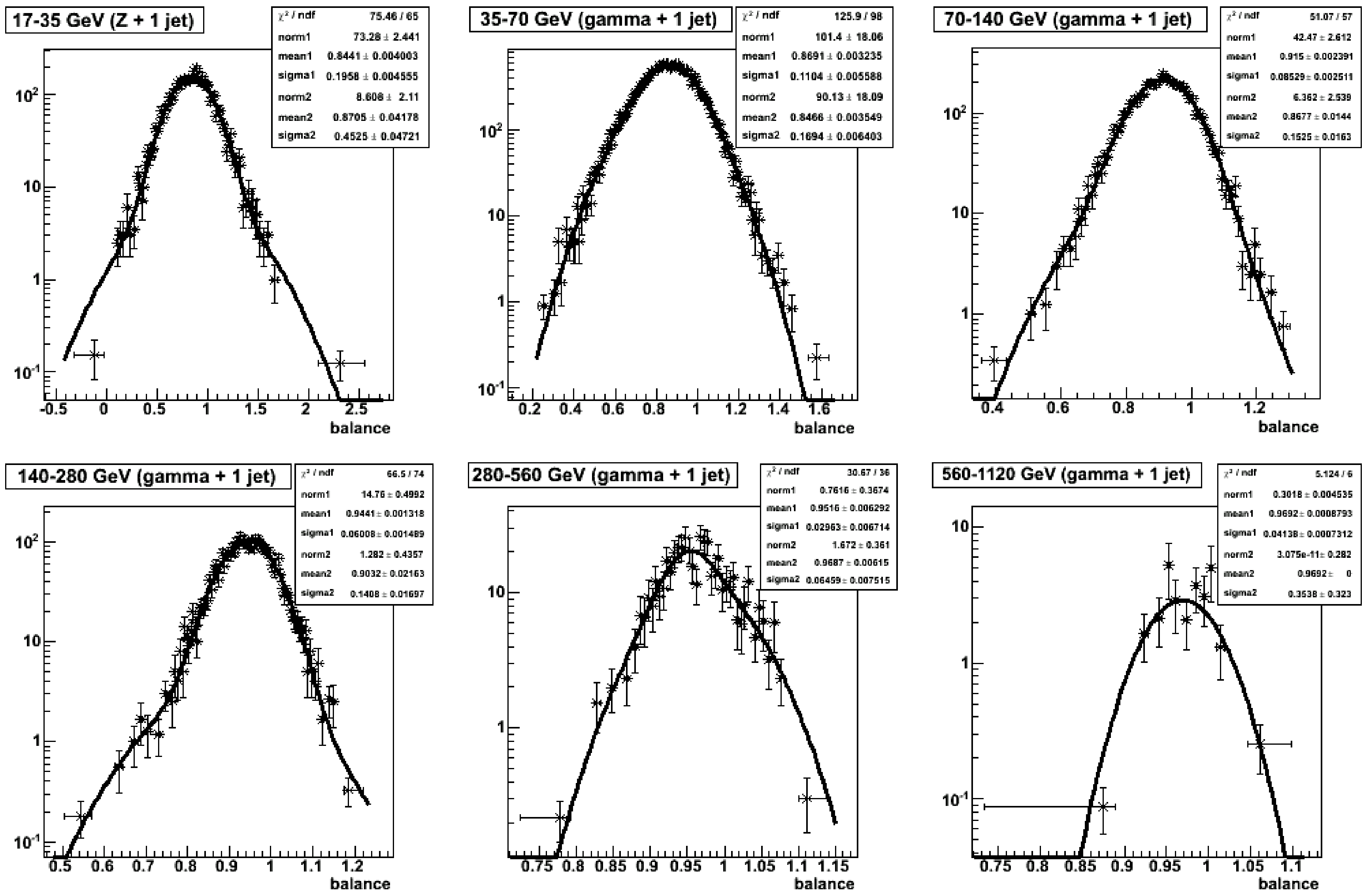
$p_T(Z)$ / $p_T(j)$ correction factors



Resolution Functions
(~ p_T(had) / p_T(Z))



Two Gaussian Fitting

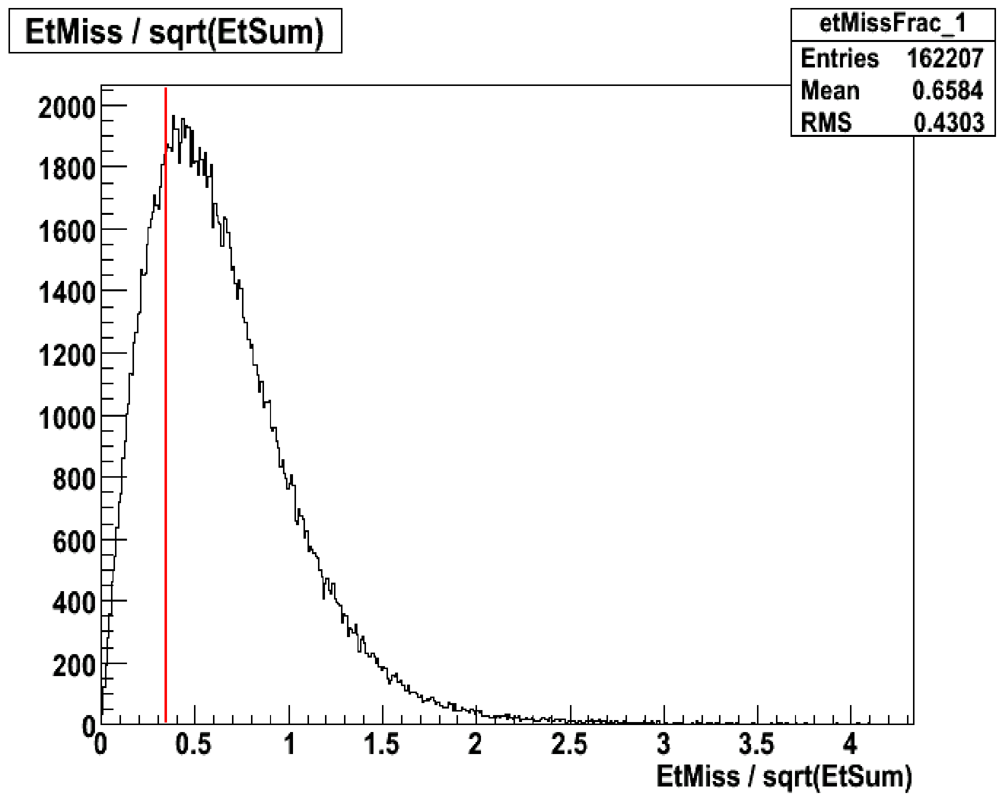


QCD Seed Event Selection

- csc11.005013.J4_pythia_jetjet.recon.v11004103
- csc11.005014.J5_pythia_jetjet.recon.v11004103

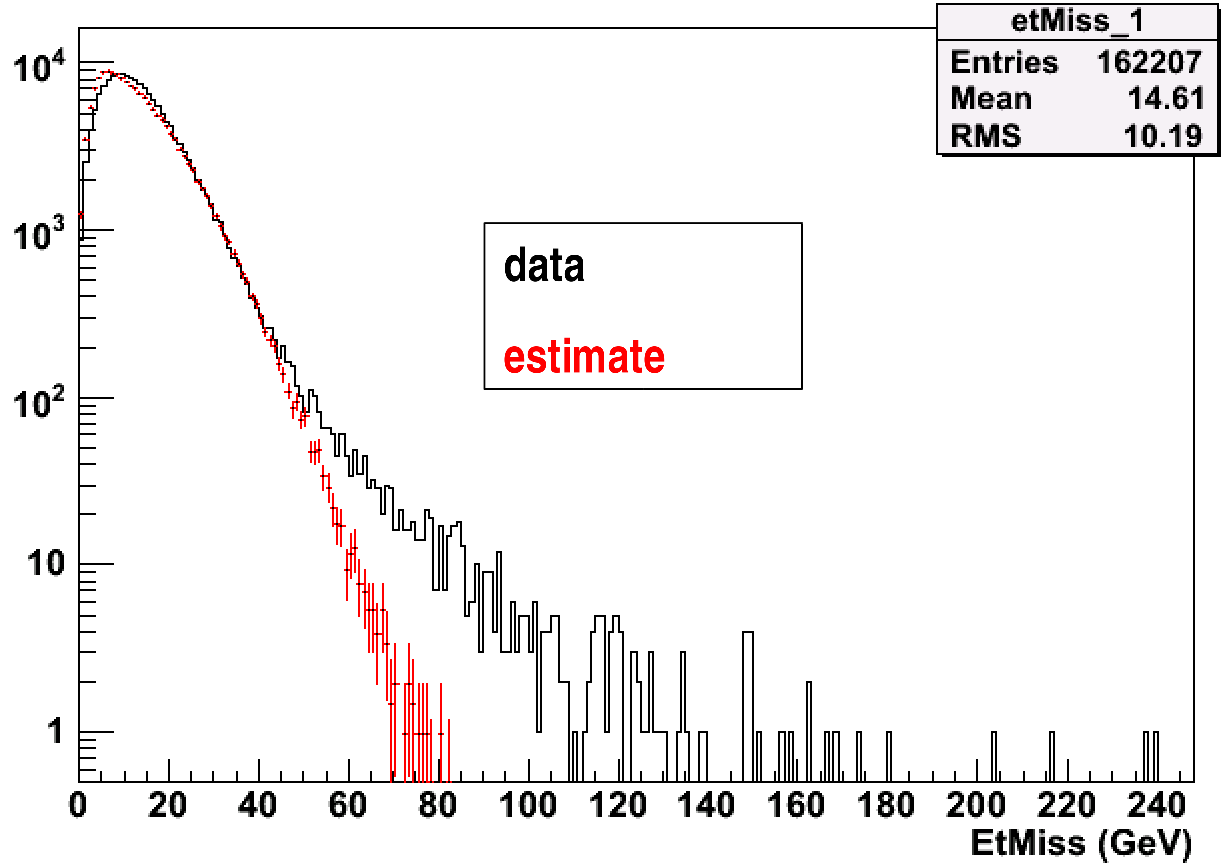
- Normalised to 0.7 pb^{-1}

- Make selection using EtMiss / sqrt(EtSum) variable (<0.35$GeV^{1/2}$).
- Factors out (?) correlations with other SUSY selection variables ($p_T(j1)$, $p_T(j2)$, …, NJets).



Smearing with Single Gaussian Fits

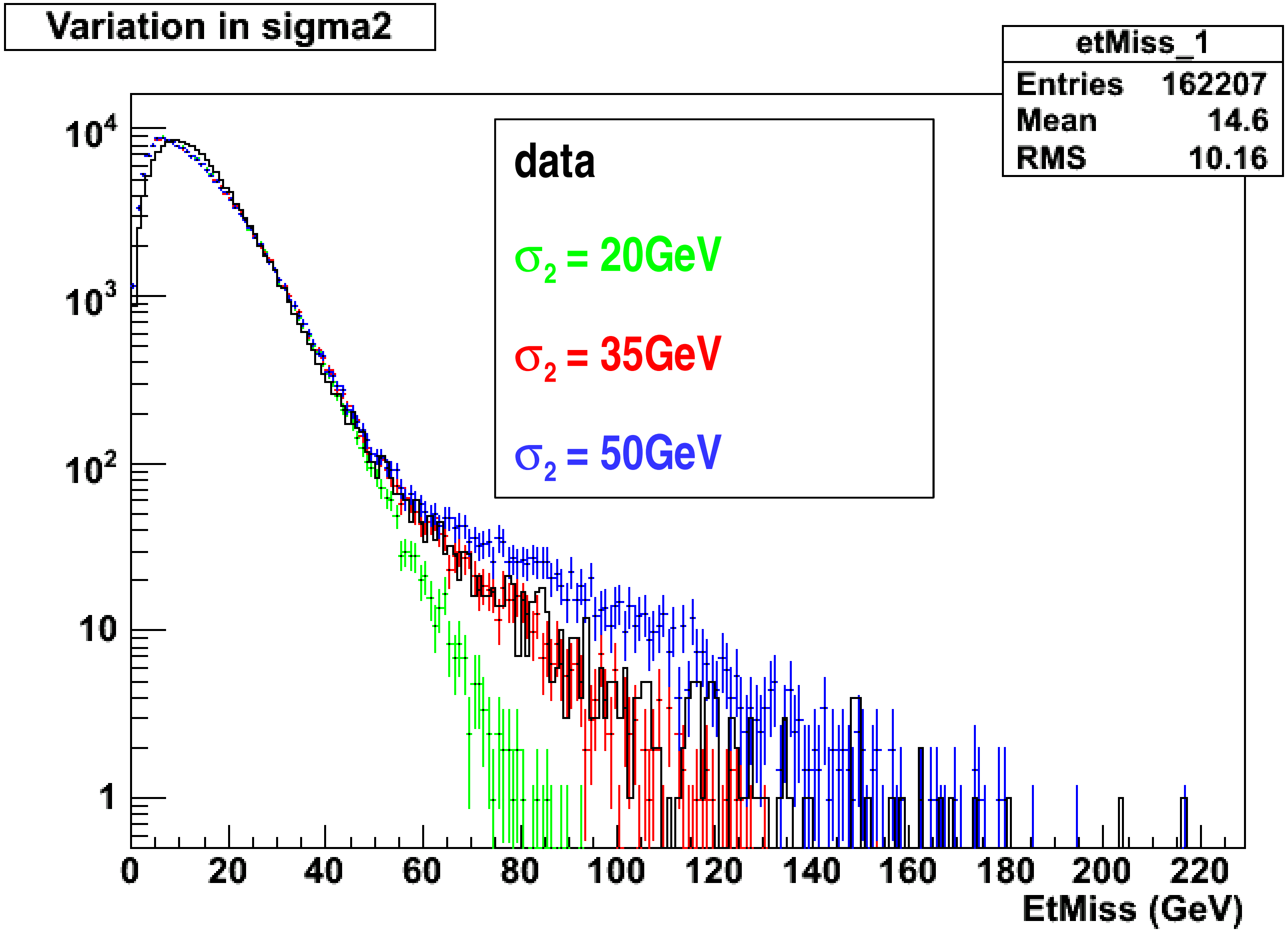
- Smear jets with single gaussians fitted to calibration data :



- Good agreement with bulk of distribution.

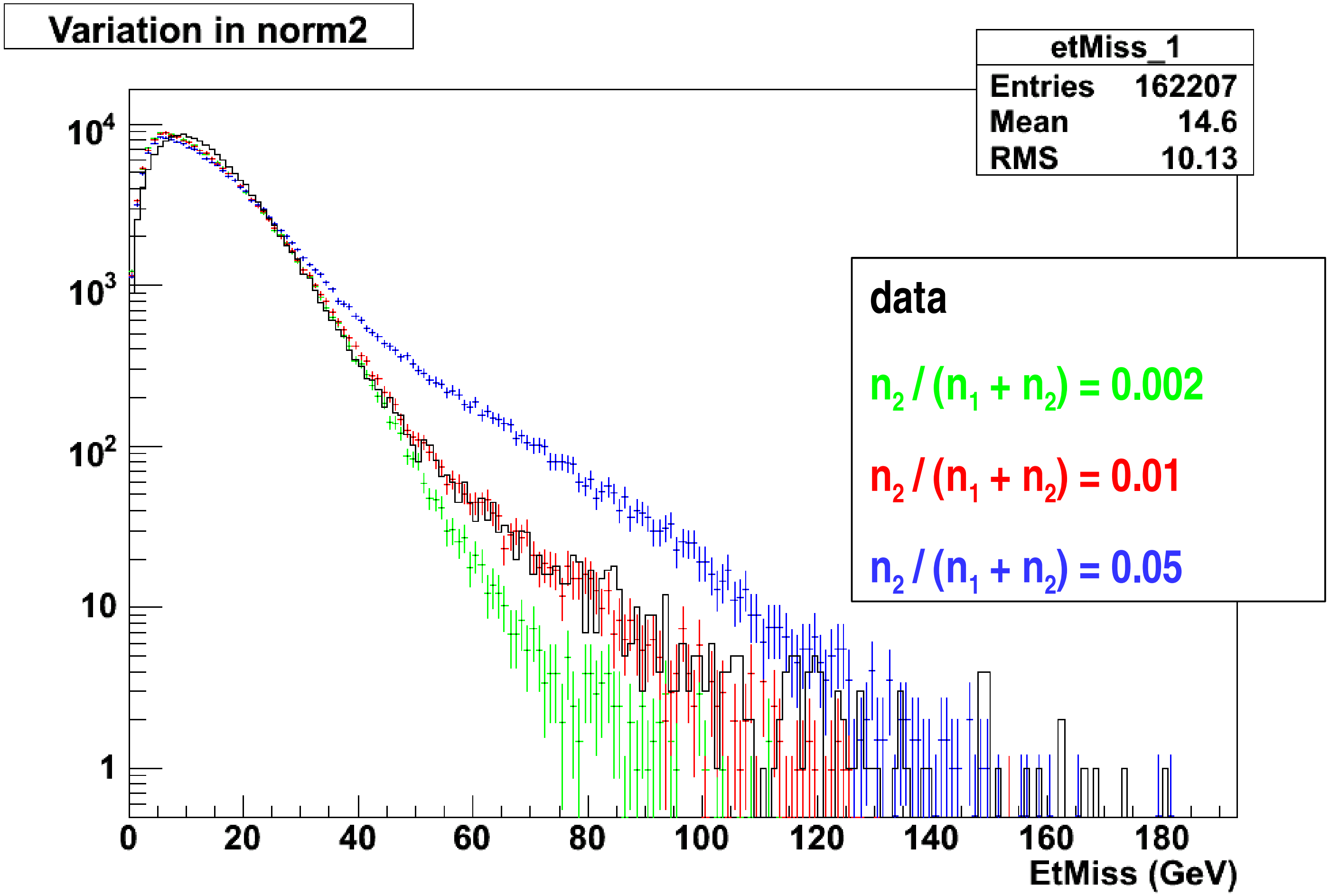
Smearing with Double Gaussians (1)

- First gaussian from fits to calibration data.
- Second gaussian added by hand with $n_2 / (n_1 + n_2) = 0.01$.



Smearing with Double Gaussians (2)

- σ_2 fixed at 35 GeV.



Conclusions

- Jet – EtMiss phi correlations give good discrimination between QCD and SUSY.
- Can define fiducial jet regions from data.

- Can reproduce bulk of EtMiss distribution with single gaussian fits to calibration data.
- Tail can be reproduced by adding a second gaussian to smearing functions.
- Needs more work to extract second gaussian from data – currently large systematics in fit. May be insufficient statistics (set limits from intermediate EtMiss QCD data?).
- Also need to look at NJet, p_T(jet), … distributions in estimated EtMiss tail – will estimate work with full SUSY cuts?