A QCD background filter based on an E_T^{miss} estimator

Robindra Prabhu

University of Freiburg/Bonn

ATLAS-D, Heidelberg 22.09.06

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(2) Fake E_T^{miss} estimation technique

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(5) Summary & Outlook

Motivation

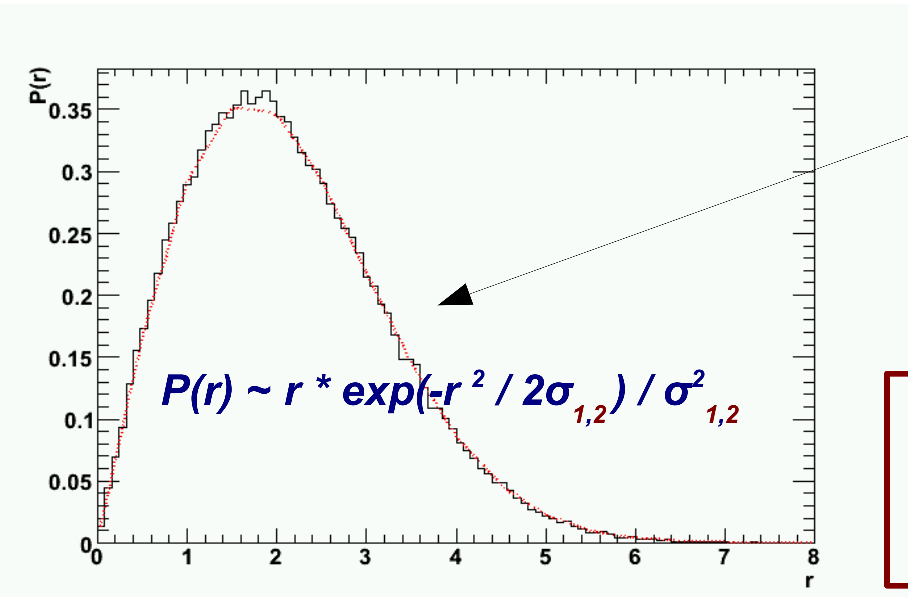
- E_T^{miss} is a key observable of R-parity conserving SUSY
- QCD contributes to E_T^{miss} in two ways:
  - Real: semileptonic decay of b,c quarks
  - Fake: instrumental $\rightarrow$ host of different causes
- QCD has a huge cross section $\rightarrow$ difficult to study rare events
  - Require a filtering mechanism at generator level
- Real E_T^{miss} is easy to handle: $\rightarrow$ Select events with high-p_T ν
- Fake E_T^{miss} is much harder to predict!
  - Find method to estimate <Fake E_T^{miss}> at generator level

Fake E_T^{miss} estimation (I)

- Assume dijet pair is back-to-back in φ
- Consider $\Delta p(1,2) = p_{meas}(1,2) - p_{true}(1,2)$
- Define $\text{Fake } E_T^{miss} = \Delta p_T(1,2) = \sqrt{(\Delta p_x^2(1,2) + \Delta p_y^2(1,2))}$
- Assume gaussian spread of p_{meas} about p_{true} :

$$\Delta p_x = \Delta p_x(1) + \Delta p_x(2)$$

Independent gaussians with mean 0, spread σ_1 and σ_2



Shape of $\Delta p_T(1,2)$ known analytically

→ Mean value :

$$\langle \text{Fake } E_T^{miss} \rangle = \sigma_{1,2} * \sqrt{(\pi / 2)}$$

Method easily extendable to N-jet events:

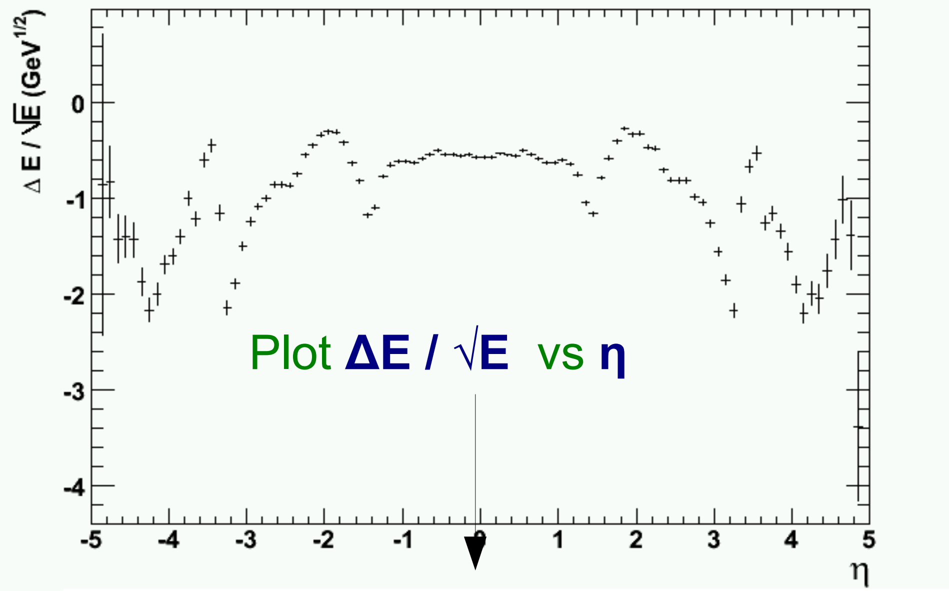
$$\langle \text{Fake } E_T^{miss} \rangle = \sigma_N * \sqrt{2}\, \Gamma((N+1)/2) / \Gamma(N/2)$$

Fake E_T^{miss} estimation (II)

Find $\sigma(\eta, E_{jet})$ from

Rome Jn dijet samples

(+ private samples, court. M.Heldmann)



Plot **ΔE / √E** vs **η**

Extract **RMS** from each **η**-bin

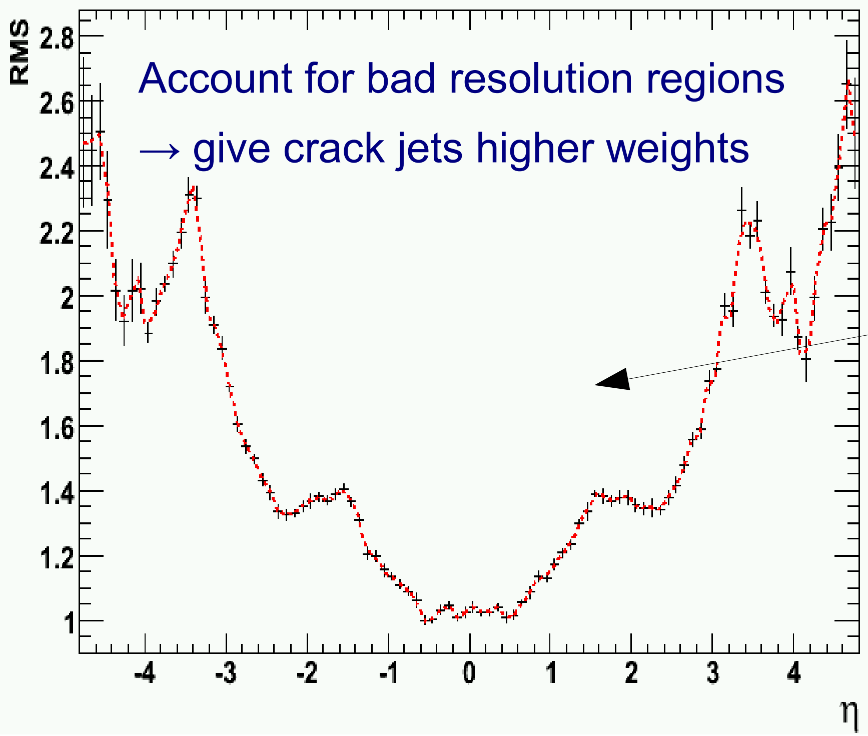
→ Fit distribution with a **spline**

one jet:

$$\sigma\,(\,jet\ i\,) = RMS(\eta) * \sqrt{E} * \sin(\theta)$$

all jets:

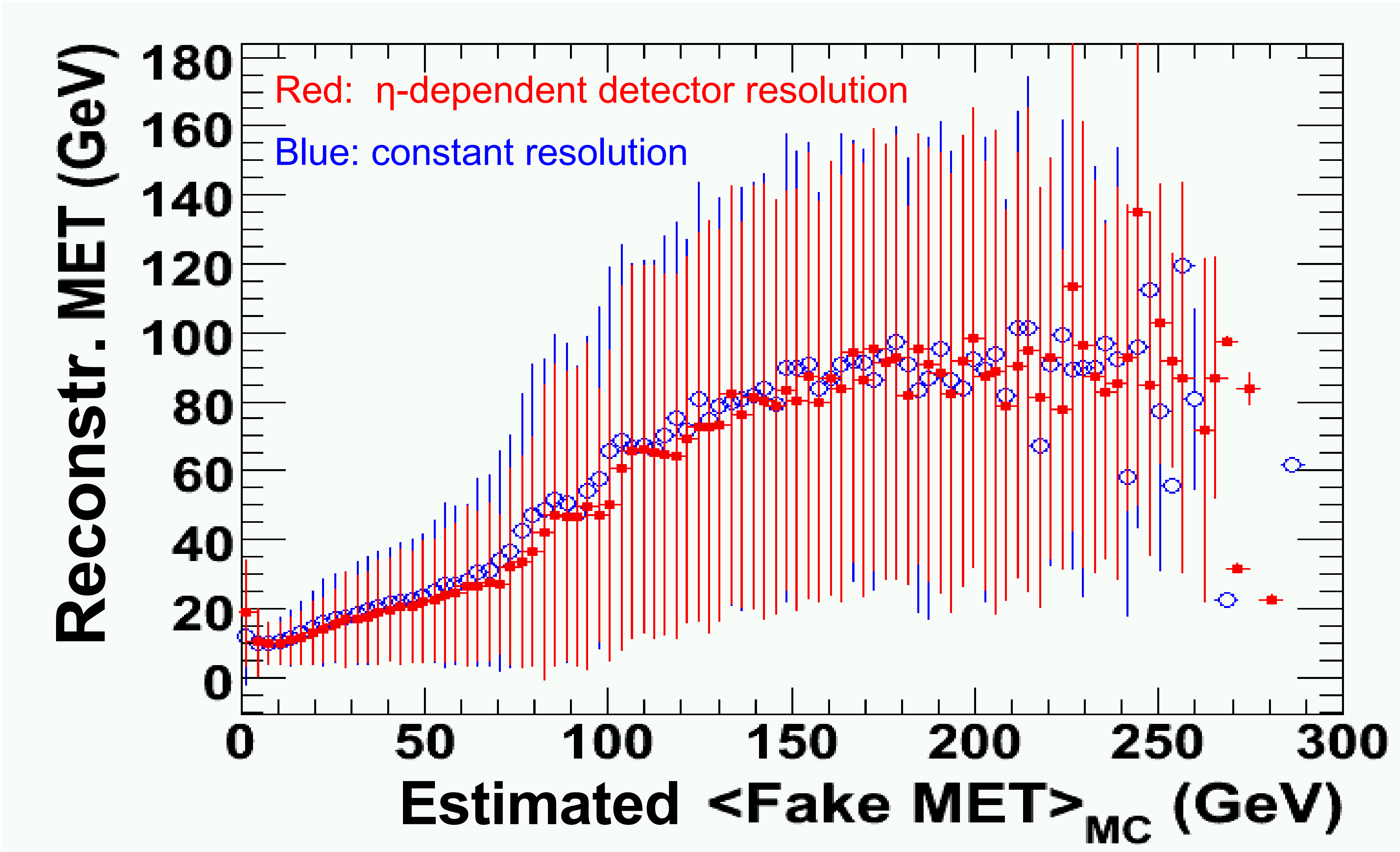
$$\sigma_N = \sqrt{(\Sigma\, \sigma_i^{\,2})}$$



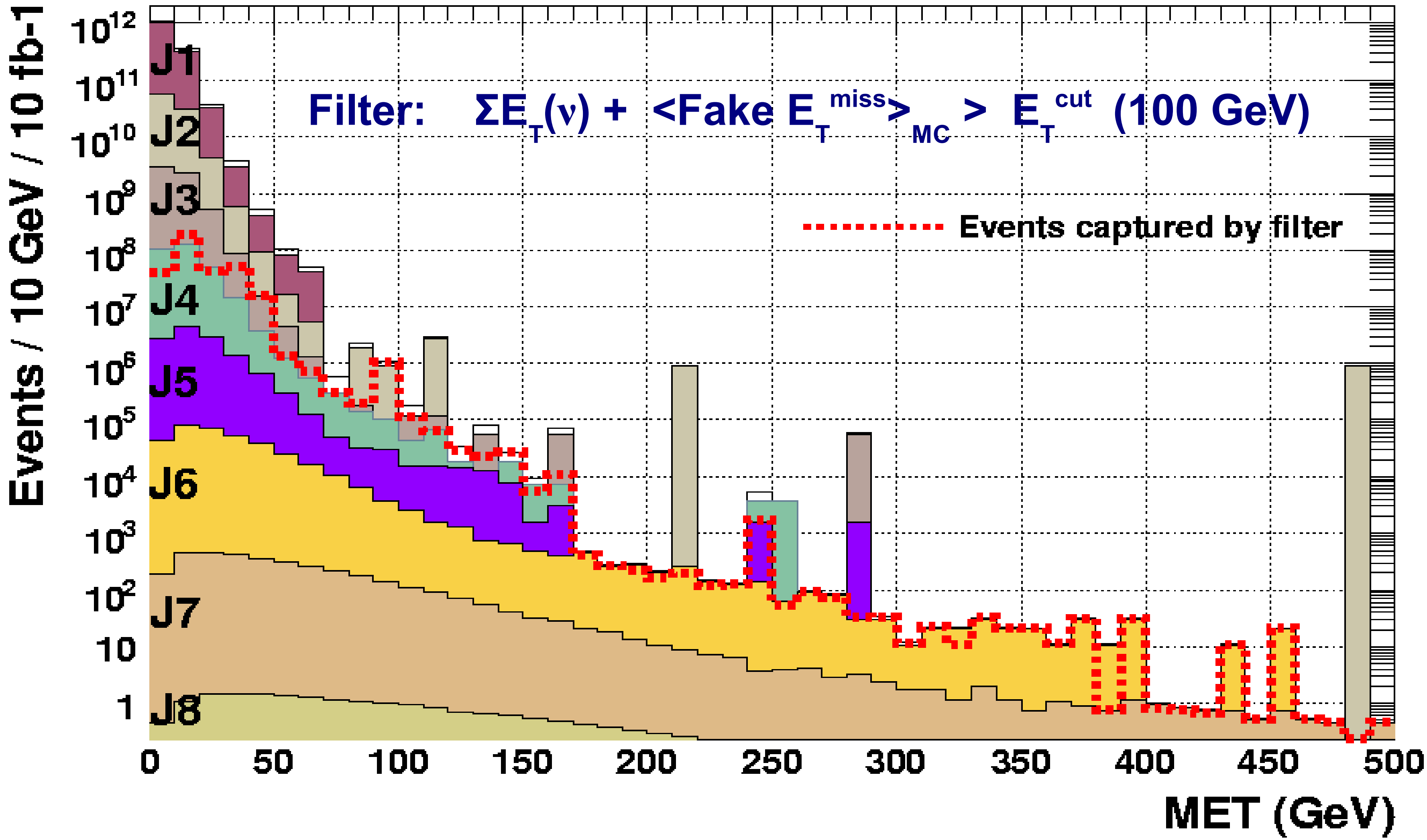
Account for bad resolution regions

→ give crack jets higher weights

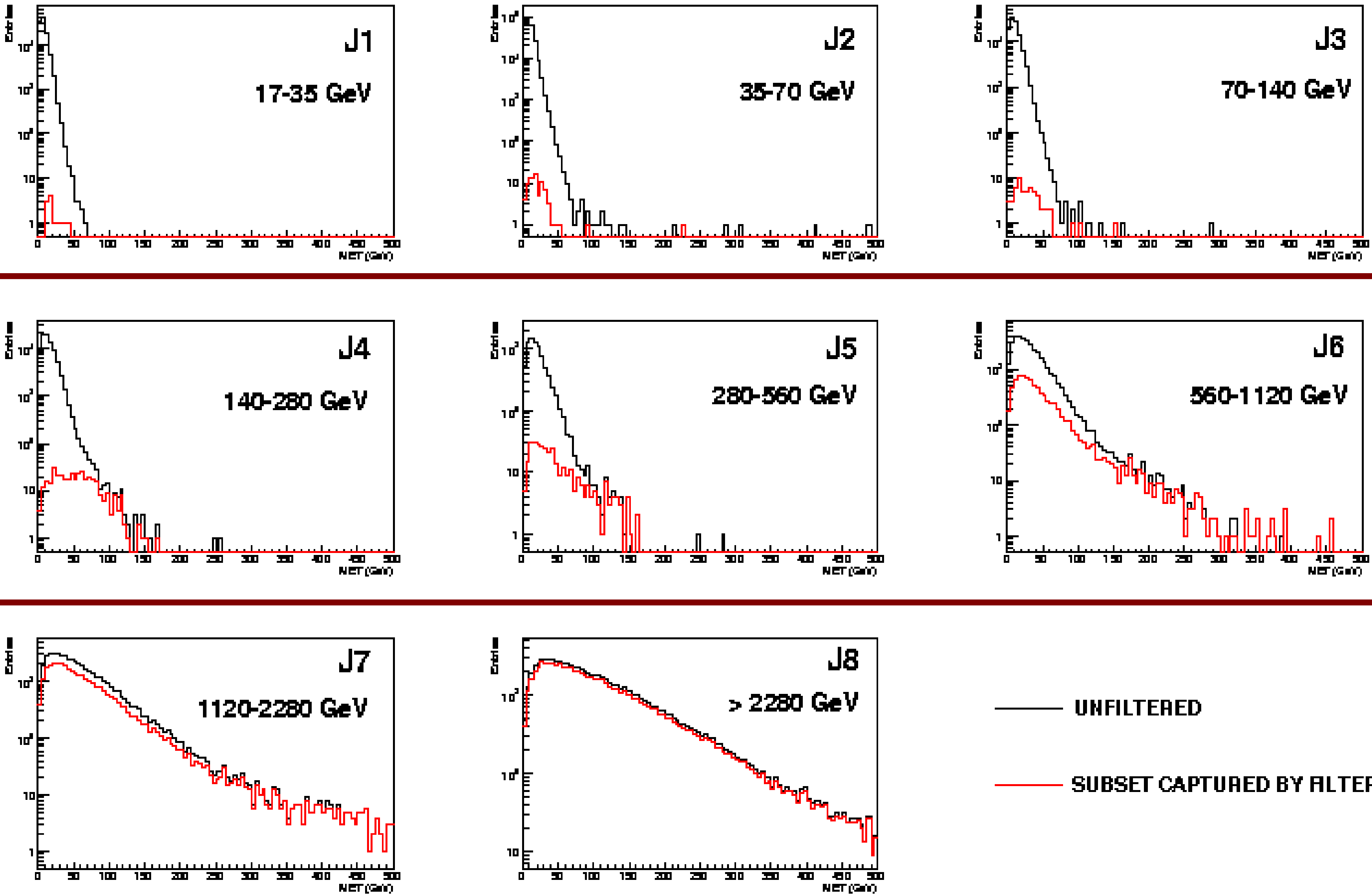
Fake E_T^{miss} estimation (III)



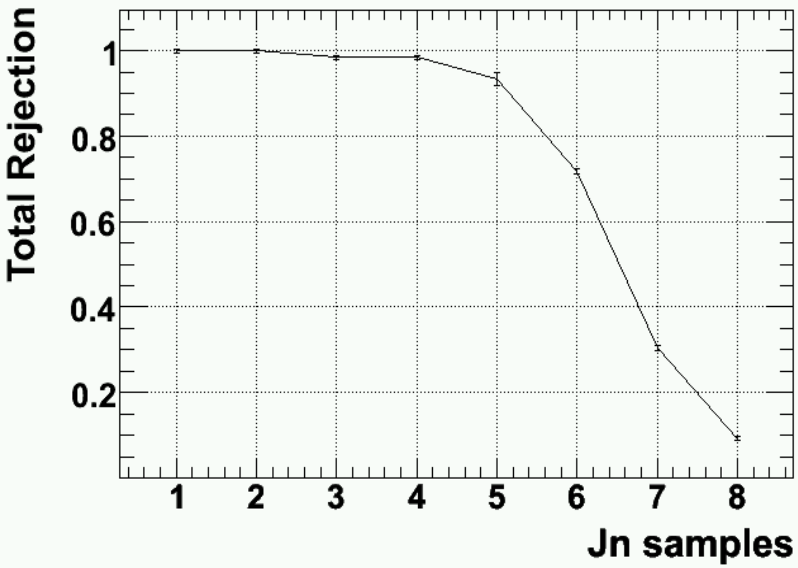
Performance (csc11 Jn dijets)

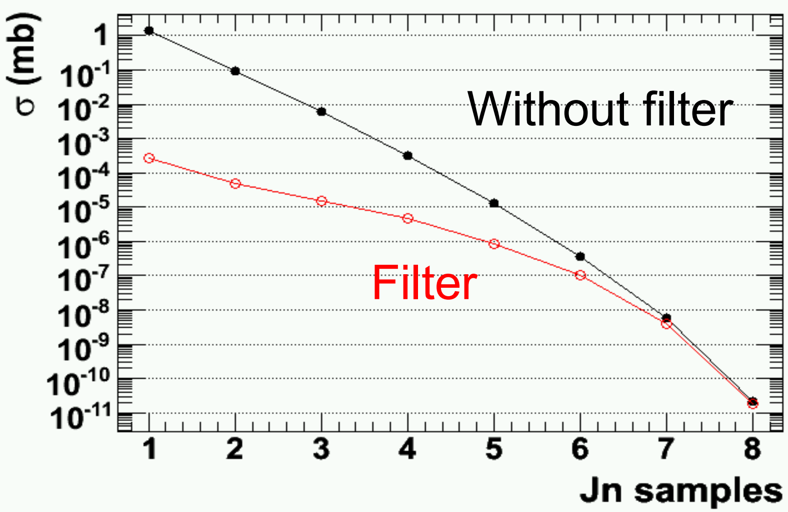


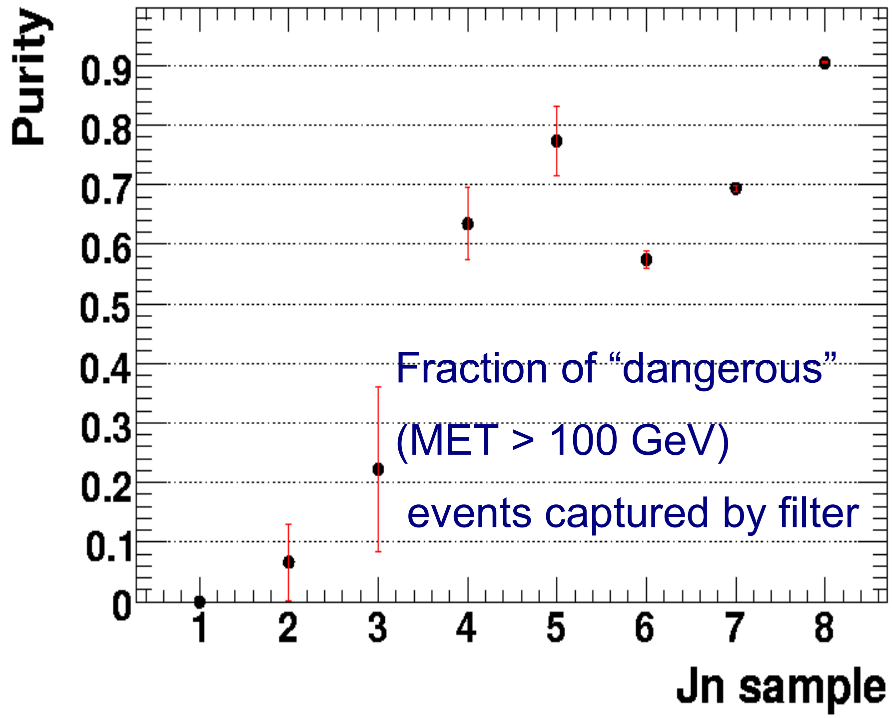
Performance (csc11)



Performance (csc11)







Good overall performance

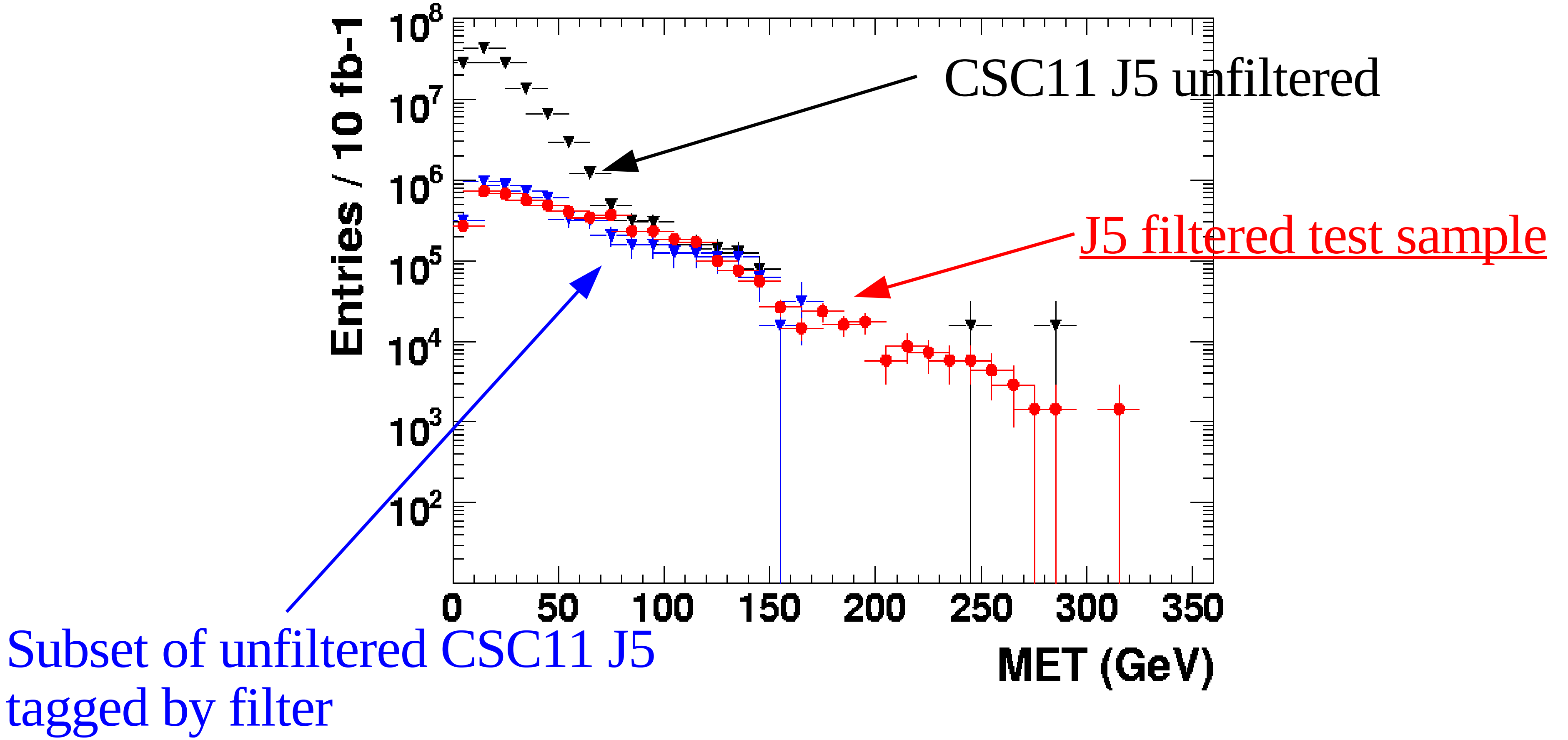
→ e.g. for J5 :

~96% reduction in # fullsim events

~80% of dangerous events captured

Proof of Principle: J5 test sample

- Apply filter on J5 (+ “trigger-like” precuts)
  - Privately produced ~3500 filtered J5 events w/ Athena 11.0.42



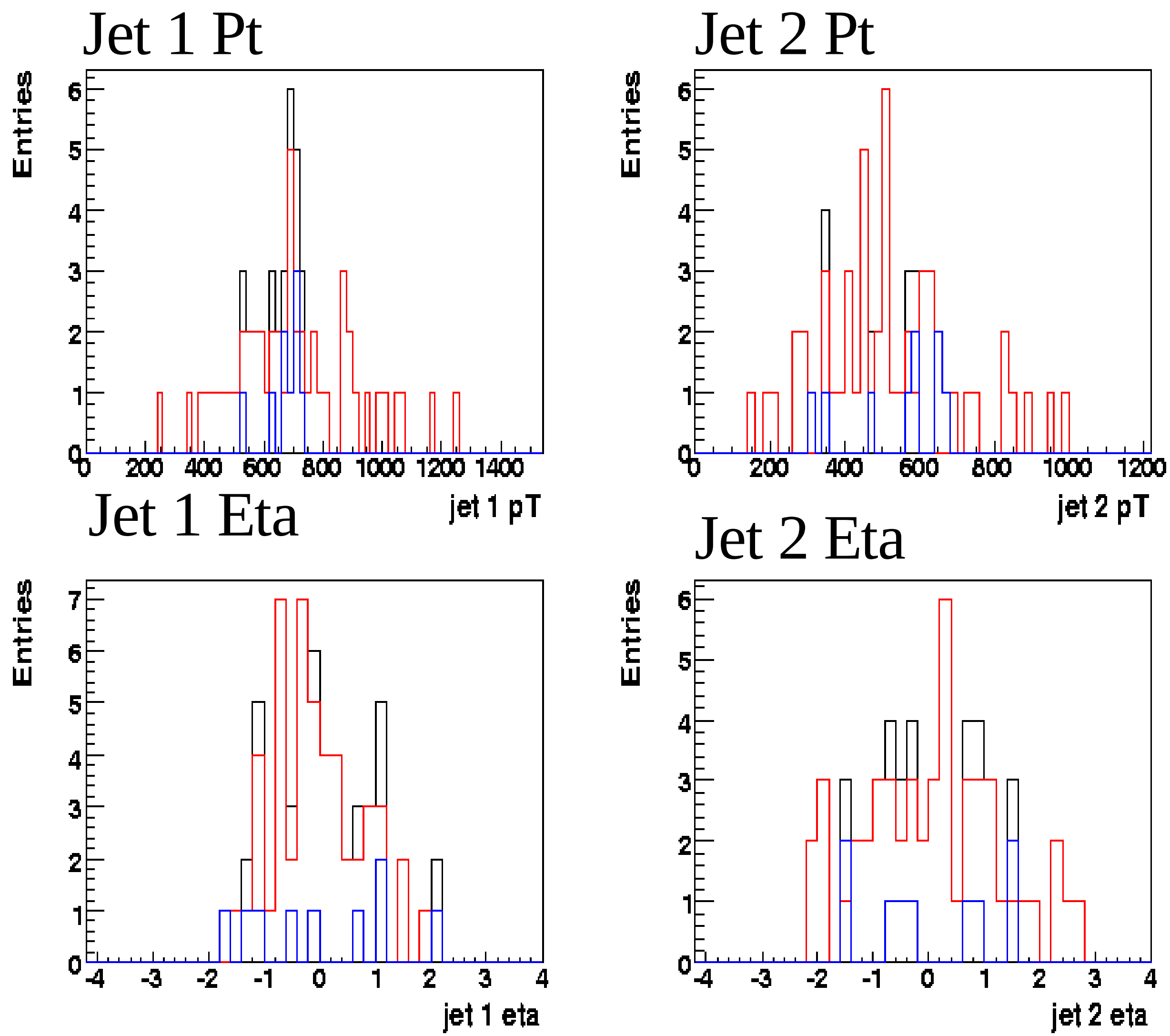
Bias: SUSY 0-lepton mode (J6)

- $E_T^{miss} > 100$ GeV
- $N_{jet} \geq 4$
  (100,50,50,50 GeV)
- $S_T > 0.2$
- Lepton veto

Unfiltered

Pass Filter

Fail Filter



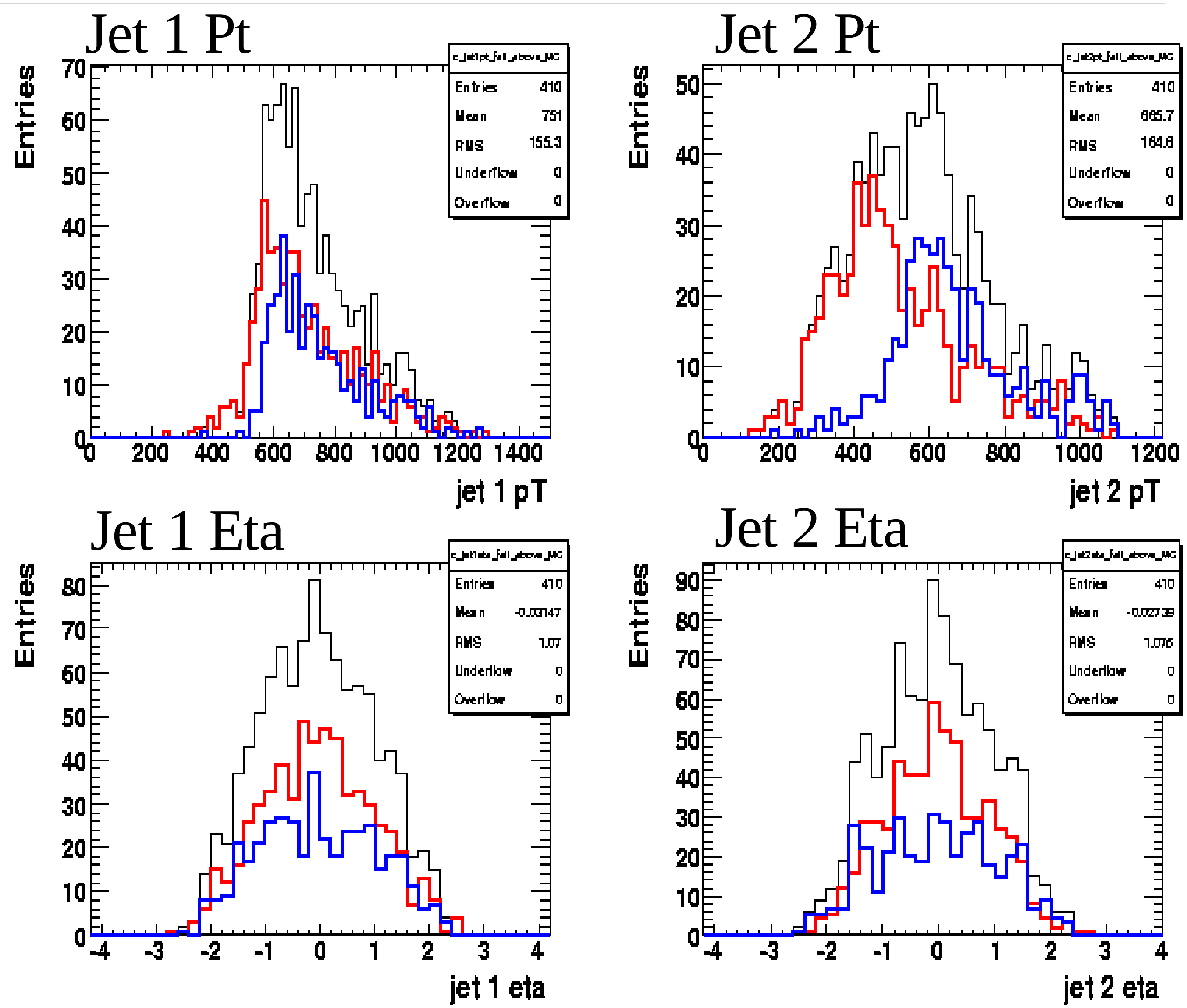
Summary / Outlook

- Mismeasured jets contribute in a large way to *fake* E_T^{miss}
- Constructed a *generator level* variable correlated to reconstructed MET
  → allows for a reasonable estimation of *fake* E_T^{miss} at generator level
- Filter: Use *fake* E_T^{miss} *estimator* in combination with real E_T^{miss} to select potentially dangerous high MET events at *generator level*
- CSC11 Jn samples: Overall rejection good + good MET tail coverage
- Official production of filtered CSC12 J4, J5, J6 is underway
- A generator filter implementing this MET estimation method is available in CVS ("JetMETEstimator") → ready for use.
- Method and filter performance will be summarized in note

BACKUP

Filter Bias: no precuts (MET>100 GeV)

Only events with reconstructed MET> 100 GeV



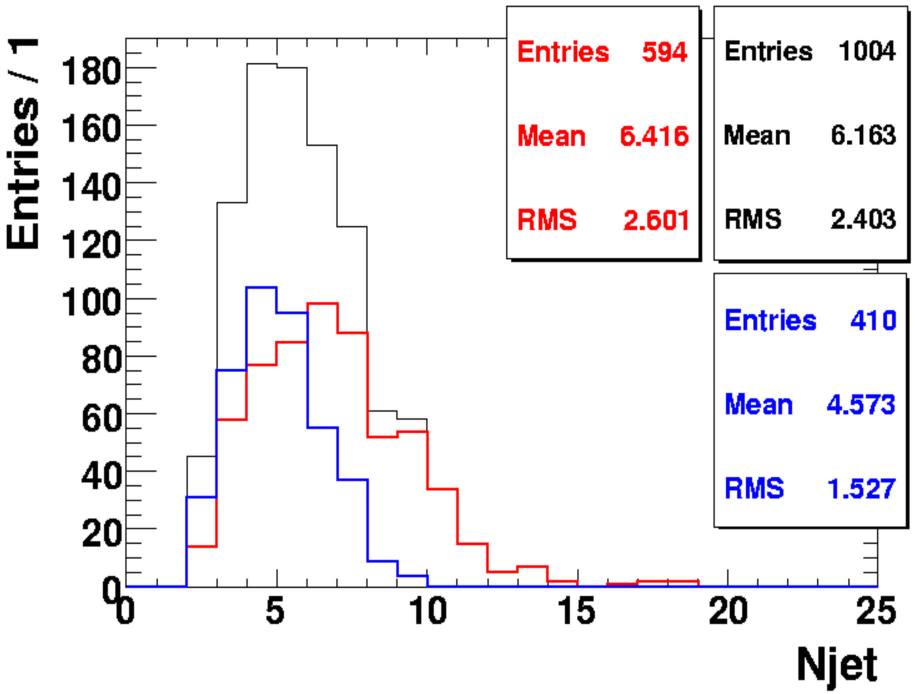
Unfiltered

Pass Filter

Fail Filter

Filter Bias: Jet multiplicity

No precuts



SUSY 0-lepton mode