MC VBF+MET QCD Samples Studies

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Today's presentation

Topics

- Event with fake met study
- GenJets Filter with $\Delta\phi$ cut

Introduction

QCD are by far the most frequent processes in collisions at CMS. The elevated cross sections of such processes mean it is normally impossible to generate samples big enough to simulate significant amounts of of equivalent luminosity so they can be used in data analysis.

Methodology

In order to overcome this problem we generated MC QCD samples with MET plus VBF-like jets.

- Real MET (vectorial sum of generator level neutrino p_T)
- VBF-like jets (AK5 generator level jets)

This type of event have a significantly smaller cross section and so to simulate high integrated luminosity samples.

MC Filter Details

MC Filter: Vectorial sum of neutrino E_T

- $\sum E_{\perp}(\vec{\nu}) > 40\ GeV$

MC Filter: Dijet Filter

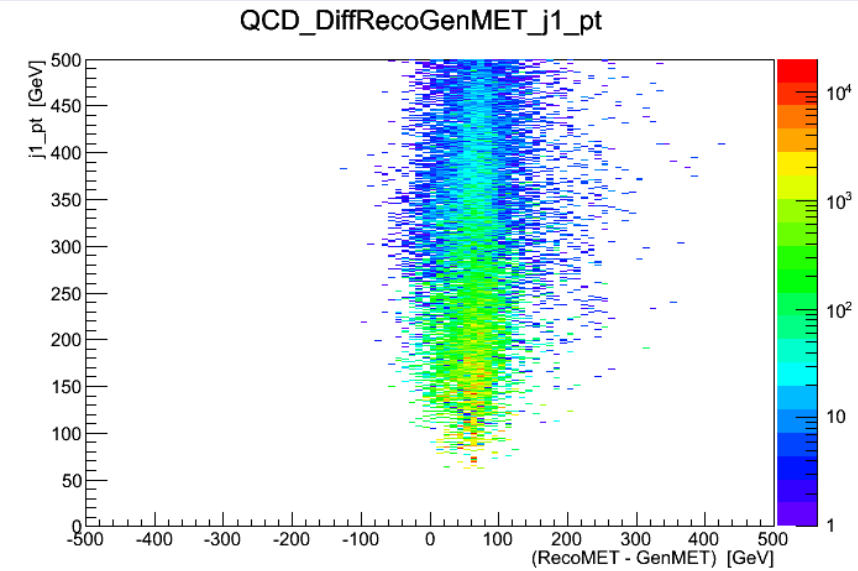
- Select jets with:
  - $p_{\perp} > 20\ GeV$
  - $|\eta| < 5.0$
- From selected jets at least one pair with:
  - $m_{jj} > 700\ GeV$
  - $\Delta\eta > 3.2$

Fake MET variable dependency I

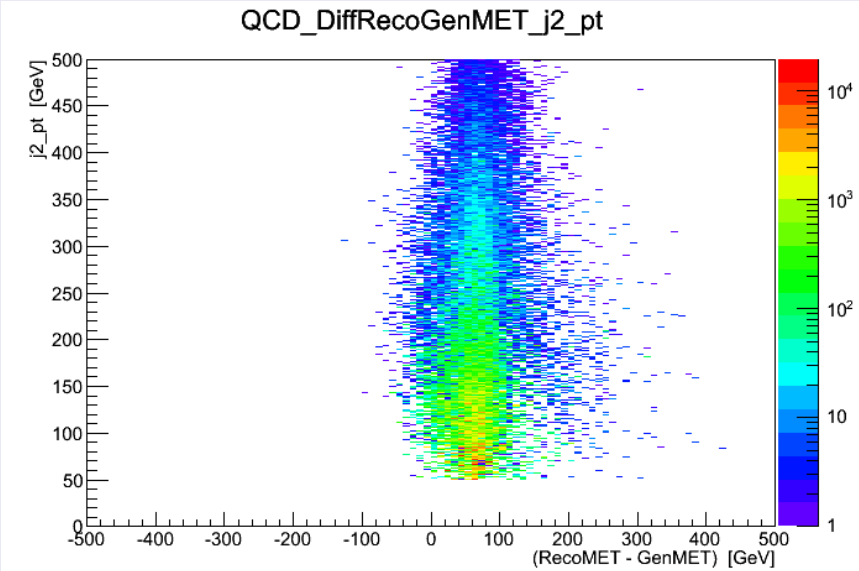
How:

- Next plots are produced with the following conditions:
  - Pass VBF trigger (L1+HLT)
  - Same point of the prompt selection where BDT was trained. Implies passing vetos, having 2 reconstructed jets, etc.
  - Pass generator jets cut (same as MC VBF QCD samples)

$MET_{RECO} - MET_{GEN}$ vs p_T^{jet1}



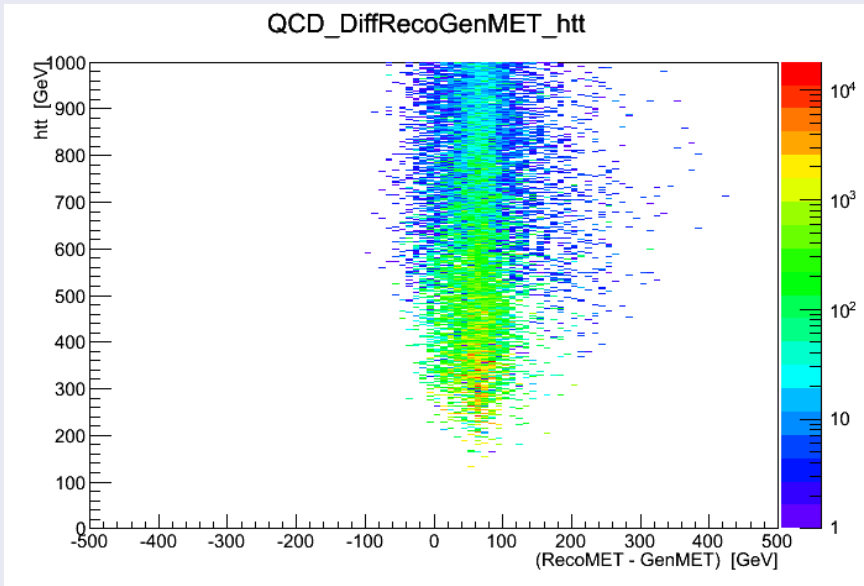
$MET_{RECO} - MET_{GEN}$ vs p_T^{jet2}



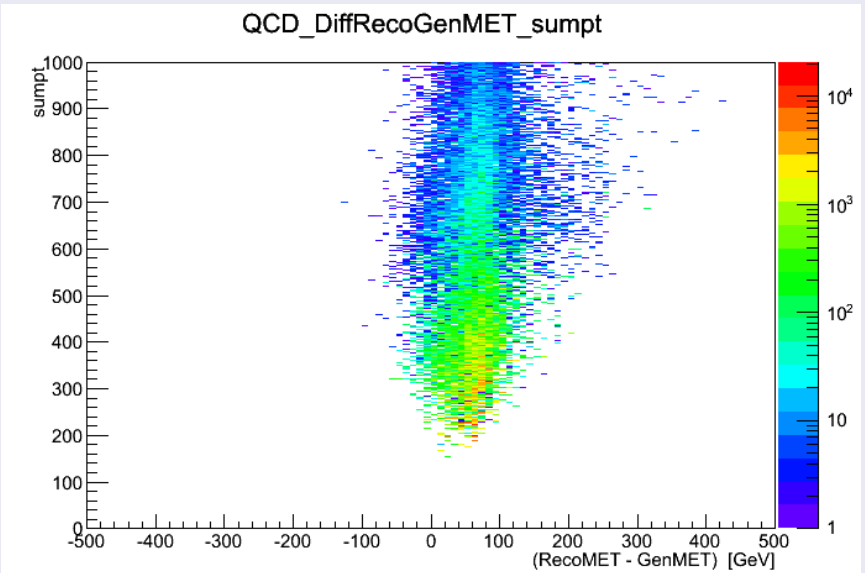
p_T of the jets seams to be fairly decorated with the difference between RECO and GEN MET

Fake MET variable dependency II

$MET_{RECO} - MET_{GEN}$ vs HT



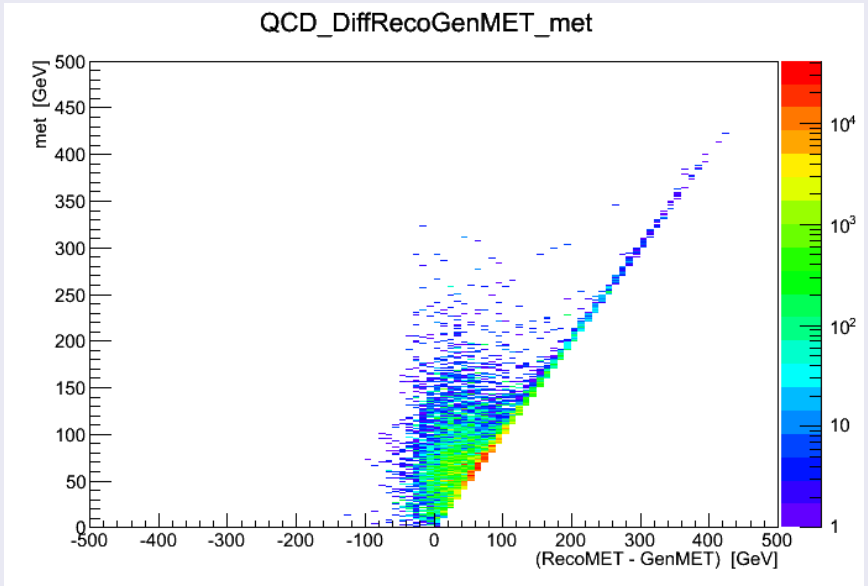
$MET_{RECO} - MET_{GEN}$ vs $\sum p_T(j_1, j_2, MET)$



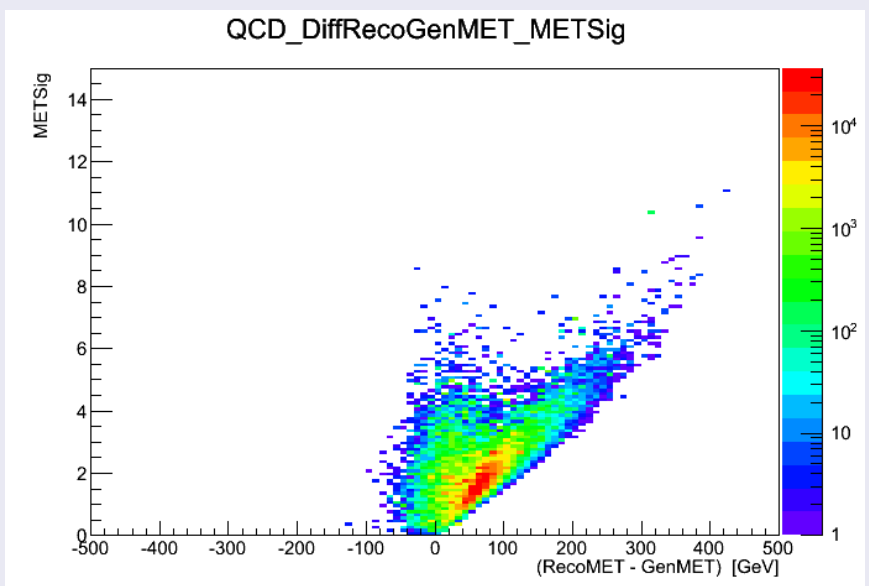
Energy sums also look fairly decorated with the difference between RECO and GEN MET. But as expected the more energy is available the bigger is the tail into higher energy of fake met.

Fake MET variable dependency III

$MET_{RECO} - MET_{GEN}$ vs MET_{RECO}



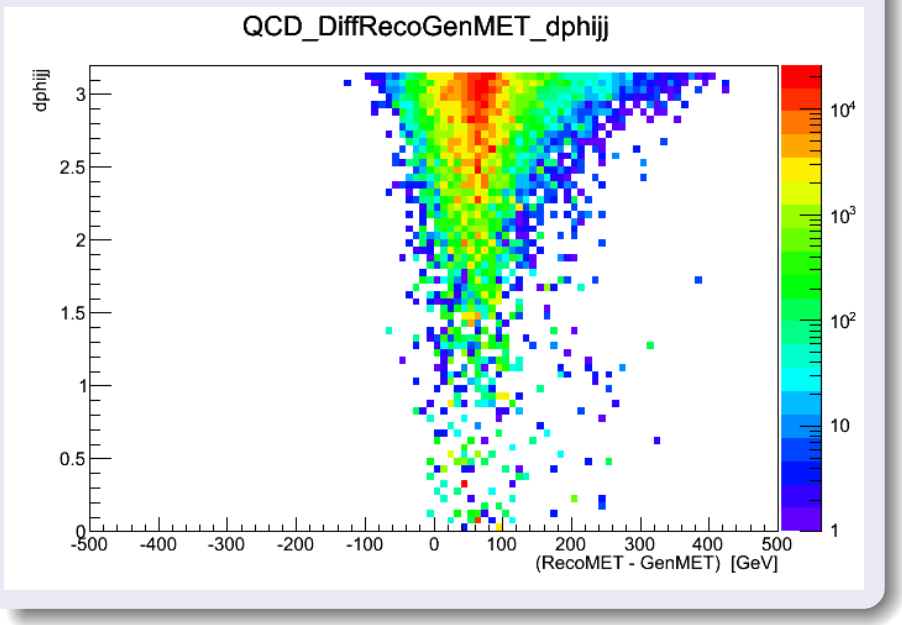
$MET_{RECO} - MET_{GEN}$ vs MET_{Sig}



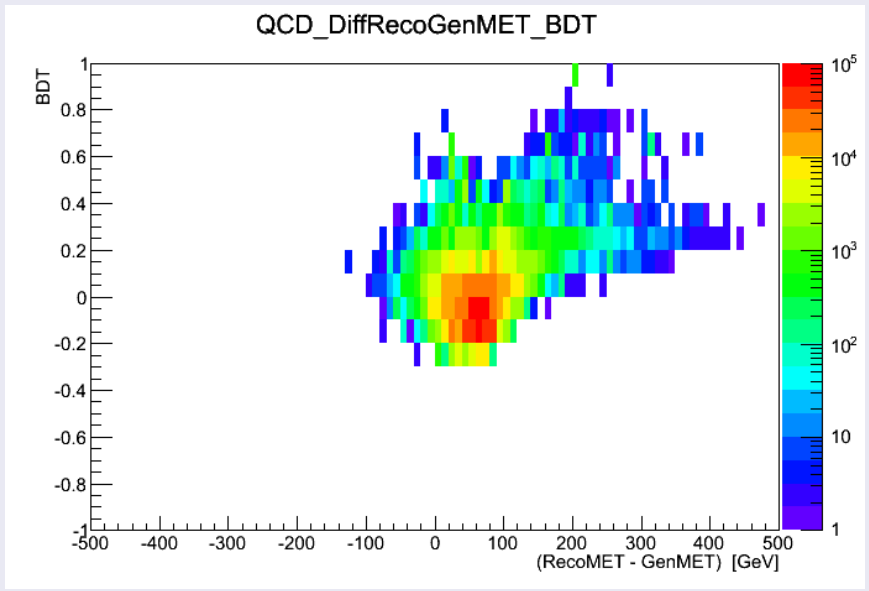
- Left Plot: We can see clearly the 2 populations of events. Note that most events are fake met.
- Right Plot: MET significance is NOT helpful to discriminate against fake met. Events with high fake met also have high met significance...

Fake MET variable dependency IV

$MET_{RECO} - MET_{GEN}$ vs $\Delta\phi_{jet-jet}$



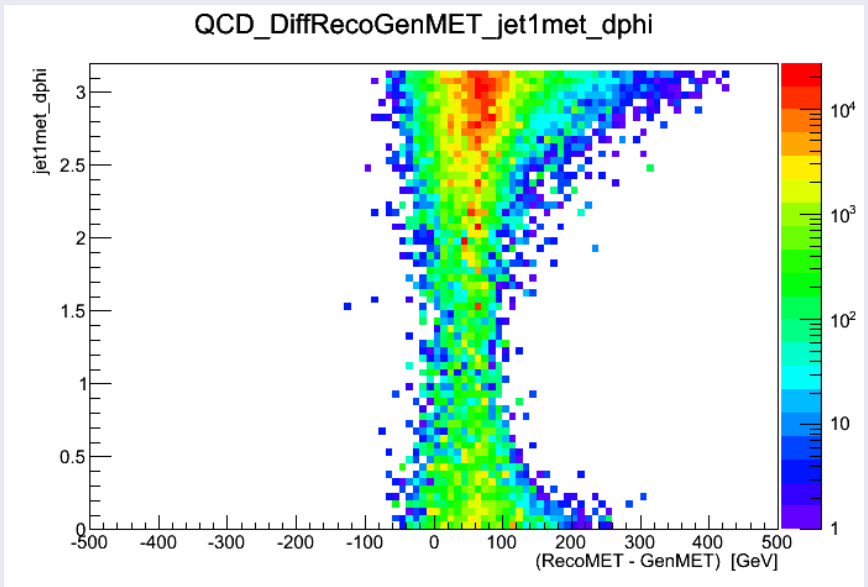
$MET_{RECO} - MET_{GEN}$ vs BDT_{Score}



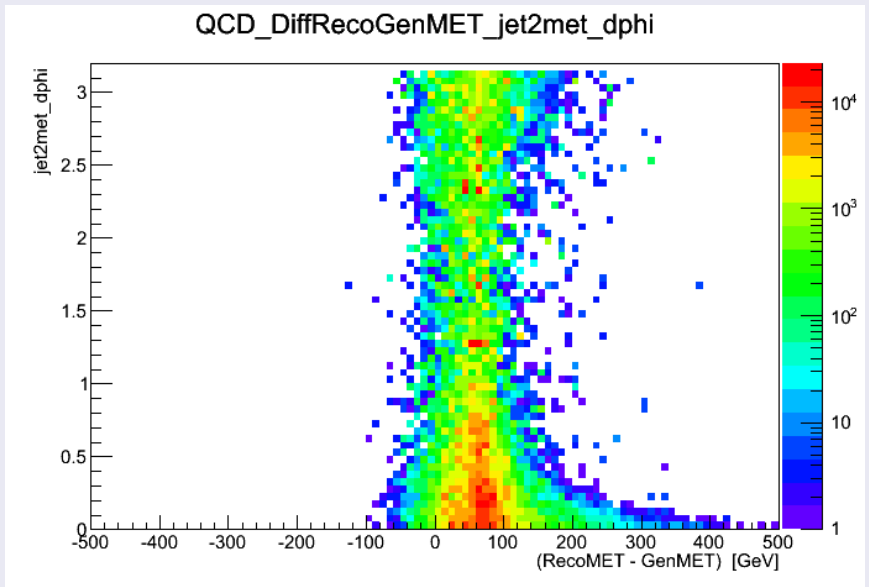
- Left Plot: We can see that most population of fake met events have high $\Delta\phi_{jet-jet}$ as expected but significant tails can be seen still at low values
- Right Plot: Here we can see that the BDT is not being very efficient in rejecting fake met events.

Fake MET variable dependency V

$MET_{RECO} - MET_{GEN}$ vs $\Delta\phi_{jet_1 - MET}$



$MET_{RECO} - MET_{GEN}$ vs $\Delta\phi_{jet_2 - MET}$



We can see here strong correlations between fake met and angles between met and jets.

- Left Plot: Most events with high fake met are in the pi or zero angles to leading jet
- Right Plot: Similar but reversed, most events with fake met are in 0 or pi angles to leading jets

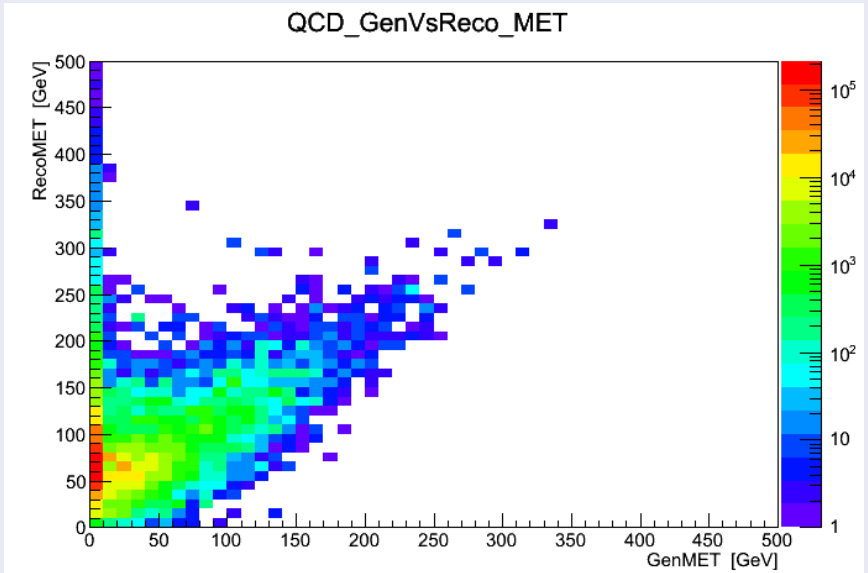
Implies that a major cause of fake met miss measurement sub-leading and leading jets. We can try to select events based on this variables.

Selecting based on jet(1,2) $\Delta\phi$ to met I

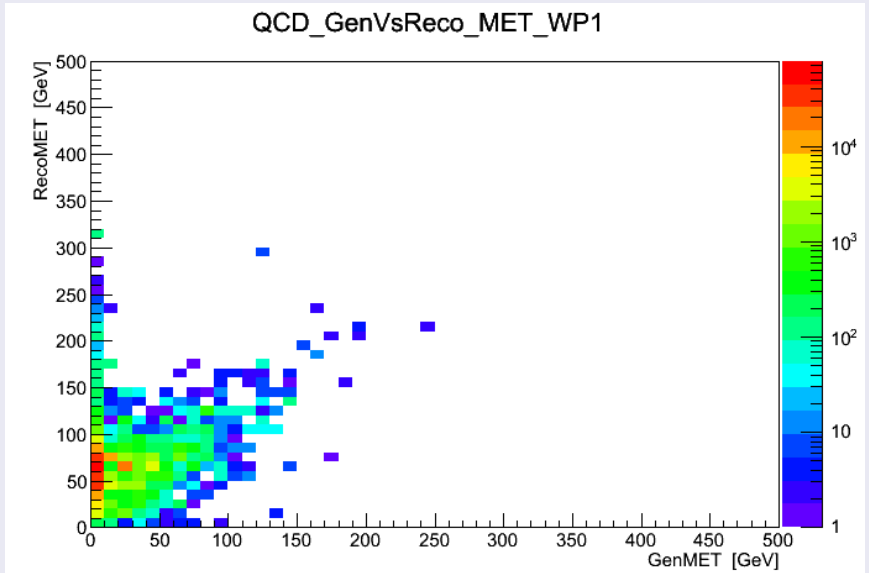
We will select events based on jet(1,2) $\Delta\phi$ to met

- WP1: jet1 to met $0.5 < \Delta\phi < 2.5$
- WP2: jet2 to met $0.5 < \Delta\phi < 2.5$
- WP3: both conditions

No cut

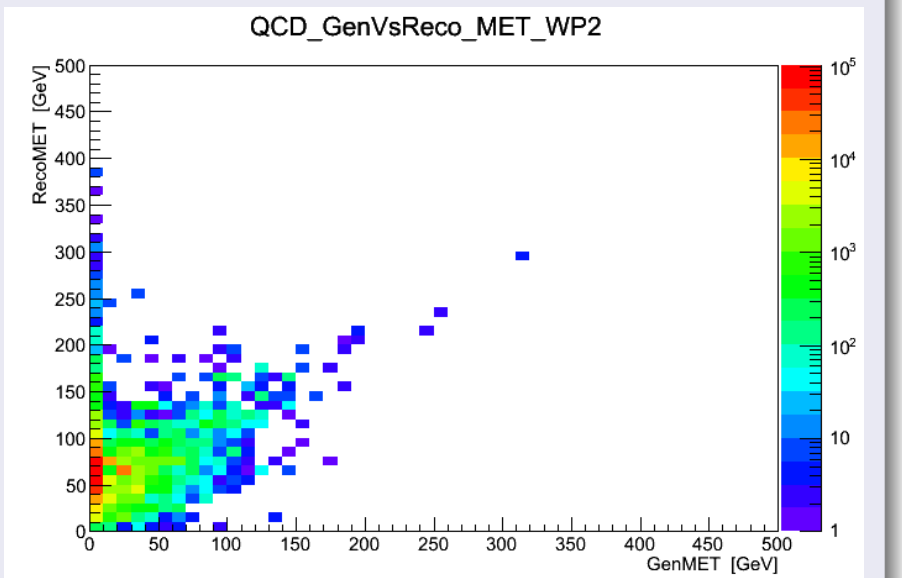


WP1

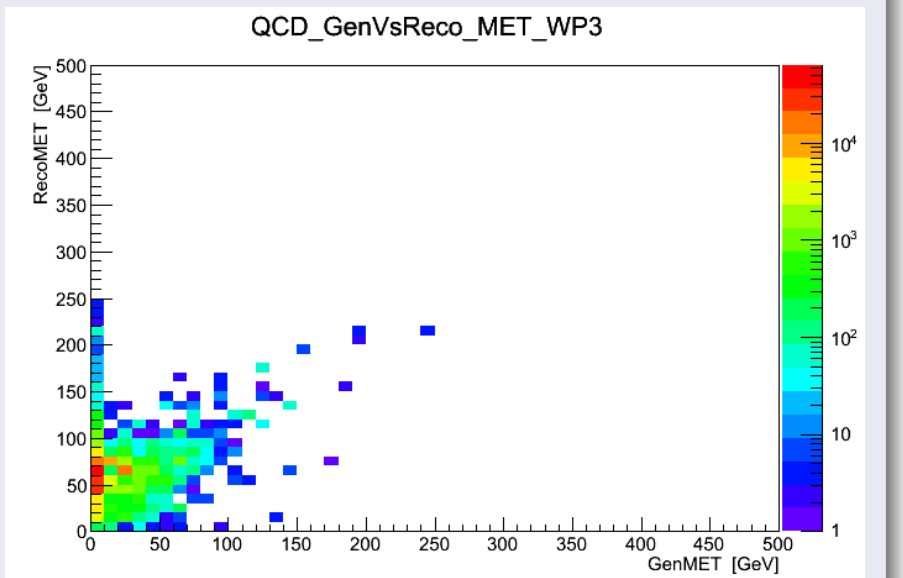


Selecting based on jet(1,2) $\Delta\phi$ to met II

WP2



WP3



Cutting on this variables helps to control the fake met tail to high energies.

Study on GenJet Filter only

On possibility to avoid the a pre-selection altogether would be to produce new samples with just GenJets filter but adding more cuts there in other to get additional suppression thus removing the need for a GenMET cut.
The obvious variable to add would be $\Delta\phi$. Have have made a quick study to check this possibility.

1/Efficiency

p_T hat	50to80	80to120	120to170	170to300	300to470	470to600
Current GenFilters	333333	24390	3413	988	385	239
GenJet Filter $+\Delta\phi < 1.5$	158	78	36	24	14	11
GenJet Filter $+\Delta\phi < 1.0$	204	113	54	33	20	16

Event using cut as high as $\Delta\phi < 1.0$ we are not even close to the necessary event suppression used to create the current VBF QCD sample.

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