MET Performance in the 2011 Data

CMS Collaboration

Abstract

We present studies of missing transverse energy reconstruction using jets and photon+jets events collected in 2011.
We have a comprehensive set of MET performance results from 2010 data, summarized in MET JINST (arXiv:1106.5048)

We reproduce some plots using the 2011 data collected with higher instantaneous luminosities and with 50 ns bunch spacing
- MET distributions before and after event cleaning in jet triggered data
- MET resolution measured in the photon-jet plots as a function of vertex multiplicities compared to the 2010 data.
Data and MC samples
- Data:
  - Single jet triggered dataset
- MC samples
  - QCD Pythia6 TuneZ2
  - TTbar+jets Madgraph+Pythia TuneZ2
  - W(→llν)+jets Madgraph TuneZ2
  - Z(→llν)+jets Madgraph TuneD6T

Reconstruction
- We use the particle flow MET and jets.
Event selection

- Jet event selection
  - Inclusive dijet events with $p_T^{(jet1)} > 400$ GeV & $p_T^{(jet2)} > 200$ GeV

- Event cleaning
  - Removal of scraping events
  - $\geq 1$ primary vertex
  - Beam halo events removal using CSC detector information [1]
  - HBHE noise removal using pulse shape and topological information [2]
  - Event charge fraction (Track sum $p_T / H_T > 0.1$)
  - JetID cuts on jets with $p_T > 100$ GeV
    - If $|\eta|<2.4$, # of constituents>1, # of charged hadrons>0, photonEnergyFraction<0.90, neutralHadronEnergyFraction<0.9, electronEnergyFraction<1.00 (same as those used for inclusive jet cross section measurement, arXiv:1106.0208)
    - If any jet fails this requirement, the event is removed.

The structure around 400 GeV in the MET distribution before cleaning is due to the jet selection: $p_T^{(1)(2)} > 400(200)$ GeV.

After cleaning, the data and MC are in good agreement.
MET in Photon+Jet Events

- The photons play a role of simple and well-understood probe to assess the more complicated object, MET.

- Notations:
  - $q_T$ – vector boson momentum in transverse plane
  - $u_T$ – hadronic recoil, defined as the transverse momentum sum of all particles, except the vector boson

\[
\vec{q}_T + \vec{u}_T + \vec{E}_T = 0
\]

- The bosons provide: (1) a momentum scale, (2) unique event axis

- The hadronic recoil can be projected onto this axis
  - parallel projection, $u_\parallel$
  - perpendicular projection, $u_\perp$
MET in Photon+Jet Events

- Data sample
  - Single photon triggered dataset

- Photon selection – exactly the same as the 2010 analysis
  - Hadronic/EM < 0.05
  - Isolation (ECAL, HCAL, TK)
  - Cluster Shape requirements – for better QCD suppression
  - Electrons rejection – the supercluster is required not to match pixel hits consistent with a track from the interaction region.

  - Barrel only photons
  - Photon $p_T > 20$ GeV
  - Only one clean photon in the event

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The resolution degrades with increasing # of vertices as expected.

Even at 1 vertex, the resolution is degraded in 2011 by ~6 GeV in quadrature compared to the 2010 due to out-of-time pileup.

Work in progress to mitigate the pileup effects in MET reconstruction and to understand the slight worsening of MET resolution in 2011.