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Results of visual scan of high $\not\!\!E_{\mathrm{T}}$ events in 7 TeV pp collision data

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Abstract

We present the results of a visual scan of high $\not\!\!E_{\mathrm{T}}$ events (Calo$\not\!\!E_{\mathrm{T}} > 45$ GeV OR tc$\not\!\!E_{\mathrm{T}} > 45$ GeV OR pf$\not\!\!E_{\mathrm{T}} > 45$ GeV) in a sample of 12 nb^{-1} of 7 TeV pp collision data, after applying the official noise clean-up. The CMS software *Fireworks* has been used to produce the event displays. The high $\not\!\!E_{\mathrm{T}}$ events have been visually inspected and classified in different cathegories. The resuls of this scan can be used to further improve the noise cleaning algorithms and identify possible problems in the three algorithms employed in CMS for the $\not\!\!E_{\mathrm{T}}$ reconstruction.

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1 Introduction

Commissioning studies performed with test beams, cosmic runs and early 0.9 TeV, 2.36 TeV and 7 TeV pp collision data have identified several sources of anomalous noise (i.e. noise not produce solely from expected fluctuations in the electronics) in the calorimeters of the CMS experiment:

- *ECAL barrel spikes* - Energy deposits in individual channels affected by the noise are cleaned using both topological and timing information of the reconstructed hits. Noise correlated with collisions. More details are available at XXX.
- *HF PMT hits* - Energy deposits in individual channels affected by the noise are cleaned using both topological and timing information of the reconstructed hits. Noise correlated with collisions. More details are available at XXX.
- *HPB/RBX noise in HCAL barrel and endcaps* - Events with identified HPD/RBX noise are removed from the analysis using a filter based on both topological and timing information of the reconstructed energy deposits. Noise not correlated with collision. More details are available at XXX.

In addition, machine-induced background, in the form of beam halo [XXX] and beam scraping events [XXX], have been observed.

The overlap of either anomalous noise or machine-induced background with a pp collision event produces an unbalance in the reconstructed missing transverse energy in the event, which can produce large tails in the $\not\!\!E_{\rm T}$ distribution.

In this note, we present the results of a visual scan of high $\not\!\!E_{\rm T}$ events (> 45 GeV) in a sample of 7 TeV pp collision data, after applying the noise clean-up developed by joint effort of several groups in the CMS collaboration, and described in Section 2. The CMS software *Fireworks* [XXX] has been used to produce the event displays. The high $\not\!\!E_{\rm T}$ events have been visually inspected and classified in different cathegories. The resuls of this scan can be used as a starting point to further improve the noise cleaning algorithms and to identify possible problems and inconsistencies in the three algorithms employed in CMS for the $\not\!\!E_{\rm T}$ reconstruction.

2 Datasample, Event Selection, and Noise Cleaning

Information on the dataset and CMSSW release used to reconstruct the data:

- dataset: /MinimumBias/Commissioning10-May6thReReco-v1/RECO
- CMSSW release: CMSSW_358p3

Event selection:

- BPTX
- GOOD VERTEX
- BEAM SCRAPING FILTER
- etc..

Noise cleaning (see details at https://twiki.cern.ch/twiki/bin/view/CMS/METNoiseCleanup):

- ECAL barrel spikes: topology (swiss cross variable) + timing (kOutOfTime flag) [XXX]
- HF PMT hits: topology ("v2": PET+S9S1) + timing (rechit-time window cut) = "v4" cleaning [XXX]
- HPD/RBX noise in HBHE: topology (cut on hit multiplicity in an HPD) [XXX]

Figure shows the cleaned Calo$\not\!\!E_{\rm T}$ and tc$\not\!\!E_{\rm T}$ distributions for the 19.6 M events passing the selection described above.

3 Scan of high $\not\!\!E_{\mathrm{T}}$ events

The high $\not\!\!E_{\mathrm{T}}$ events have been divided in three mutually exclusive categories and stored in the directory SKIMDIR = /castor/cern.ch/user/s/santanas/MET/Skims/METtails_45GeVcut_May27_2010/ :

- Category 1 - Calo$\not\!\!E_{\mathrm{T}} > 45$ GeV AND tc$\not\!\!E_{\mathrm{T}} > 45$ GeV
  Root file in RECO format at:
  SKIMDIR/picked_events_CaloMET_and_tcMET_gt_45GeV_Artur.root
- Category 2 - Calo$\not\!\!E_{\mathrm{T}} > 45$ GeV AND tc$\not\!\!E_{\mathrm{T}} < 45$ GeV
  Root file in RECO format at:
  SKIMDIR/picked_events_CaloMET_gt_45GeV_Artur.root
- Category 3 - Calo$\not\!\!E_{\mathrm{T}} < 45$ GeV AND tc$\not\!\!E_{\mathrm{T}} > 45$ GeV
  Root file in RECO format at:
  SKIMDIR/picked_events_tcMET_gt_45GeV_Artur.root

A visual scan of these events have been performed using the CMS event display software "Fireworks". It should pointed out that the results of a visual scan are subject to personal judgment. Nevertheless, they should provide with good approximation a realistic picture of which are the events that populates the tails of the $\not\!\!E_{\mathrm{T}}$ after applying the current noise clean-up.

The result of the scan are summarized in the following sub-sections.

3.1 Category 1: Calo$\not\!\!E_{\mathbf{T}} > 45$ GeV AND tc$\not\!\!E_{\mathbf{T}} > 45$ GeV

3.2 Category 2: Calo$\not\!\!E_{\mathbf{T}} > 45$ GeV AND tc$\not\!\!E_{\mathbf{T}} < 45$ GeV

3.3 Category 3: Calo$\not\!\!E_{\mathbf{T}} < 45$ GeV AND tc$\not\!\!E_{\mathbf{T}} > 45$ GeV