Update on MET Significance

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MET Working Group Meeting
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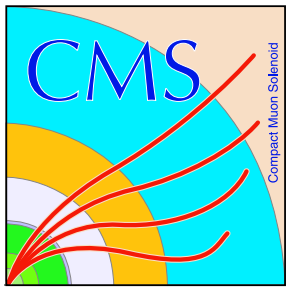


Outline

1. Port code into CMSSW_2_2_6
   - Algorithm code unchanged
   - Currently the code is for **MHT** Significance
   - For details see talks in confId 23829, 28105, 29433, 38967.
2. Performance on SUSY and Wenu Analysis
3. Objects Resolution Study

Port Code into CMSSW_2_2_6

- The `PATMHTProducer` code has been ported to CMSSW_2_2_6
- One can check out the code with the following tags
  - $\Rightarrow$ DataFormats/PatCandidates V03-18-08
  - $\Rightarrow$ PhysicsTools/PatAlgos V04-14-25
  - PhysicsTools/PatUtils V03-05-02
  - CondFormats/JetMETObjects V01-08-02
  - RecoMET/METAlgorithms V02-06-06

"$\Rightarrow$" contains the code we checked in

Input Objects in MHT

- "Selected Layer1" Jets, Electrons, and Muons from PAT

  with additional cuts:

  - Jets : $p_T > 20$ GeV, $|\eta| < 5.0$, EMFraction < 0.9
  - Electrons : $p_T > 10$GeV, $|\eta| < 3.0$
  - Muons : $p_T > 10$GeV, $|\eta| < 2.5$

  If user changes the selection cuts in the "Selected Layer1" config file, it will affect these objects.

- Objects resolutions taken from formula inside `PATMHTProducer`

  For jets, the fractional E_T resolution is written as an expansion in $1/\sqrt{E_T}$ of the reconstructed jet,

$$\left(\frac{\sigma_{E_T}}{E_T}\right)^2 = \left(\frac{a}{E_T}\right)^2 + \left(\frac{b}{\sqrt{E_T}}\right)^2 + c^2$$

  with $a = 5.6$, $b = 1.25$, and $c = 0.033$ as given in Physics TDR (Ch. 11.4).

SUSY All Hadronic Analysis (CMS CR 2007/053)

Datasets

/SUSY_LM1-sftsht/Summer08_IDEAL_V11_redigi_v1/GEN-SIM-RECO
/TTJets-madgraph/Fall08_IDEAL_V11_redigi_v10/GEN-SIM-RECO

Source Code

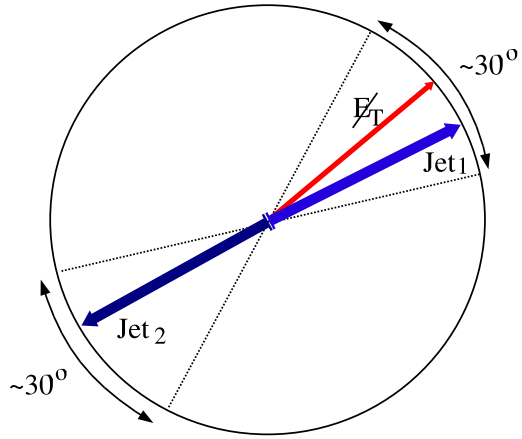
- SusyAnalysis/EventSelector V01-02-01 *
- SusyAnalysis/AnalysisSkeleton V01-01-01

* Need to create MHTEventSelector.

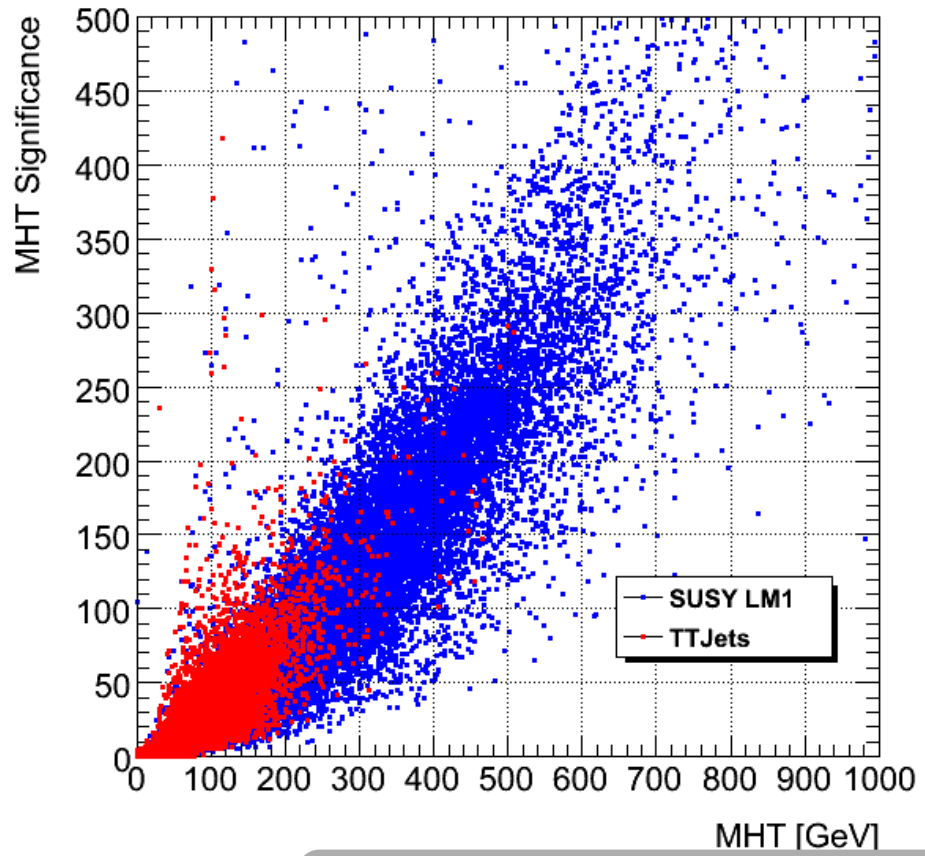
Events Selection

- Num of jets ≥ 3
- jet_0 ET $>$ 180 GeV, jet_1 ET $>$ 110 GeV, jet_2 ET $>$ 30 GeV
- R1 $>$ 0.5, R2 $>$ 0.5 where
  $R_{1(2)} = \sqrt{\delta\phi_{2(1)}^2 + (\pi - \delta\phi_{1(2)}^2)^2}$
  $\delta\phi_1 = |\phi_{j1} - \phi(E_T^{miss})|$, $\delta\phi_2 = |\phi_{j2} - \phi(E_T^{miss})|$
- EM Fraction > 0.1

R1& R2



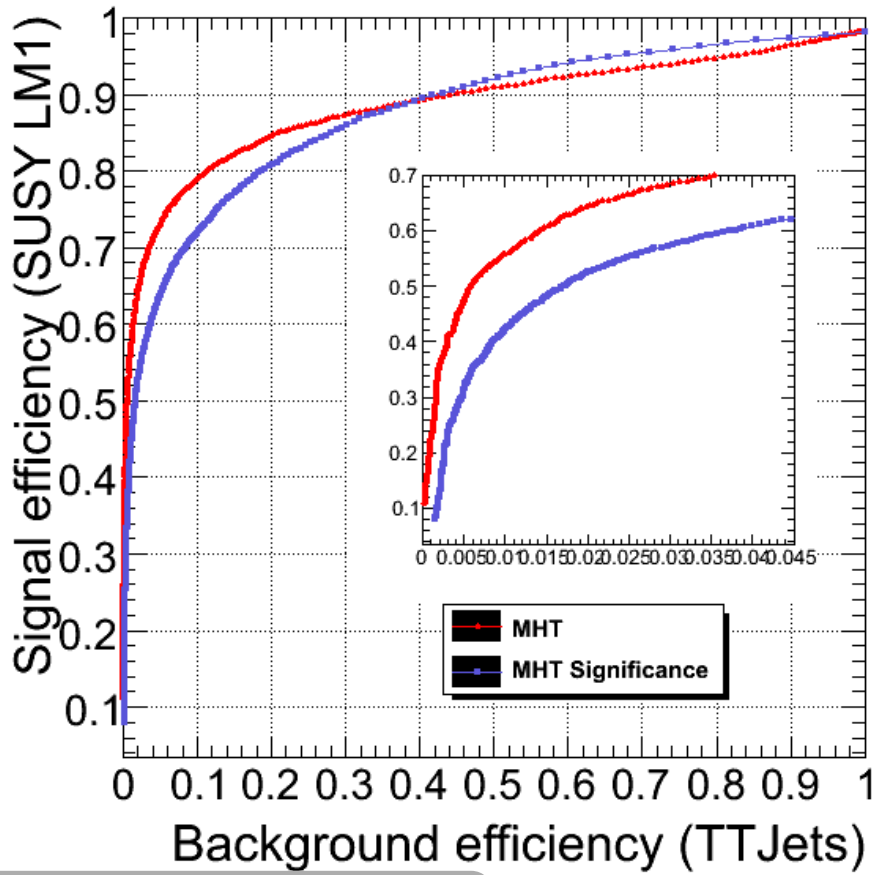
MHT vs. MHT Significance (SUSY LM1 and TTJets)



MHT and MHT Significance does almost the same job.

Signal Efficiency vs. Background Efficiency

MHT is better than MHT Significance in the background suppressing region.



The Significance might not be very useful in large MET case...

Wenu Analysis (CMS AN2007/026)

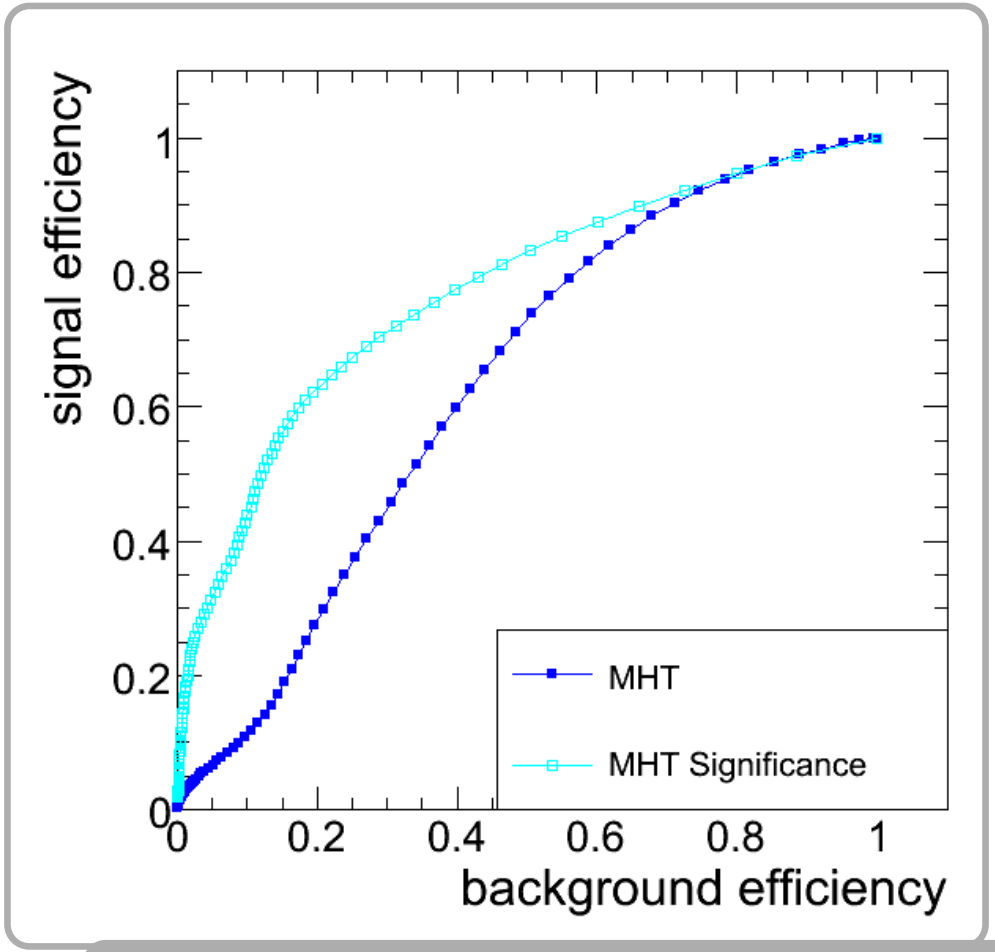
Datasets

/Wenu/Summer08_IDEAL_V9_v1/GEN-SIM-RECO
/Zee/Summer08_IDEAL_V9_v1/GEN-SIM-RECO
/Wtaunu/Summer08_IDEAL_V9_v1/GEN-SIM-RECO
/QCD_EMenriched_Pt20to30/Summer08_IDEAL_V9_v1/GEN-SIM-RECO
/QCD_EMenriched_Pt30to80/Summer08_IDEAL_V9_v1/GEN-SIM-RECO
/QCD_EMenriched_Pt80to170/Summer08_IDEAL_V9_v1/GEN-SIM-RECO

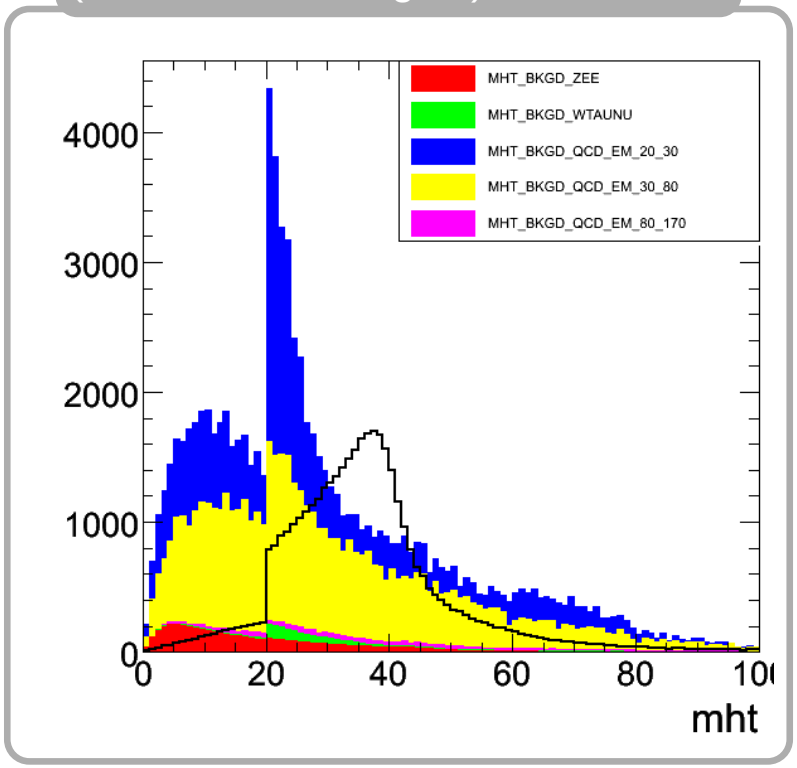
Event Selection

- HLT: Ele15_LW_L1R
- Electron in Fiducial $|\eta| < 2.5$ with $1.444 < |\eta| < 1.560$ excluded
- Electron PT > 20 GeV
- Track isolation
- Electron ID (modified robust)

Wenu - Signal Efficiency vs. Background Efficiency



MHT Distribution
(Black curve is signal)



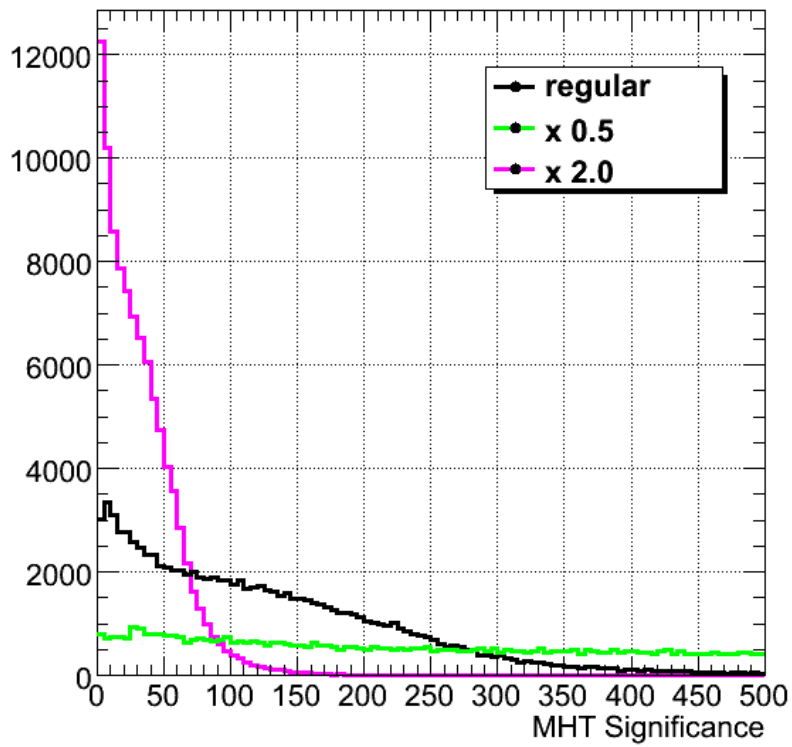
The MHT Significance looks useful in the small MET cases.

Input Objects Resolution Study

We multiply a Scale Factor on the coefficients of the resolution function of the input objects.

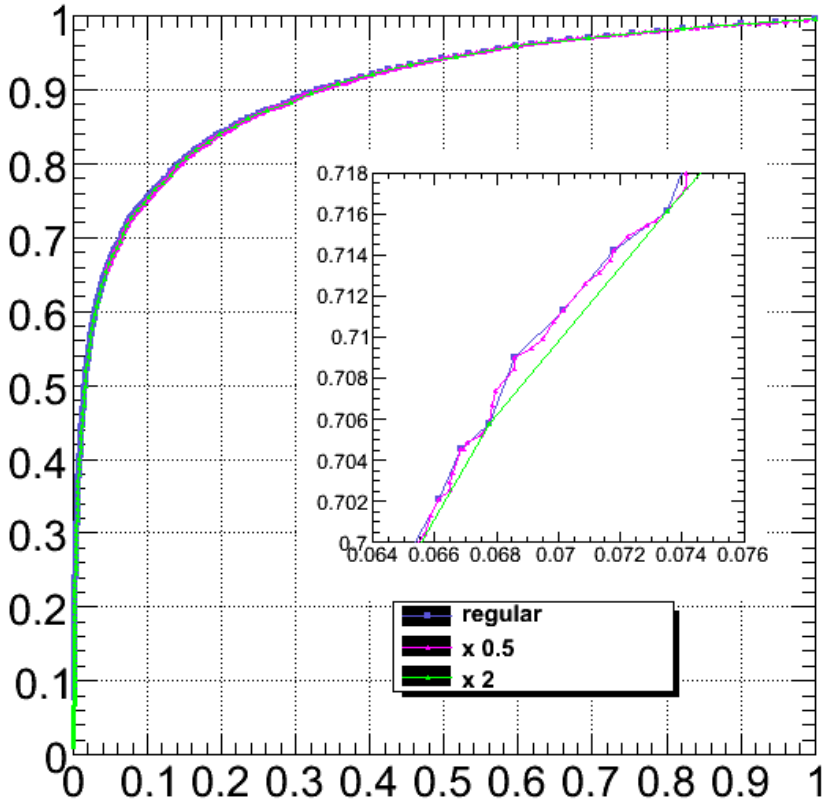
$$\left(\frac{\sigma_{E_T}}{E_T}\right)^2 = \left(\frac{a}{E_T}\right)^2 + \left(\frac{b}{\sqrt{E_T}}\right)^2 + c^2$$

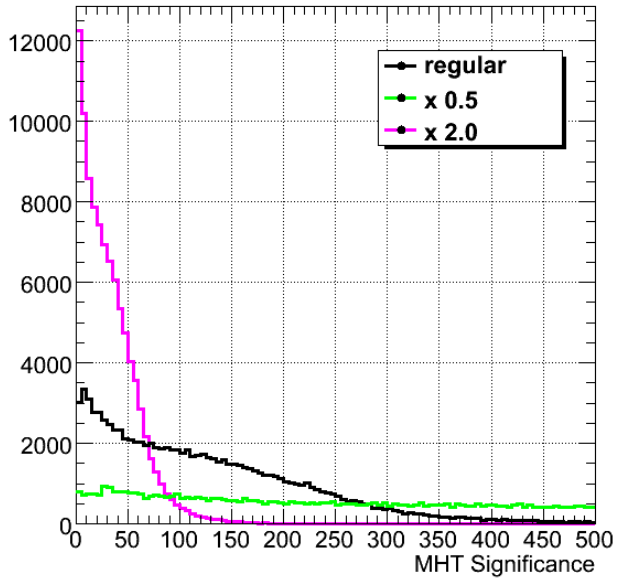
with $a = 5.6$, $b = 1.25$, $c = 0.033$



When resolution becomes small the Significance goes up (the flat green curve) .

Resolution Scale Factor





... the efficiency is insensitive to the resolution.
(by varying individual coefficient shows the same result.)

Summary

1. Ported code into CMSSW_2_2_6
2. Performance on SUSY and Wenu Analysis shows it is useful in small MET case
3. The Significance is less dependent of the input object's resolution.

Todo

- Add taus, photons into MHT Significance
- Add unclustered calo tower info $\Rightarrow$ MET Significance
- Try Particle Flow Objects

Back up slides

Number of Input Objects