MET-like L1 trigger and TP saturation effects

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Setting the stage

MET is a powerfull handle for SUSY searches

- Want to check its robustness as L1 seed
- As usual MET or MHT is the most sensitive to detector effects

Two things are important to keep in mind :

- The input to the RCT
  - Saturation/Calibrations heavily affect the resolution

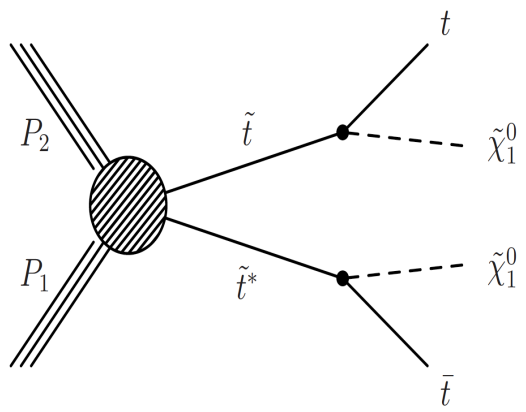
Focus of this talk

- The algorithmic part
  - Jets vs towers
  - Pt and eta threshould

In a future talk

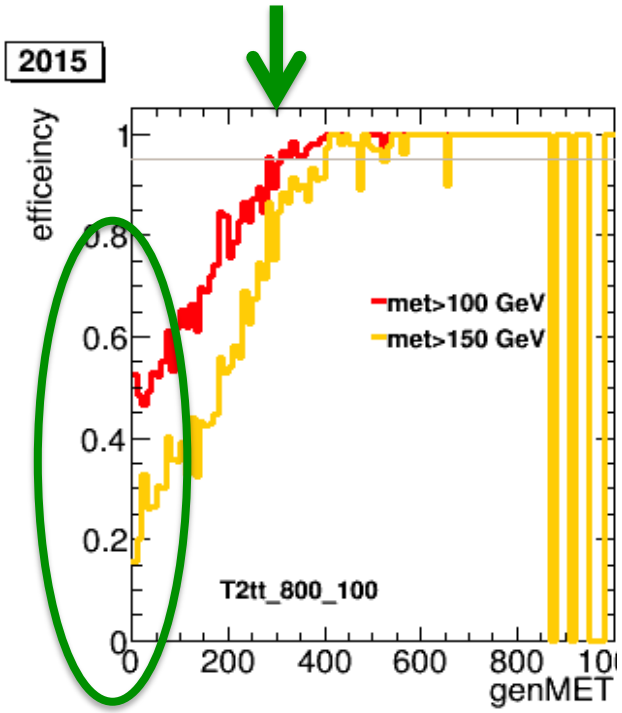
SUSY outlook

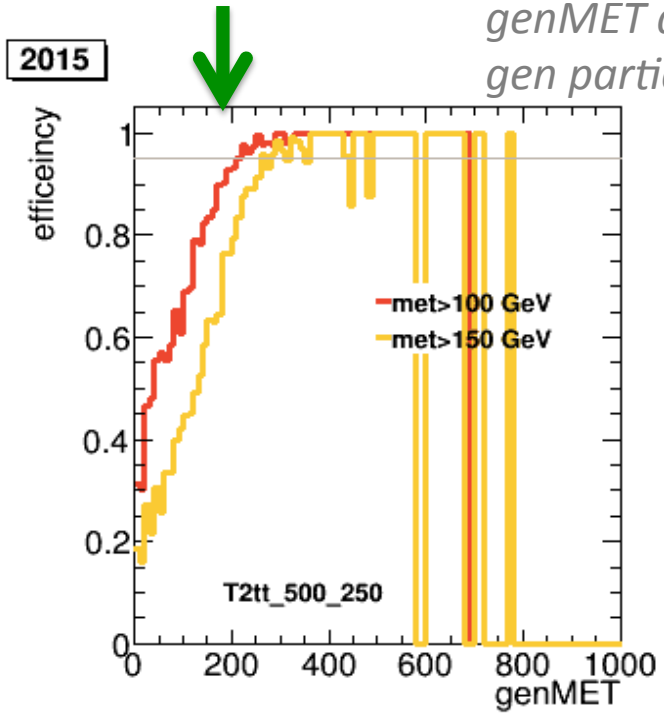
The L1 performaces studied with the simulation package
https://twiki.cern.ch/twiki/bin/viewauth/CMS/UCT2015



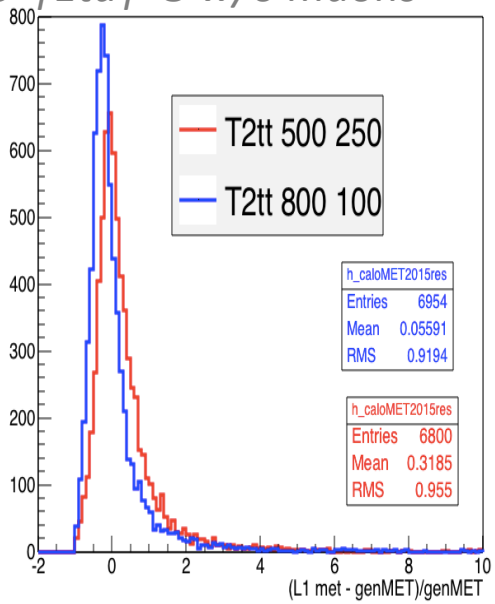
Used T2tt susy signal (effectively
ttbar with higher pt tops and extra MET) with
mass point [Stop,LSP]=[800,100] [500,250]

2015-MET turn ON





genMET defined with
gen particles |Eta|<3 w/o muons



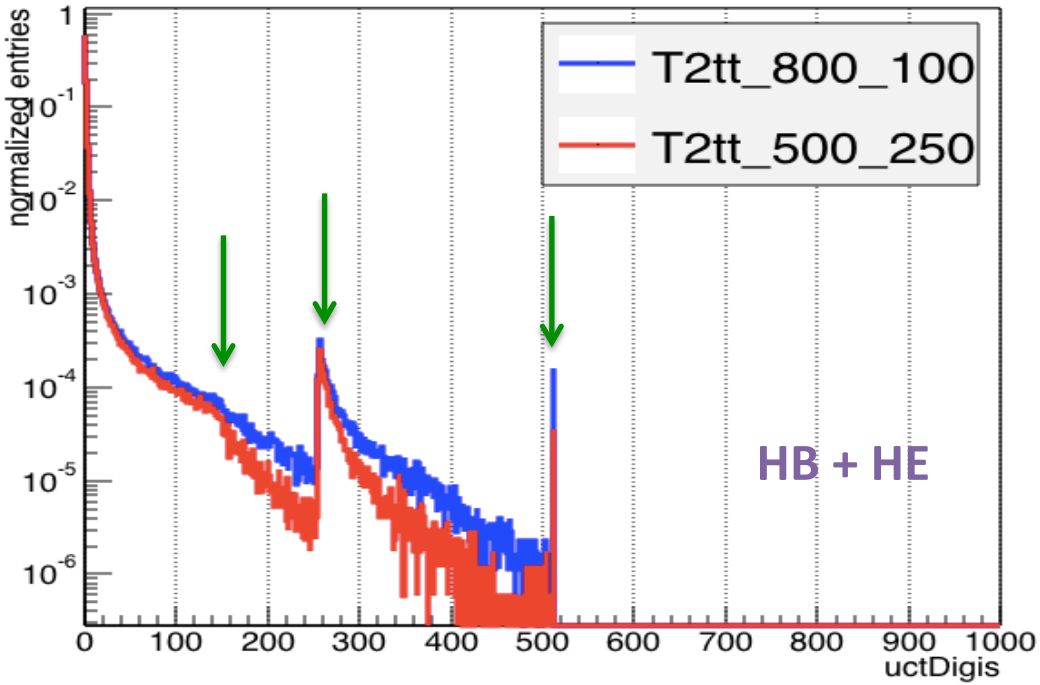
First look at the MET turn ON:

affected the low part of the turn on and position of start of the plateau.

Resolution is not ideal.

This motivated the investigation that follows in the rest of the talks

Input to the sums (4x4 = regions)



Plotted the Et of the regions that are used for the "Sums" for the two signal points considered

➔ three saturation energies are evident.

➔ T2tt_800_100 has longer tails then the T2tt_500_250 expected since has jets with higher energy than T2tt_500_250.

Saturations

Saturation of the trigger readout of the MET inputs (TP or RCT) can affect two aspects:

1. Create signal inefficiency
2. Increase the BKG rate

In next slides, evaluated the impact on MET for both.

Saturations

Here my understanding of features of our system.
https://twiki.cern.ch/twiki/bin/viewauth/CMS/L1TriggerCalorimeterScales

HCAL:

- HB/HE - 8-bit non-linear scale, decompress to 0.5 GeV LSB in RCT

ECAL:

- 8-bit linear scale, 0.5 GeV LSB

(saturate 256x0.5 GeV = 128 GeV)

RCT:

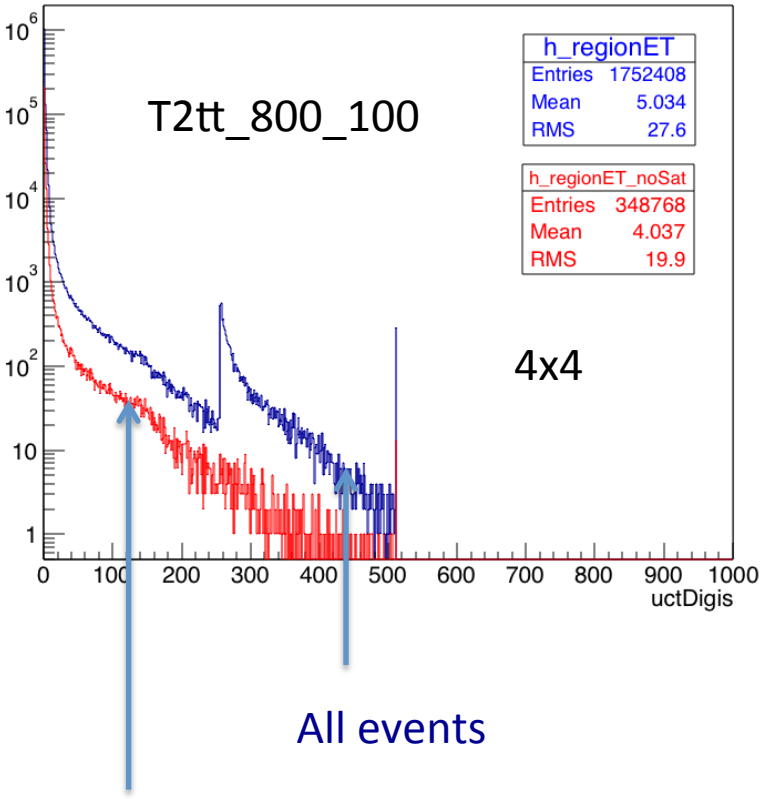
2x1 ------E/G - 6-bit linear scale, 1 GeV LSB (64 GeV max)

(saturate 64x1 GeV = 64 GeV)

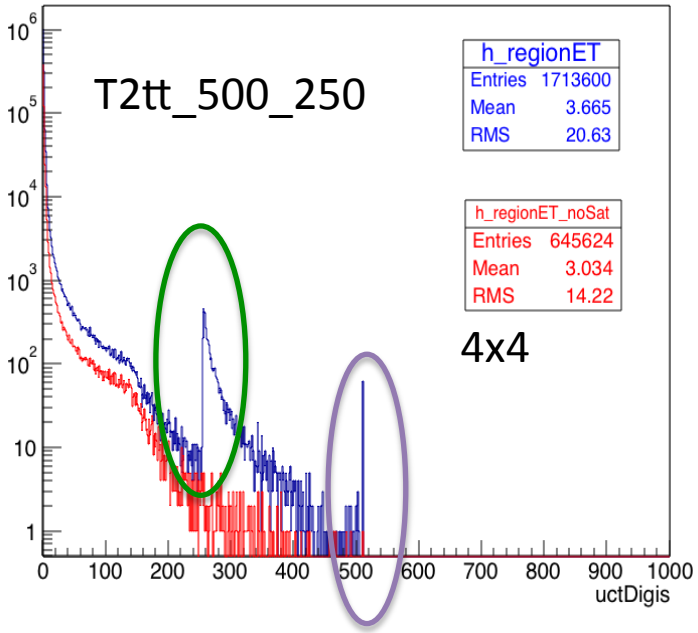
4x4 ------Region - 10-bit linear scale, 0.5 GeV LSB

(saturate 1024x0.5 GeV = 512 GeV)

ECAL Trigger primitive (1)



All events

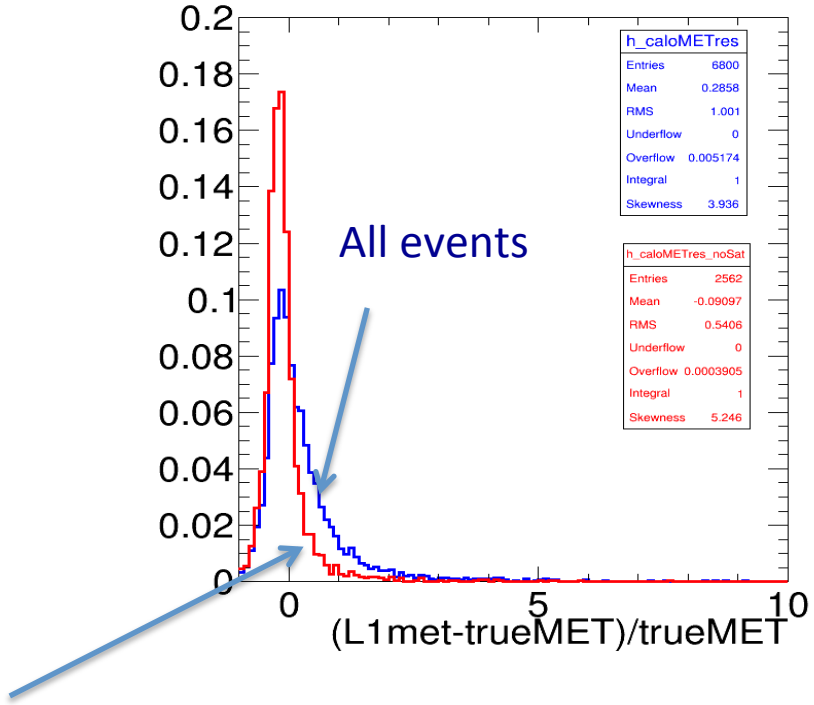


Saturation of the 8-bit of the ECAL TP

Saturation of the 10 bit of the 4x4 region

Restricted to events w/o ECAL saturation

ECAL Trigger primitive (2)



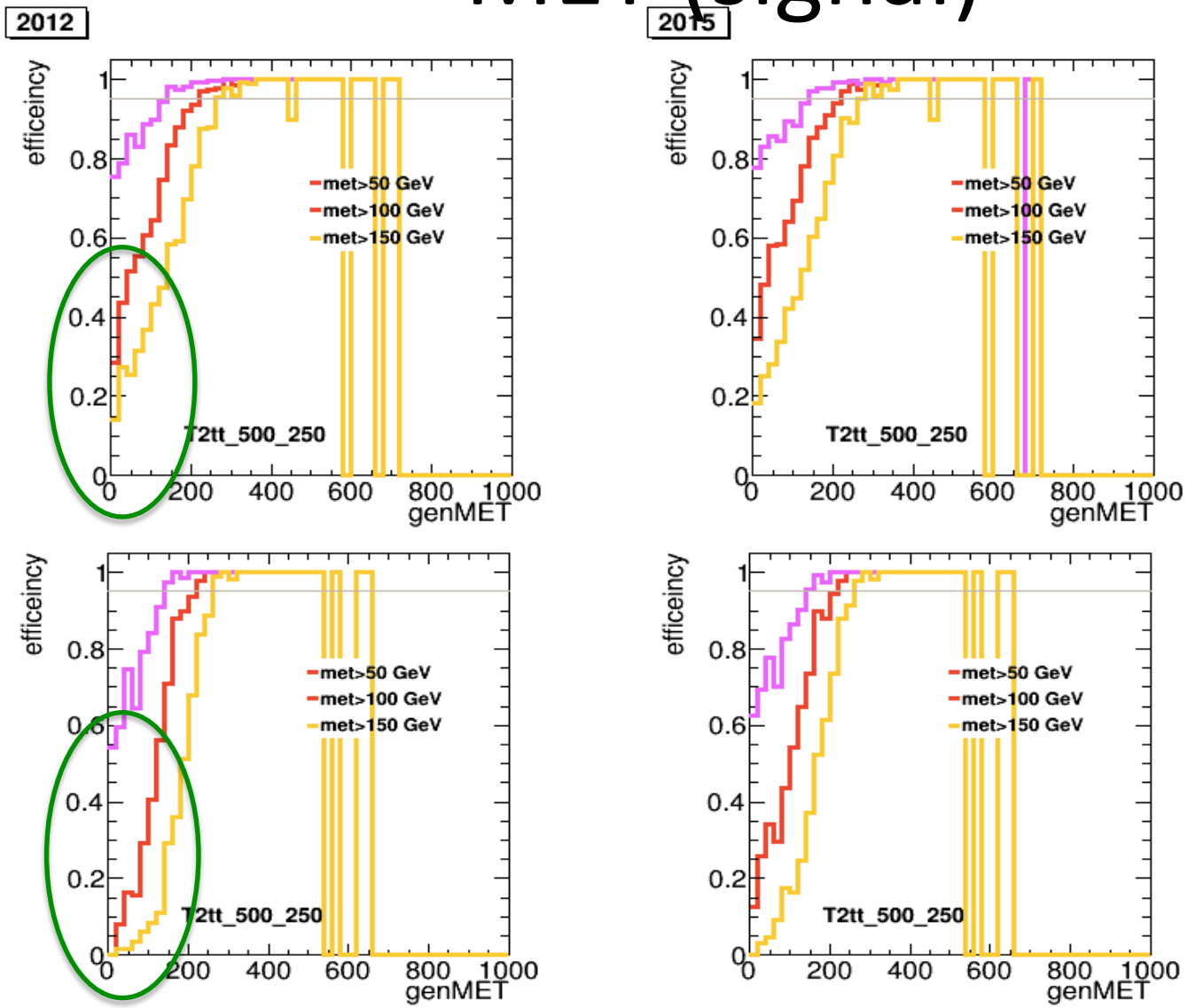
Restricted to events w/o ECAL saturation

For events w/o the saturated TP the resolution I much better.

MET (signal)

All events

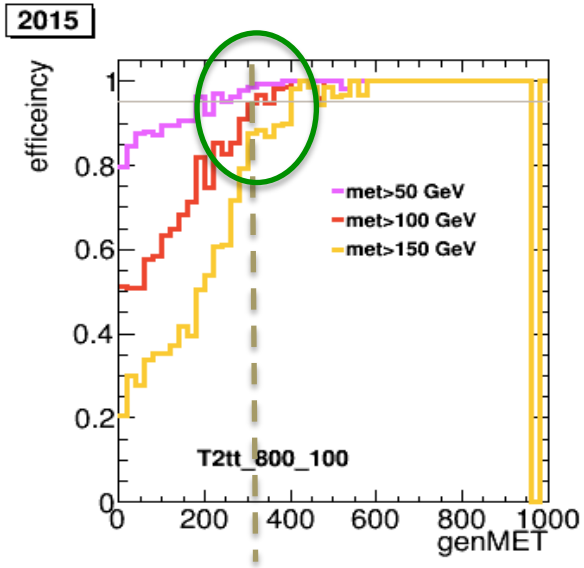
Restricted to events w/o ECAL saturation

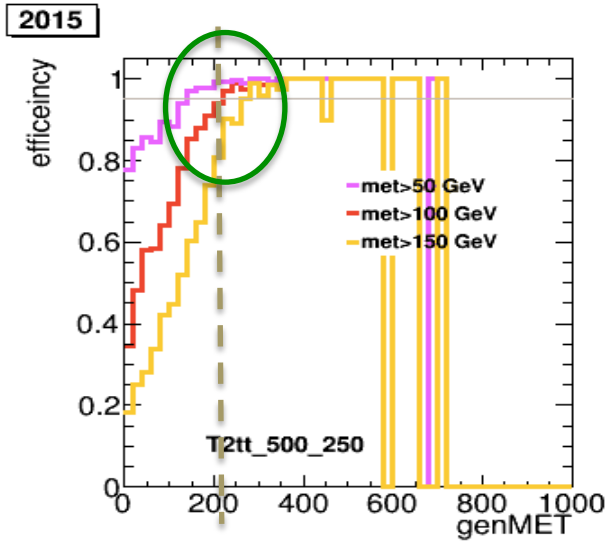


For events w/o the saturated TP the turn on is much sharper.

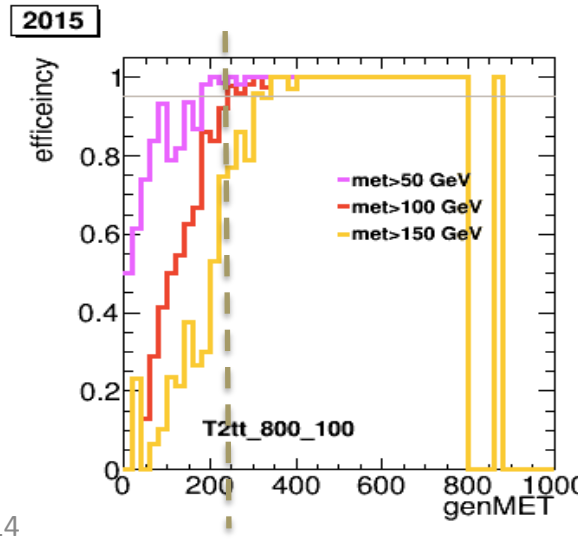
Plateau MET (signal)

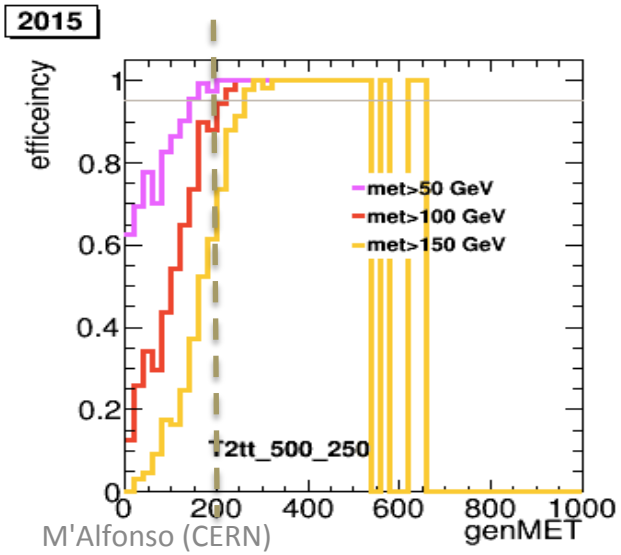
All events





Restricted to events w/o ECAL saturation





95% is different in the two signals.

95% at 200 GeV in similar in both cases as should be.

Signal Efficiency

- Tabulated the signal efficiency on the T2tt Stop=800 GeV , LSP=100 GeV

All events

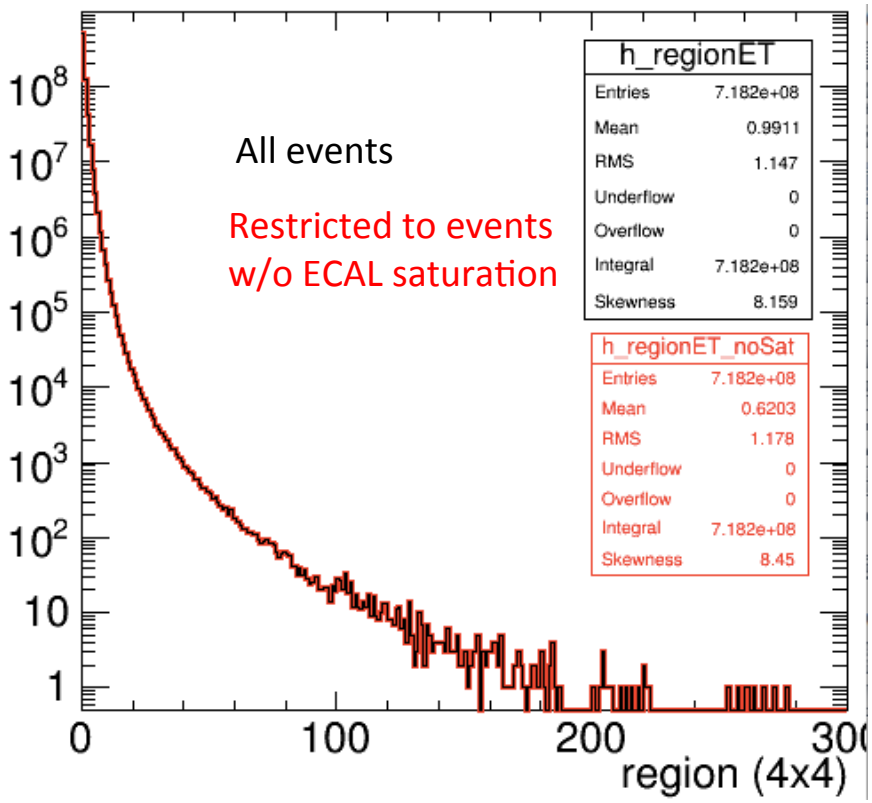
Events w/o saturated ECAL TP

	L1MET>50	L1MET>100	L1MET>150	L1MET>250
genMET > 50	94.7% → 96.%	80.4% → 85.3%	63.2%→69.9	33.3%→ 37.6%
genMET > 100	95.9% →97.1%	83.3% → 89.8	66.8%→75%	36.3%→ 40.7%
genMET > 150	96.9% →98.8	87.8% → 94.2	72.9%→ 81.1%	41.6% →45.5%
genMET > 200	97.9% →99.7	91.5%→97.4	80.0% →89.4%	48.6% →51.8%

Fixing the TP saturation effect is roughly a 5-10% increase signal efficiency for the same L1 threshold.

Next slides focus on the BKG rate

Minimum Bias

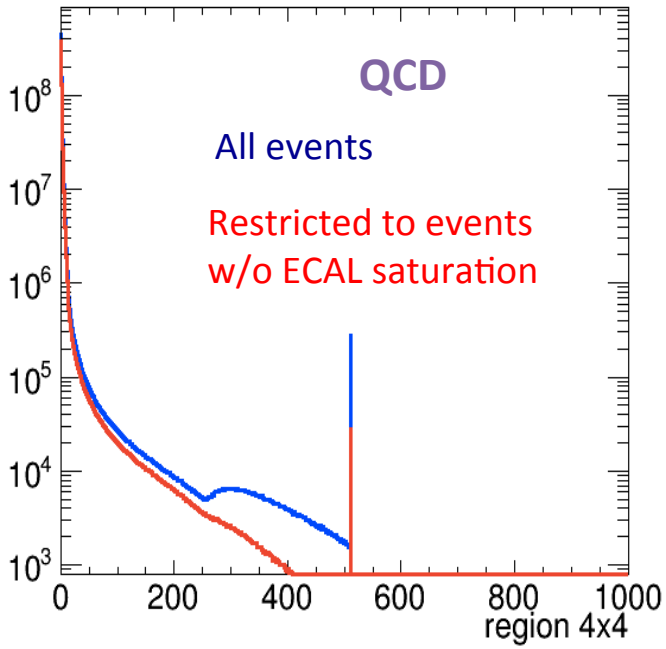


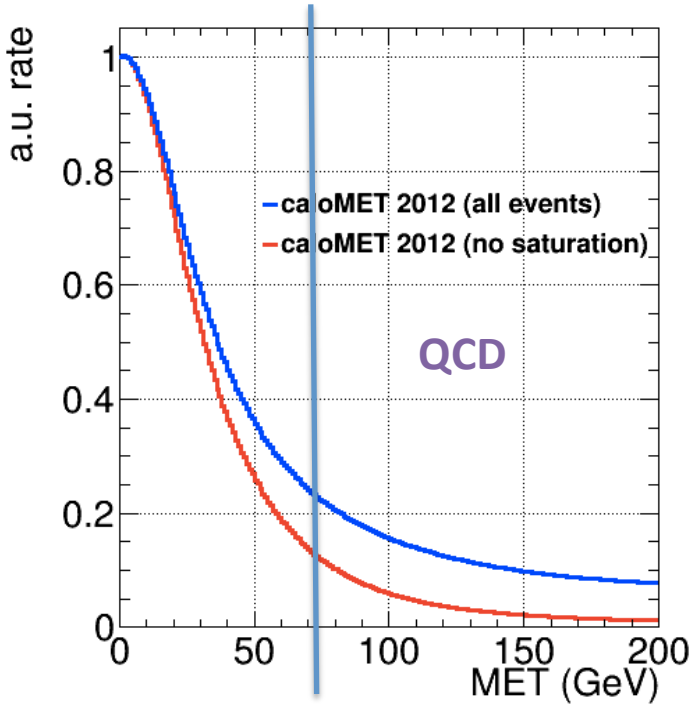
Minimum Bias
PU 40 BX 50

Plotted the Et of the regions that are used for the "Sums" in **Minimum Bias events**.
→**Regions do not saturate**

QCD

/QCD_Pt-15to3000_Tune4C_Flat_13TeV_pythia8/Fall13dr-PU40bx25_POSTLS162_V2-v1/GEN-SIM-RAW

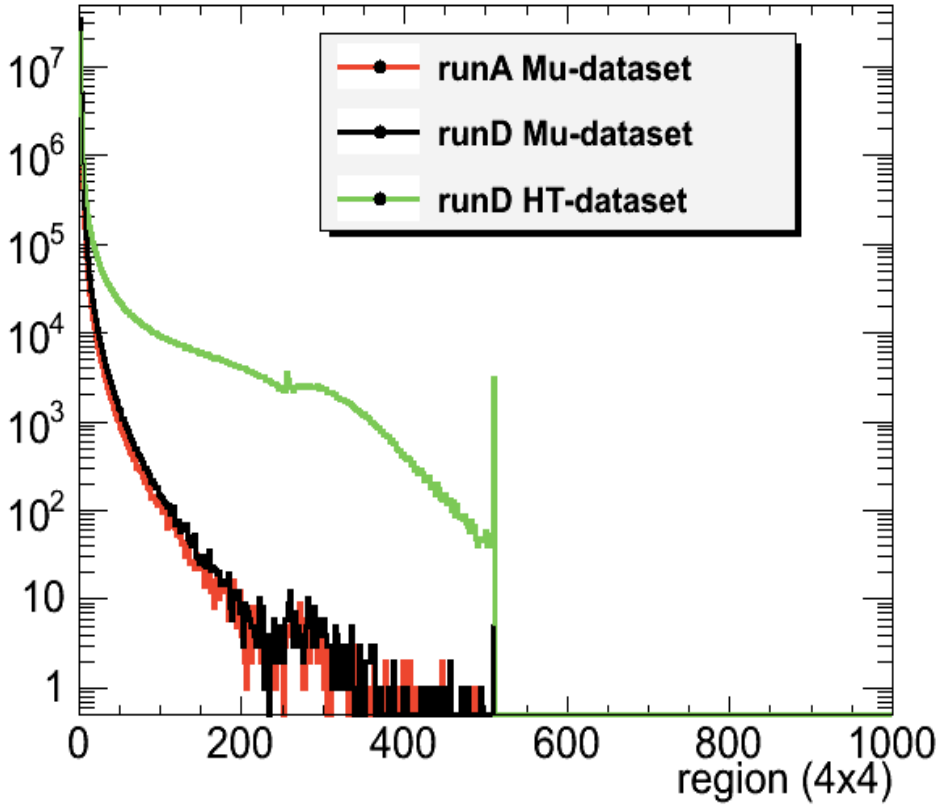




Plotted the Et of the regions
→**Regions do saturate**

MET rate for all events and w/o saturations.
There is a maximal reduction of a factor 2 in the QCD rate. The rate is arbitrary (do no know how to compare to minimum Bias rate).

2012 DATA

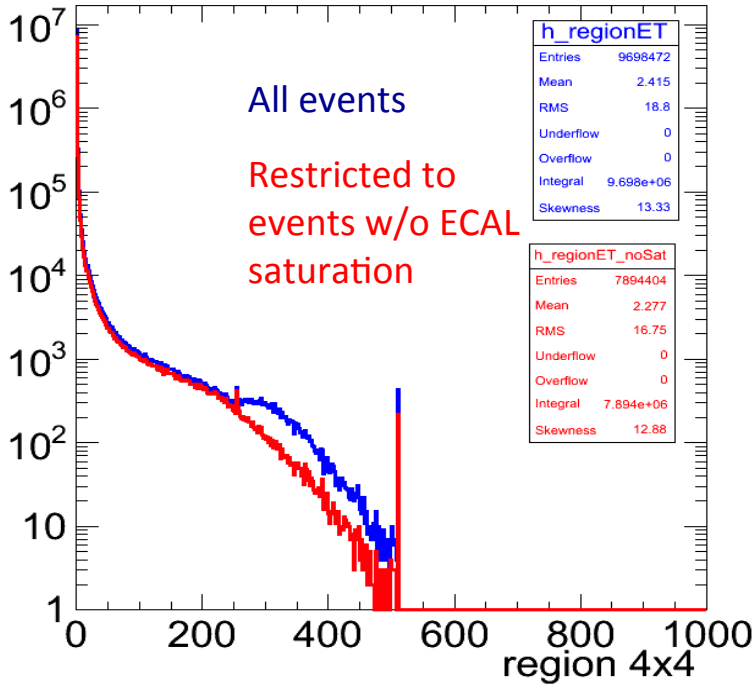


Events Trigger:
Mu-dataset:
HLT_IsoMu24*_v*
Trigger HT-dataset:
HLT_PFNoPUHT*_v*

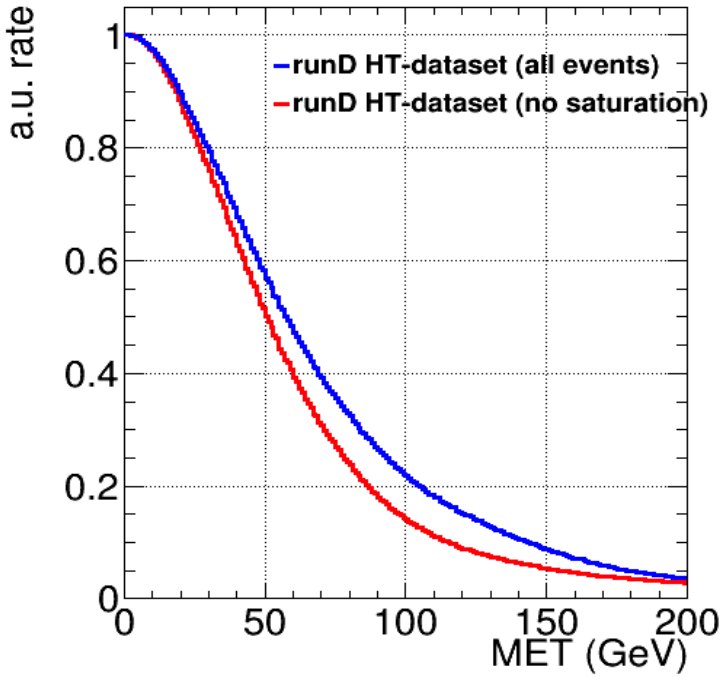
Plotted the Et of the regions for different runA and runD
→ **(Mu-dataset) Regions do not saturate**
→ **(HT-dataset) Regions do saturate** (***more on next slides)***

ECAL TP saturations HT dataset (runD)

Dataset: /Run2012D/JetHT/RAW/
Trigger: HLT_PFNoPUHT*_v*



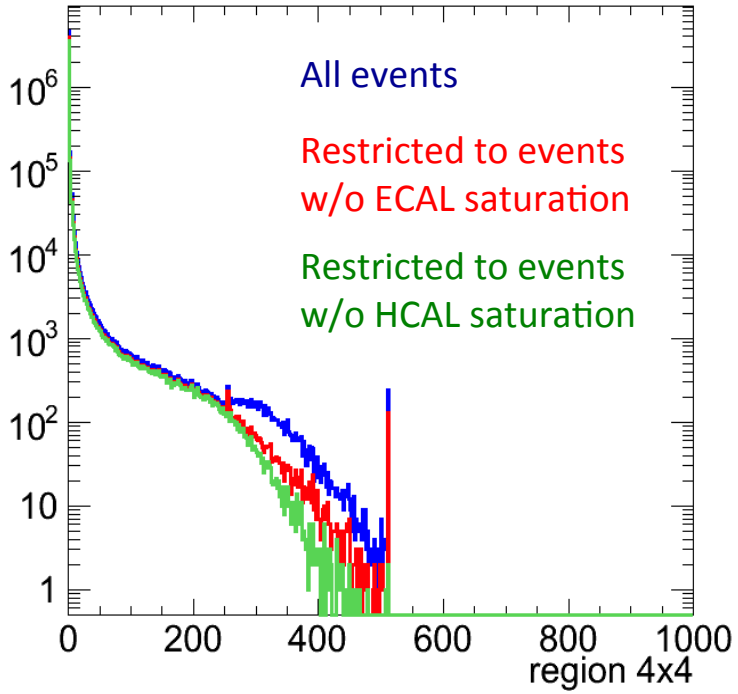
Even removing the ECAL TP saturated , we see a residual saturations at 255

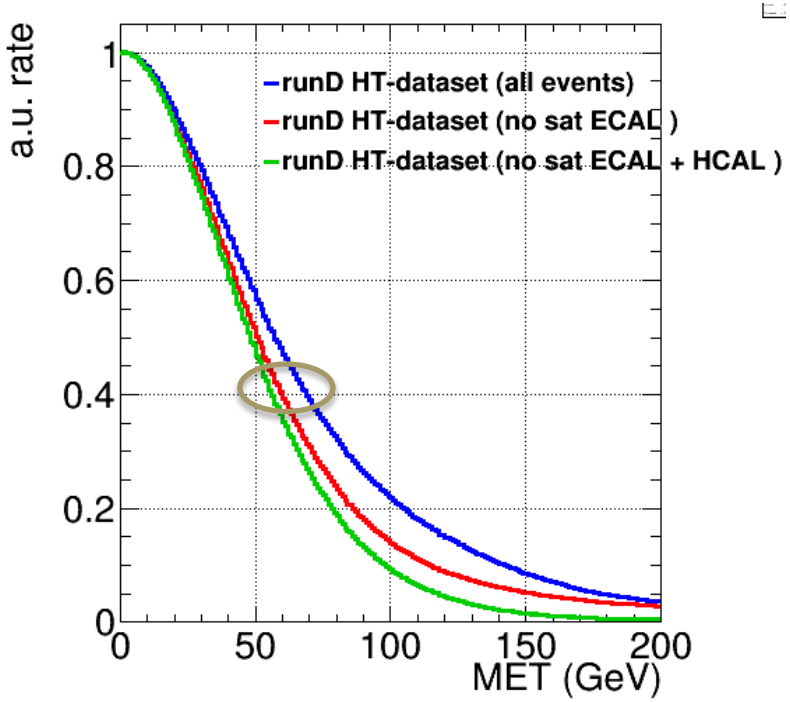


The MET rate is reduced of a factor 1.5 at L1MET=70GeV.

HCAL TP saturations HT dataset (runD)

Dataset: /Run2012D/JetHT/RAW/
Trigger: HLT_PFNoPUHT*_v*





HCAL TP have 8 bits → saturate at 255 too

In practice for the same rate you can get a lower Met threshold.

Why fix this ?

- In 2012 we were able to keep those events thanks to the HT triggers.

- For 2015 we want to be robust for saturation for met for trigger strategy:
  - i.e. HT+MET or jet+MET add cross trigger

Conclusion/questions

Demonstrated saturation effects for both signal and QCD BKG.

Questions for the hardware experts:

Ecal:

- adjust the dynamic range (non linear scale) ?

Hcal

- Can we use one extra bit (Qbit is not used now) ?
- adjust the dynamic range ?