

# **Resolving Overlap between $H \rightarrow \tau\tau \rightarrow \ell\ell$ and $H \rightarrow WW$ Channels**

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# Selection in the $H \rightarrow WW$ Channel

- For the CMS-wide combination overlap between  $H \rightarrow WW$  and  $H \rightarrow \tau\tau$  channels should be resolved
  - apply of cuts orthogonal to the  $H \rightarrow WW$  selection
  - $H \rightarrow WW$  selection cuts :

$$p_{T,\ell} > 20 \text{ (15) GeV}/c$$

$$m_{\ell\ell} > 20 \text{ GeV}$$

$$p_{T,\ell\ell} > 30 \text{ GeV}/c$$

$$E_T^{\text{mis}} > 37 + N_{\text{vtx}}/2$$

$$m_T > 30 \text{ GeV}/c$$

$$m_T = \sqrt{2 \cdot E_T^{\text{mis}} \cdot p_{T,\ell\ell} (1 - \cos \Delta\phi)}$$

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# Selection in the $H \rightarrow WW$ Channel

Cut  $m_T > 30 \text{ GeV}$  seems to be loose  
pre-selection cut in  $H \rightarrow WW$  analysis

## According to Guillelmo

Hi Giovanni,

I think the main worry is the emu channel. In this case we have an almost ensure not-overlapping by requiring  $m_T < 60$  ( $H\tau\tau$ ) and  $m_T > 50$  ( $Hww$ ). Indeed, there is a tiny 10GeV region with possible overlap, but in that region there is little amount of  $H \rightarrow \tau\tau$  nor  $H \rightarrow WW$  events. Furthermore, there is a projected  $MET > 20$  cut in  $H \rightarrow WW$  which kills all the  $H\tau\tau$  background.

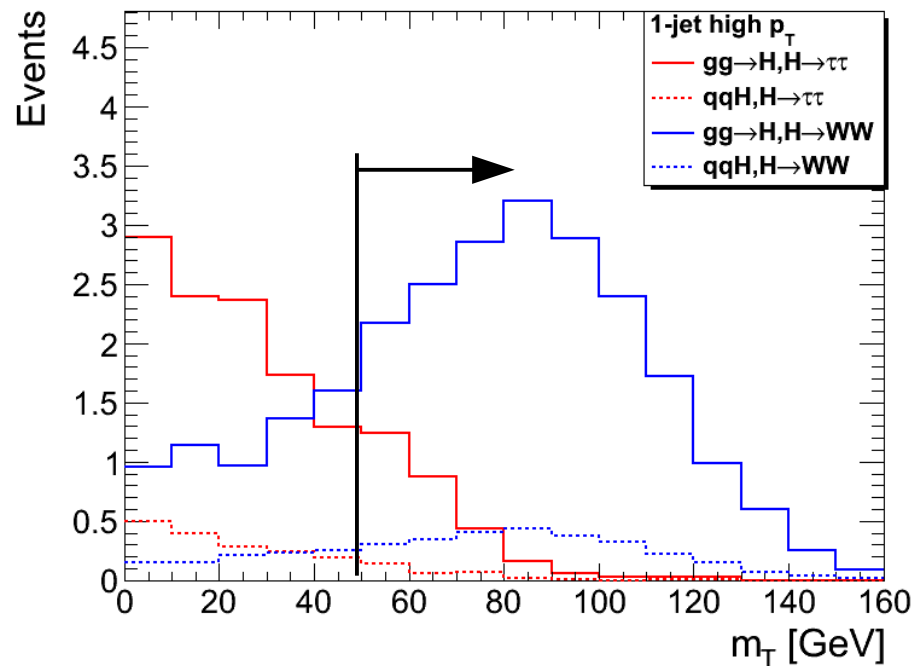
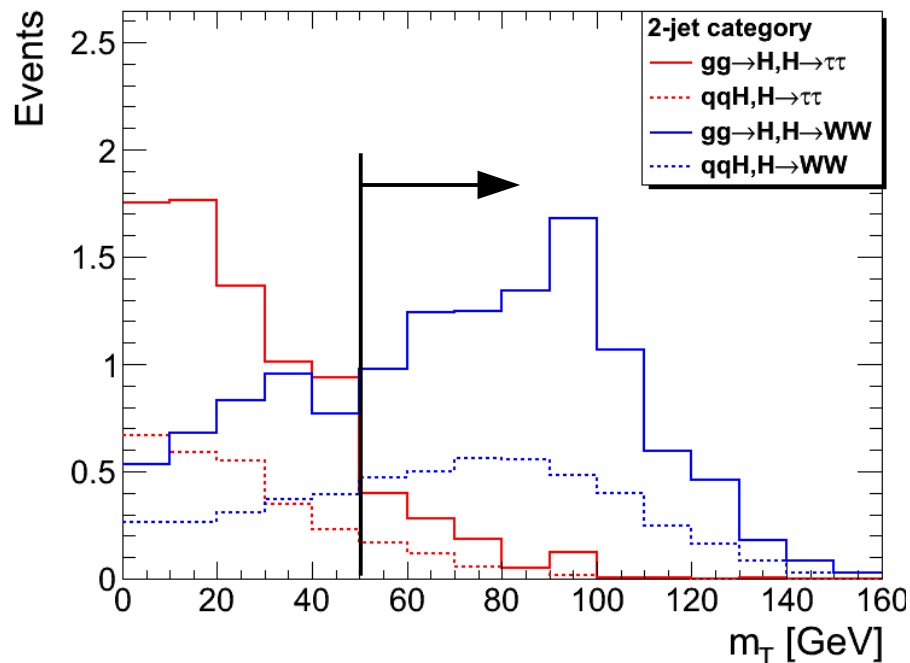
Cheers, Guillelmo

This suggests usage of looser cuts

$m_T < 50(60) \text{ GeV}$

# Studies with signal MC

- Study with signal MC (EE channel)

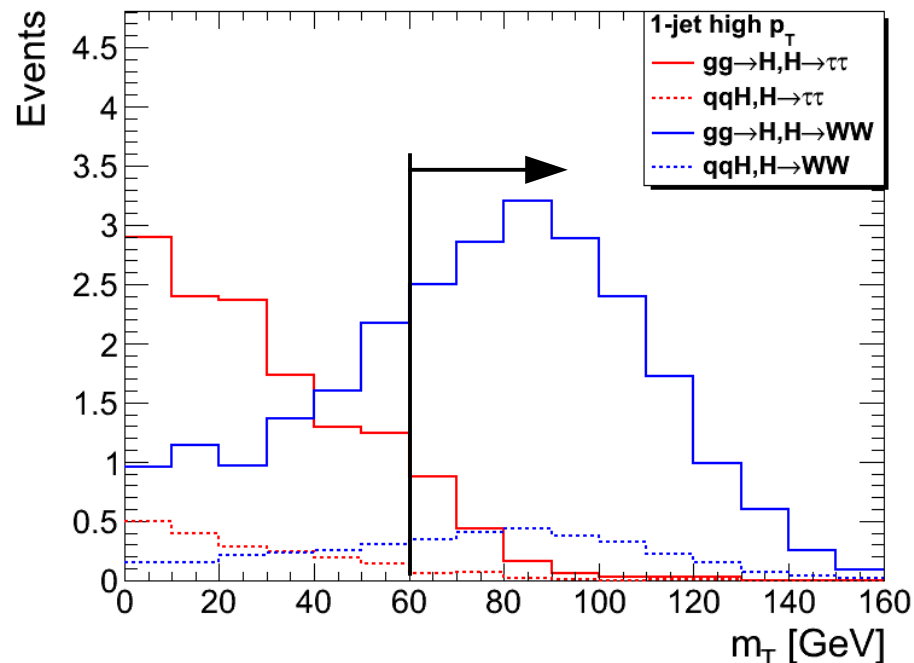
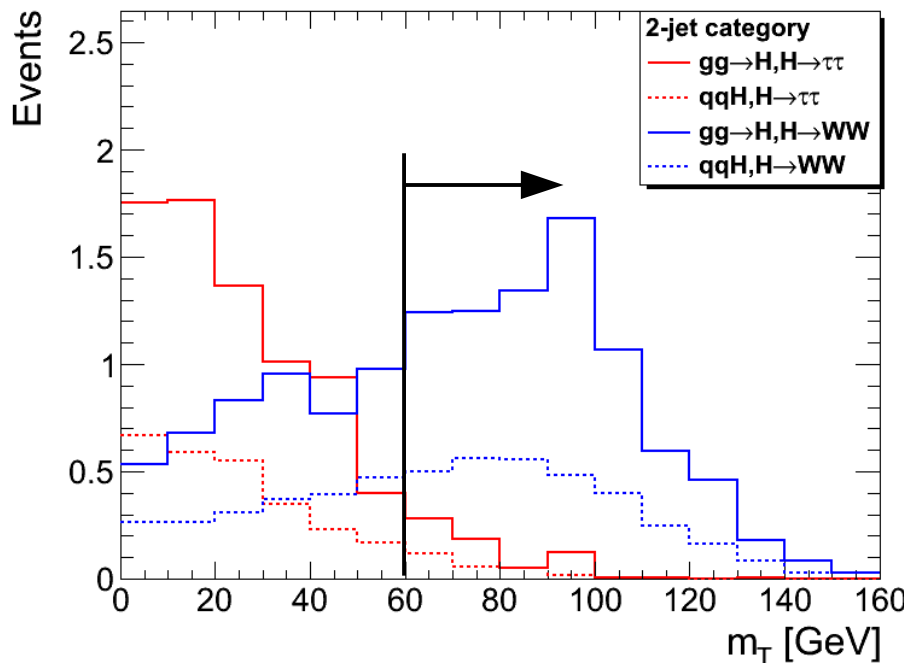


$$m_T < 50 \text{ GeV}$$

**$\approx 5\text{-}20\%$  loss in efficiency depending on event category**

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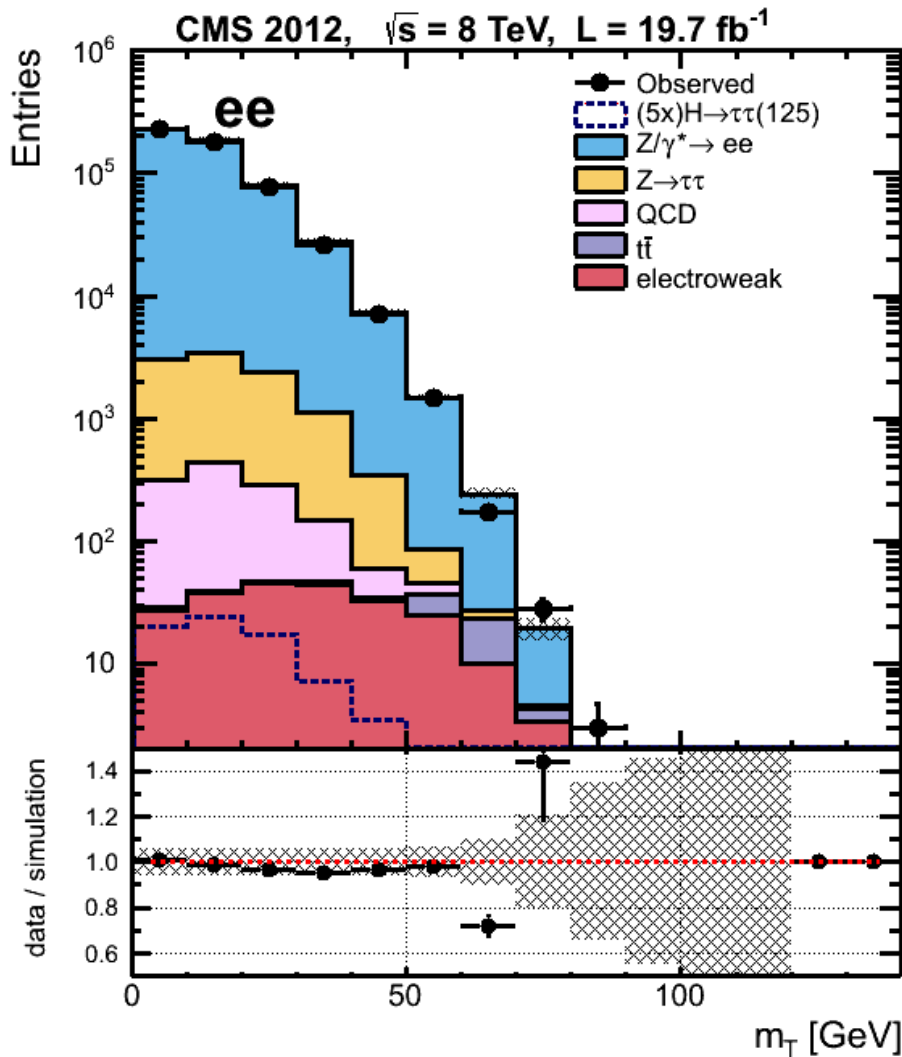


$$m_T < 60 \text{ GeV}$$

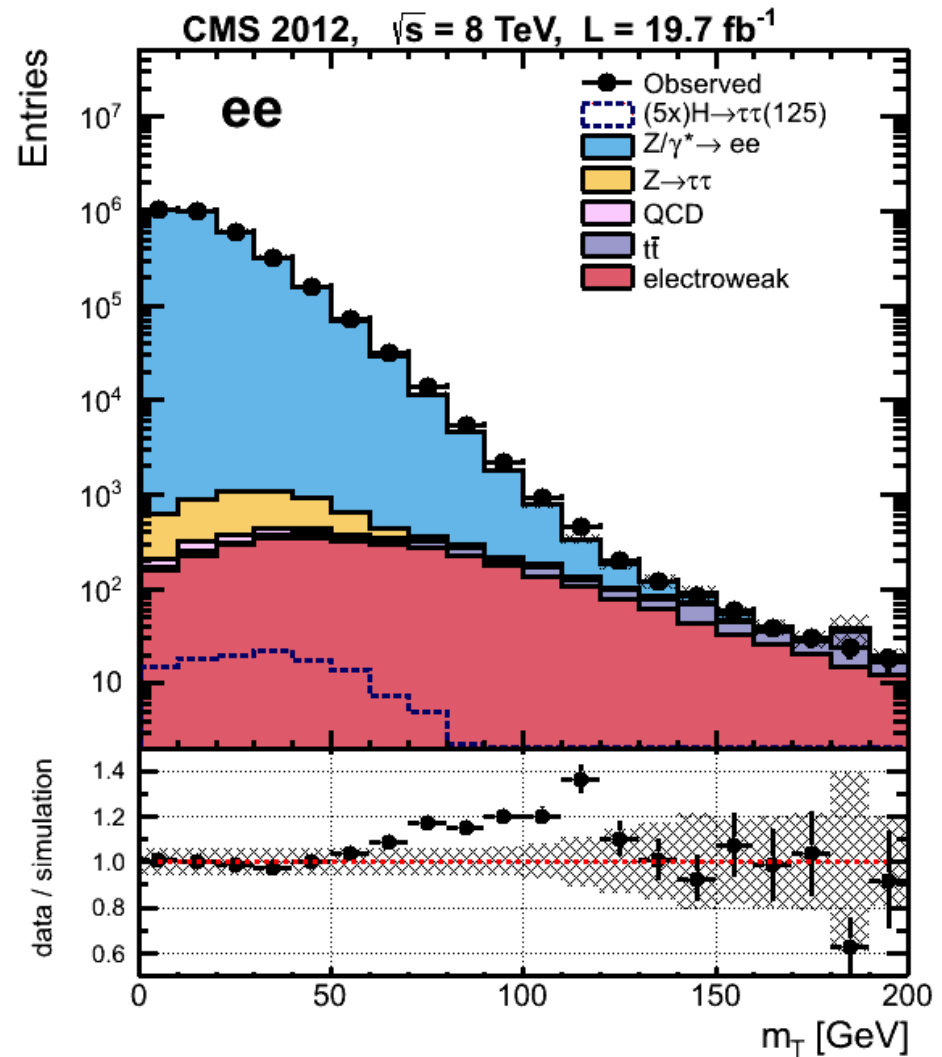
$\approx 2\text{-}15\%$  loss in efficiency depending on event category

# Data and Background

## 0-jet low $p_T$



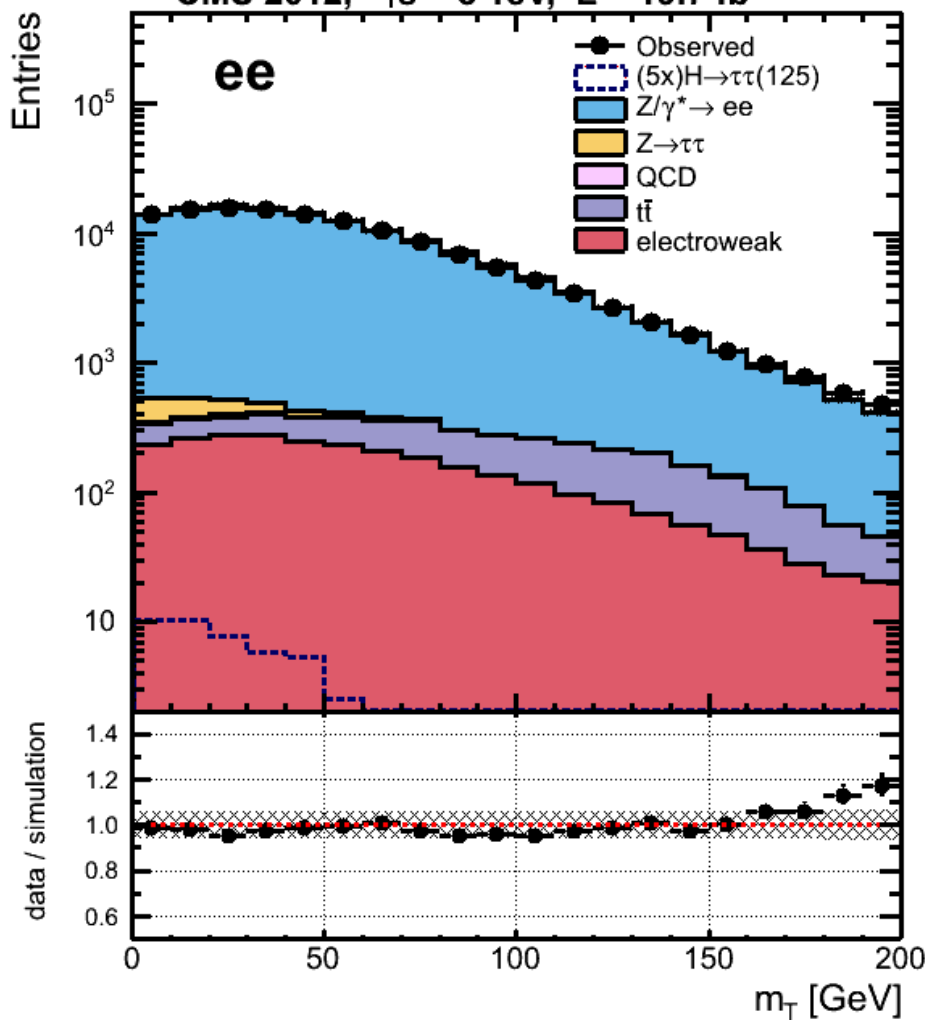
## 0-jet high $p_T$



# Data and Background

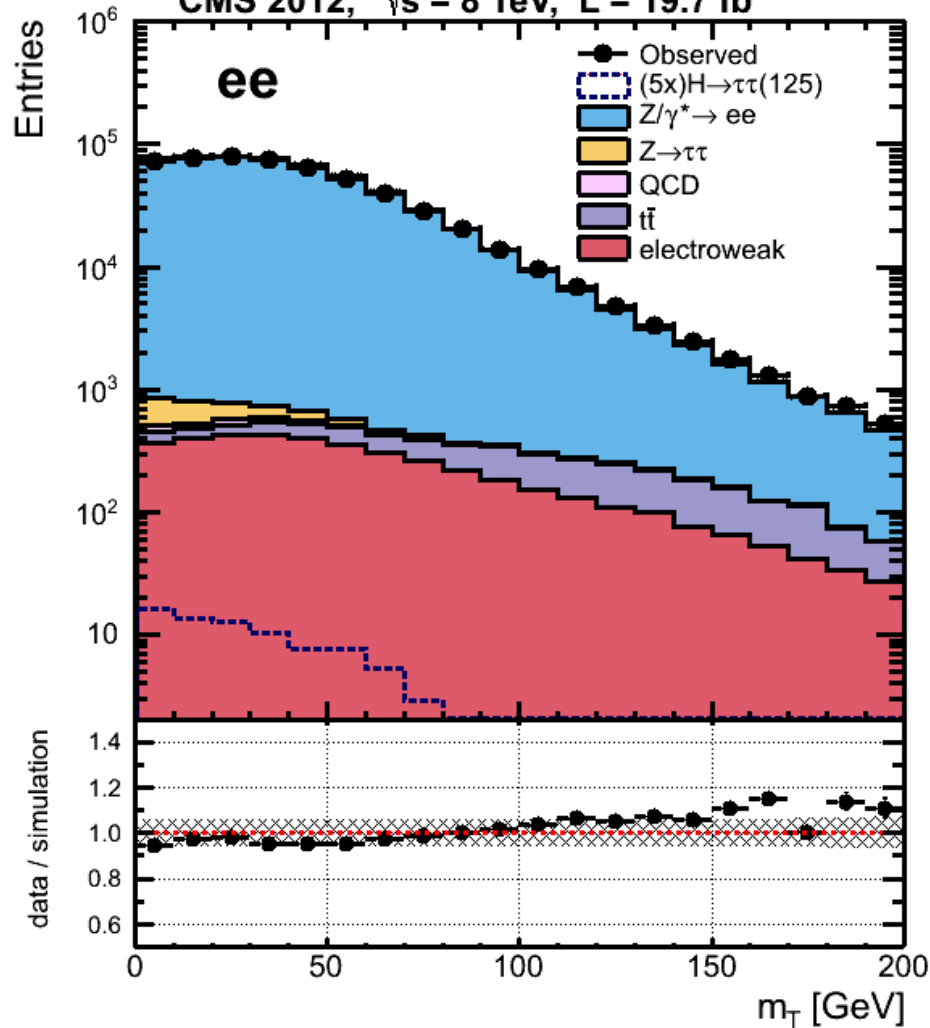
## 2-jet

CMS 2012,  $\sqrt{s} = 8 \text{ TeV}$ ,  $L = 19.7 \text{ fb}^{-1}$



## 1-jet high $p_T$

CMS 2012,  $\sqrt{s} = 8 \text{ TeV}$ ,  $L = 19.7 \text{ fb}^{-1}$





# Notes on Background normalization

- **Uncertainty model in the  $H \rightarrow \tau\tau \rightarrow \mu\mu/ee$  channels is very sensitive to the  $Z \rightarrow \mu\mu/ee$  background normalization**
  - **$\%_0$  -  $\%$  level**
- **Cuts on  $m_\tau$  may change overall normalization by amount  $\gg$  uncertainty on the  $Z \rightarrow \mu\mu/ee$  background normalization**
  - **Normalizations of the  $Z \rightarrow \mu\mu/ee$  backgrounds must be recomputed after applying  $m_\tau$  cut**
  - **Use first bin in final discriminant distributions as a side-band to determine  $Z \rightarrow$  normalization**
- **Does  $m_\tau$  cut significantly affect shape of final discriminant**
  - **If yes, DY MC corrections should be re-determined**
- **Overlap with  $H \rightarrow WW$  selection is being verified with event list provided by Guillelmo Check**
- **SONAS disk on NAF2 is currently down**
  - **delays further tests and datacards production in the  $H \rightarrow \tau\tau \rightarrow ee$  channel**