

# VBF Higgs to Invisible

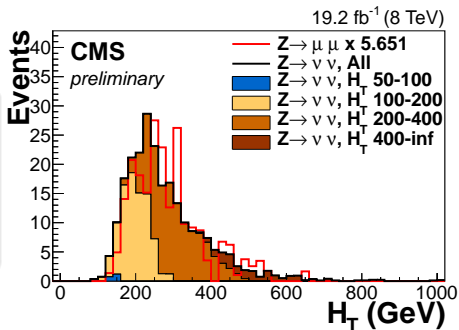
HIG-14-038, AN-14-243

## Overview

- ▶ Investigate whether ATLAS/CMS difference is due to use of  $Z \rightarrow \mu\mu$  sample
  - They use a real  $Z \rightarrow \nu\nu$  sample
- ▶ Our  $Z \rightarrow \nu\nu$  sample is missing the  $H_T < 50$  GeV region

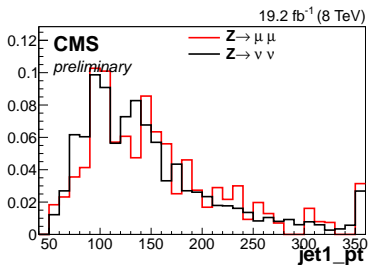
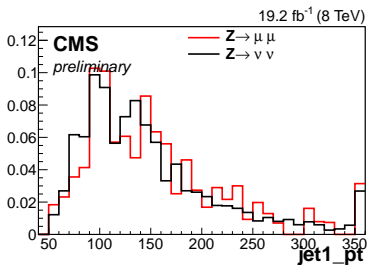
## HT makeup of $Z \rightarrow \nu\nu$ sample

- ▶ Signal region selection applied
- ▶ No steps visible due to  $H_T$  binning
- ▶  $Z \rightarrow \nu\nu$  appears slightly softer than  $Z \rightarrow \mu\mu$
- ▶  $H_T > 50$  GeV cut doesn't seem to bias the sample in this region



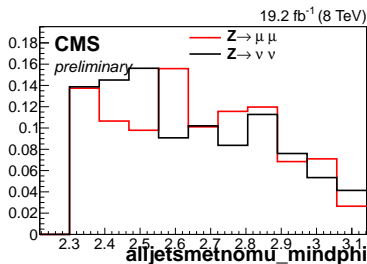
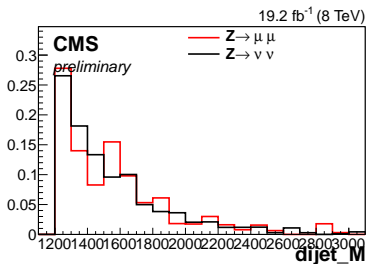
## Distribution comparison

- Normalise  $Z \rightarrow \nu\nu$  and  $Z \rightarrow \mu\mu$  to 1 and compare



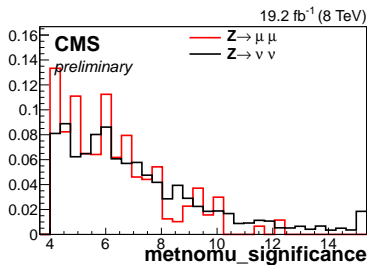
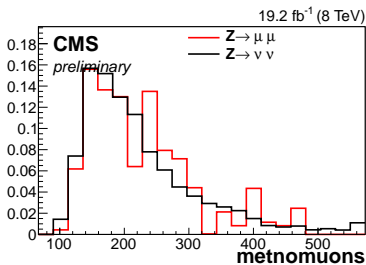
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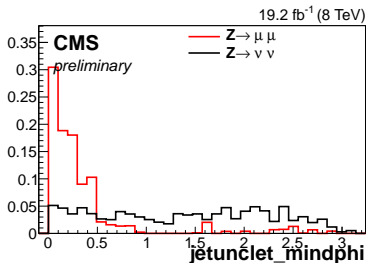
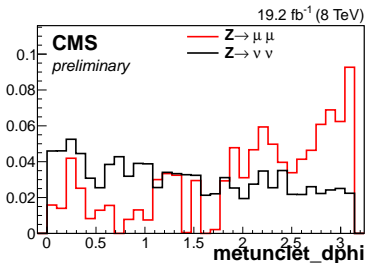
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- $Z \rightarrow \mu\mu$  events always have met opposite and jets aligned with unclustered

## Unclassified issue

- Check definition of unclassified

$$\begin{aligned}\overrightarrow{\text{Unclassified}} &= mET - mhT \\ &= - \sum_{\text{all pF candidates}} \overrightarrow{} + \sum_{\text{jets}} \overrightarrow{} \\ &= - \sum_{\text{all nonjet pF candidates}} \overrightarrow{}\end{aligned}$$

- Jet collection that was used to generate unclassified has been cleaned for leptons
- Unclassified in events with leptons is therefore opposite the leptons
- This explains the behaviour seen on the previous slide



## Summary

- ▶  $Z \rightarrow \nu\nu$  sample looks very similar to  $Z \rightarrow \mu\mu$  sample in signal region
  - Only difference is understood and not in a variable used in the analysis
- ▶ Therefore not likely to be cause of difference with ATLAS
  - Could study looser regions
- ▶ In run 2 there is a request for an EWK  $Z \rightarrow \nu\nu$  sample
- ▶ We could maybe use these and drop the different Z background method
  - Better stats and fewer theory uncertainties

## Backup