Imperial College London

VBF Higgs to Invisible

HIG-14-038, AN-14-243

Overview

- We predict almost twice as many $\mu\nu$ events than $e\nu$ events
  - $W \to \mu\nu$: $101.8 \pm 6.1 \pm 12.2$, $W \to e\nu$: $57.4 \pm 7.3 \pm 6.7$
- Data driven scale factors are different but compatible at just over 1σ when systematics are accounted for
- We see a significant difference in the signal region MC yield (24% difference)
- It was suggested that we separate events by gen lepton in/outside acceptance
  - If difference is due to ID we should see no difference outside acceptance

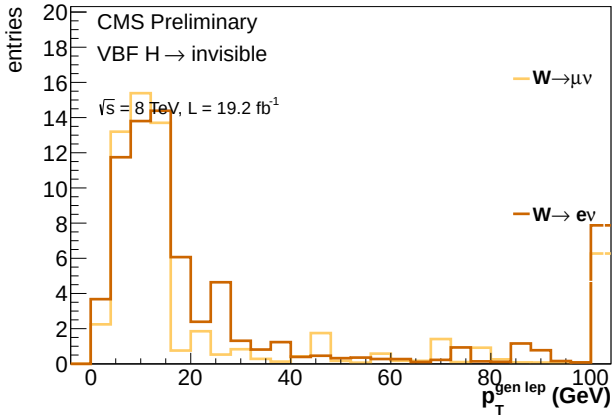
Inside/outside acceptance check

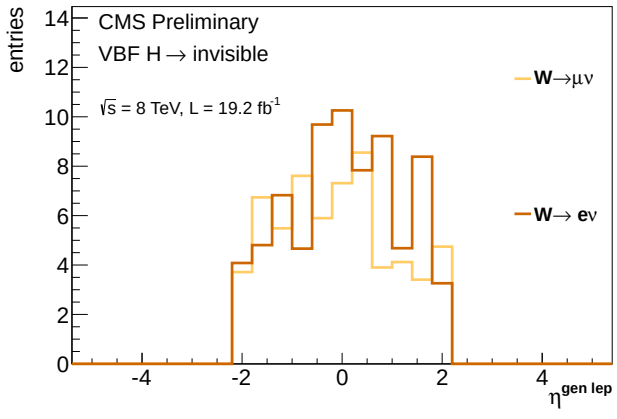
- Check MC yield in signal region from $W \to e/\mu\nu$
  - i.e. we veto any reconstructed leptons
- Split into events with gen lepton inside acceptance ($|\eta| < 2.1$) and outside acceptance ($|\eta| > 2.4$)

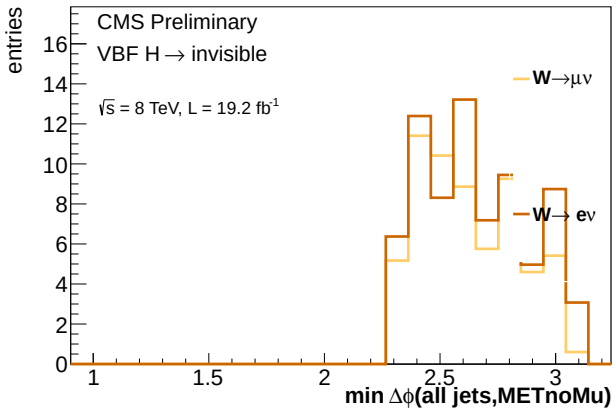
Process	Inside acceptance	Outside acceptance
$W \to e\nu$	73.7 ± 6.8	30.2 ± 4.9
$W \to \mu\nu$	61.5 ± 6.8	74.4 ± 7.3

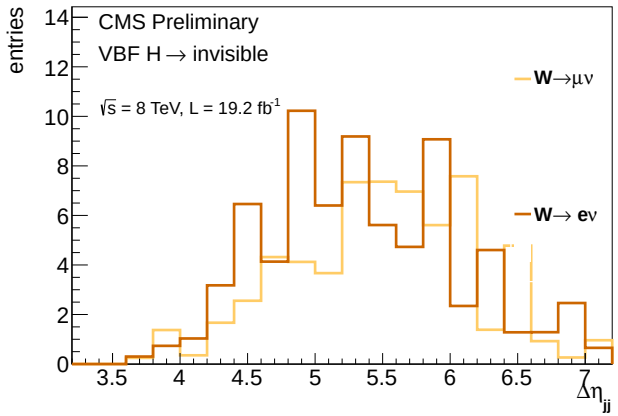
- Inside acceptance results are as expected:
  - slightly more $e\nu$ events
  - this is because electron ID efficiency is lower so fewer events are vetoed
- Outside acceptance results not as expected:
  - outside acceptance there are a lot fewer $e\nu$ events than $\mu\nu$

Distributions inside acceptance



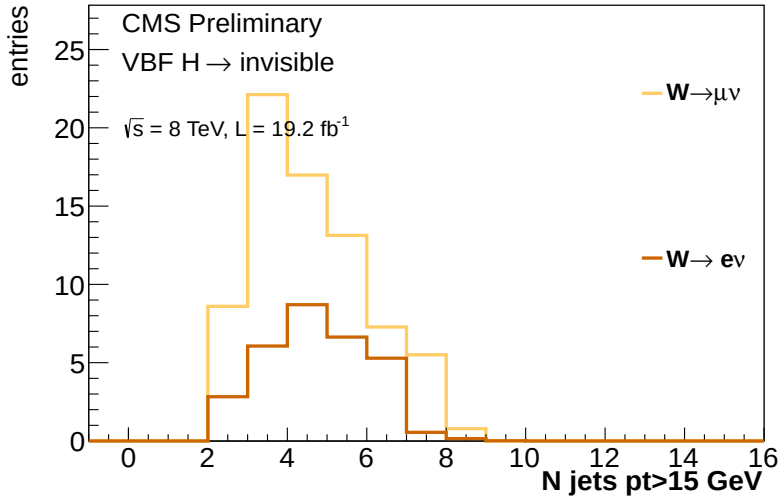


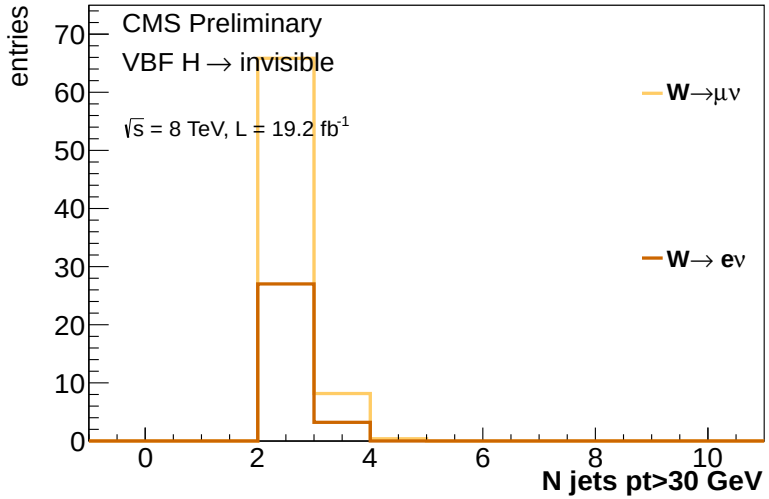


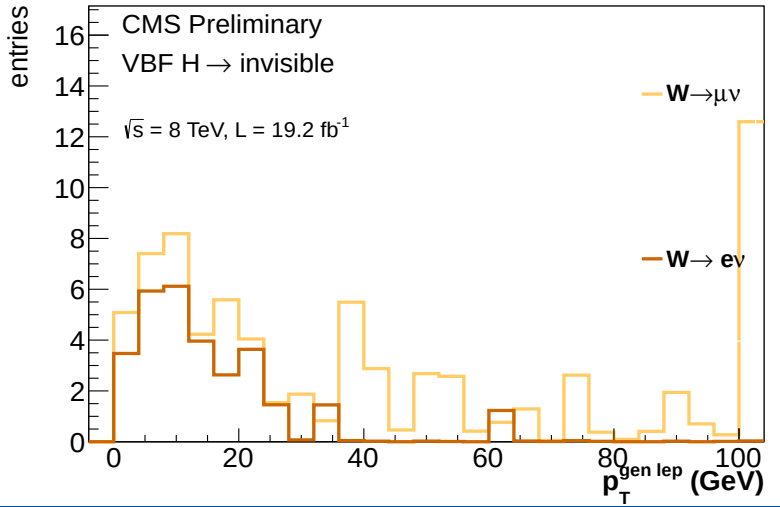


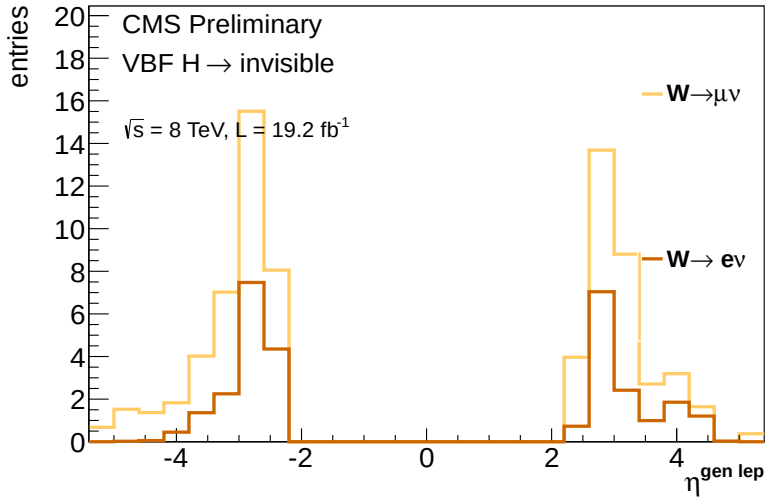
- Shape agreement is also reasonably good inside acceptance

Distributions outside acceptance





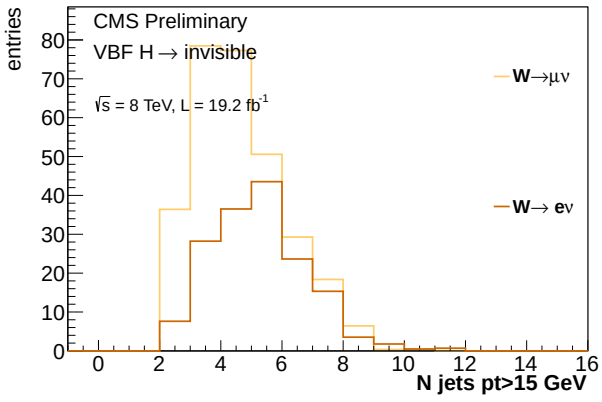


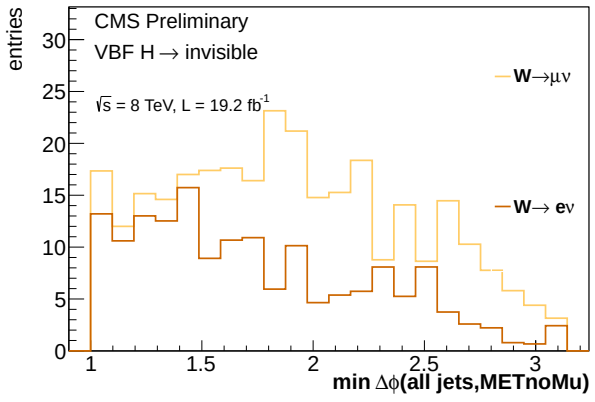


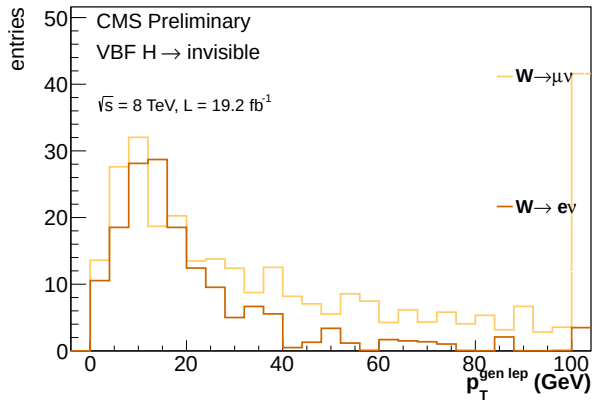
Analysis of outside acceptance distributions

- Outside acceptance $e\nu$ events have a lot more jets
- No $e\nu$ events with gen lepton p_T much higher than 30 GeV
- We believe this is because outside acceptance electrons are often reconstructed as jets
  - this is much rarer for muons
- Extra jets then cause the event to fail the jetmetdphi cut
- As a further check jetmetdphi was loosened to check that this cut was rejecting $e\nu$ events

Outside acceptance - jetmetphi> 1







- $e\nu$ events still have more jets when jetmetdphi is loosened
- $e\nu$ events have lower jetmetdphi than $\mu\nu$
- $e\nu$ Events with gen lepton p_T much higher than 30 GeV are still failing even this looser jetmetdphi cut
- All consistent with hypothesis that $e\nu$ events are failing because outside acceptance electrons are often reconstructed as a jet

Summary

- $W \to e\nu$ vs $W \to \mu\nu$ difference is mostly for outside acceptance events
- In this region unreconstructed electrons are reconstructed as jets more often than muons are
- These fake jets then cause events to fail our jetmetdphi cut
  - Also as the electrons deposit their energy they don't contribute to the met, so even if the event doesn't fail jetmetdphi it may not pass the met cut

Backup