Imperial College London

Higgs to Invisible MC Comparison

Introduction

- We wanted to check if the differences seen between Madgraph+delphes and Powheg+CMS were from generator or reconstruction
- Powheg samples generated with the same config as the CMS samples have been processed with delphes
- We have used these samples to validate our delphes model
- Powheg+CMS and Powheg+Delphes yields now match to 10%
- Next check is Madgraph+delphes against Powheg+delphes

Cut flow

- Compare yields cut by cut (numbers shown are numbers of events)
- Start with $\eta_{j1} \cdot \eta_{j2} < 0$, MET significance$>$ 3, $\Delta\eta_{jj} > 3.6$, jet 1 $p_T > 35$ GeV, jet 2 $p_T > 35$ GeV, $M_{jj} > 700$ GeV, trigger MET$>$ 40 GeV
  - All variables at trigger threshold plus MET significance$>$ 3 for technical reasons

Cut added	Powheg + CMS	Powheg + Delphes
Start point	1552	2311
jet 1 $p_T > 50$ GeV, jet 2 $p_T > 45$ GeV	1203	1834
MET$>$ 90 GeV	1170	1793
$M_{jj} > 1200$ GeV	412	689
MET significance$>$ 4	315	519
min$\Delta\phi(j, MET) > 2.3$	143	248

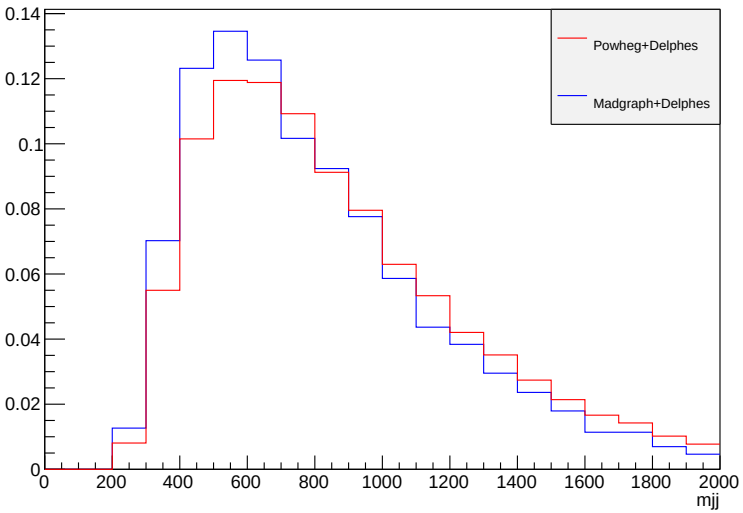
Efficiencies

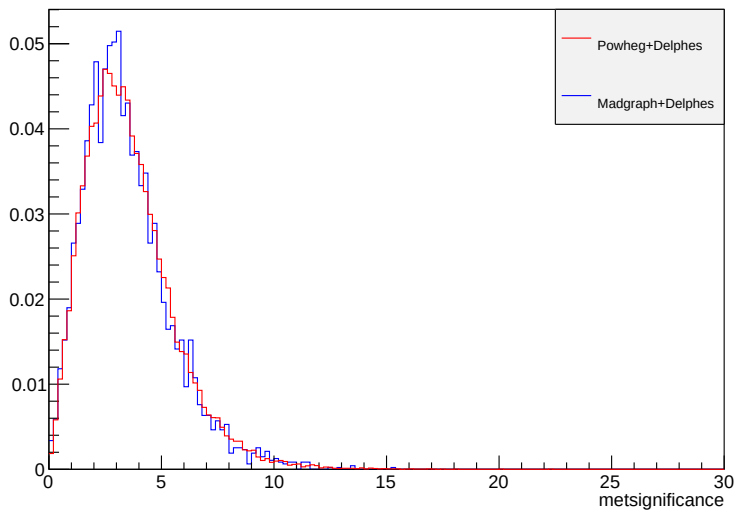
- Compare efficiencies of last cut cut by cut (numbers shown are efficiencies)
- Start with $\eta_{j1} \cdot \eta_{j2} < 0$, MET significance$>$ 3, $\Delta\eta_{jj} > 3.6$, jet 1 $p_T > 35$ GeV, jet 2 $p_T > 35$ GeV, $M_{jj} > 700$ GeV, trigger MET$>$ 40 GeV
  - All variables at trigger threshold plus MET significance$>$ 3 for technical reasons
- Efficiencies are quite similar
- Implies events are already missing at start point

Cut added	Powheg + CMS	Powheg + Delphes
jet 1 $p_T > 50$ GeV, jet 2 $p_T > 45$ GeV	0.78	0.79
MET$>$ 90 GeV	0.97	0.98
$M_{jj} > 1200$ GeV	0.35	0.38
MET significance$>$ 4	0.76	0.75
min$\Delta\phi(j, MET) > 2.3$	0.45	0.48

Compare Distributions

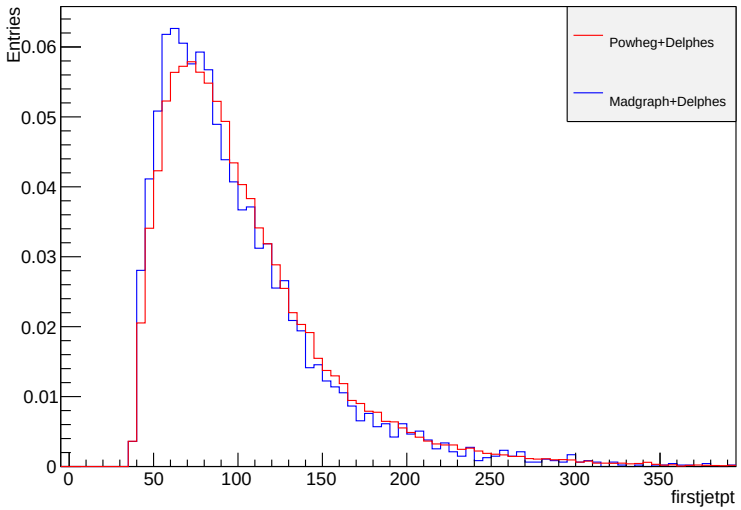
- Use looser selection to look for differences in distributions between Powheg and Madgraph
- All plots are normalised to same number of events
- Selection: $\Delta\eta_{jj} > 3.6$, jet 1/2 $p_T > 35$ GeV, trigger MET>40 GeV, $\eta_{j1} \cdot \eta_{j2} < 0$
- M_{jj} lower in Madgraph, MET significance very similar

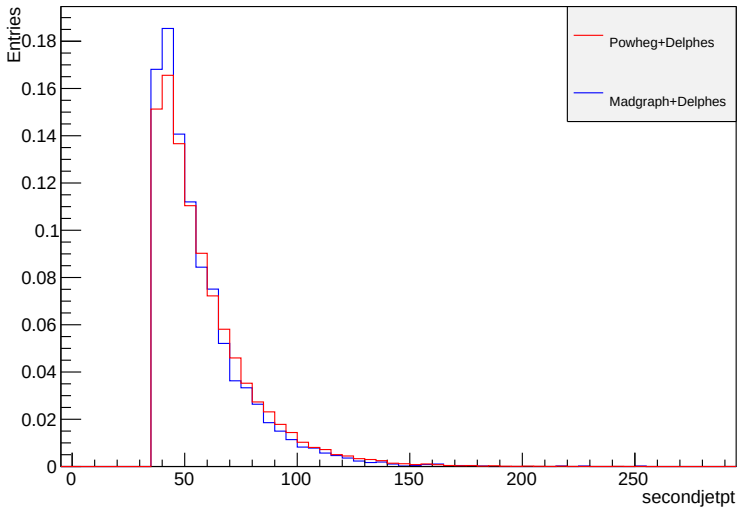




Compare Distributions

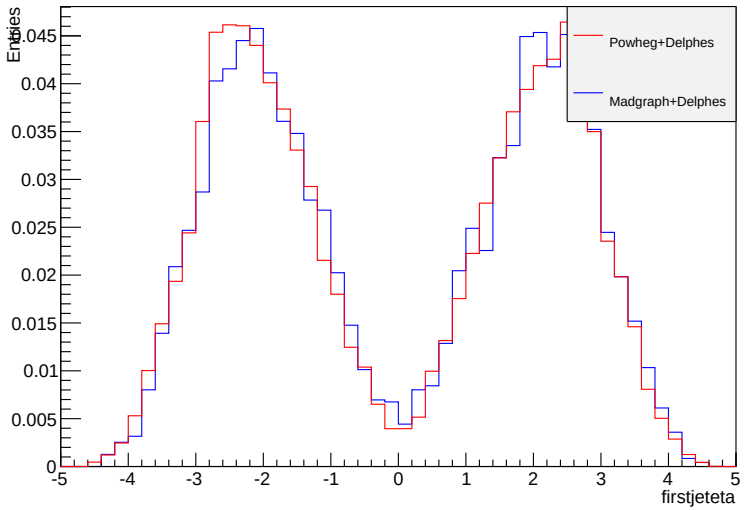
- Selection: $\Delta\eta_{jj} > 3.6$, jet 1/2 $p_T > 35$ GeV, trigger MET>40 GeV, $\eta_{j1} \cdot \eta_{j2} < 0$
- Jet pts lower in Madgraph

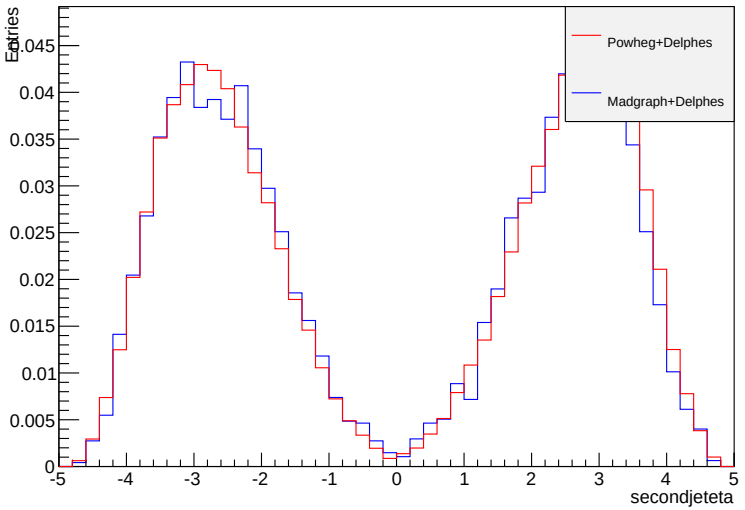




Compare Distributions

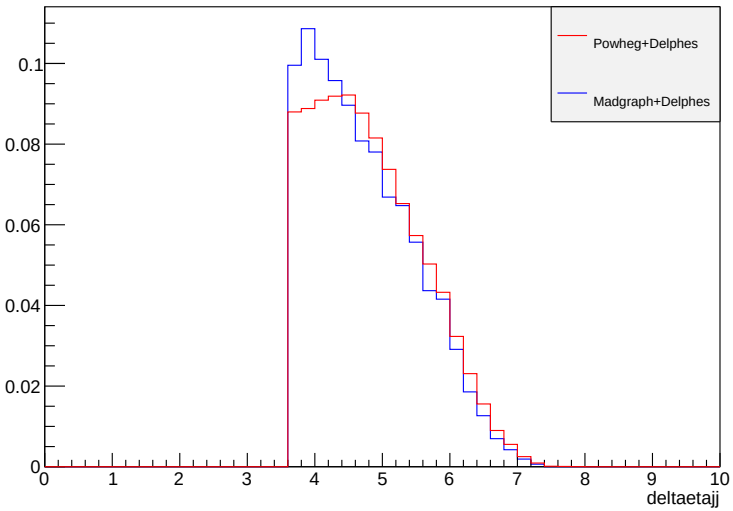
- Selection: $\Delta\eta_{jj} > 3.6$, jet 1/2 $p_T > 35$ GeV, trigger MET>40 GeV, $\eta_{j1} \cdot \eta_{j2} < 0$
- Madgraph jets more central than powheg

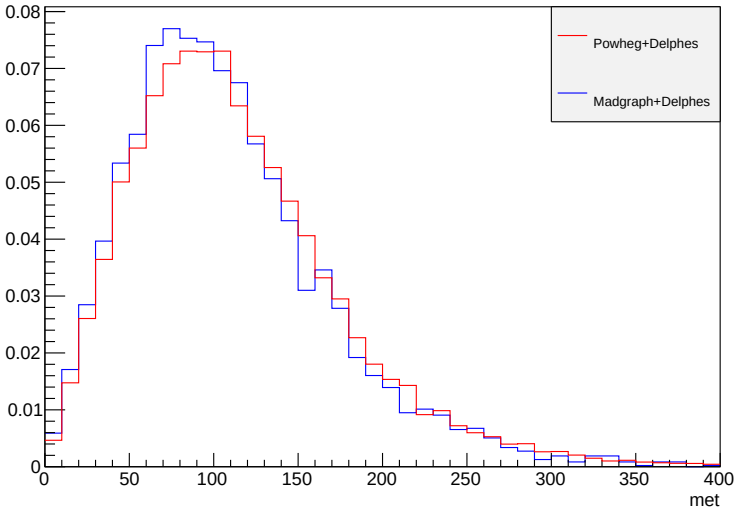




Compare Distributions

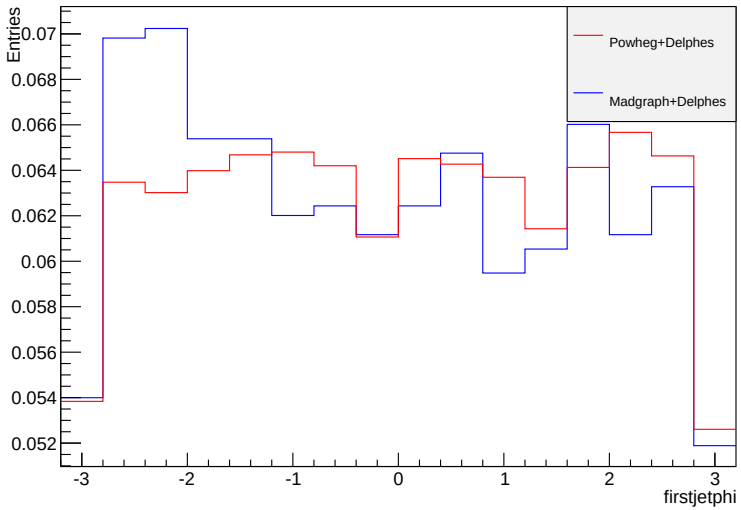
- Selection: $\Delta\eta_{jj} > 3.6$, jet 1/2 $p_T > 35$ GeV, trigger MET>40 GeV, $\eta_{j1} \cdot \eta_{j2} < 0$
- Again see madgraph jets being more central
- Met a bit lower in madgraph

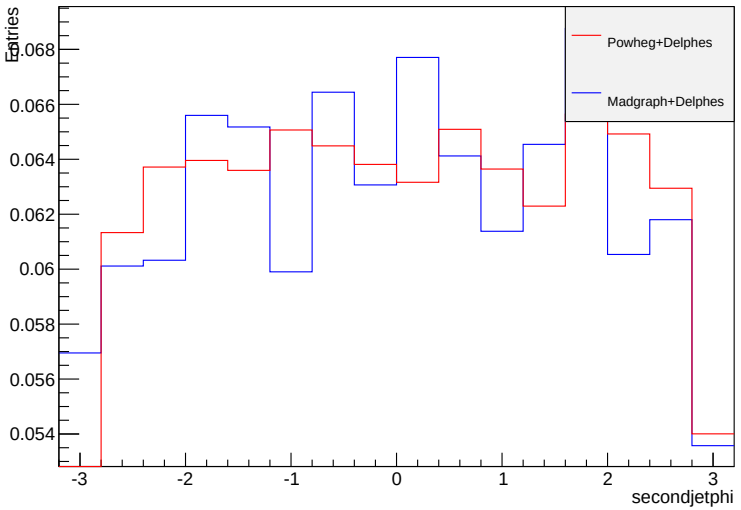




Compare Distributions

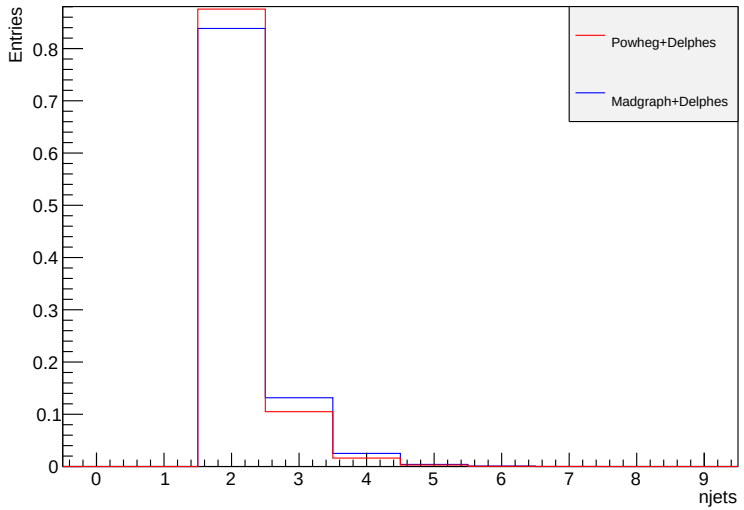
- Selection: $\Delta\eta_{jj} > 3.6$, jet 1/2 $p_T > 35$ GeV, trigger MET>40 GeV, $\eta_{j1} \cdot \eta_{j2} < 0$
- Limited statistics in phi

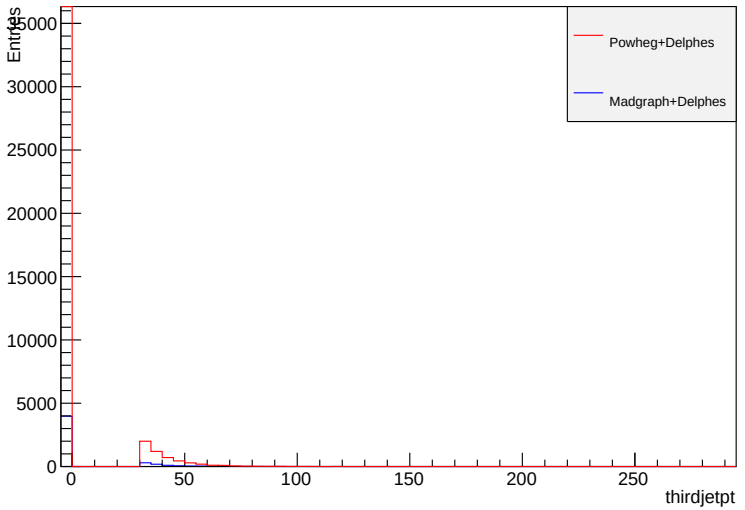




Compare Distributions

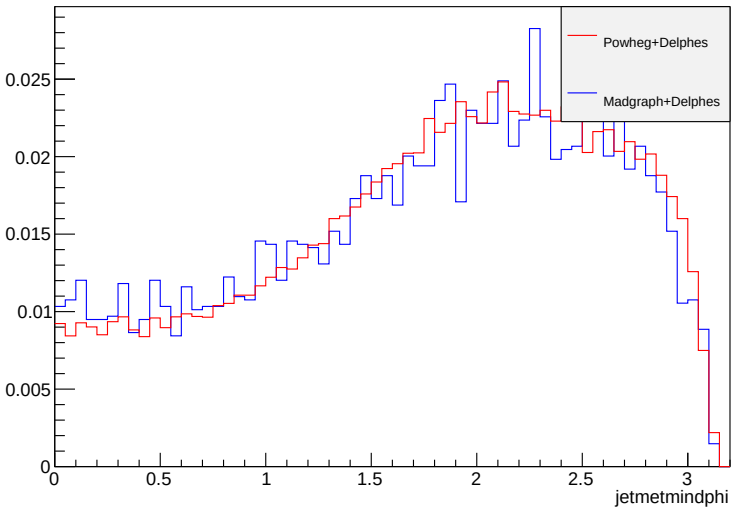
- Selection: $\Delta\eta_{jj} > 3.6$, jet 1/2 $p_T > 35$ GeV, trigger MET>40 GeV, $\eta_{j1} \cdot \eta_{j2} < 0$
- More additional jets in madgraph

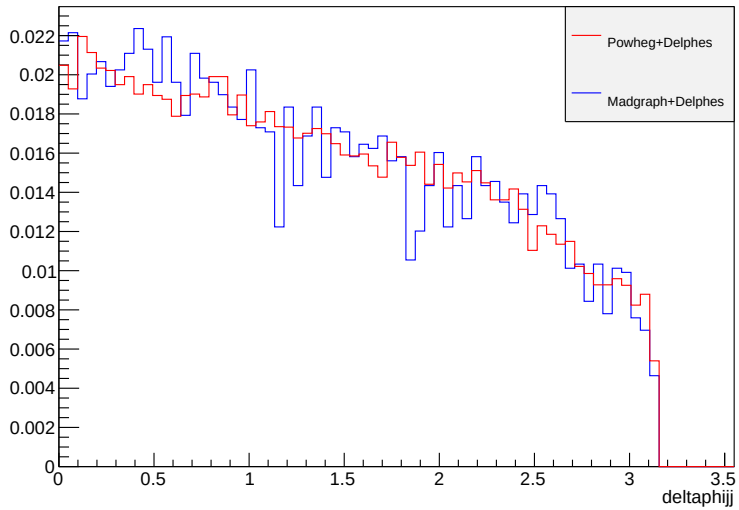




Compare Distributions

- Selection: $\Delta\eta_{jj} > 3.6$, jet 1/2 $p_T > 35$ GeV, trigger MET>40 GeV, $\eta_{j1} \cdot \eta_{j2} < 0$
- More additional jets might make jetmetdphi lower
- No difference discernible





Summary

- We see a factor two difference in final yield between powheg and madgraph
- Main effect seems to come from softer M_{jj} and jet p_T distributions.

Backup