Imperial College London

JES uncertainty studies for W+Jets background

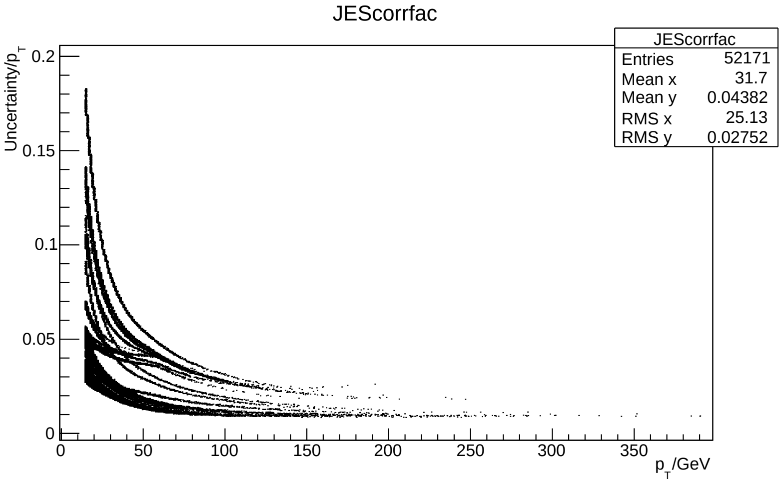
P. Dunne, A. Magnan, S. Nikitenko

29/04/2013

Method

- Using the method from WorkBookJetEnergyCorrections twiki.
- Uncertainties are from Fall12_V7_MC_Uncertainty_AK5PF.txt which is the “total” uncertainty.
- Jet 4-vector scaled up/down by percentage given in the file.
- Also correct met px and py by minus the correction to the jet px and py then recalculate met energy.
- Rerun analysis with these corrected objects
- Note: all plots are for W+2 jets MC sample with type0+1 MET and no trigger efficiency corrections

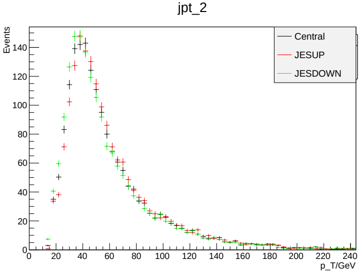
Uncertainty as a function of p_T

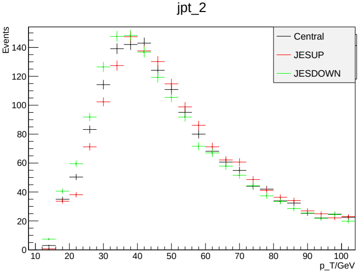


Check whether leading two jets are the same for JES up/down

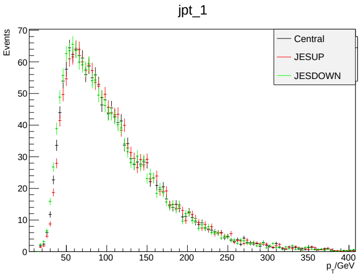
- Calculated percentage of events where the leading two jets are not the same after scaling up/down.
- Does not count events where jet 1 and 2 just swap order.
- For W samples 1.0-3.5% of events have different leading jets depending on sample.
- For Z samples 0.5-2.0% of events have different leading jets
- Full numbers in email from 25th April

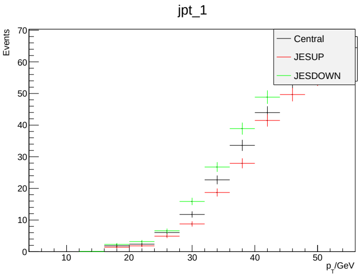
- Check to see whether pt and met shift smoothly and in the right direction



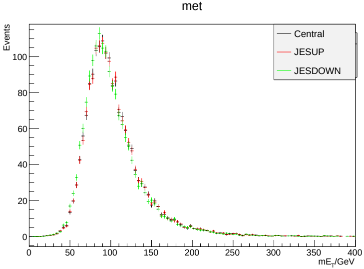


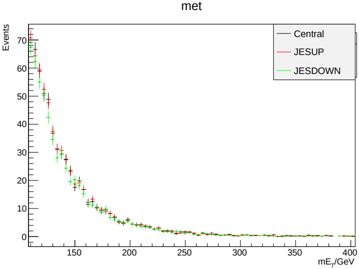
- Check to see whether pt and met scale up and down smoothly





- Check to see whether pt and met scale up and down smoothly





Data-driven W+jets estimates - electrons

- Last two columns are number ± statistical error
- Systematic error from JESUP is superscripted and from JESDOWN is subscripted
- Numbers in parentheses are relative systematic errors

From data: electron signal

	Signal Region	Control Region
N_{data}	XXX	111
N_{EWK}	n/a	37.1 ± 5.1
ϵ_{lepsel}	0.264 ± 0.00144	0.118 ± 0.00106
ϵ_{VBF}	0.0054 ± 0.000467	0.00989 ± 0.000942
$N^{MC}_{W\rightarrow e\nu}$	133 ± 11	109 ± 9
$N^{data}_{W\rightarrow e\nu}$	90.2 ± 18.2	73.9 ± 12.1

From data: electron QCD

	Signal Region	Control Region
N_{data}	XXX	113
N_{EWK}	n/a	22.5 ± 4.08
ϵ_{lepsel}	0.264 ± 0.00144	0.118 ± 0.00106
ϵ_{VBF}	0.00605 ± 0.000494	0.00898 ± 0.000899
$N^{MC}_{W\rightarrow e\nu}$	149 ± 10	99 ± 8
$N^{data}_{W\rightarrow e\nu}$	136 ± 22.7	90.5 ± 11.7

Data-driven W+jets estimates - muons

From data: muon signal

	Signal Region	Control Region
N_{data}	XXX	336
N_{EWK}	n/a	81.8 ± 7.29
ϵ_{lepsel}	0.276 ± 0.00147	0.318 ± 0.00153
ϵ_{VBF}	0.00467 ± 0.000427	0.00999 ± 0.000581
$N^{MC}_{W\rightarrow\mu\nu}$	119 ± 10	293 ± 16
$N^{data}_{W\rightarrow\mu\nu}$	103 ± 13	254 ± 19.4

From data: muon QCD

	Signal Region	Control Region
N_{data}	XXX	305
N_{EWK}	n/a	54.9 ± 5.39
ϵ_{lepsel}	0.276 ± 0.00147	0.318 ± 0.00153
ϵ_{VBF}	0.00589 ± 0.000479	0.00886 ± 0.000547
$N^{MC}_{W\rightarrow\mu\nu}$	150 ± 10	260 ± 14
$N^{data}_{W\rightarrow\mu\nu}$	144 ± 16.1	250 ± 17.8

Conclusions

- All distributions seem to change correctly as JES is varied
- Largest effect is -13% for electron channel
- Uncertainty sometimes goes in one direction only. This is allowed from the formula used for W+jets background.

BACKUP

Method for estimating W+jets background

- VBF selection: jet pair + MET + M_{jj} + $\Delta\eta_{jj}$.
- Lepton veto: $p_T(e,\mu) > 10$ GeV, $|\eta| < 2.4$, loose ID and isolation.
- W$\rightarrow \mu\nu$ selection: exactly one μ $p_T > 20$ GeV, $|\eta| < 2.4$, tight ID and isolation, $m_T > 40$ GeV. Veto additional loose leptons.

Signal Region

- Where we want to estimate the contribution from W+jets.
- VBF selection + Lepton veto + $\Delta\Phi_{jj}$ selection.
- $N^S_{MC} = \sigma \mathcal{L} \epsilon_{HLT} \epsilon_{lepVeto} \epsilon^s_{VBF}$ from W+0,1,2,3,4 jets MC samples.
- N^S_{Data}: the unknown.

Control Region

- Dominated by W$\rightarrow \mu\nu$ events, but with VBF+$\Delta\Phi_{jj}$ selection.
- VBF selection, with MET=MET+p^{μ}_T + W$\rightarrow \mu\nu$ selection.
- $N^C_{MC} = \sigma \mathcal{L} \epsilon_{HLT} \epsilon_{\mu} \epsilon_{m_T} \epsilon^C_{VBF}$ from W+0,1,2,3,4 jets MC samples.
- $N^C_{Data} = N_{Data} - N^{t\bar{t}}_{MC} - N^{WW,WZ,ZZ}_{MC}$.

Result

- Hypothesis: $\frac{N^S_{Data}}{N^S_{MC}} = \frac{N^C_{Data}}{N^C_{MC}} \Rightarrow N^S_{Data} = N^C_{Data} \frac{\epsilon_{lepVeto}}{\epsilon_{\mu}\epsilon_{m_T}} \frac{\epsilon^s_{VBF}}{\epsilon^C_{VBF}}$