UNFOLDING THE JET MASS IN Z + JETS EVENTS

Christine McLean, Ashley Parker and Salvatore Rappoccio

ash.marie.parker@gmail.com

August 20, 2019

University at Buffalo The State University of New York

CMS AN-18-240

- A Measurement of normalized double differential jet production cross section in Z + Jet events :

$$\frac{1}{\frac{d\sigma}{dp_T}} \frac{d^2\sigma}{dp_T dm} \left(\frac{1}{GeV}\right)$$

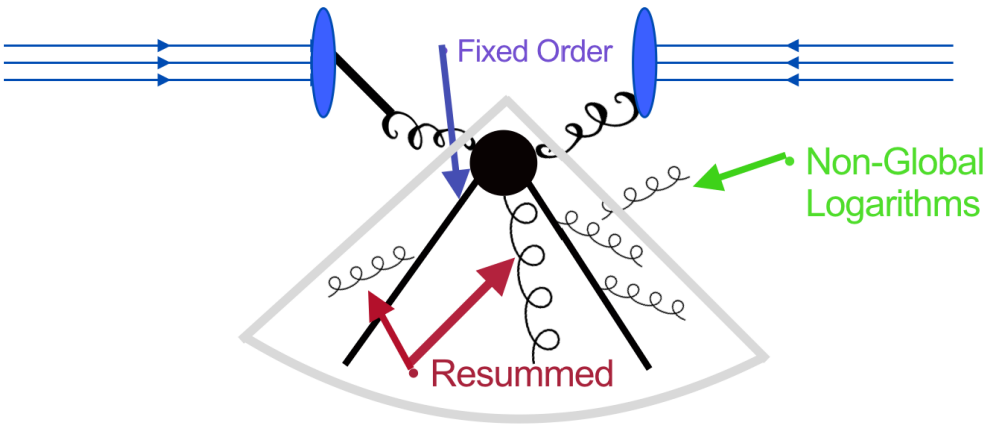
- We use TUnfoldDensity to perform 2D unfolding:

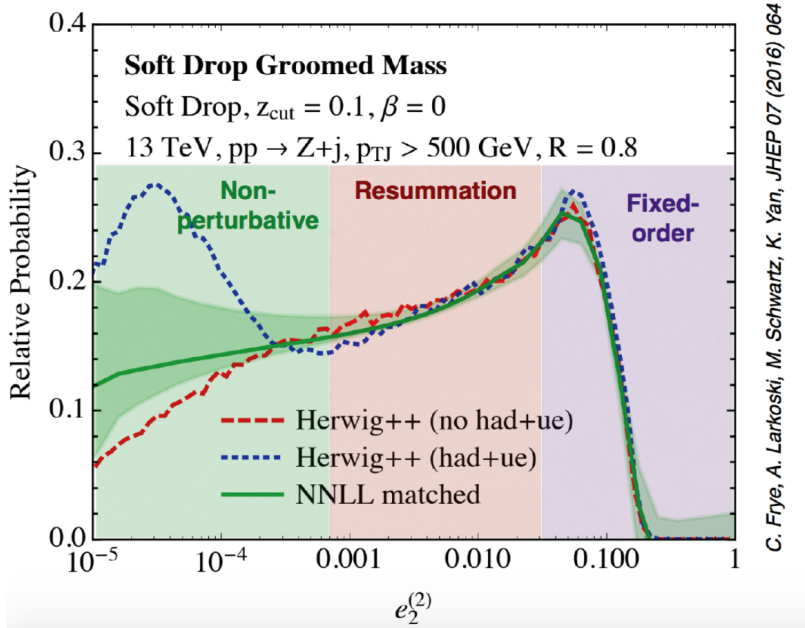
$$(p_T, [m_u || m_g])$$

- We compare the ungroomed and groomed jet masses (9 combinations of the soft-drop parameters)
- Today we show a preview of our preliminary results for 2017 data
- Plan to publish this fall with 2016/2017/2018 or some subset of that data

Motivation

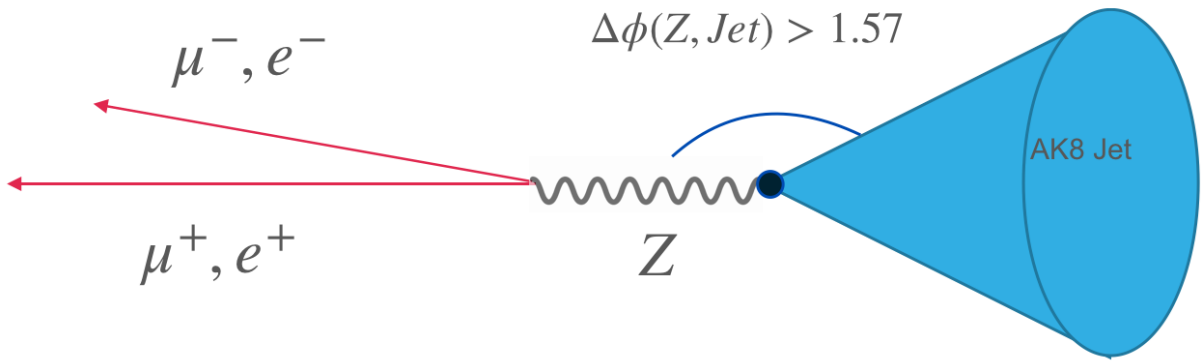
Jet Mass : A simple observable for testing QCD





- Understand evolution of the "jet" function in perturbative QCD
- Improve modeling of jets in Monte Carlo generators

Event Selection



Summary

- At least 1 Anti-Kt $R = 0.8$ Jet, $P_T > 200 GeV$, $|\eta| < 2.5$, $dR(Jet, Lepton) > 0.8$
- 2 opposite sign, same flavor leptons, $|\eta| < 2.4$
- Sum of the 2 leptons gives the Z candidate, $P_T > 90 GeV$, $d\phi(Z, Jet) > 1.57$

Event Selection

Muons

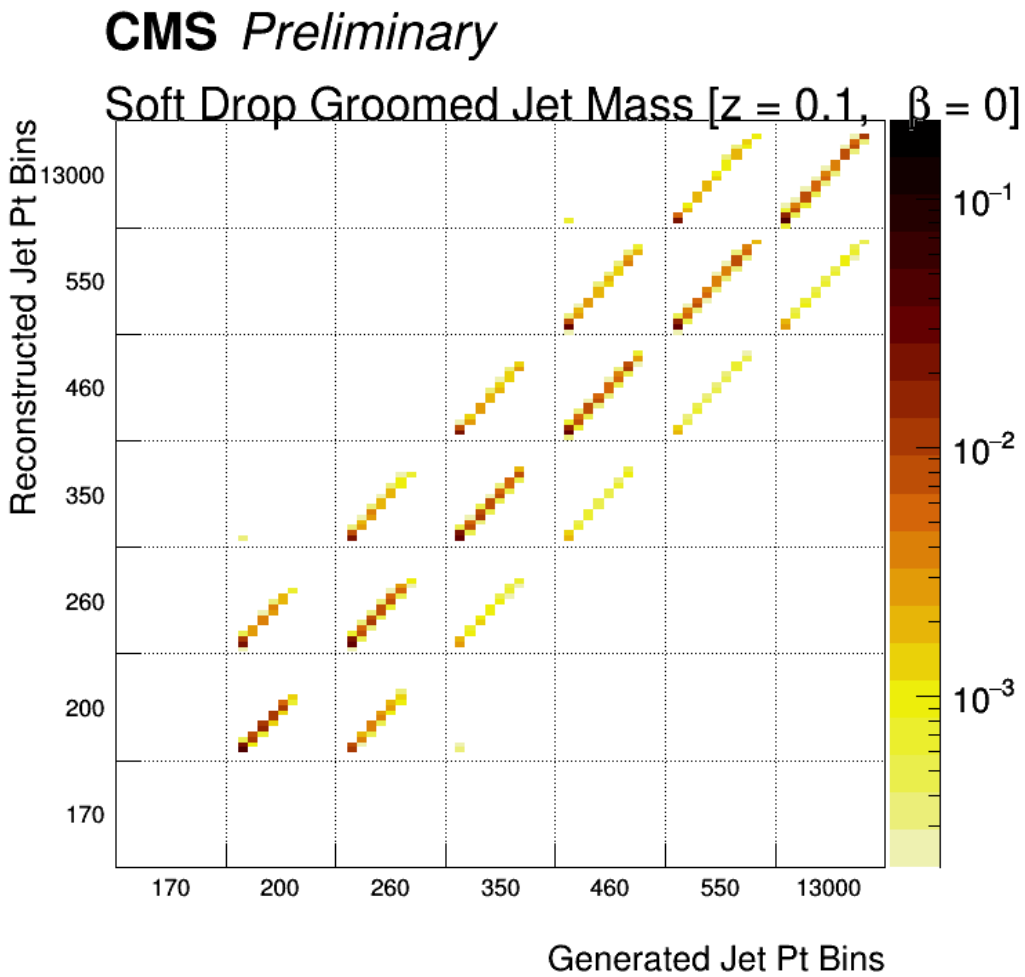
- ISO : PF relative Isolation 0.4 < 0.25
- ID : Medium cut based ID
- Trigger : IsoMu27 ($P_T > 29 GeV$)

Electrons

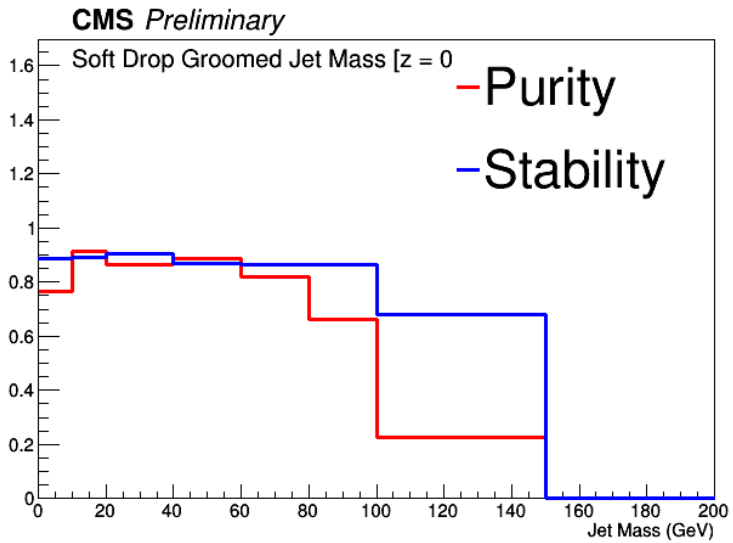
- ISO : None
- ID : Medium cut based ID
- Trigger : $Ele35_W PTight_G sfORPhoton200$ ($P_T > 37 GeV$)

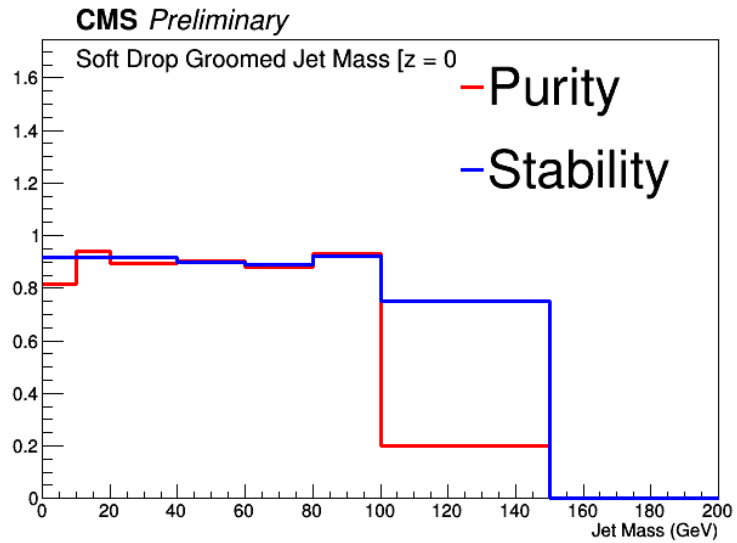
Response Matrix

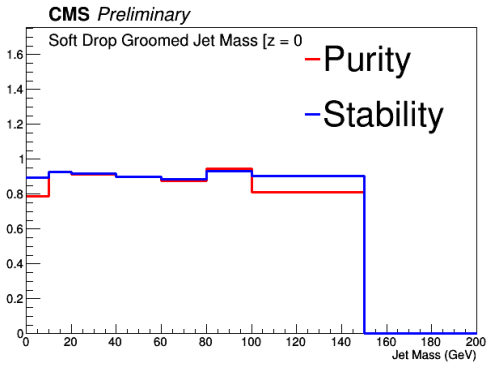
- Normalized by Reconstructed (Y axis) P_T bin
- Mass binning on X axis (Coarse/Output) :
- [0.0, 10.0, 20.0, 40.0, 60.0, 80.0, 100.0, 150.0, 200.0, 13000.0]

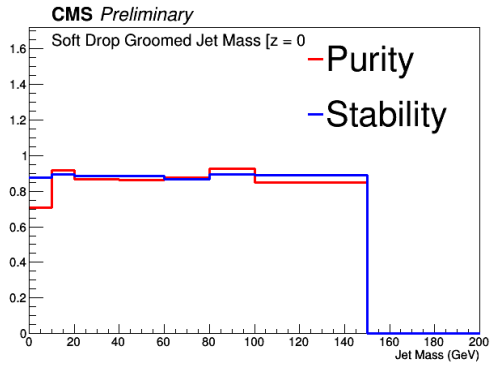


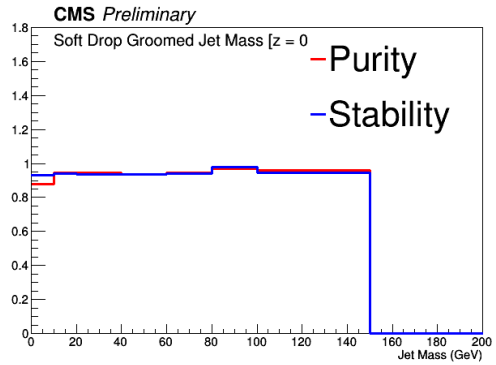
Purity and Stability of Binning Scheme



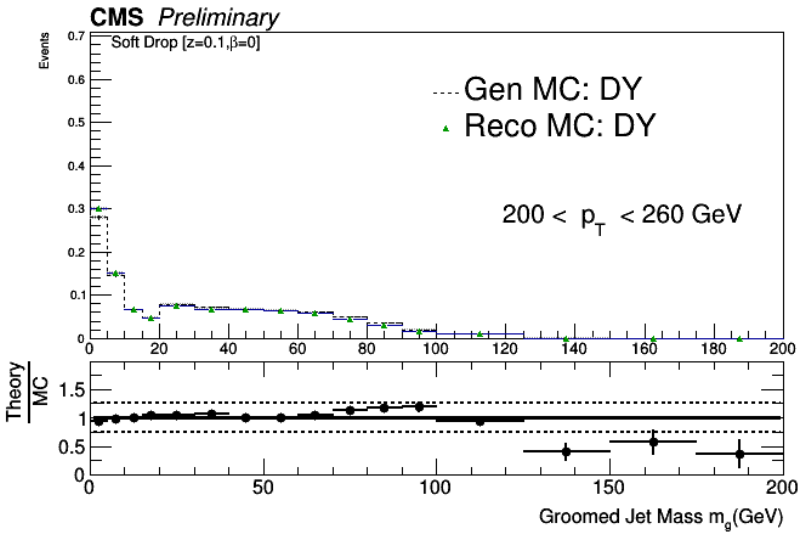


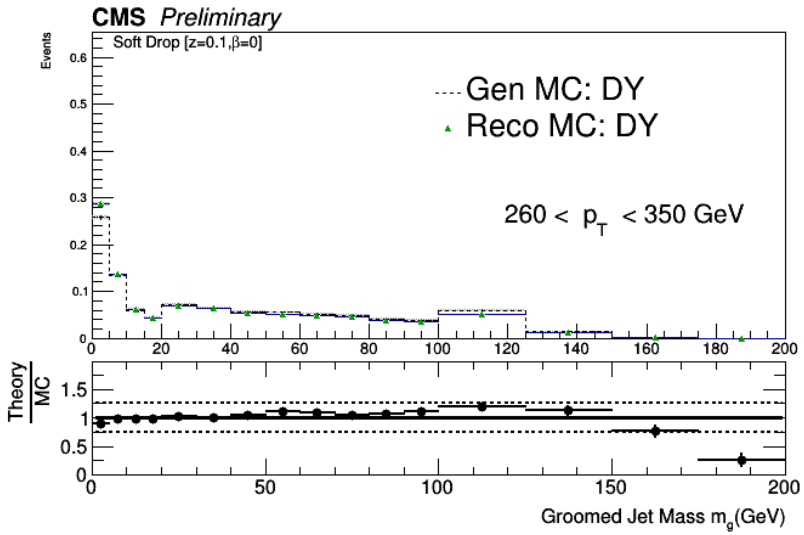


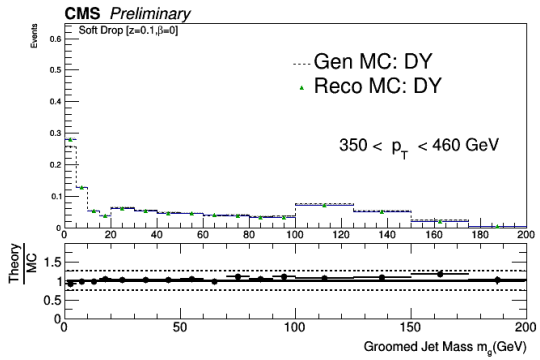


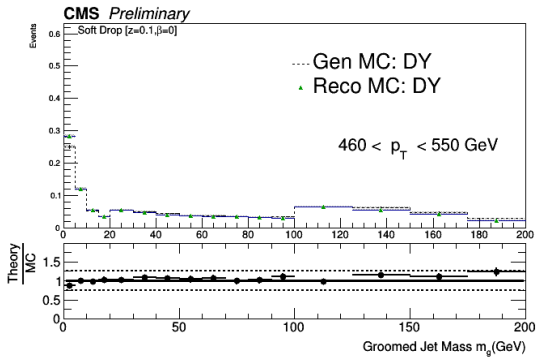


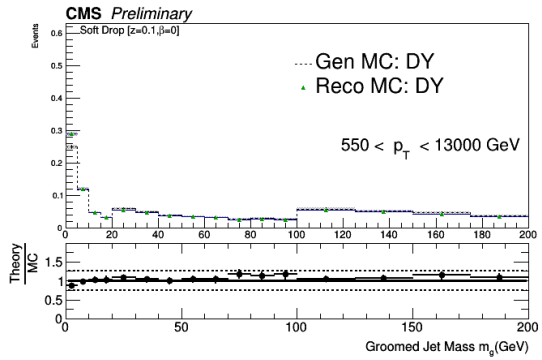
2017 Input MC



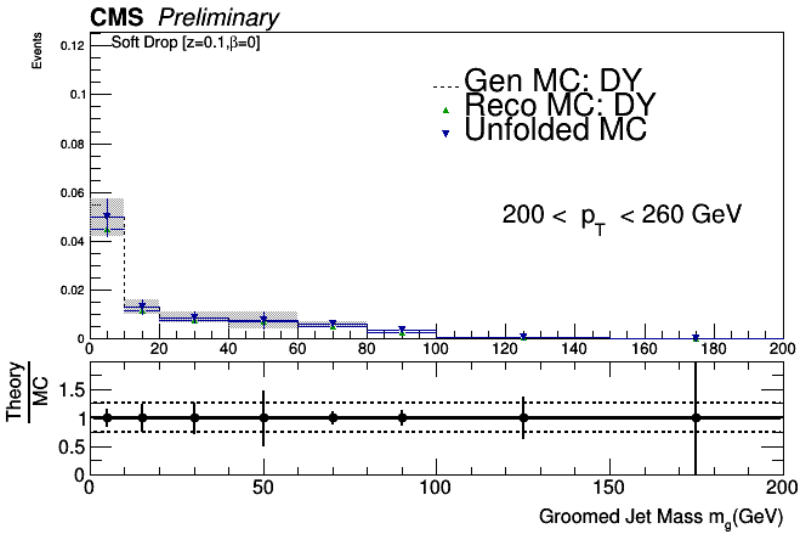


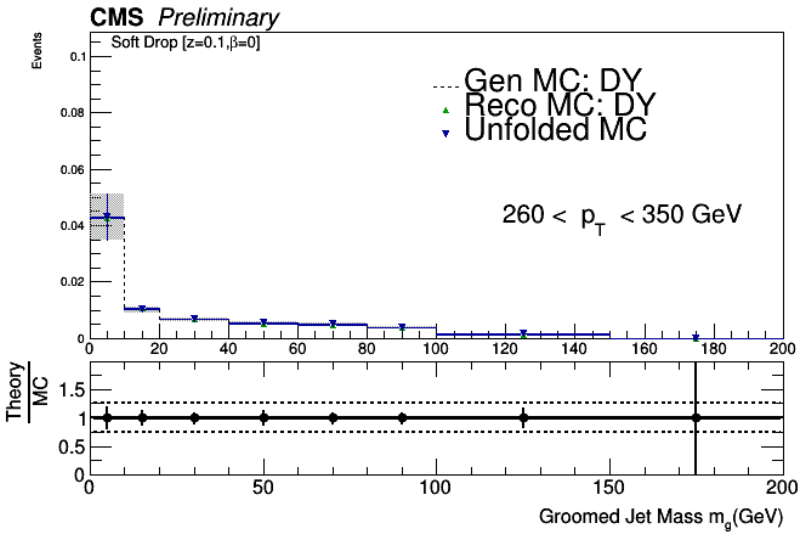


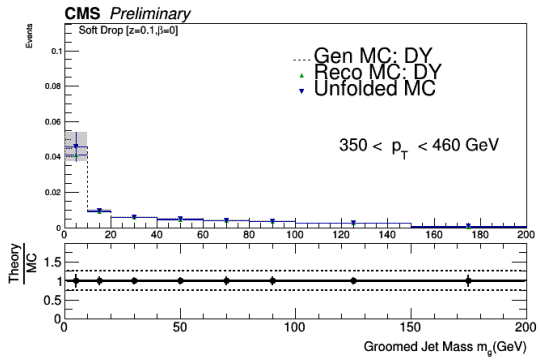


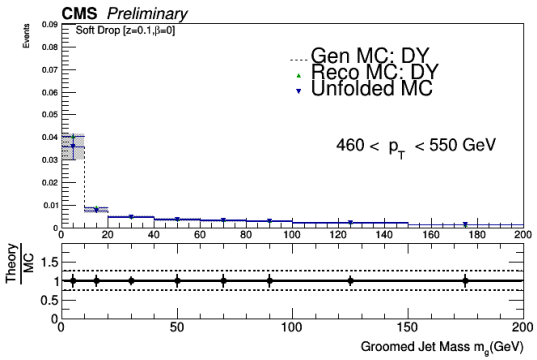


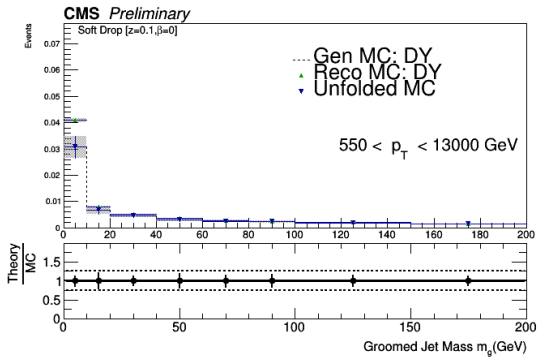
2017 MC Closure Test











2017 Data and MC Luminosities

Drell-Yan HT bin (GeV)	Fraction of Data Luminosity (41.3 $fb^{(} - 1)$)
100-200	2.1
200-400	5.6
400-600	33.9
600-800	111.0
800-1200	87.8
1200-2500	817.8
2500-Inf	2685.28

Table: The ratio of effective luminosity in data as compared to MC where $L = \sigma * N_{events}$.

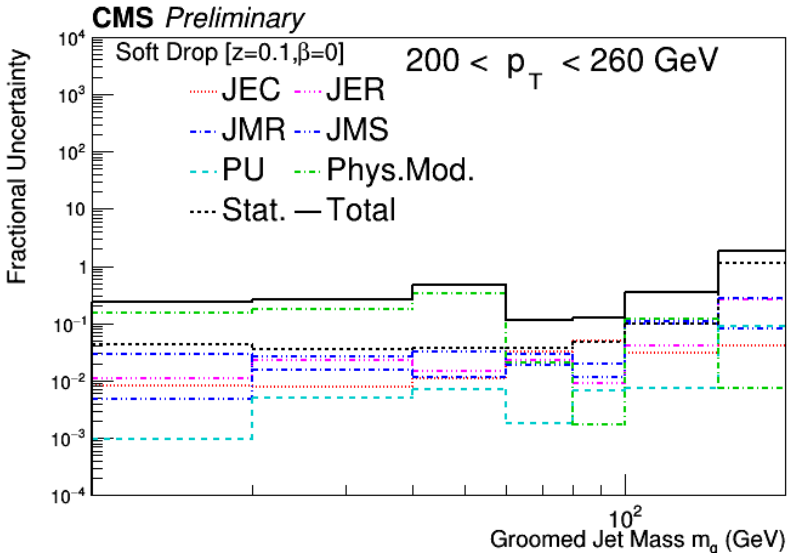
Systematic Uncertanties

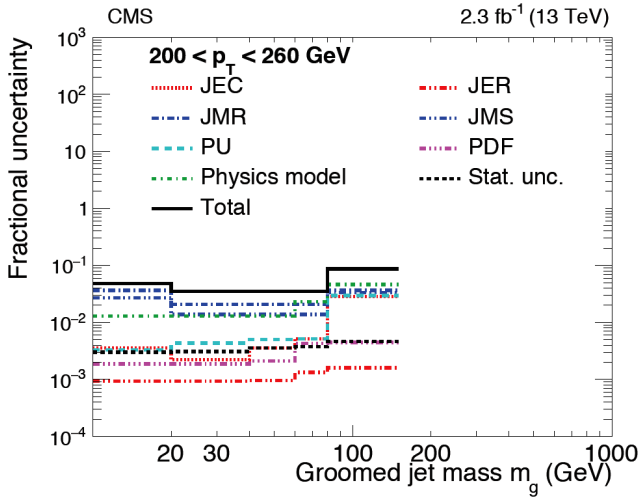
- Used TUnfoldSys to propogate uncertanties
- Input response matrices filled with observables shifted up and down 1 σ from nominal
- Physics Model, JEC, JER, JMR, JMS, PU, PDF
- Compare to Dijet uncertanties from SMP-16-10 on next slides

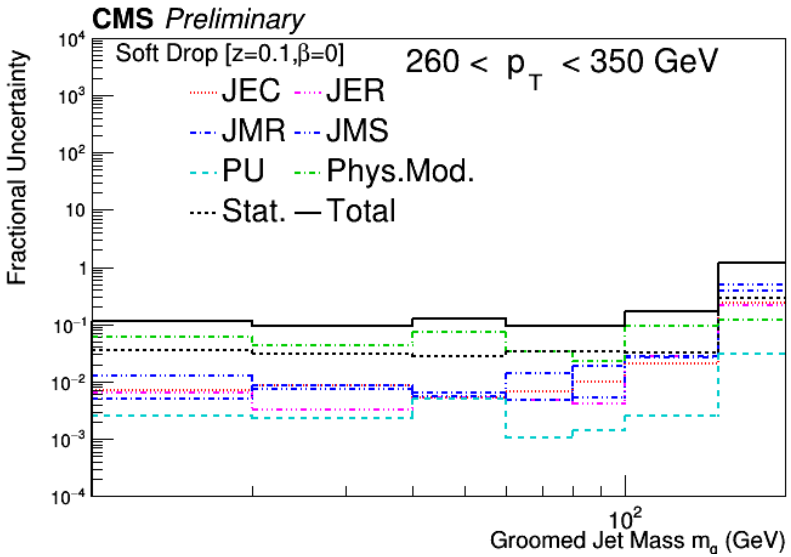
Ongoing Work

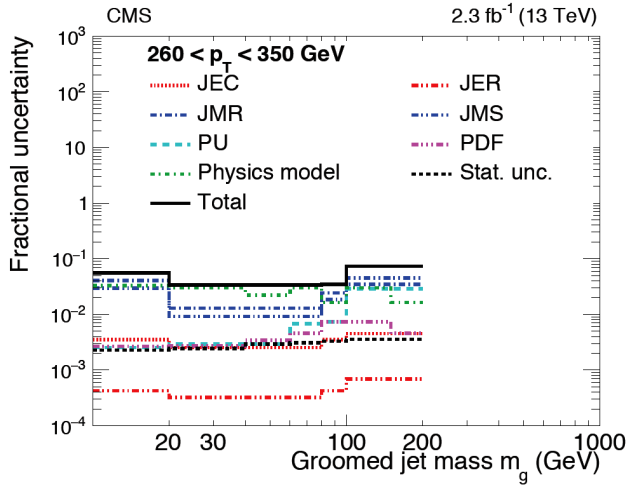
- Statistical uncertainy estimation using jacknife resampling
- Updating to Fall17_17Nov2017_V32 JECs
- Adding extension samples to Drell-Yan signal MC in increase statistics

Systematic Uncertanties: Z+Jets and DiJets

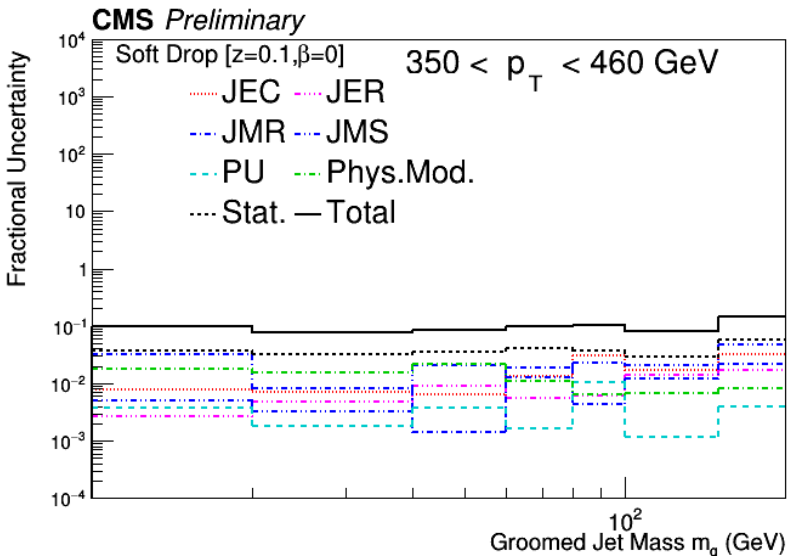


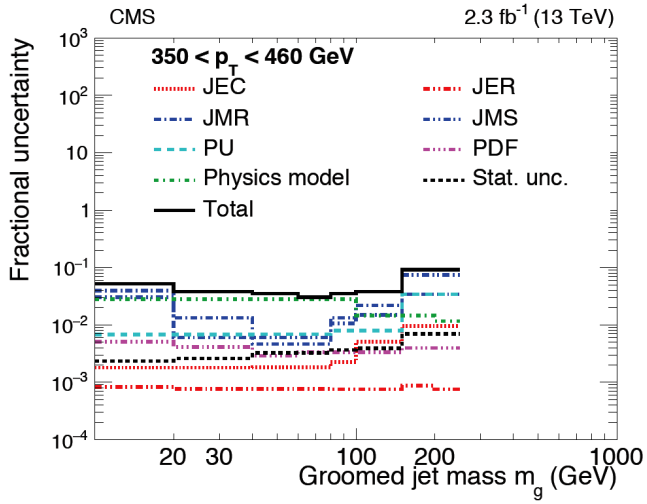


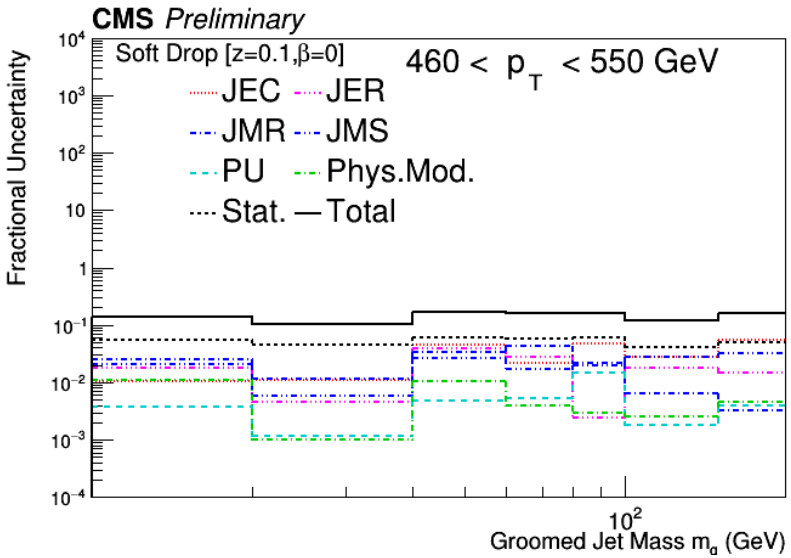


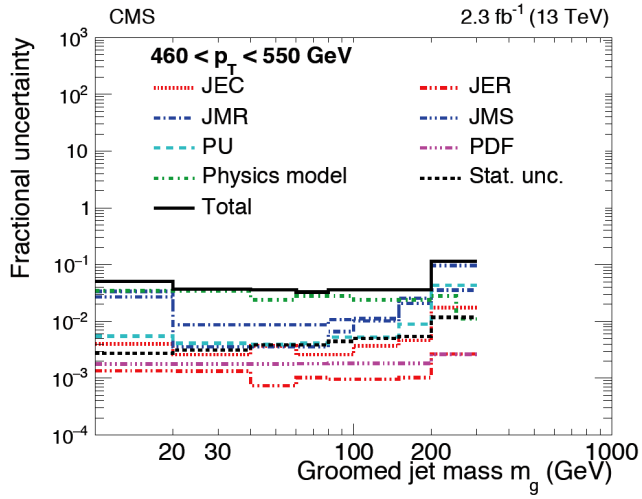


Systematic Uncertainties: Z+Jets and DiJets

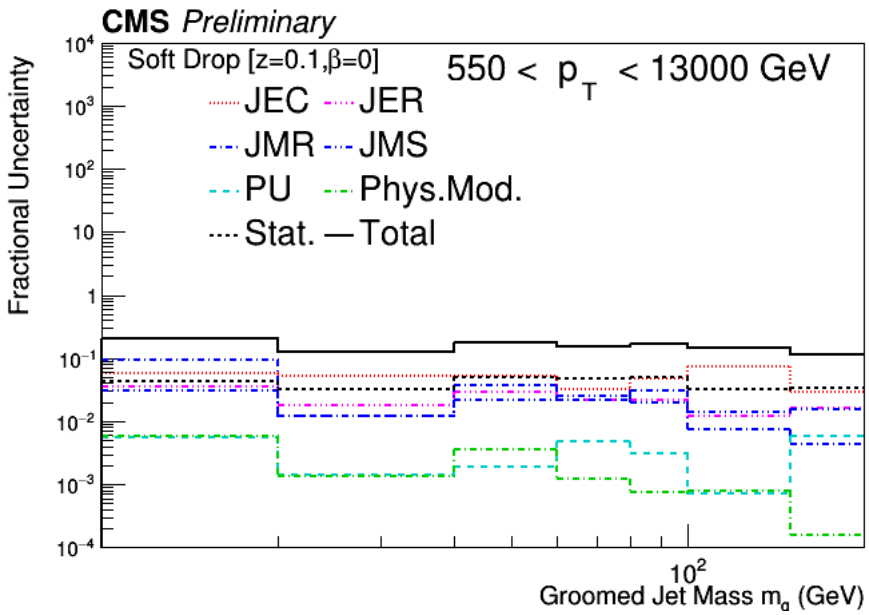


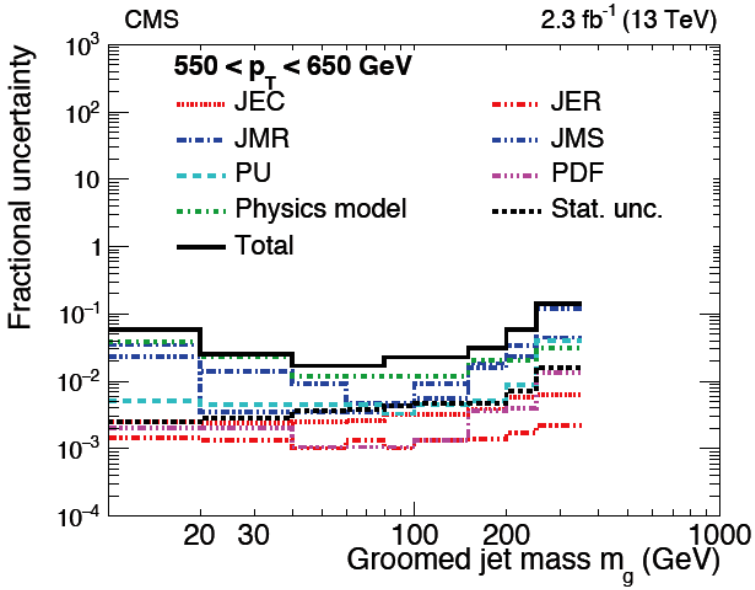


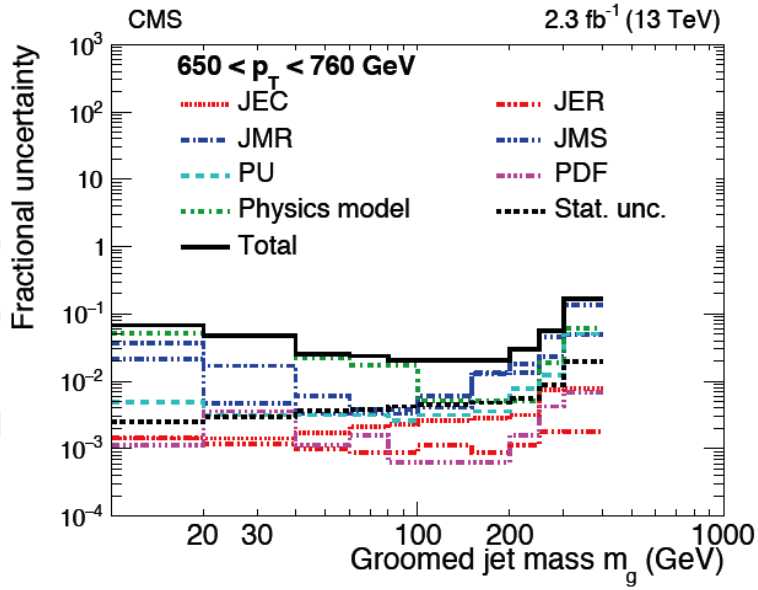




Systematic Uncertainties: Z+Jets and DiJets







Summary : AN-18-240

- A Measurement of normalized double differential jet production cross section in Z + Jet events :

$$\frac{1}{\frac{d\sigma}{dp_T}} \frac{d^2\sigma}{dp_T dm}\left(\frac{1}{GeV}\right)$$

- Method is complete and systematic uncertanites are understood
- Plan to publish this fall with 2016/2017/2018 or some subset of that data

The End

Extra Stuff