HEP NTUA
Weekly Report

14/10/2020

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Summary

- Start investigating ttbar Systematic Uncertainties
- Consistency checks with Giannis are done!
- ttX round table

- Top Angular Distributions: chi, |cosθ*| leading and subleading
  - Changed binning for the cos(θ*) distributions

- Z' analysis:
  - Production for Z' (mass, width variations)
  - Files are now available for all years

- AN 2020/156

Signal Selection

Variables	Selected Cut
pT (both leading jets)	> 400 GeV
Njets	> 1
N leptons	= 0
|eta| (both leading jets)	< 2.4
mJJ	> 1000 GeV
jetMassSoftDrop (only for fit)	(50,300) GeV
Top Tagger	> 0.2, 0, 0.1
B tagging (2 btagged jets)	> Medium WP
Signal Trigger	

Control Region Selection

Variables	Selected Cut
pT (both leading jets)	> 400 GeV
Njets	> 1
N leptons	= 0
|eta| (both leading jets)	< 2.4
mJJ	> 1000 GeV
jetMassSoftDrop (only for fit)	(50,300) GeV
Top Tagger	> 0.2, 0, 0.1
B tagging (0 btagged jets)	< Medium WP
Control Trigger	

Top Angular Distributions

- We employ the dijet angular variable χ from the rapidities of the two leading jets
- Why χ?
  - The distributions associated with the final states produced via QCD interactions are relatively flat in comparison with the distributions of the BSM models or new particles, which typically peak at low values of x

- We can measure the variable χ in two ways

1. By measuring the difference of the rapidities of the two leading jets such as the corresponding rapidity in the ZMF is:

$$y^* = \frac{1}{2}(y_1 - y_2)$$

X is defined as $\chi = e^{|y^*|} = e^{|y_1 - y_2|}$ (1) and can be measured by creating the TLorentzVector, boost it to the ZMF and find the rapidity difference of the two leading jets

2. By measuring the scattering angle θ* (angle between top quark and z-axis in the Zero Momentum Frame)

We define as $y^* = \frac{1}{2}\ln(\frac{1+|cos\theta^*|}{1-|cos\theta^*|})$ and from (1) we can find that:

$$\chi = \frac{1+|cos\theta^*|}{1-|cos\theta^*|}$$

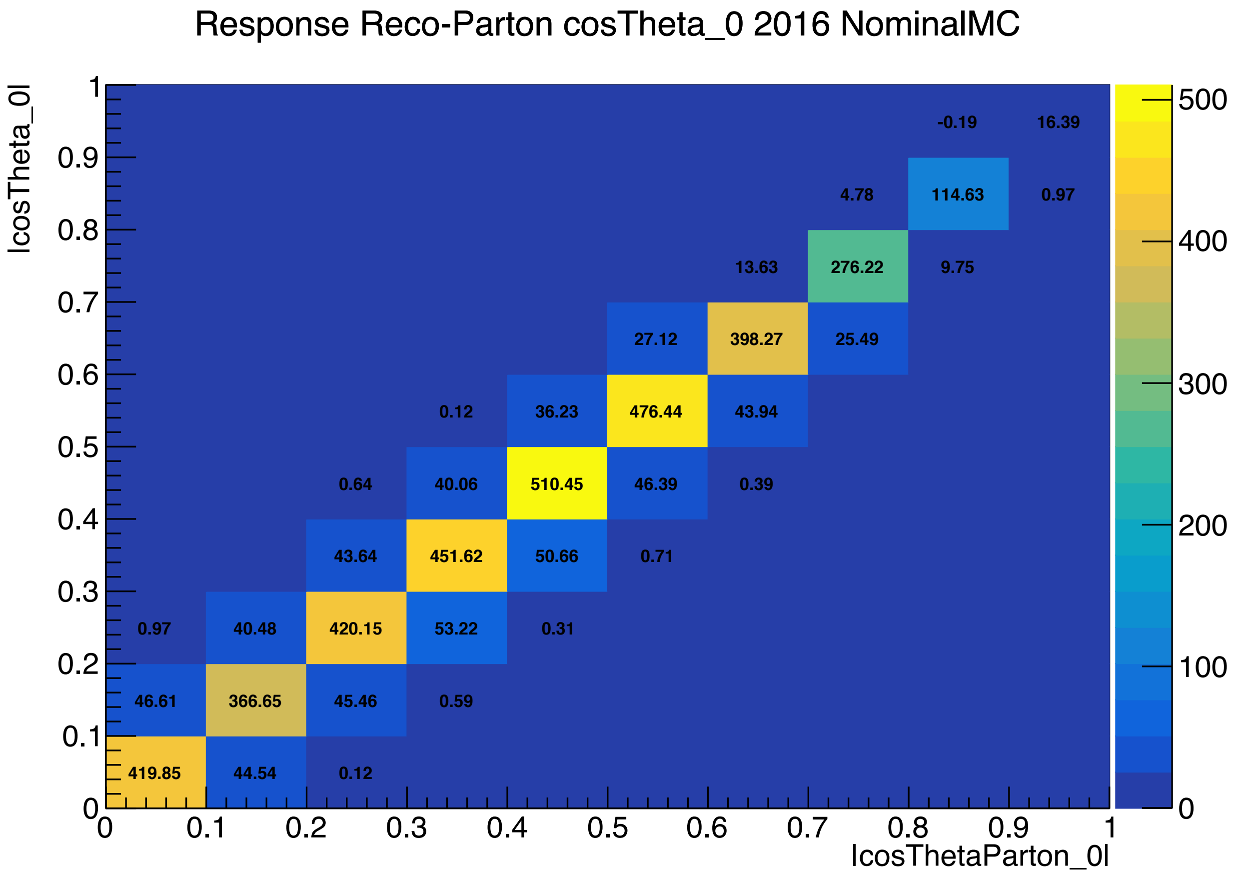
Search for top-antitop resonances

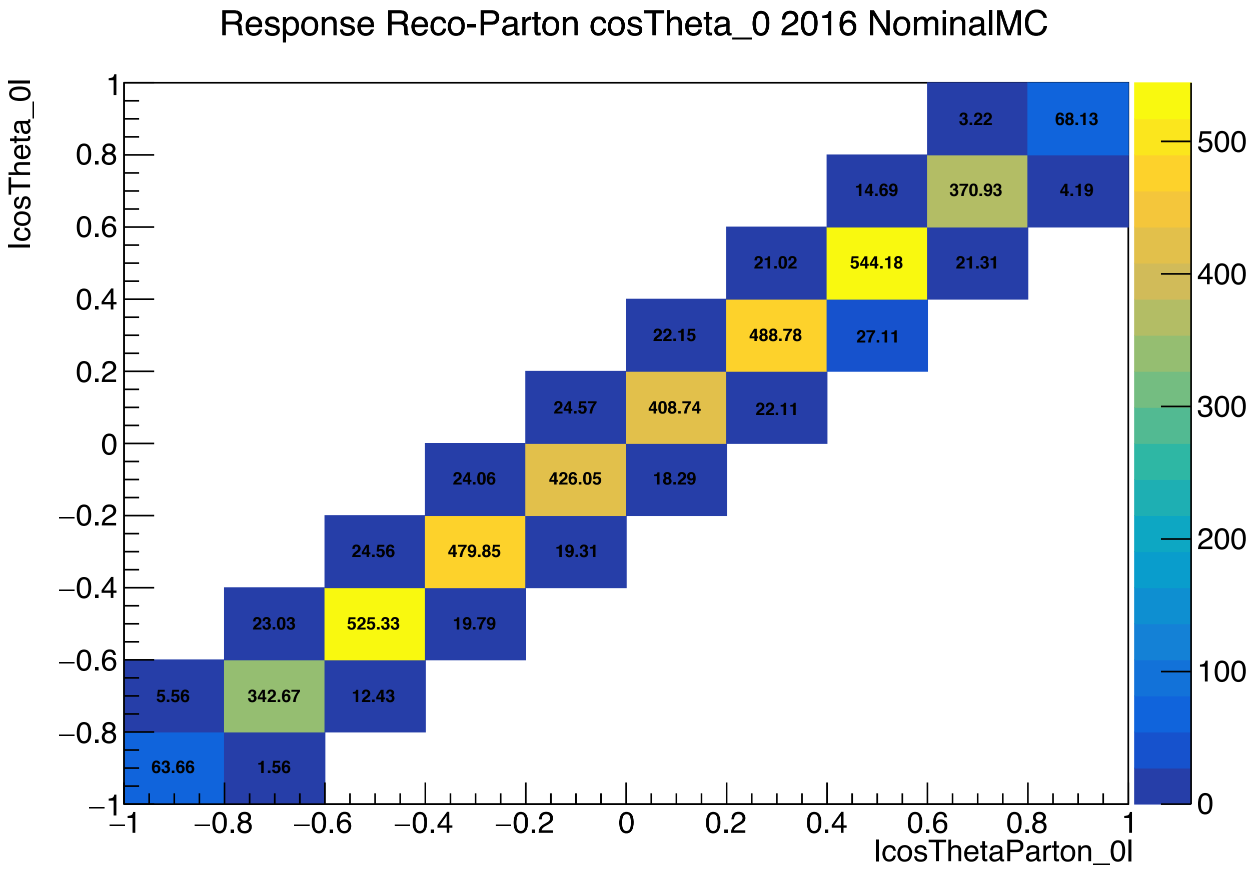
- Numerous extensions of the SM predict the existence of new interactions with enhanced couplings to third generation quarks, especially the top quark
- The associated new particle→observation as a ttbar resonance
- Examples of such resonances:
  1. Massive Color-singlet Z like bosons (Z’)
  2. Colorons
  3. Axigluons
  4. Heavier Higgs siblings
  5. Kaluza-Klein excitations of gluons
  6. Electroweak gauge bosons
  7. Gravitons in various extensions of the Randall-Sundrum model

- All of the above predict the existence of TeV-scale resonances with a cross section of a few pb’s
- Resonant ttbar production would be observable in the reconstructed invariant mass of the ttbar system

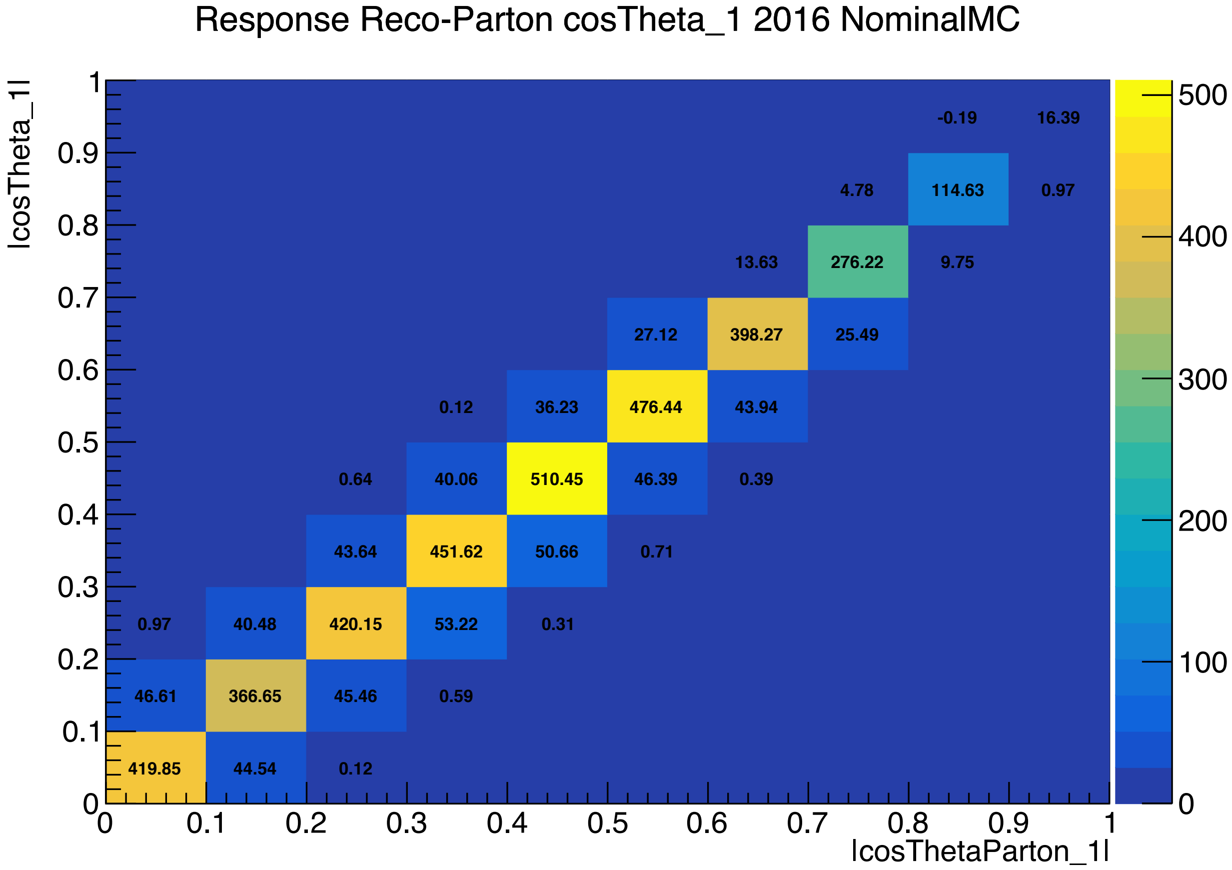
- Most analyses search for peaks in the invariant ttbar mass

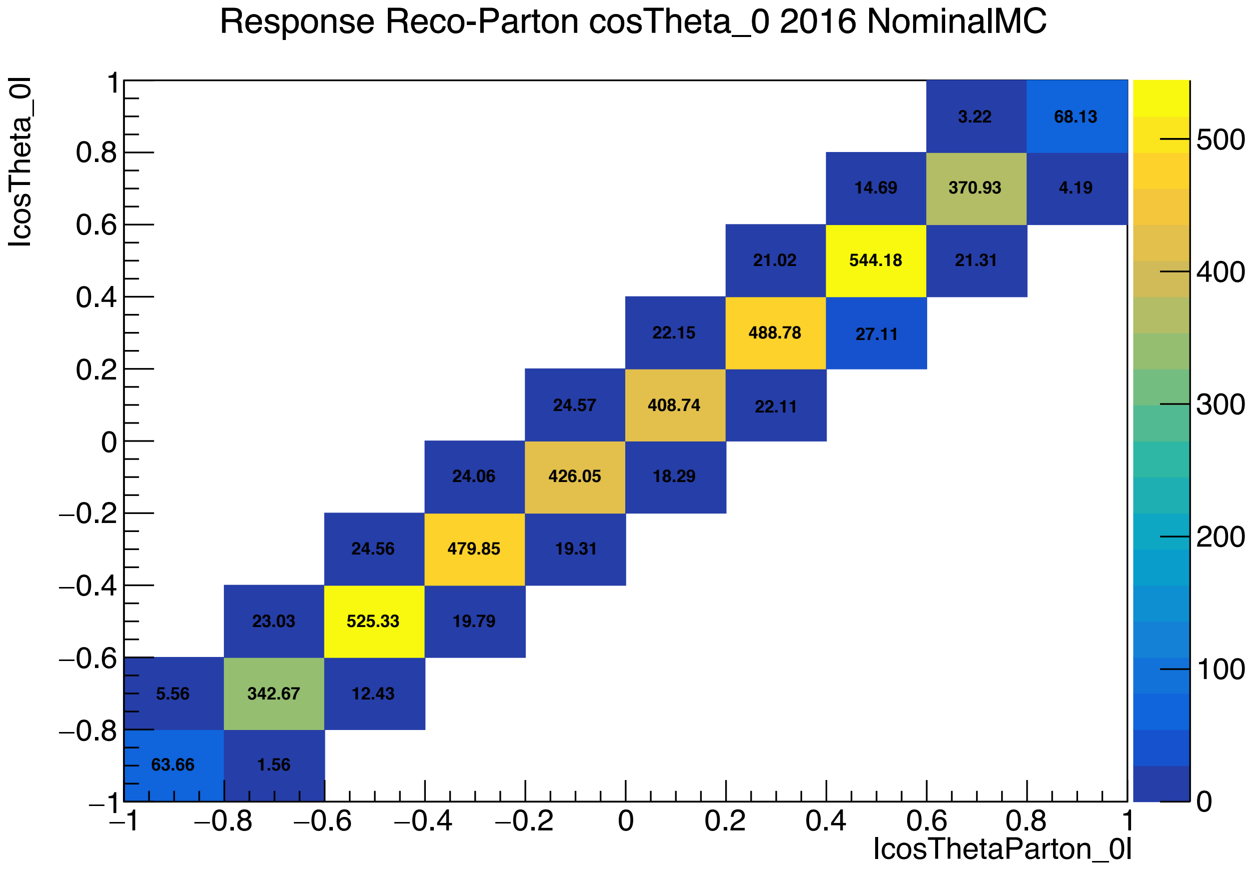
Response Matrices





Response Matrices





Signal Extraction

Measured dist from data

Fitted number of QCD events in SR_A

QCD shape taken from Data (CR)

$$S(x_{reco}) = D(x_{reco}) - C_{bkg}^{yield} N_{QCD}^{fit}(x_{reco}) Q(x_{reco}) - B(x_{reco})$$

Fiducial Yield

Transfer factor from SR_A to SR

Subdominant bkg shape and contribution (MC)

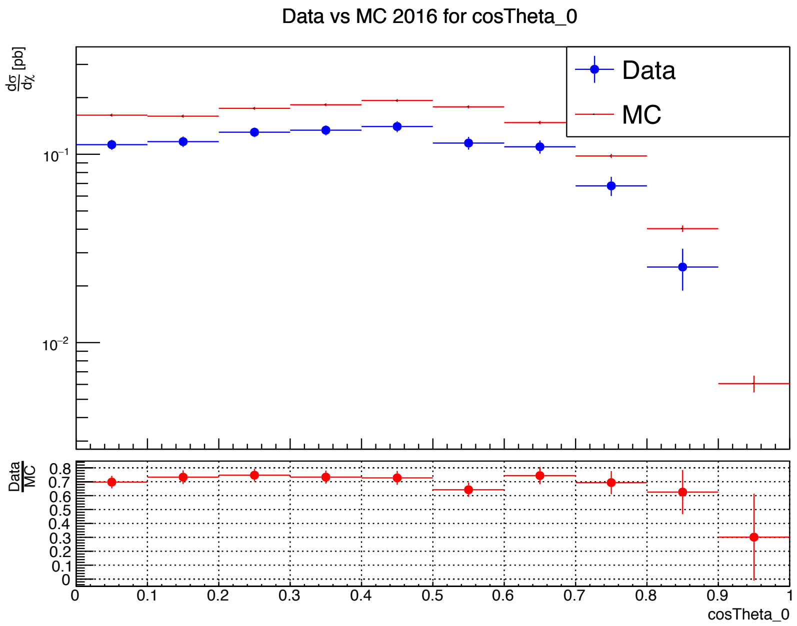
- Where x_{reco} is the respected variable of interest (ttbar mass, pt, rapidity, leading and subleading jetPt and |jetY|)

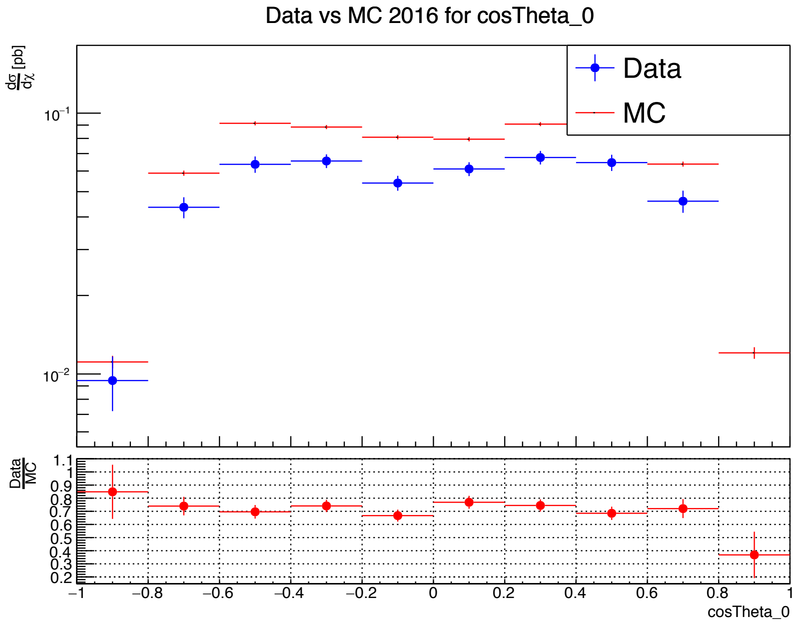
- We deploy a fit in the Signal Region (2btag) to extract the N_{QCD}^{fit}

$$D(m^t)^{(i)} = N_{tt}^{(i)} T^{(i)}(m^t, k_{MassScale}, k_{MassResolution}) + N_{bkg}^{(i)} B(m^t)(1 + k_1 x) + N_{sub}^{(i)} O^{(i)}(m^t)$$

- Our data CR is contaminated from ttbar and subdominant bkgs which has to be dealt with.

Fiducial Measurement





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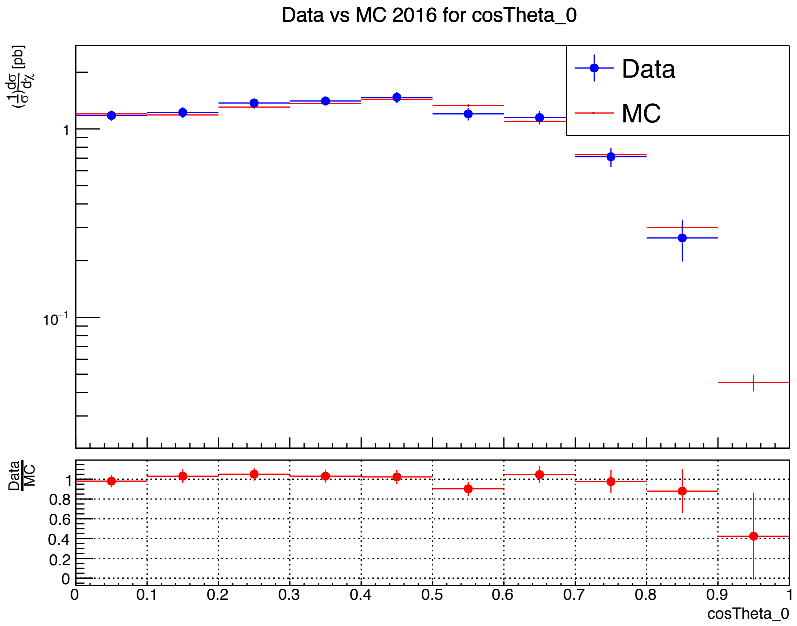

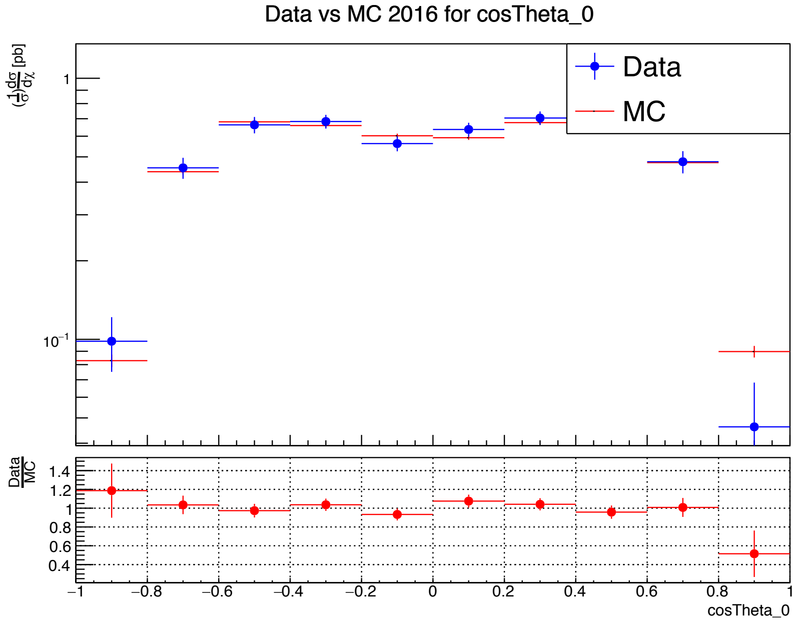

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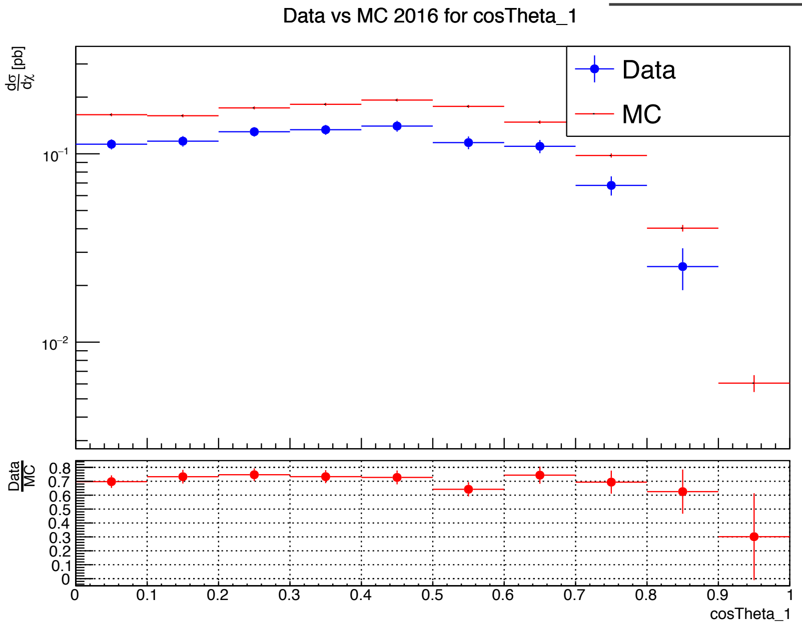

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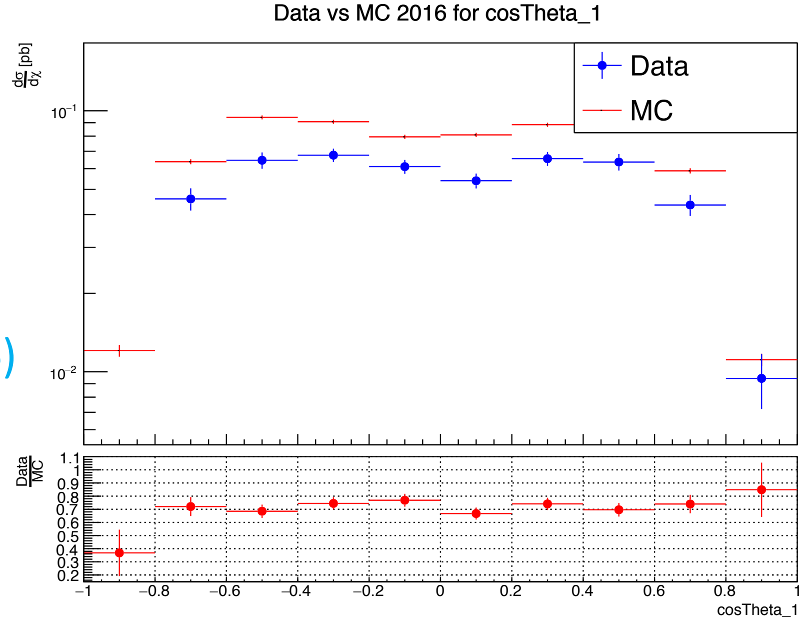

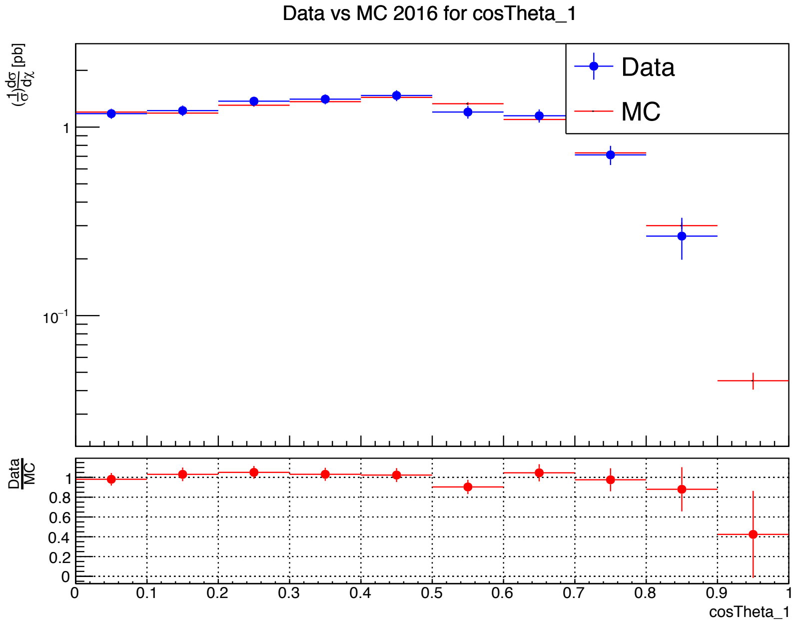

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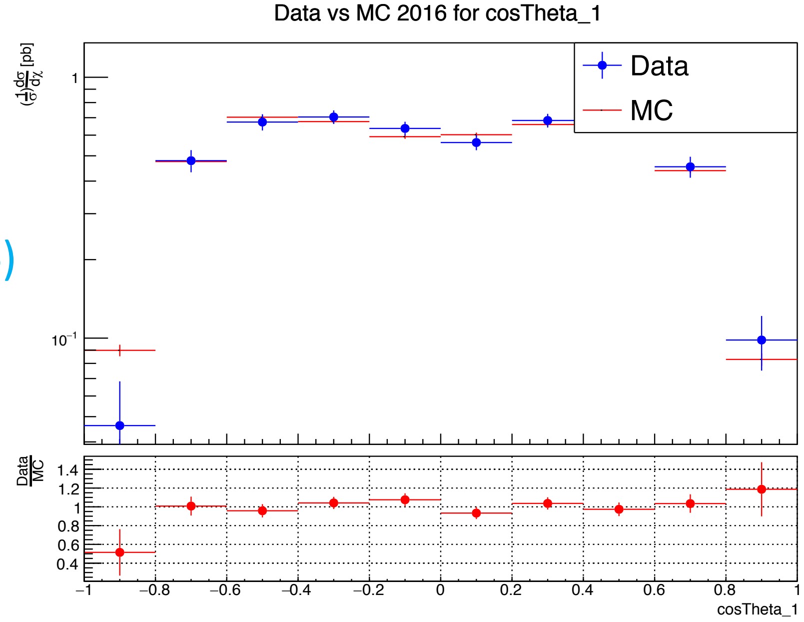
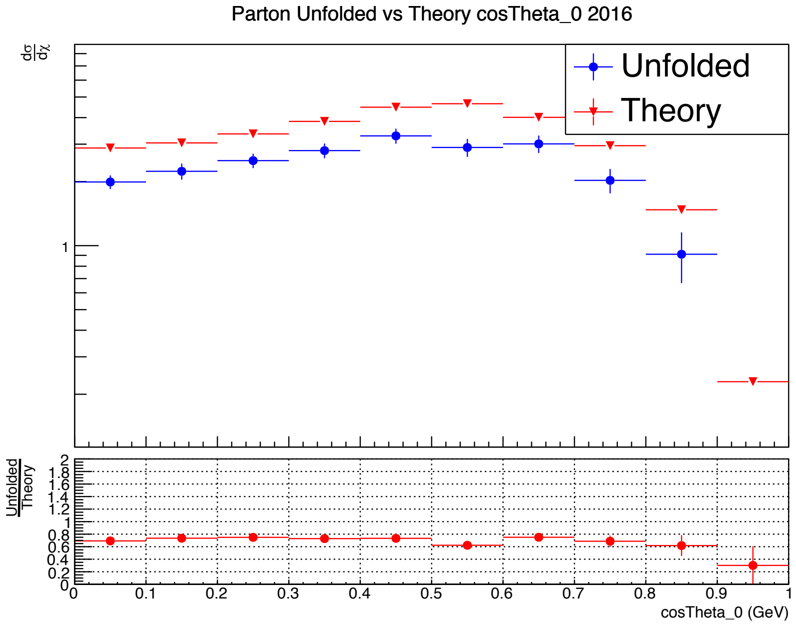


Parton Measurement



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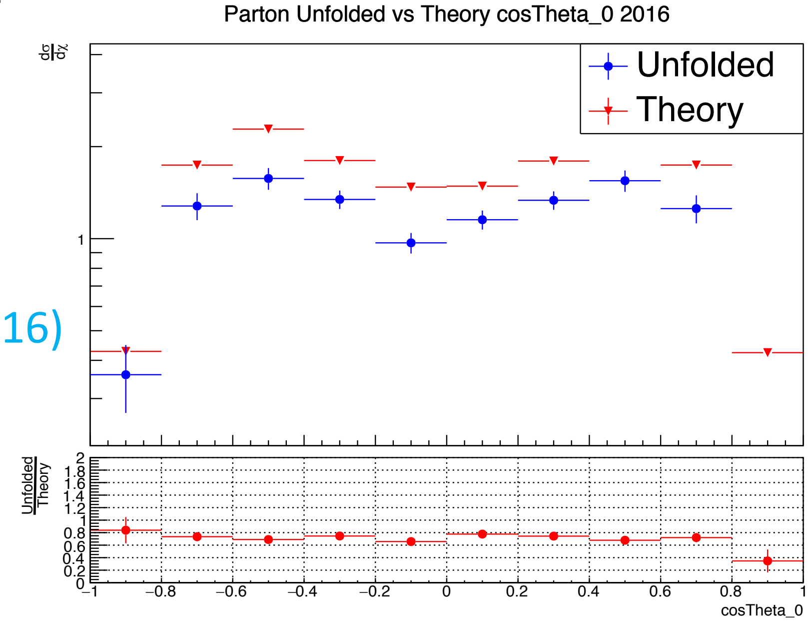

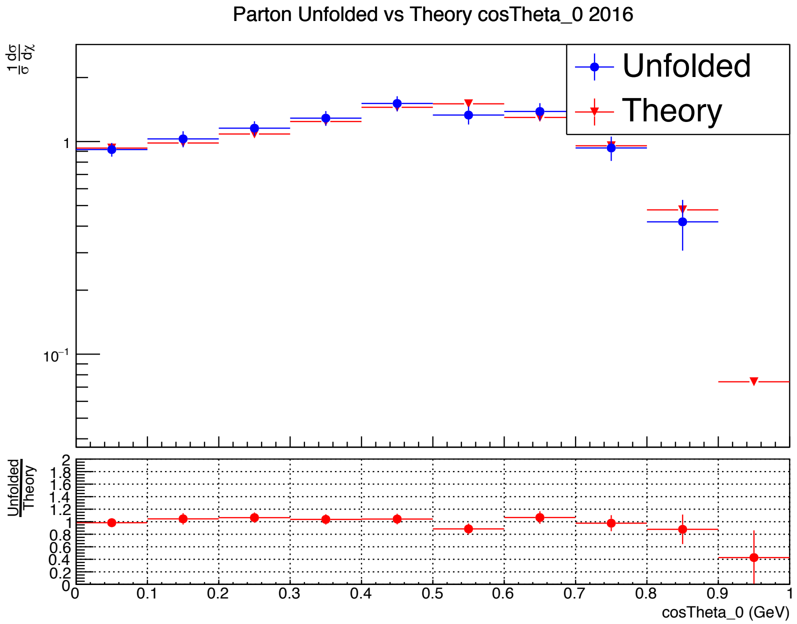

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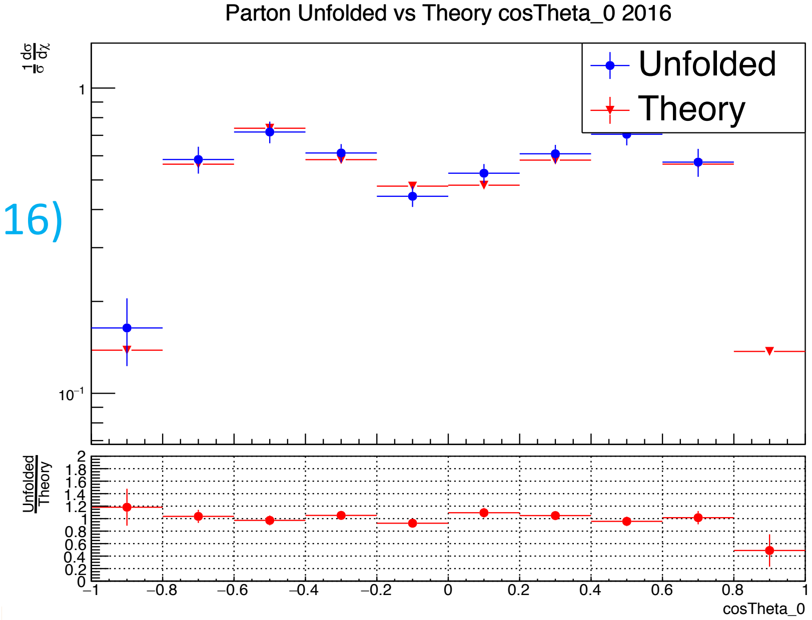

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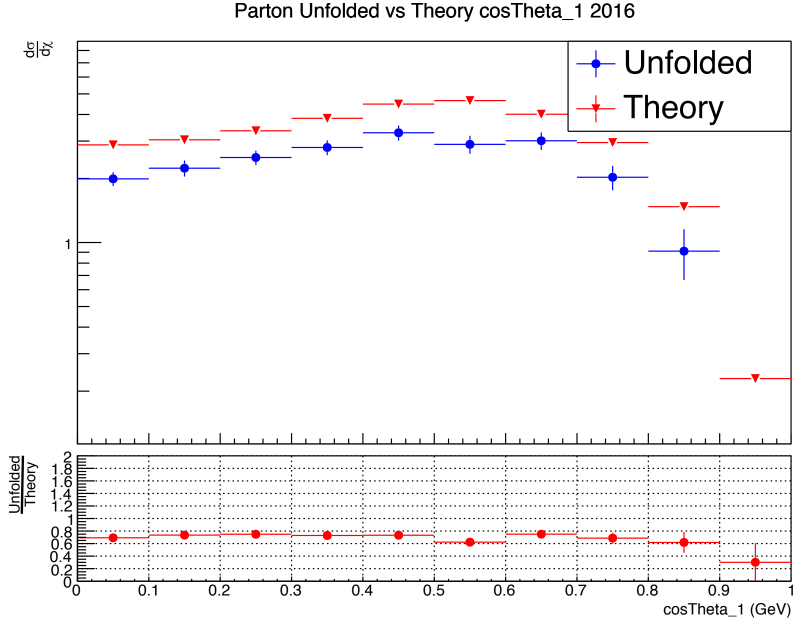

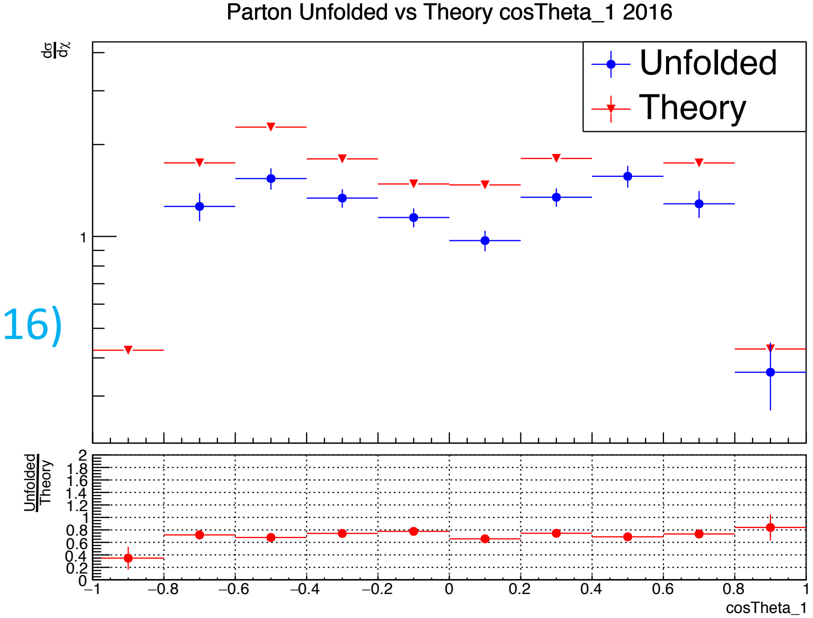

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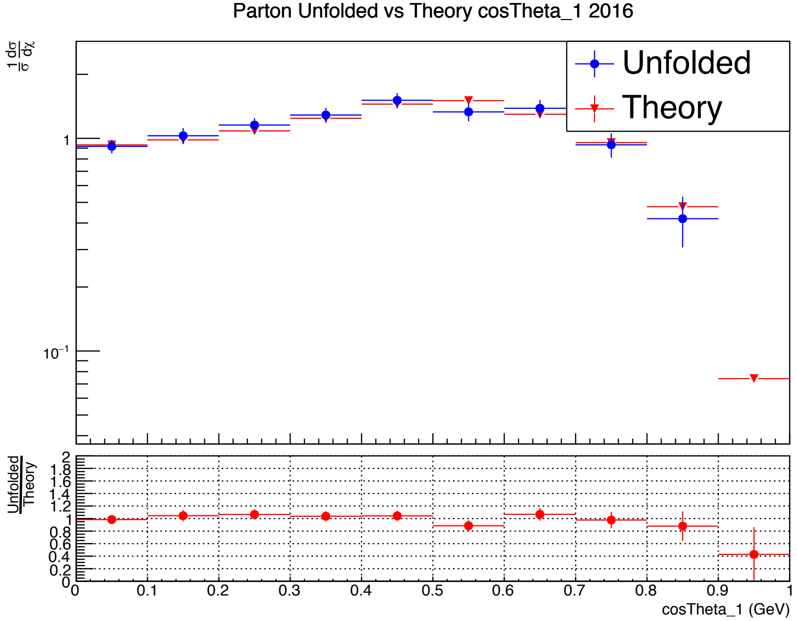

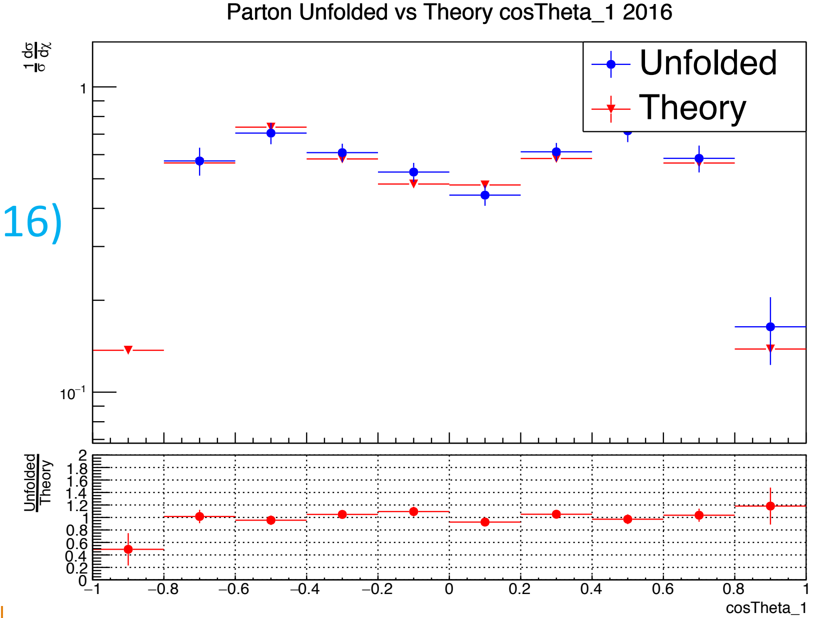

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