HEP NTUA
Weekly Report

17/3/2021

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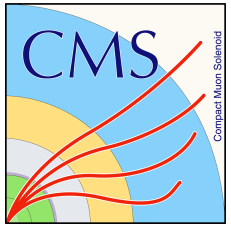

Summary

ttX analysis:

- Removed geometrical matching from files
  - Chain of analysis completed
  - Integrated angular variables
- I managed to apply combination of results
  - Comparison with Giannis
  - Particle level also
- Looking into results without matching

Z' analysis

- Switch to UL files for Z' (missing: 2016_postVFP (all widths) and 2016_preVFP, 2017, 2018 10% and 30% width files)
  - Email to B2G MC generation group
- Production of 1200, 1400, 1600 and 1800 GeV Masses
  - mJJ cut is now 1 TeV as in the ttX analysis
  - Calculation of XSEC using GenXSecAnalyzer
  - Results (work in progress, something is not looking good)

1% width: (dataset name**:** ZPrimeToTT_M*_TuneCP2_13TeV-madgraph-pythia8**)**
2016 B2G-2020Nov18-00005 17 samples Submitted Ongoing
2016APVB2G-2020Nov18-00006 17 samples Submitted DONE
2017 B2G-2020Nov18-00007 10 samples Submitted DONE
2018 B2G-2020Nov18-00008 10 samples Submitted DONE

10% and 30% width: (dataset name**:** ZPrimeToTT_M*_TuneCP2_13TeV-madgraph-pythia8**)**
2016 B2G-2021Feb17-00002 34 samples Submitted Ongoing
2016 APV B2G-2021Feb17-00004 34 samples Submitted Ongoing
2016 B2G-2021Feb17-00006 34 samples Submitted Ongoing
2016 B2G-2021Feb17-00008 34 samples Submitted Ongoing

BACKUP

Summary

Angular Distributions, Z' analysis:

- New Signal Region:
  - SR_C = SR + mJJ > 1.5TeV

- Stack histograms for SR_C

- Asymptotic Limits (Brazilian plots) for 2016, 2017, 2018
  - Total Cross section x BR
  - Total Cross section = $\sum_{i=1}^{N} S_i$, where S_i is the signal yield in the reconstructed level

- X distributions show a different slope than the B2G-16-015
  - Recreated Brazilian plot using mJJ variable (only for 2016 and Zprime 1% width)
  - Tried to increase mass cut from 1.5 TeV to 2 TeV to improve sensititvity → not enough events coming from signal extraction
  - If I use ttbar MC (χ dists) as input, the shape is the same as with the 1.5 TeV cut
  - Maybe sliding mass cuts? For each Z' use a different mJJ cut

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	

Signal Extraction

$$S_{1.5TeV}(x_{reco}) = D_{1.5TeV}(x_{reco}) - QCD_{1.5TeV}(x_{reco}) - Sub_{1.5TeV}(x_{reco}) \rightarrow$$

Where $QCD_{1.5TeV}(x_{reco}) = D^{0-btag}_{1.5TeV,shape}(x_{reco}) \boldsymbol{x} N_{SR(1.5TeV)} \boldsymbol{x} C^{shape\ SF}_{closure}$

and $N_{SR(1.5TeV)} = R^{1TeV \rightarrow 1.5TeV}_{yield} \boldsymbol{x} N^{QCD}_{SR(1TeV)} = R^{1TeV \rightarrow 1.5TeV}_{yield} \boldsymbol{x} R^{SR_A \rightarrow SR}_{yield} \boldsymbol{x} N^{QCD}_{SR_A}$

- The variable of interest here: x_{reco} → χ
- 1.5 TeV refers to the mJJ cut

- We deploy a fit in the Signal Region (2btag) to extract the N^{fit}_{QCD} in SRA (mJJ > 1TeV)

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

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:

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