

HEP NTUA Weekly Report

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Summary

ttX analysis:

- Production of UL files
 - 2016 (both pre and postVFP) is missing bTagging WP's and scale factors
- Chain of analysis:
 - Contamination
 - Closure tests
 - Mass Fit
 - Signal Extraction

 - Unfolding

 - Combination
- Consistency checks with Giannis

Z' analysis

- Switch to UL files for Z' (missing: 2016_postVFP (all widths) and 2016_preVFP, 2017, 2018 10% and 30% width files)
- Brazilian plots probably next week
 - Trying to find a variable that won't mimic ttbar when raising mJJ cut (angular ratio)

PoS for ICHEP 2020

- Review for the ICHEP presentation → comments and suggestions



BACKUP



Summary

Angular Distributions, Z' analysis:

- New Signal Region:
 - $SR_C = SR + m_{JJ} > 1.5\text{TeV}$
- 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 m_{JJ} variable (only for 2016 and Zprime 1% width)
 - Tried to increase mass cut from 1.5 TeV to 2 TeV to improve sensitivity → not enough events coming from signal extraction
 - If I use $t\bar{t}$ 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 m_{JJ} 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

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

$$\text{Where } QCD_{1.5TeV}(x_{reco}) = D_{1.5TeV,shape}^{0-btag}(x_{reco}) \times N_{SR(1.5TeV)} \times C_{closure}^{shape SF}$$

$$\text{and } N_{SR(1.5TeV)} = R_{yield}^{1TeV \rightarrow 1.5TeV} \times N_{SR(1TeV)}^{QCD} = R_{yield}^{1TeV \rightarrow 1.5TeV} \times R_{yield}^{SRA \rightarrow SR} \times N_{SRA}^{QCD}$$

- The variable of interest here: $x_{reco} \rightarrow \chi$
- 1.5 TeV refers to the mJJ cut
- We deploy a fit in the Signal Region (2btag) to extract the N_{QCD}^{fit} in SRA (mJJ > 1TeV)

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



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 χ
- 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:

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

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

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

