

HEP NTUA Top Angular Report

18/3/2021

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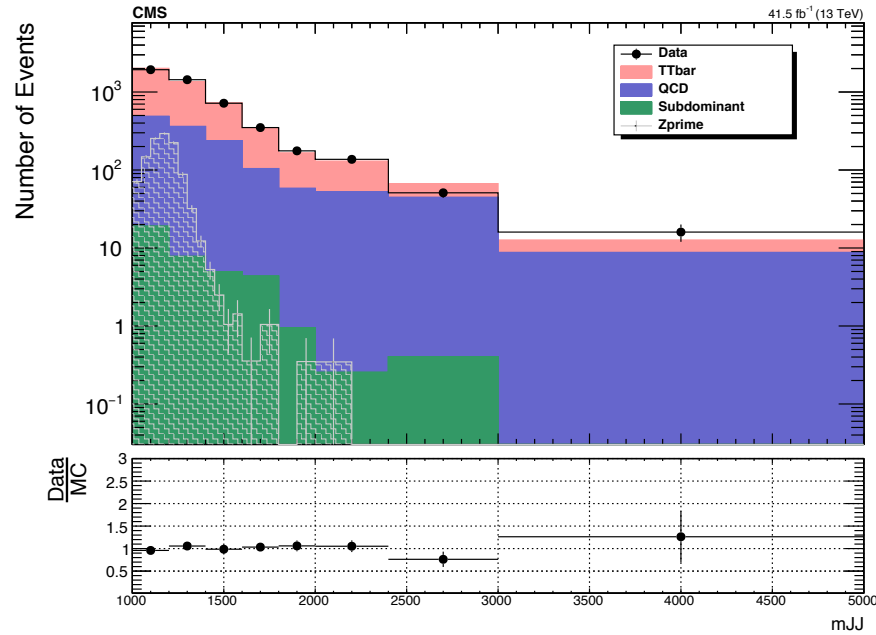
Summary

- Signal Region is now the same with ttX analysis:
 - $m_{JJ} > 1000 \text{ GeV}$
 - Angular distribution integration
- Stack histograms: ($m_{Z'}$: 1.2, 1.4, 1.6, 1.8, 2, 2.5, 3, 3.5, 4, 4.5 TeV width 1%)
 - Year 2017
 - Data vs MC (qcd scaled with k-factor to data)
 - TTbar scaled with signal strength
 - m_{JJ} and χ
- Asymptotic Limits (Brazilian plots)
 - 2017 and 2018

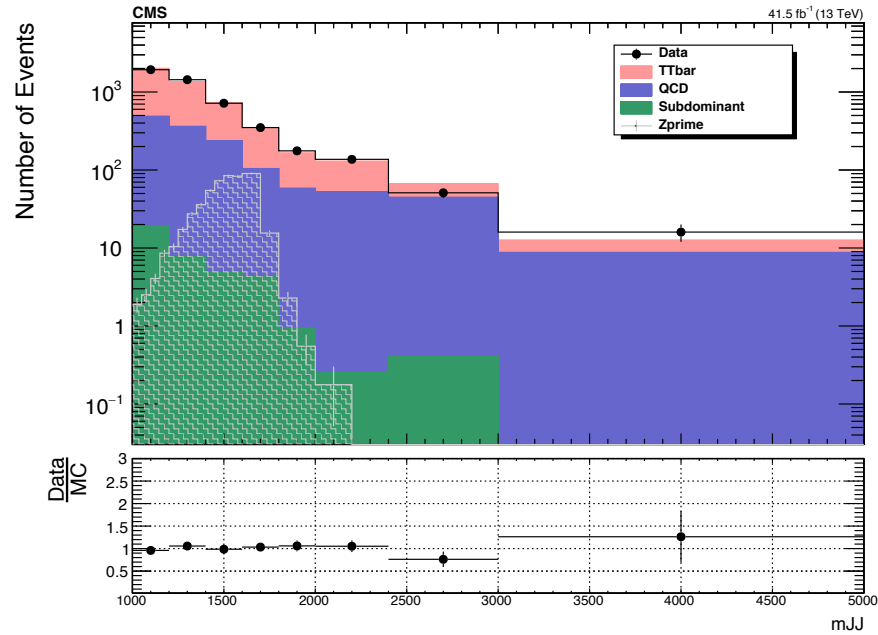


Stack Histograms mJJ

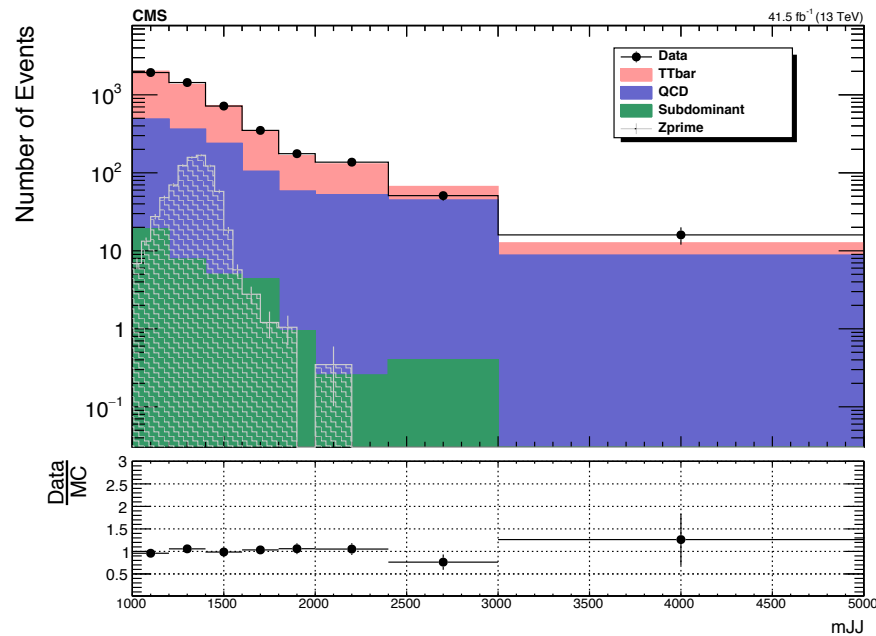
$M_{Z'} = 1200, w = 1\%$



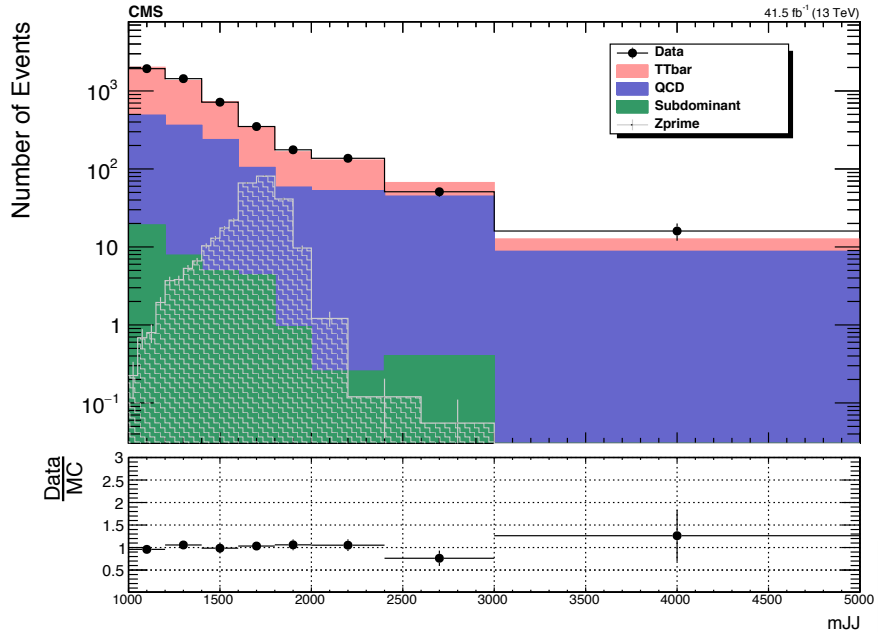
$M_{Z'} = 1600, w = 1\%$



$M_{Z'} = 1400, w = 1\%$

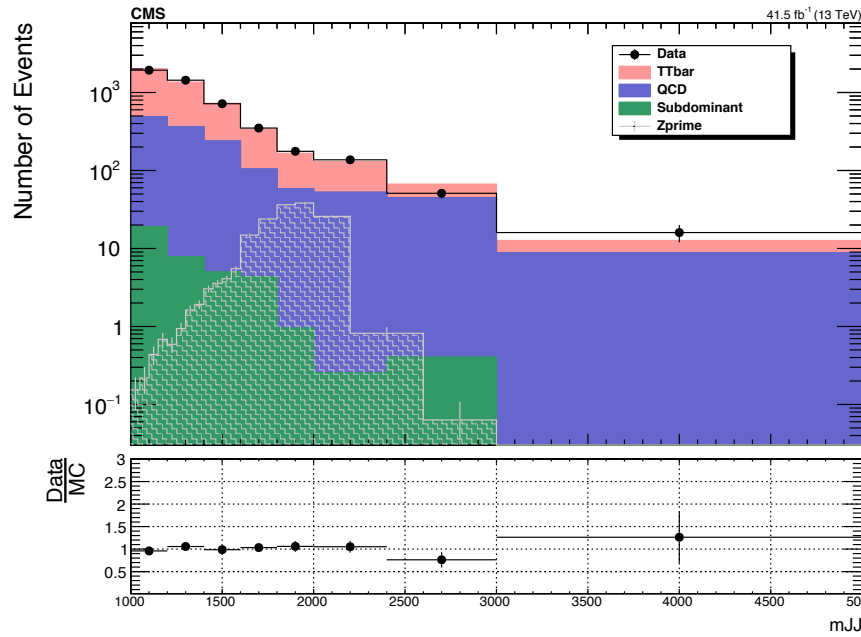


$M_{Z'} = 1800, w = 1\%$

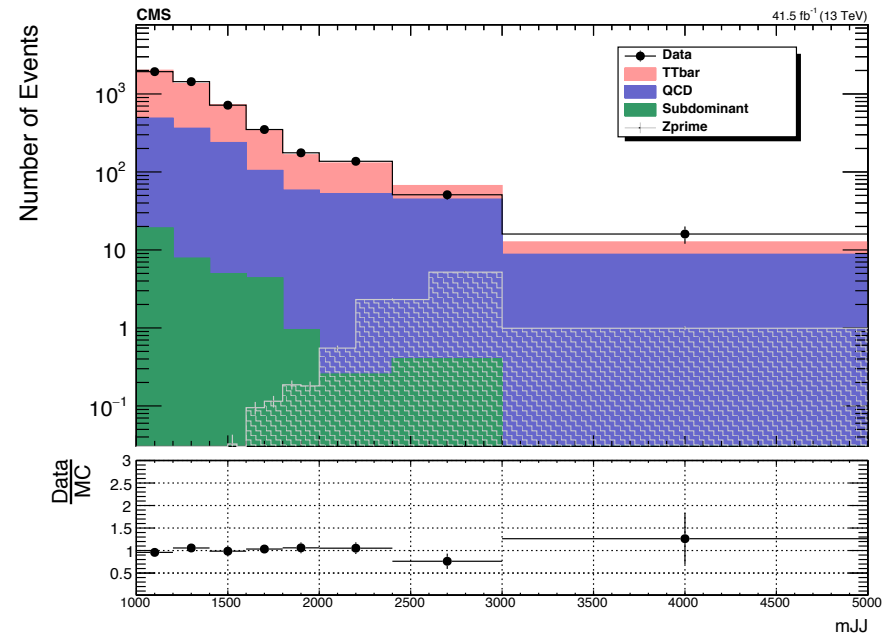


Stack Histograms mJJ

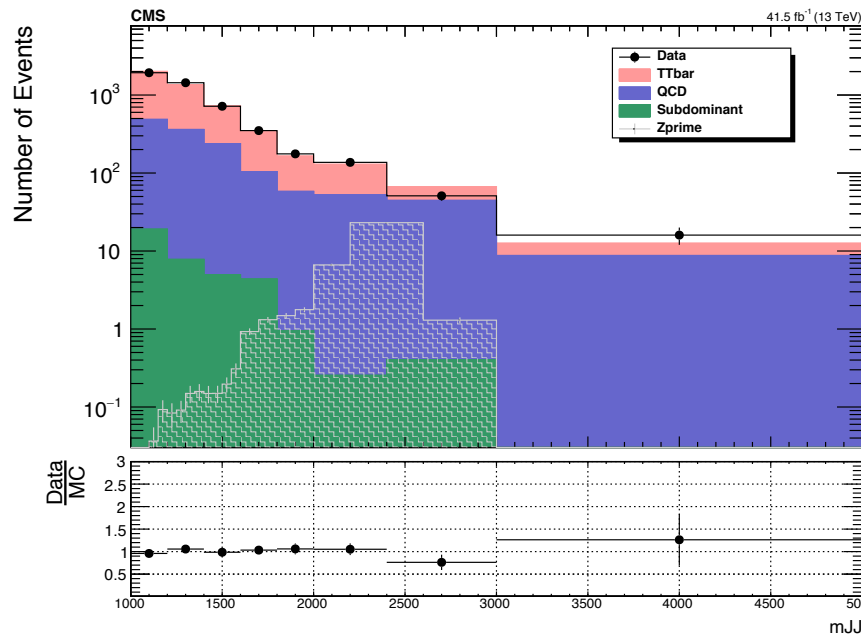
$M_{Z'} = 2000, w = 1\%$



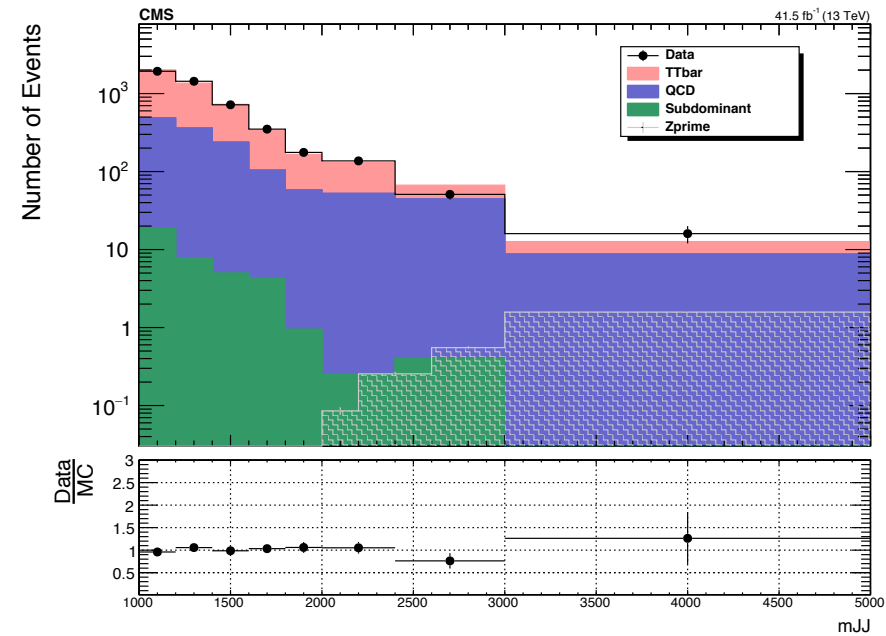
$M_{Z'} = 3000, w = 1\%$



$M_{Z'} = 2500, w = 1\%$

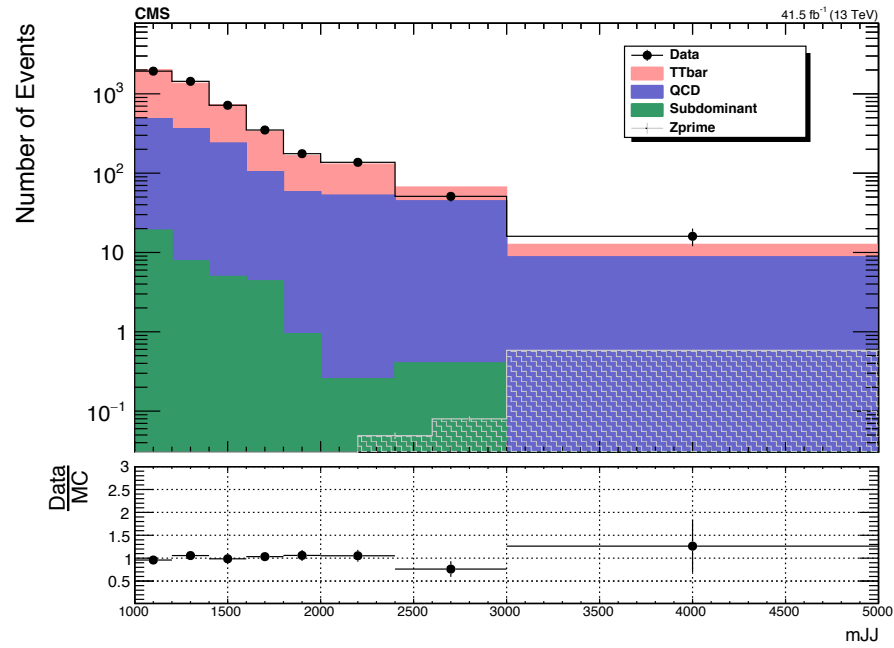


$M_{Z'} = 3500, w = 1\%$



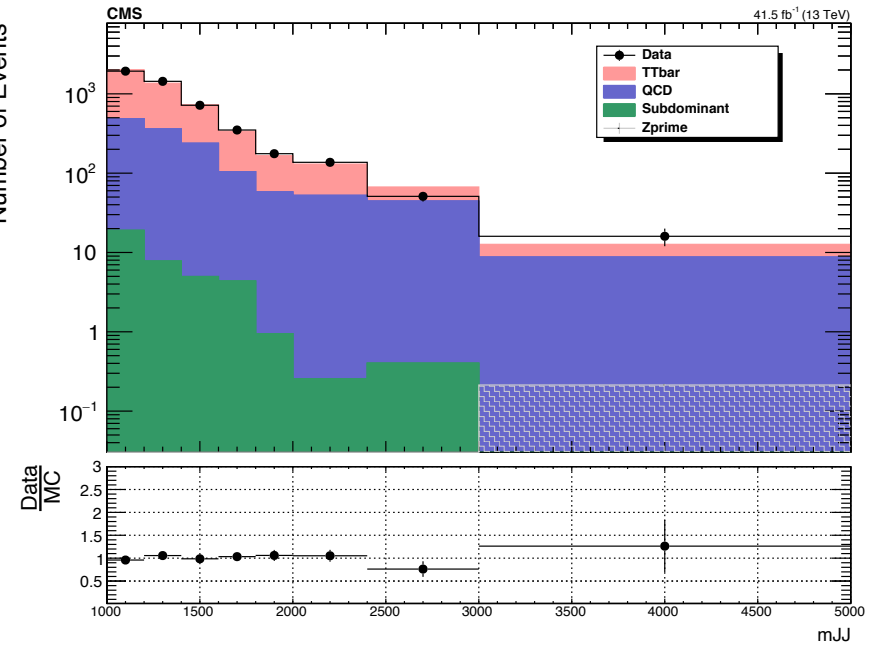
Stack Histograms mJJ

$M_{Z'} = 4000, w = 1$



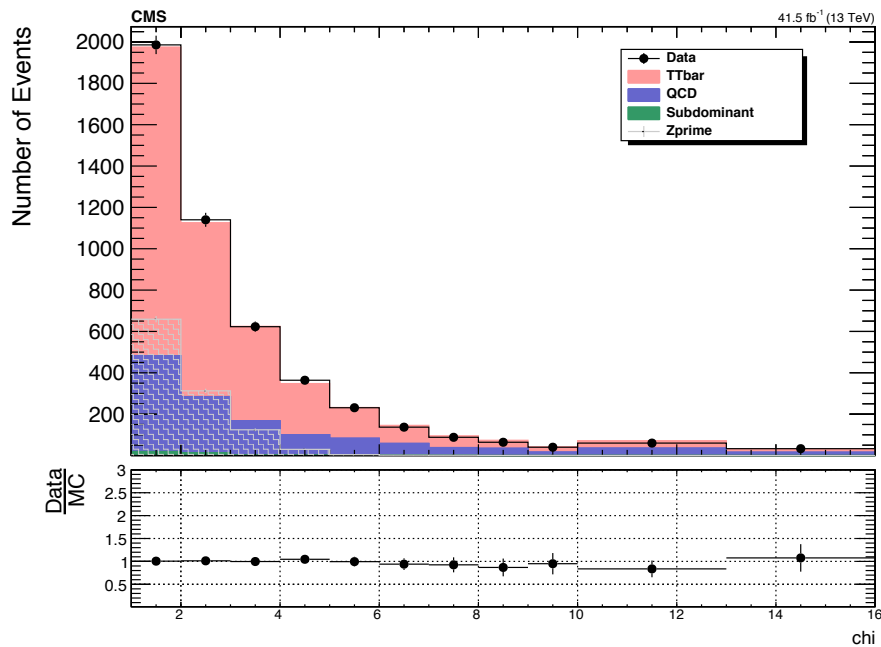
Number of Events

$M_{Z'} = 4500, w = 1\%$

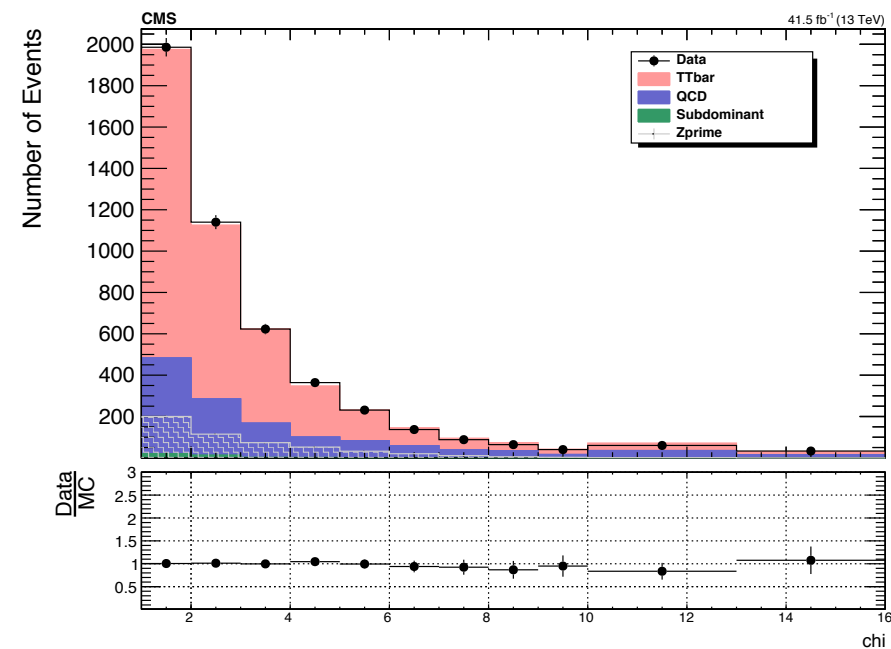


Stack Histograms chi

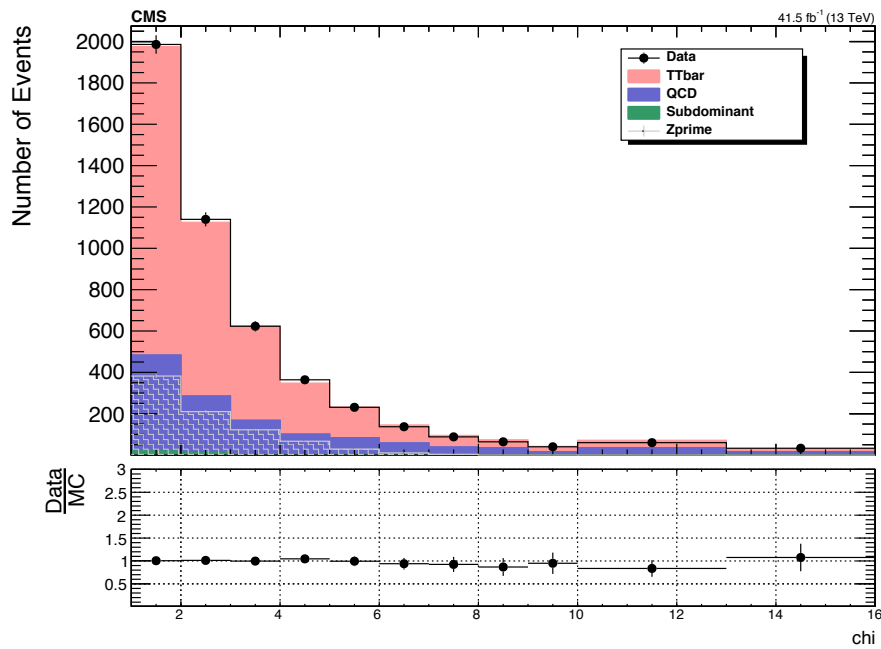
$M_{Z'} = 1200, w = 1\%$



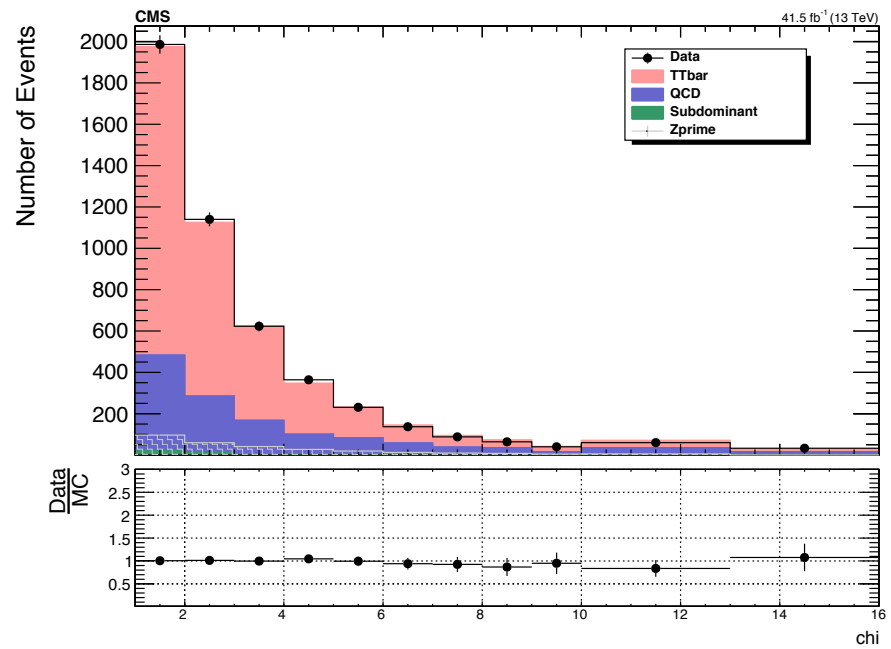
$M_{Z'} = 1600, w = 1\%$



$M_{Z'} = 1400, w = 1\%$

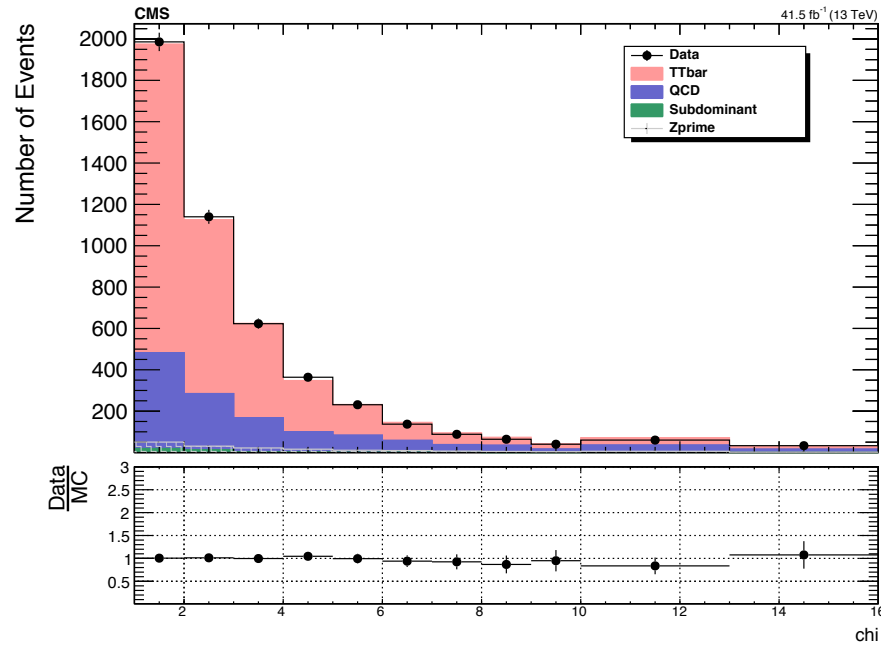


$M_{Z'} = 1800, w = 1\%$

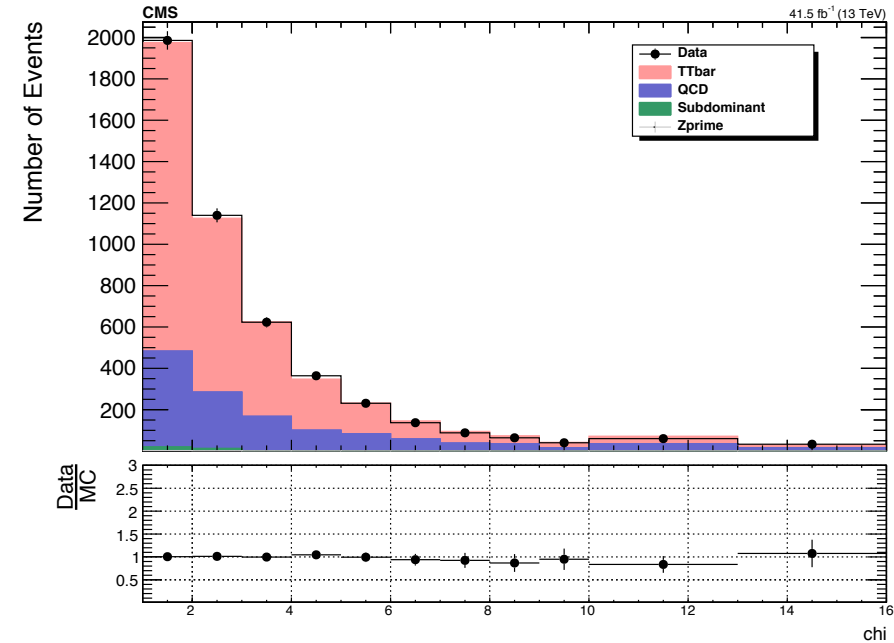


Stack Histograms chi

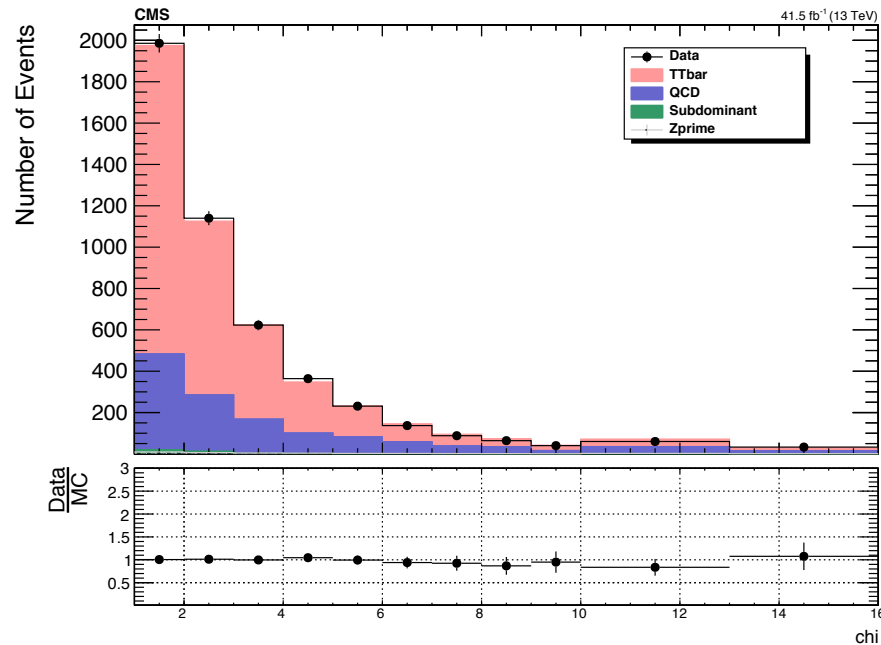
$M_{Z'} = 2000, w = 1\%$



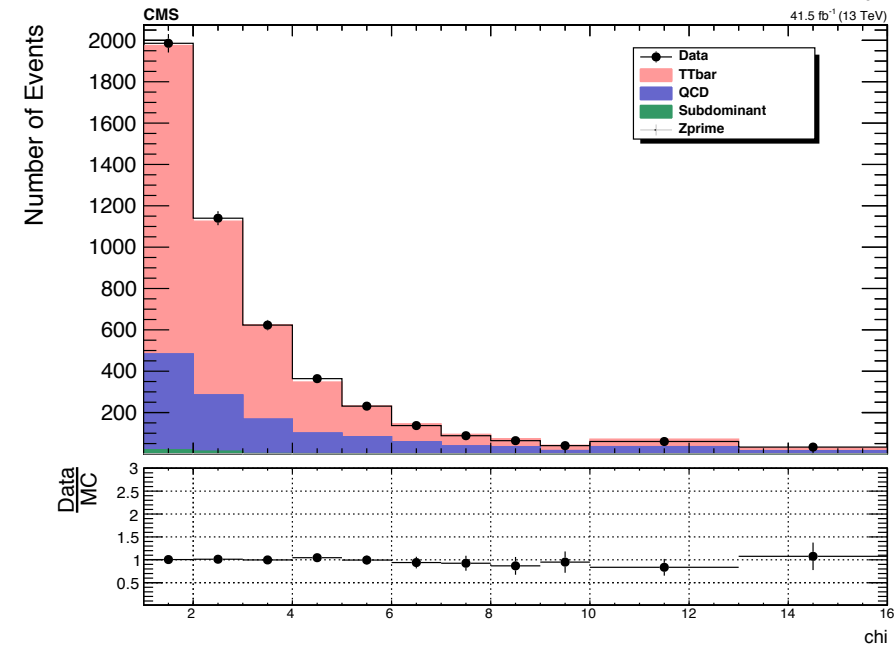
$M_{Z'} = 3000, w = 1\%$



$M_{Z'} = 2500, w = 1\%$

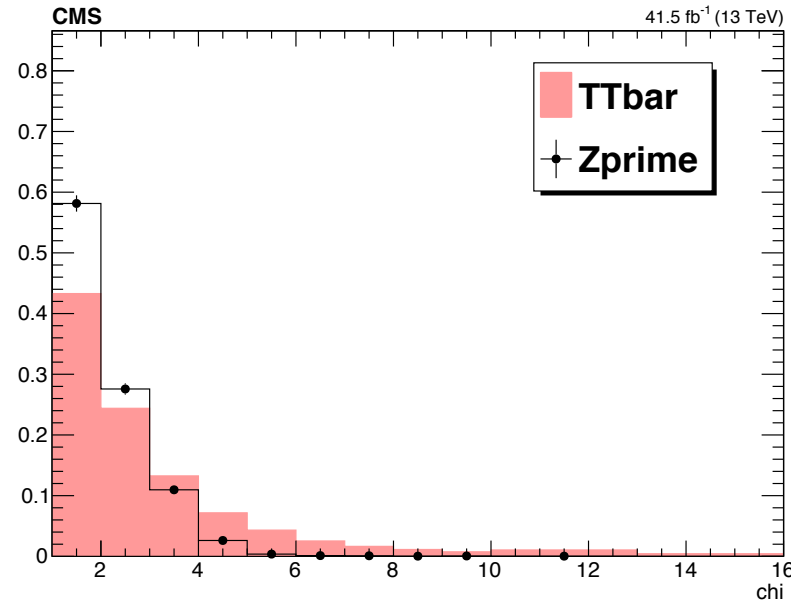


$M_{Z'} = 3500, w = 1\%$

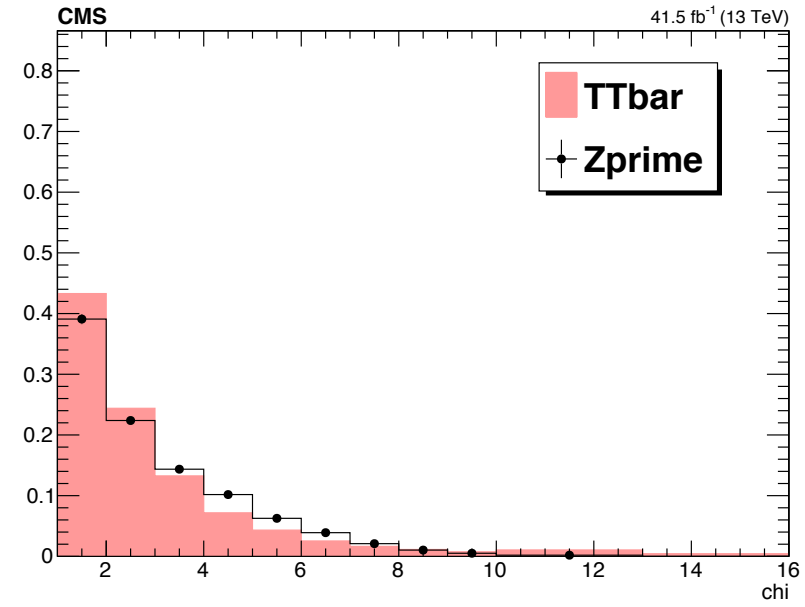


Chi (χ) sensitivity

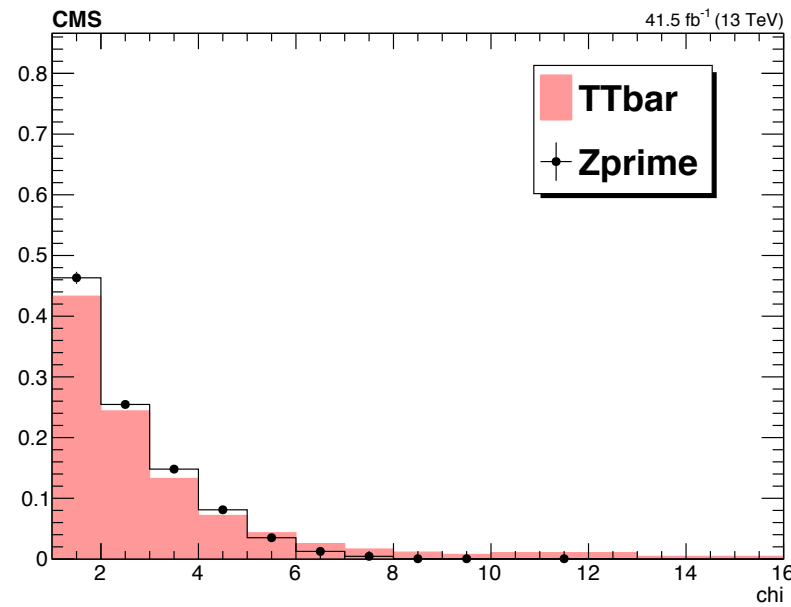
$M_{Z'} = 1200$, $w = 1\%$



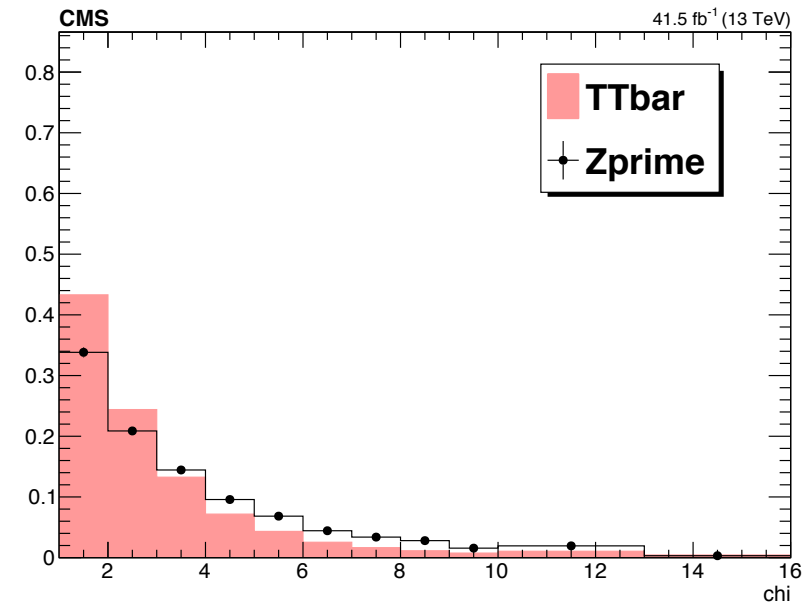
$M_{Z'} = 1600$, $w = 1\%$



$M_{Z'} = 1400$, $w = 1\%$

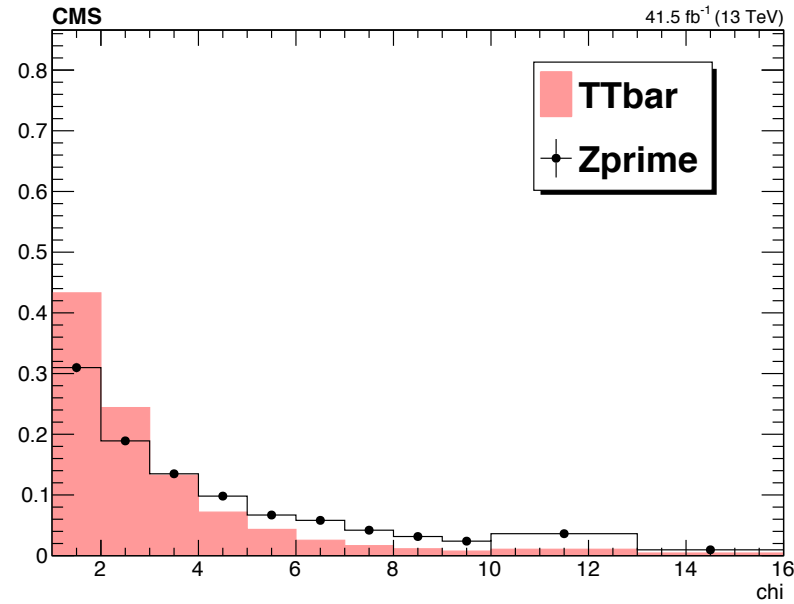


$M_{Z'} = 1800$, $w = 1\%$

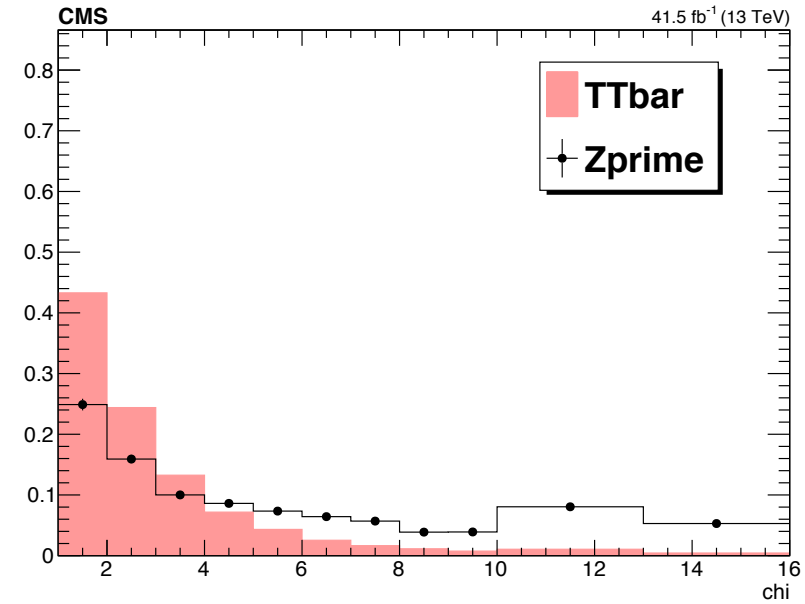


Chi (χ) sensitivity

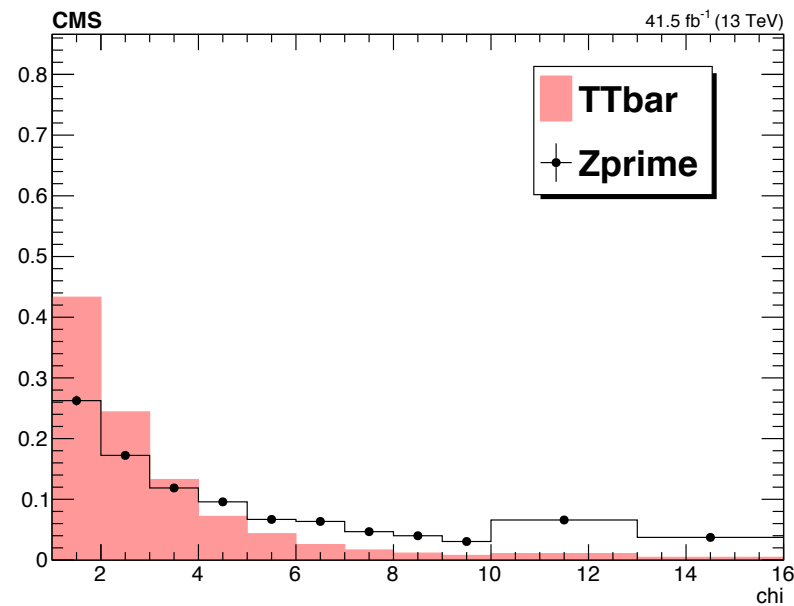
$M_{Z'} = 2000$, $w = 1\%$



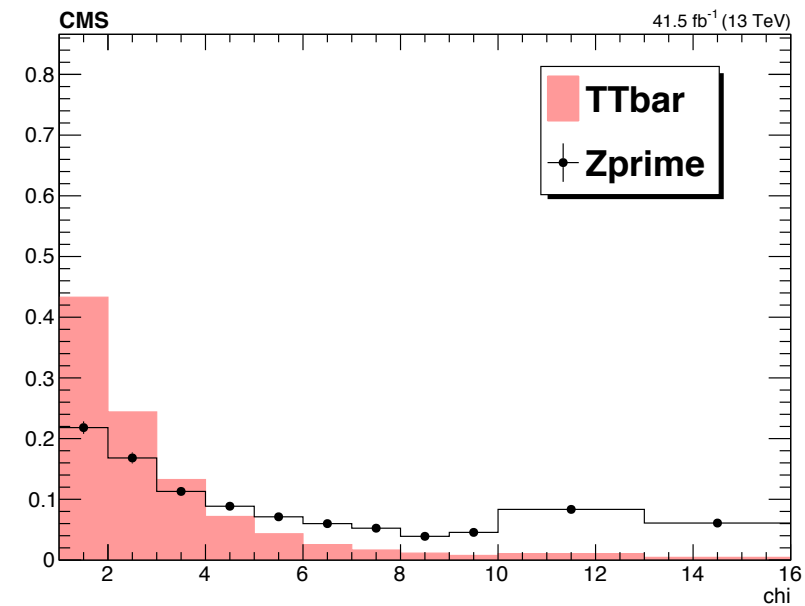
$M_{Z'} = 3000$, $w = 1\%$



$M_{Z'} = 2500$, $w = 1\%$

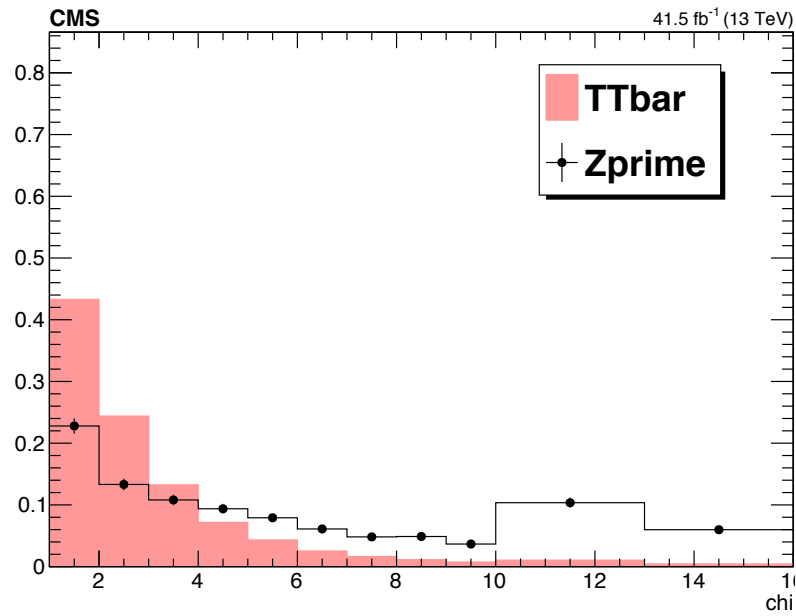


$M_{Z'} = 3500$, $w = 1\%$

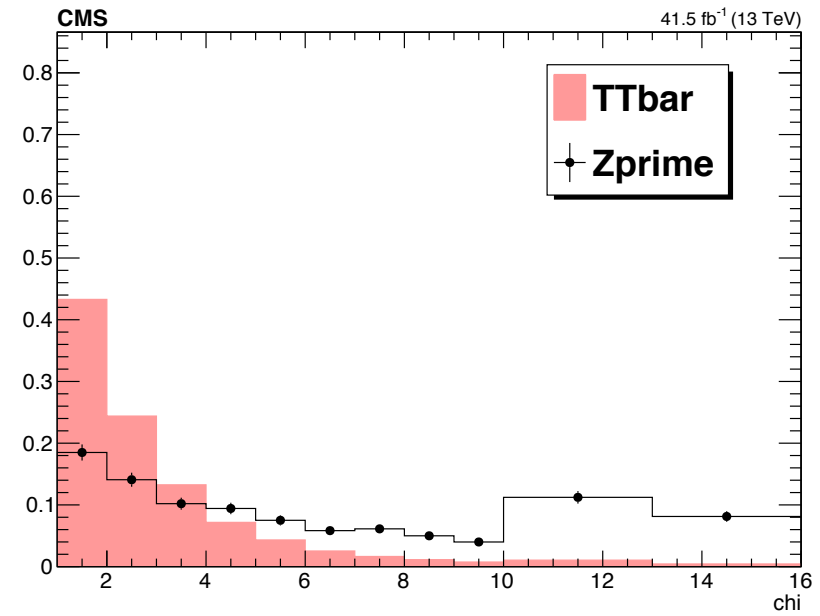


Chi (χ) sensitivity

$M_{Z'} = 4000$, $w = 1\%$



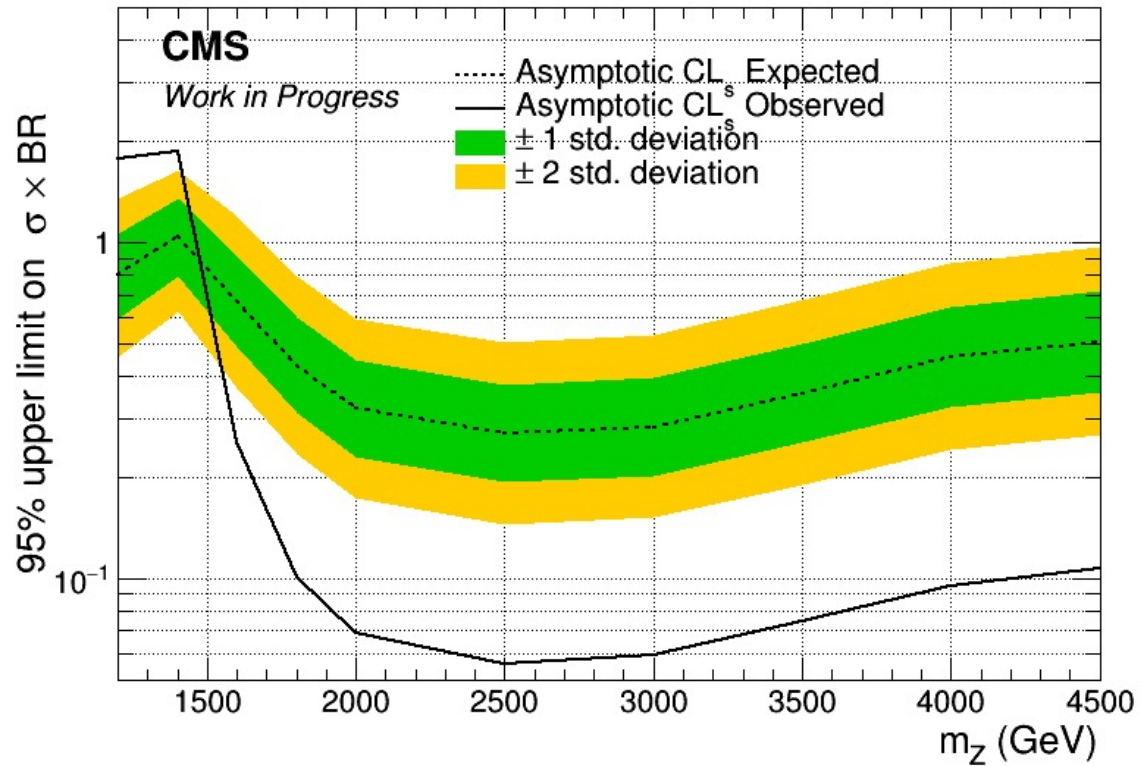
$M_{Z'} = 4500$, $w = 1\%$



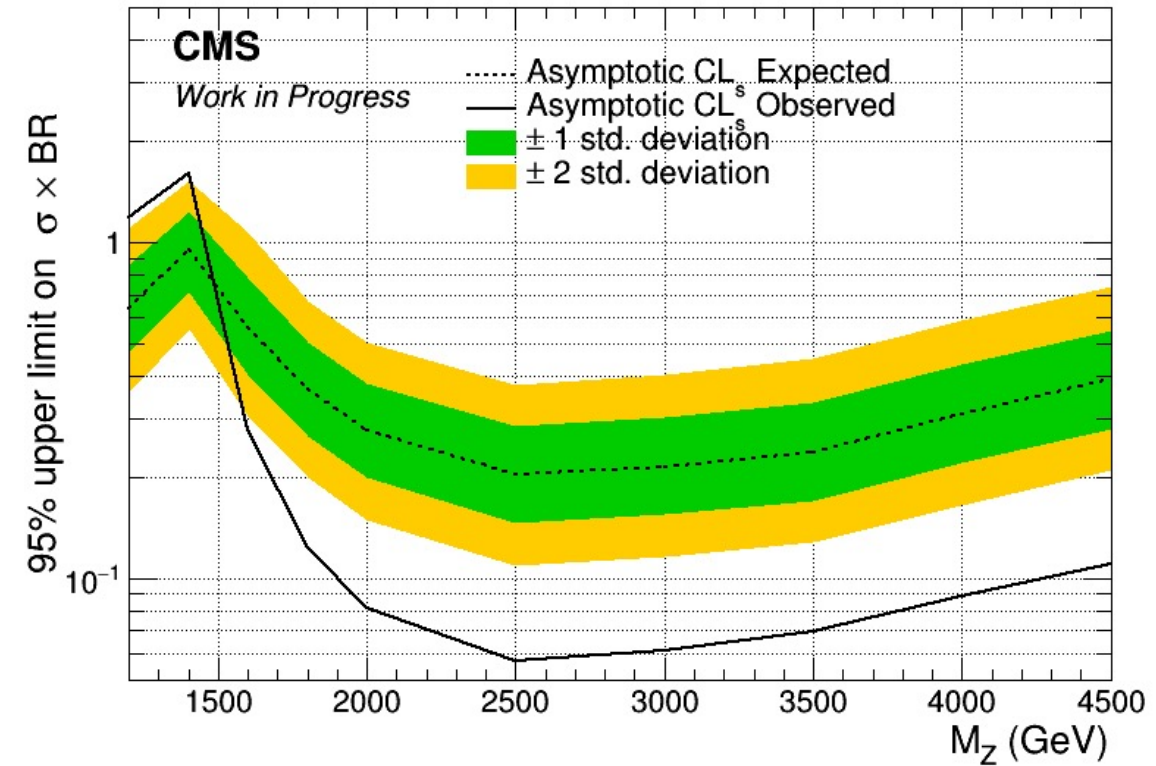
Angular Distributions (Brazilian Plot)

Asymptotic limits for $M_{Z'}$: 1.2, 1.4, 1.6, 1.8, 2, 2.5, 3, 3.5, 4, 4.5 TeV
Width 1%

2017



2018



BACKUP



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 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:

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

