

HEP NTUA Top Angular Report

11/12/2020

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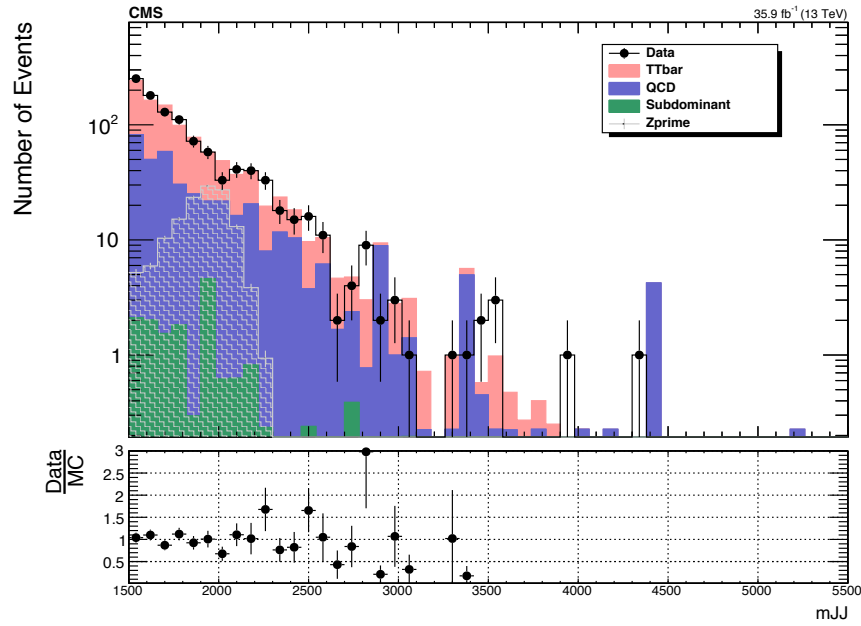
Summary

- Ttbar analysis:
 - Working on systematics
 - Consistency checks with Giannis
 - Next step is how to combine the 3 years
- 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

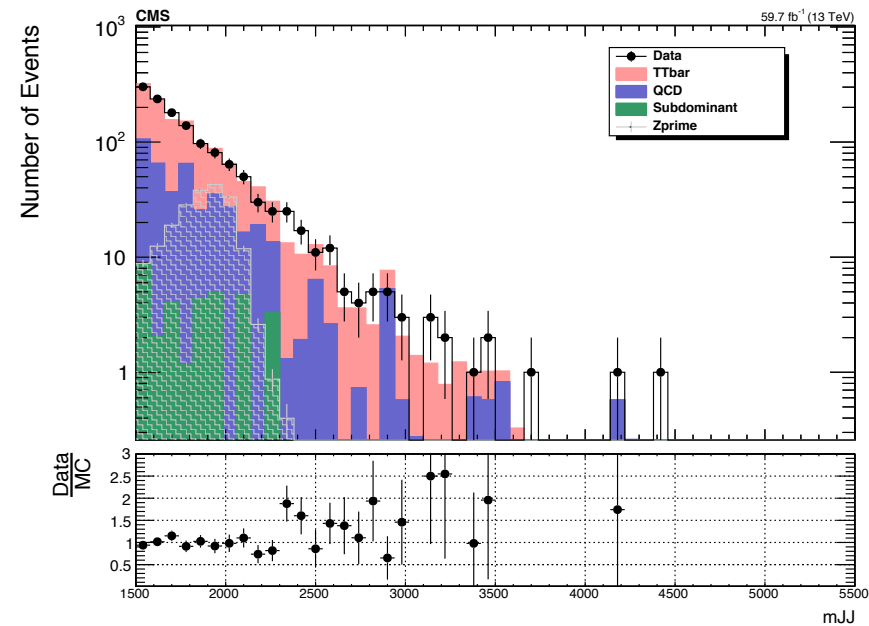


Stack Distributions vs B2G-16-015 $M_{Z'}=2\text{TeV}$, w 1%

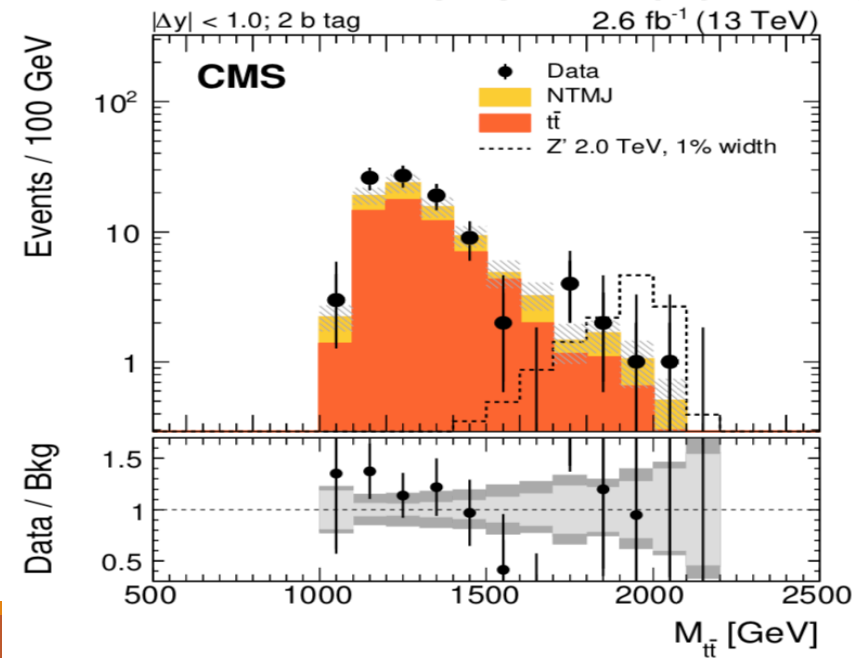
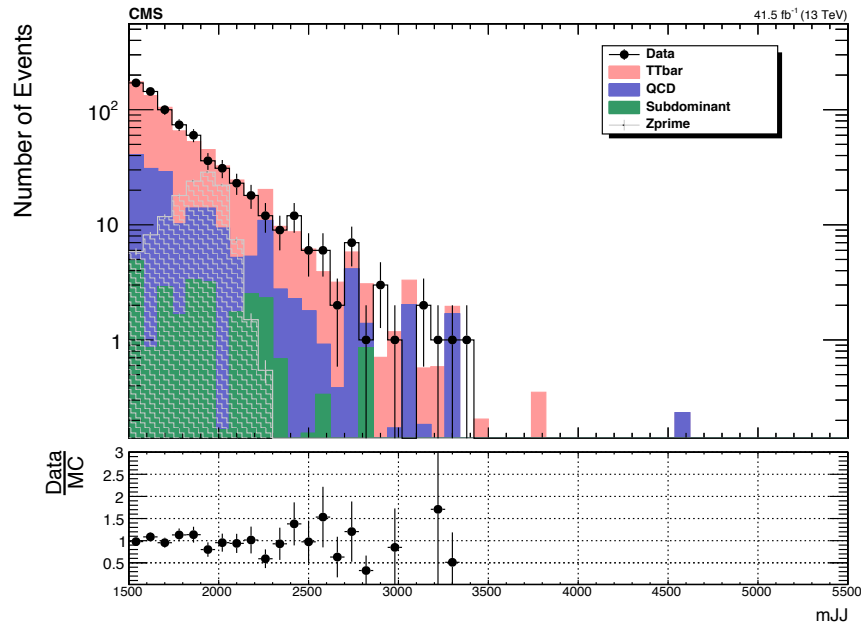
2016



2018

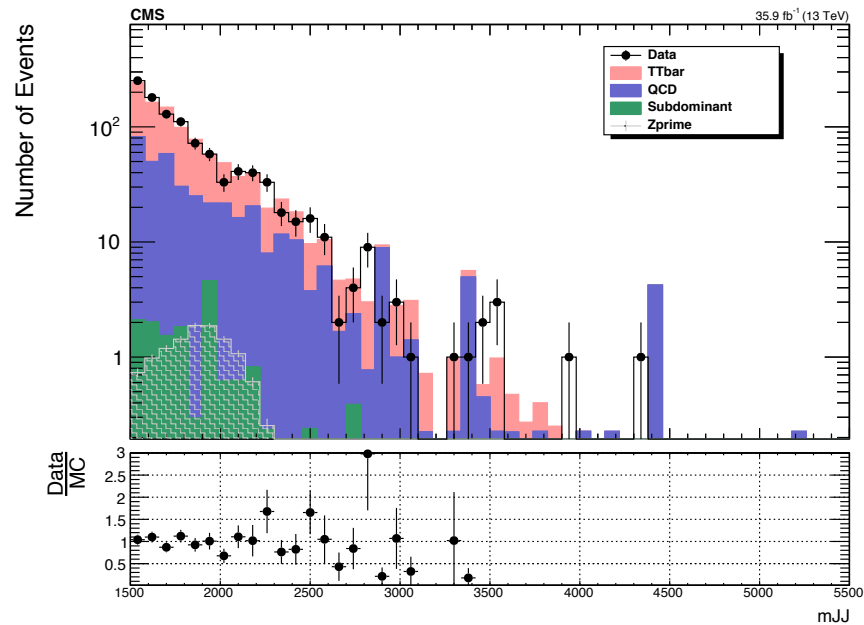


2017

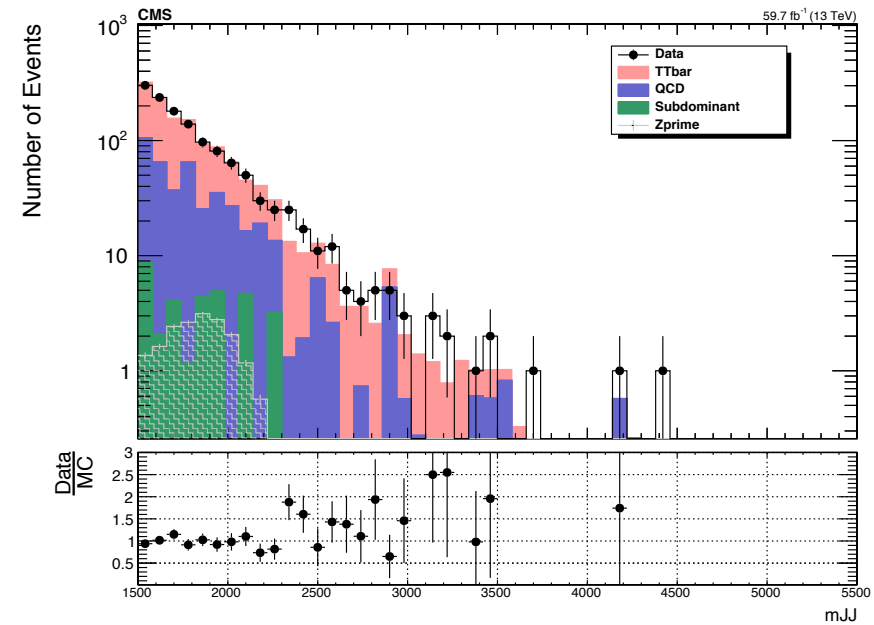


Stack Distributions vs B2G-16-015 $M_{Z}=2\text{TeV}$, w 10%

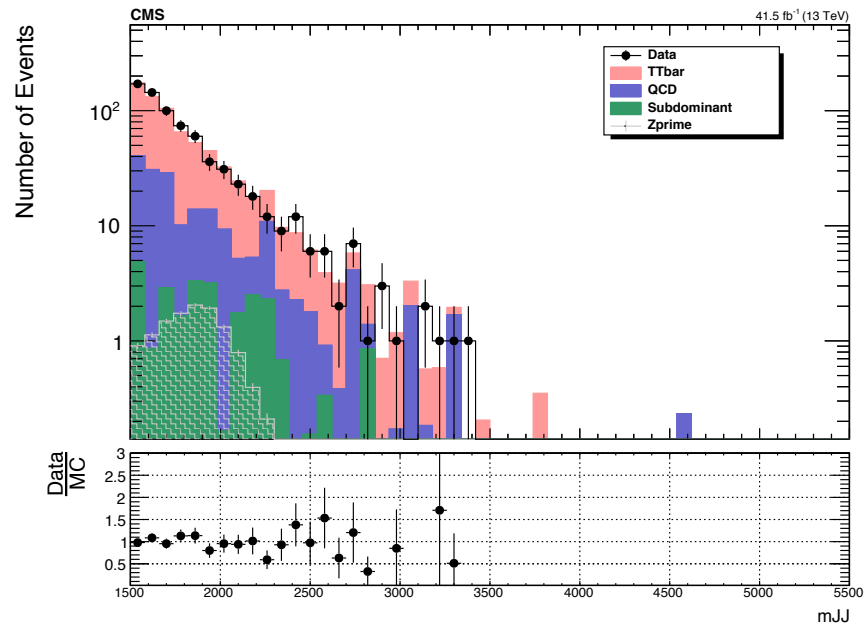
2016



2018

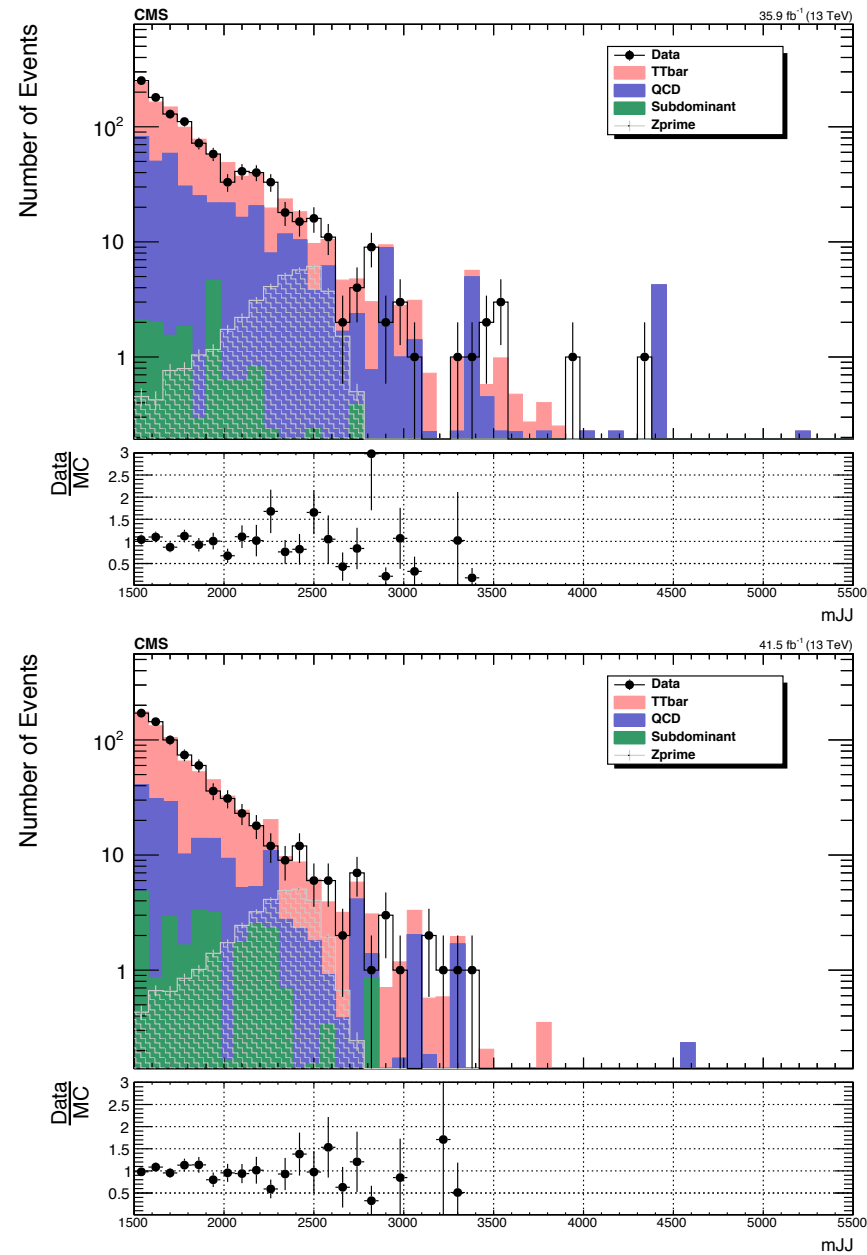


2017

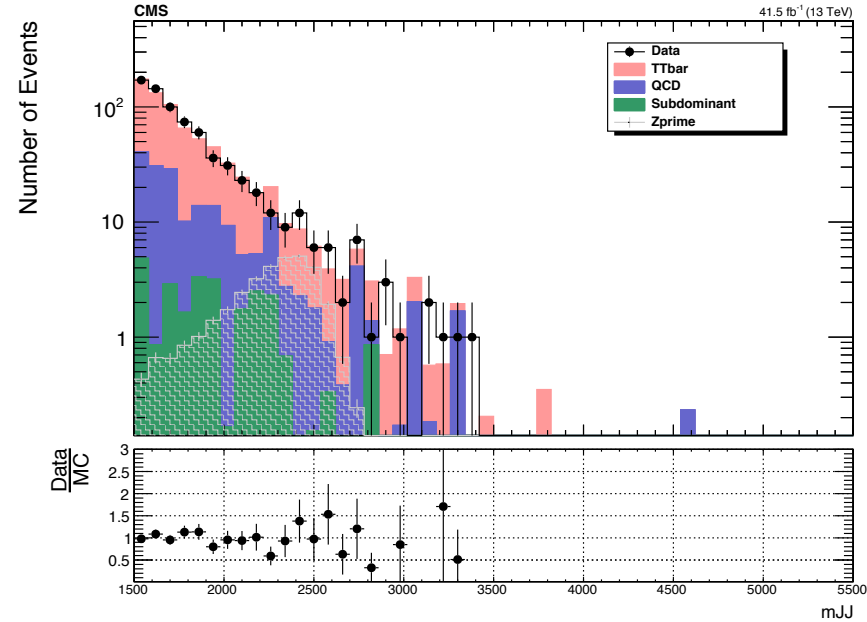


Stack Distributions $M_Z = 2.5\text{TeV}$, w 1%

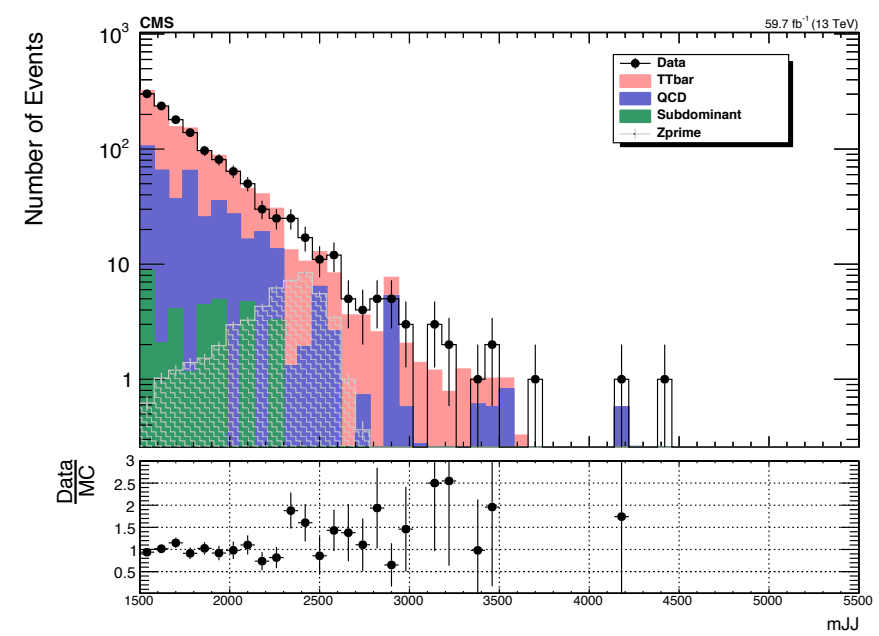
2016



2017



2018

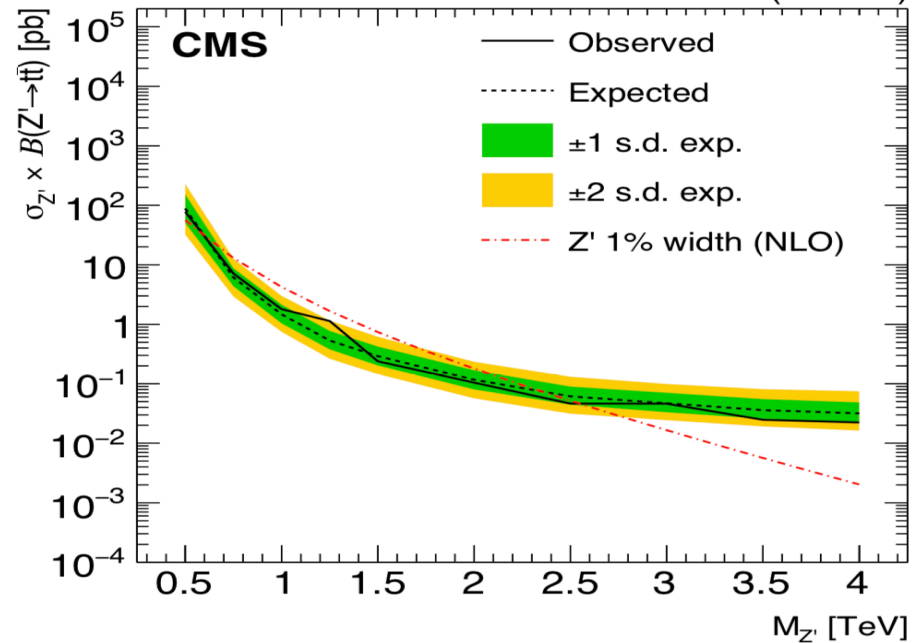
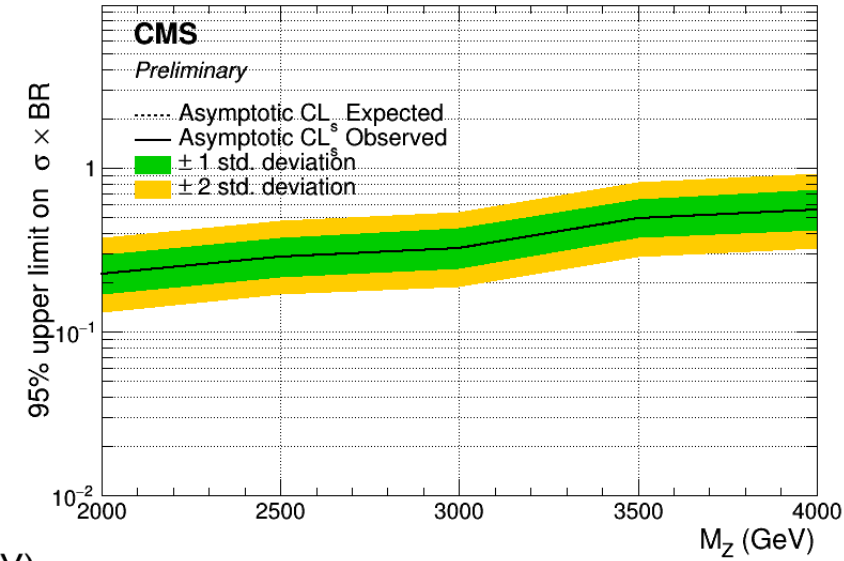
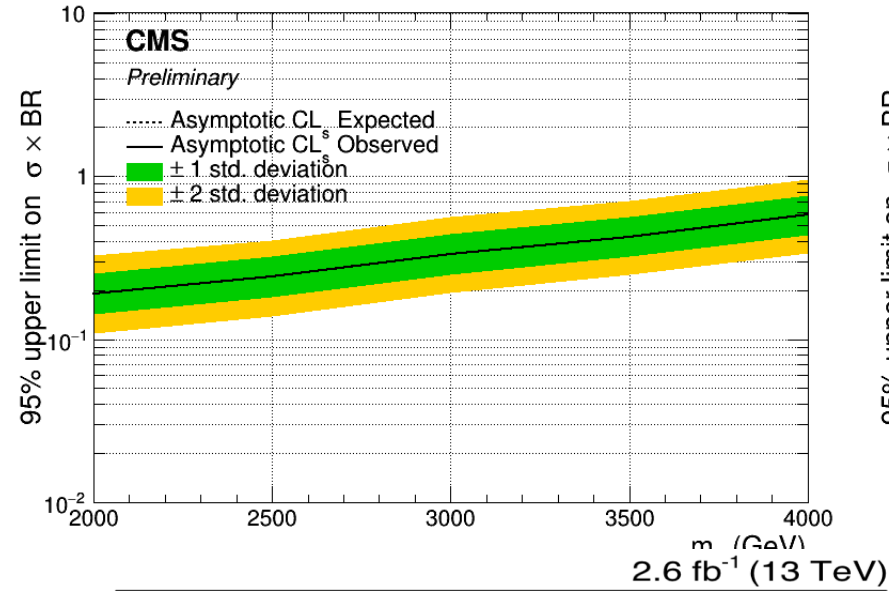
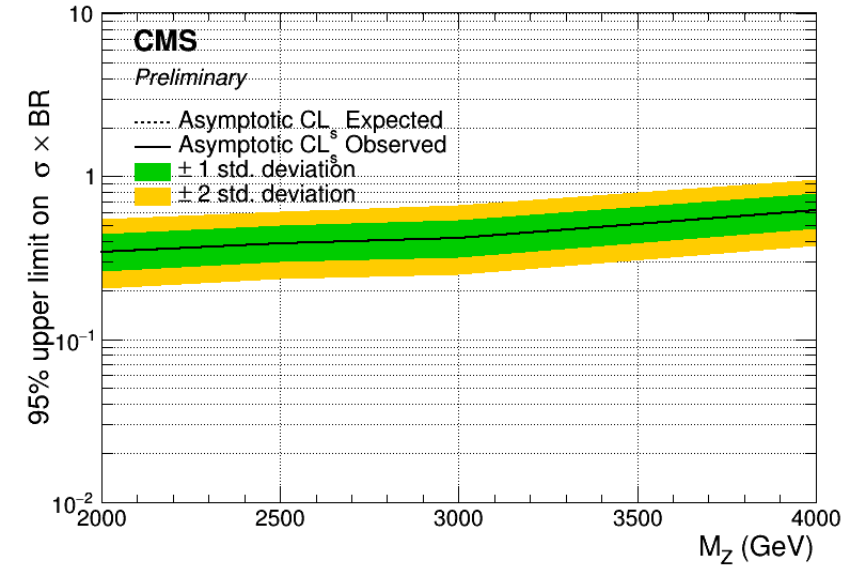


Asymptotic Limits width 1%

2016

2017

2018

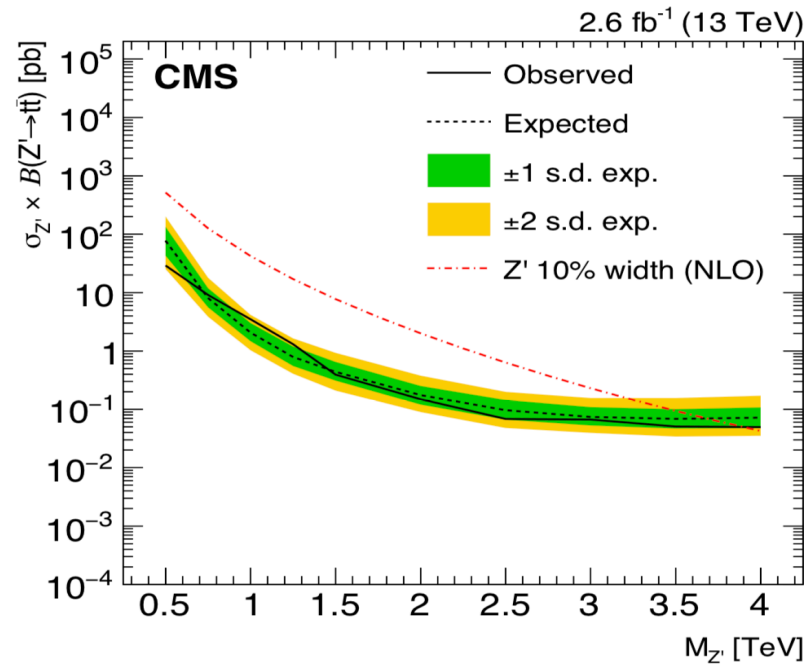
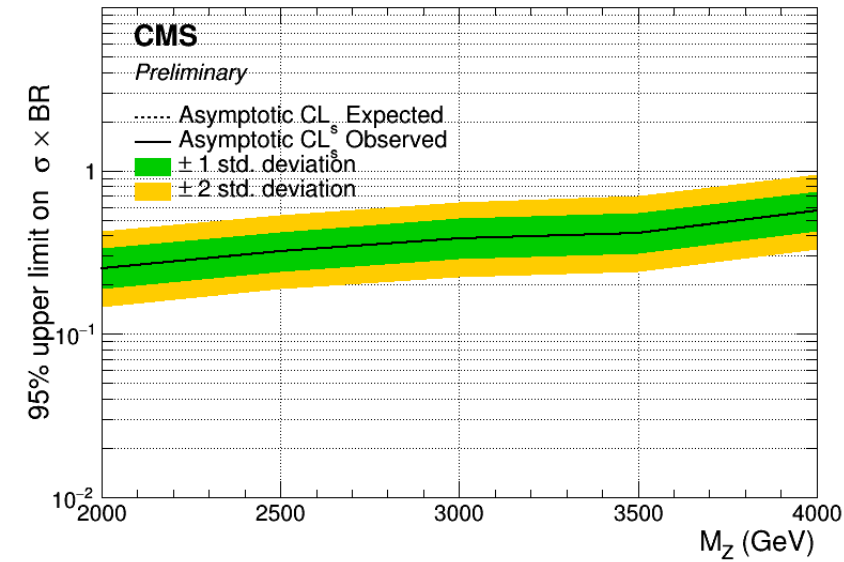
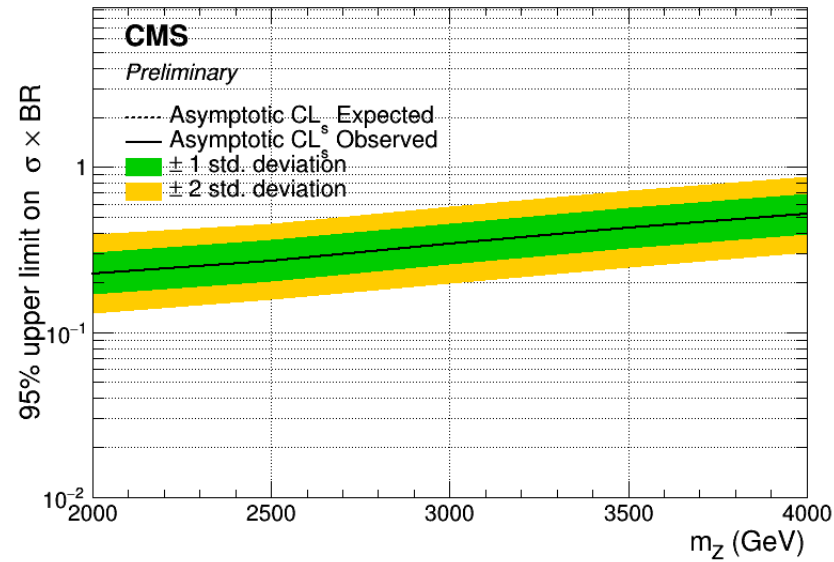
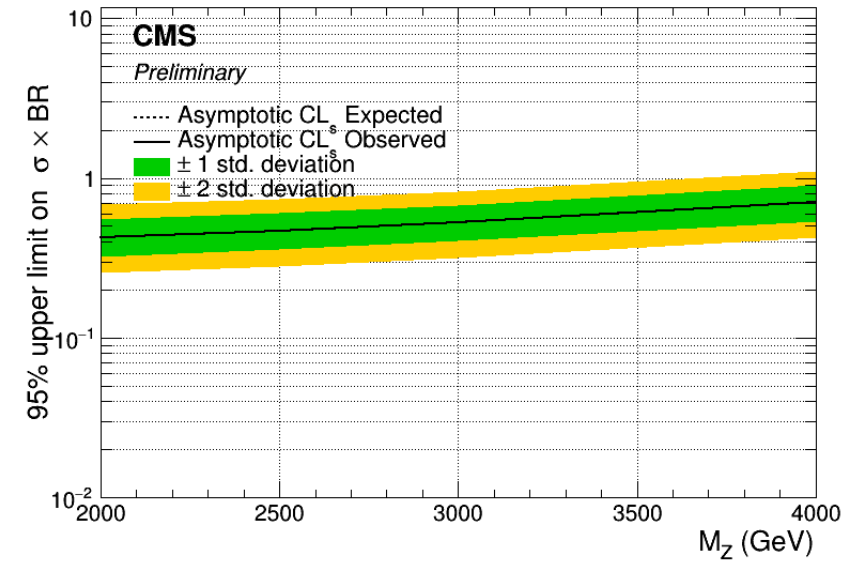


Asymptotic Limits width 10%

2016

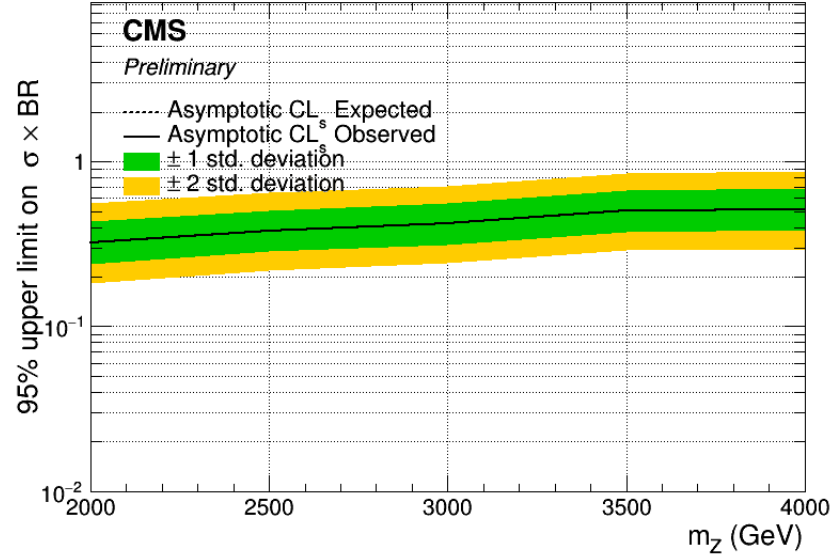
2017

2018

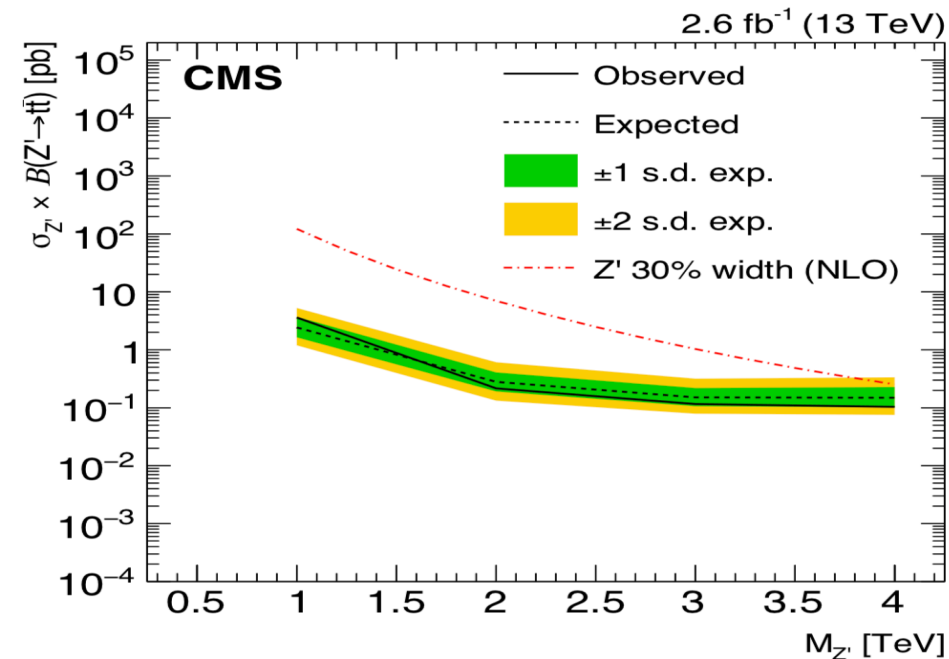
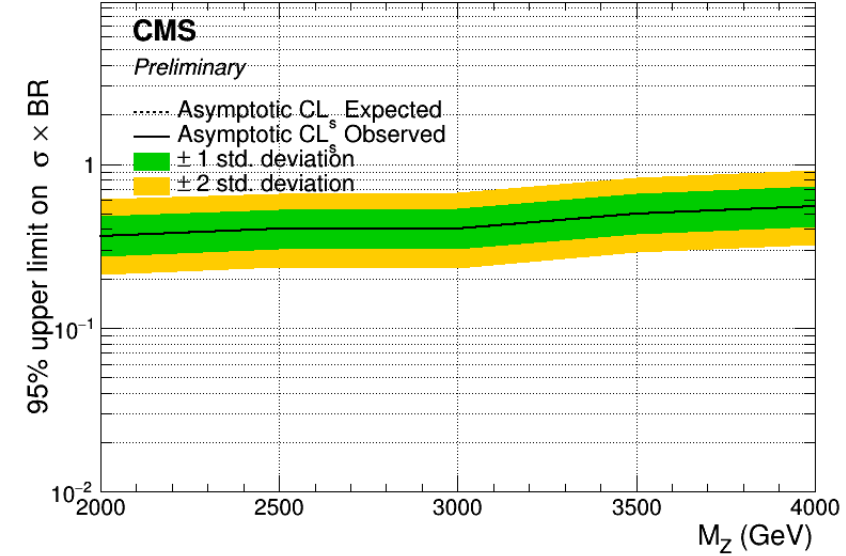


Asymptotic Limits width 30%

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	



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)

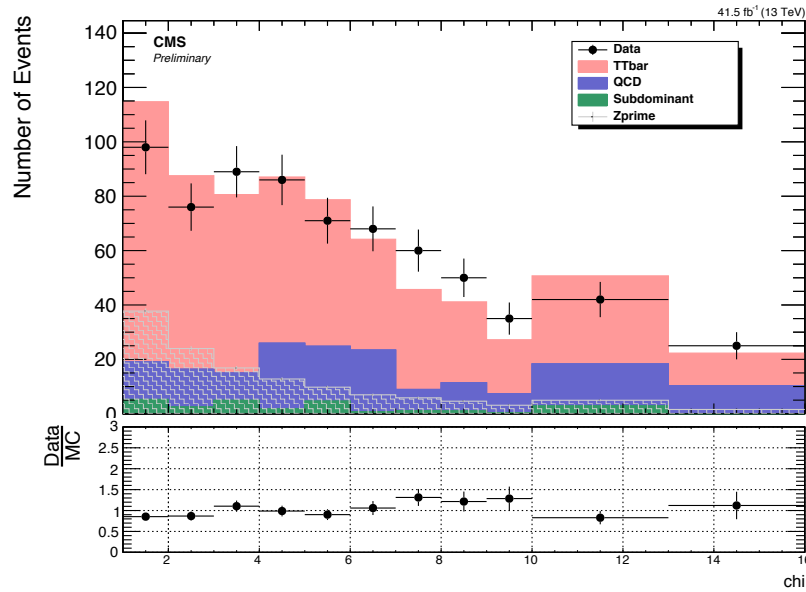
We define as $y^* = \frac{1}{2} \ln\left(\frac{1+|\cos\theta^*|}{1-|\cos\theta^*|}\right)$ and from (1) we can find that:

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

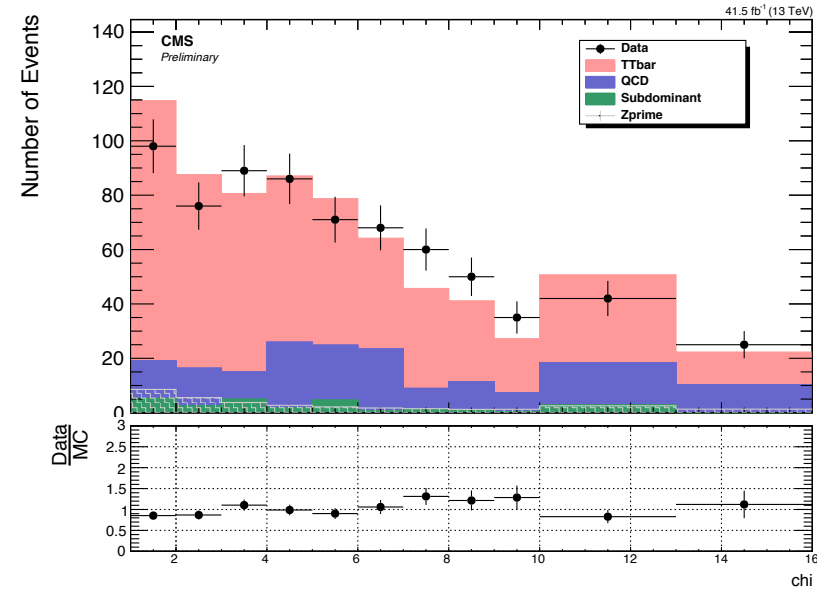


Angular Distributions (Prefit) 2017

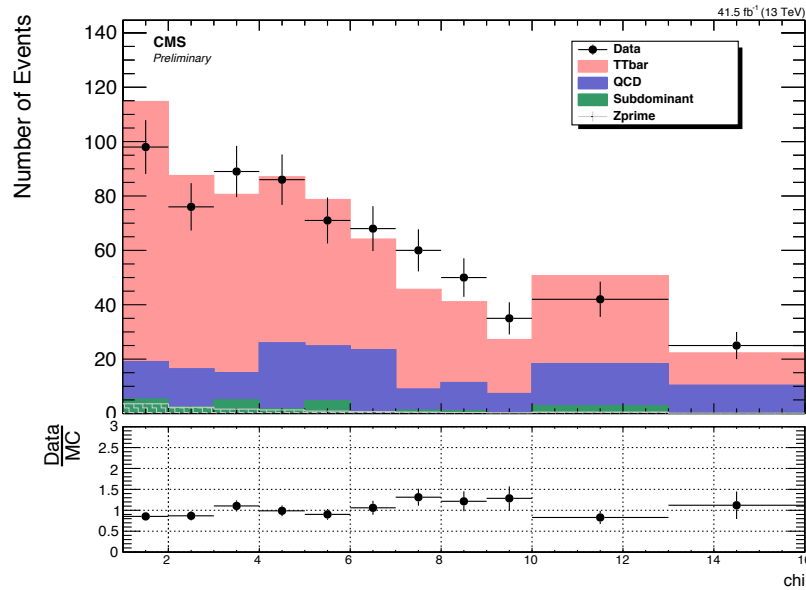
$M_{Z'} = 2000$, $w = 1\%$



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