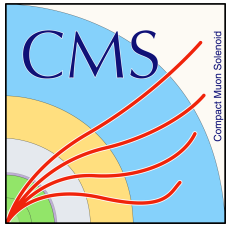
HEP NTUA
Top Angular Report

13/12/2020

George Bakas



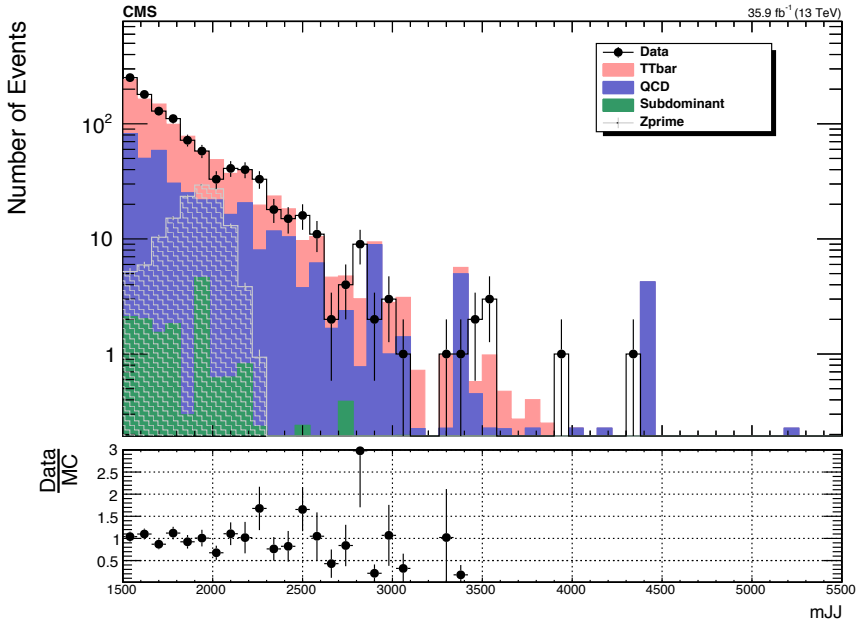
Summary

Angular Distributions, Z’ analysis:

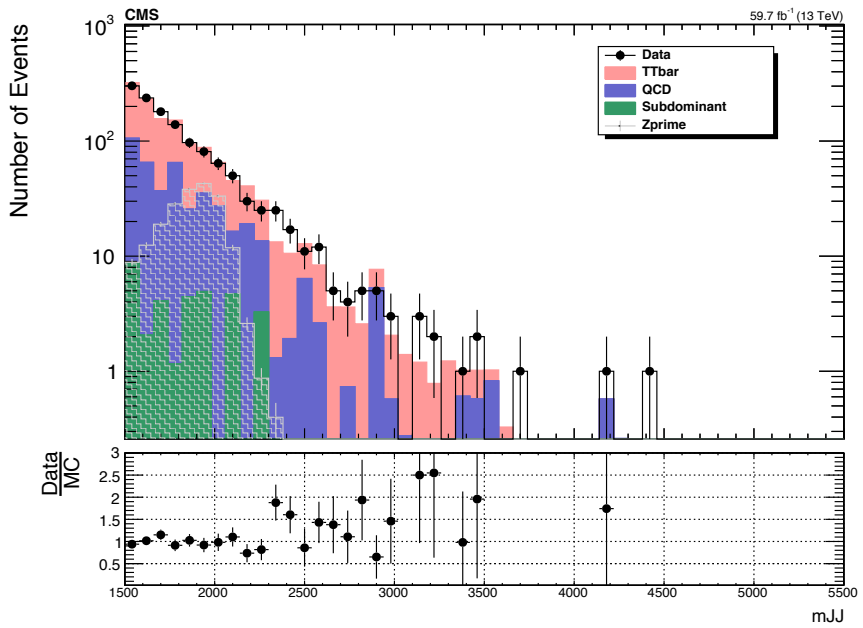
- New Signal Region:
  - SR_C = SR + mJJ > 1.5TeV
- Stack histograms for SR_C
- Asymptotic Limits (Brazilian plots) for 2016, 2017, 2018
  - Total Cross section x BR
  - Total Cross section = $\sum_{i=1}^{N} S_i$, where S_i is the signal yield in the reconstructed level

Stack Distributions vs B2G-16-015 Mz=2TeV, w 1%

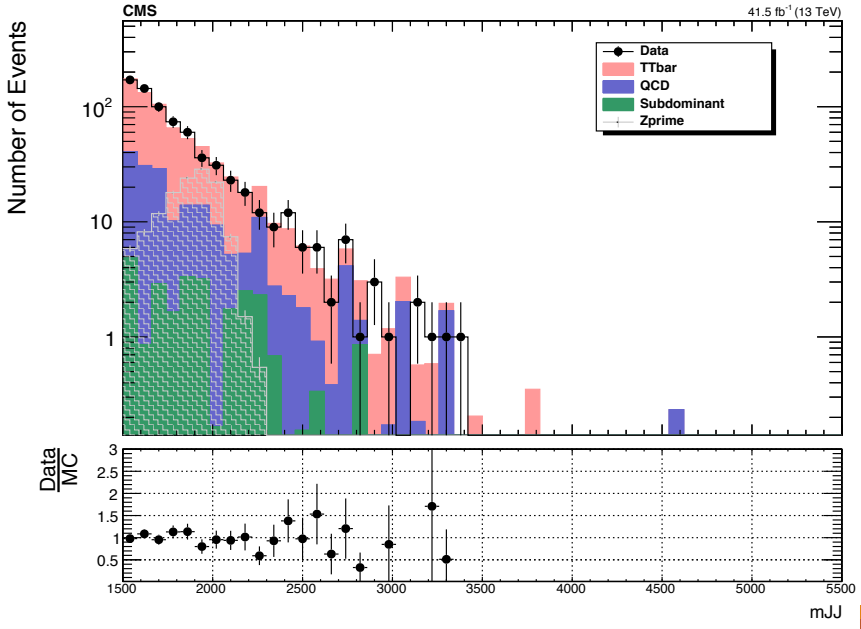
2016

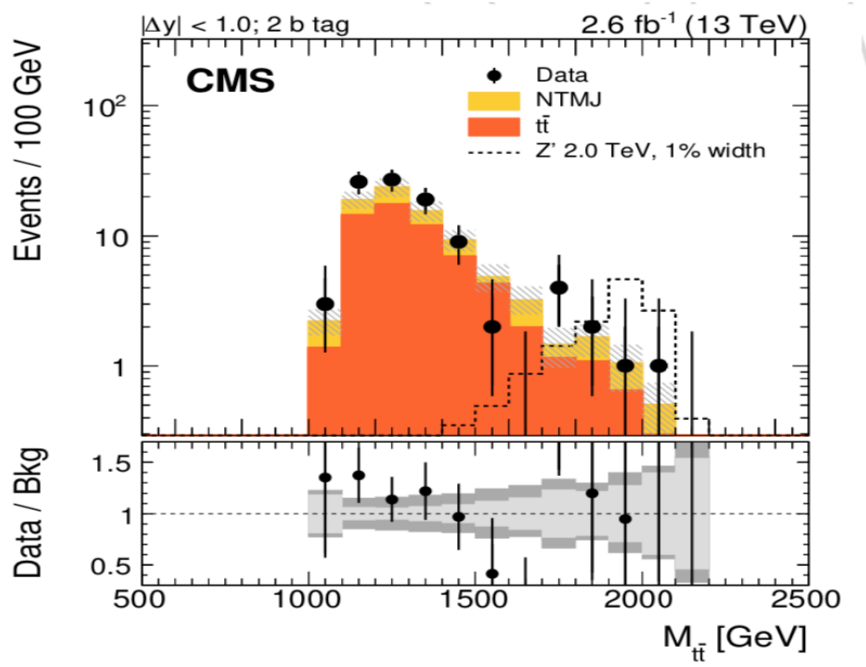


2018



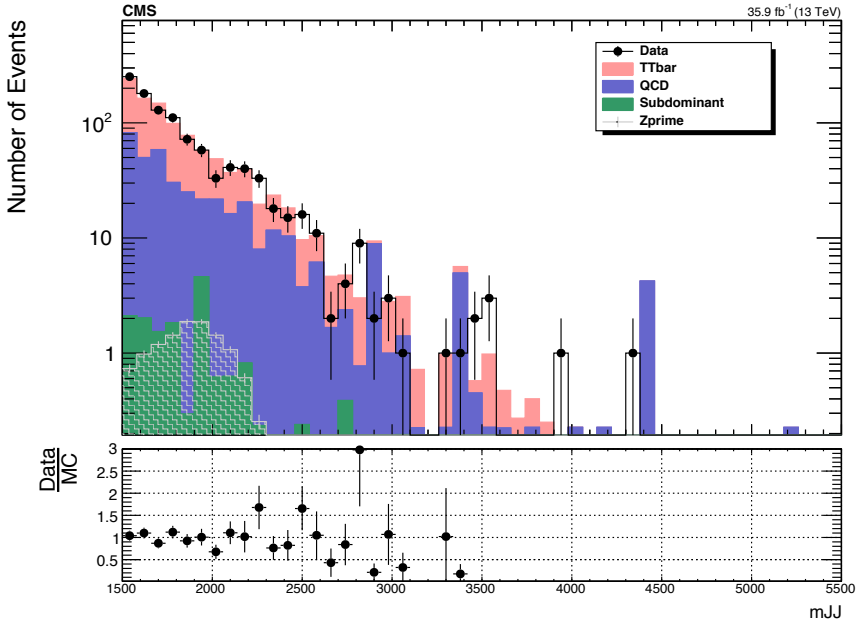
2017



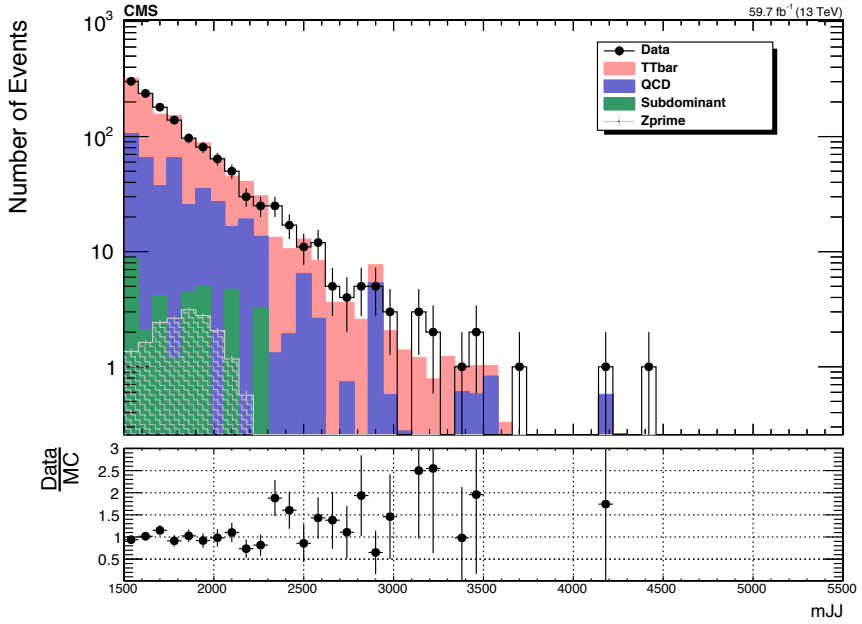


Stack Distributions vs B2G-16-015 Mz=2TeV, w 10%

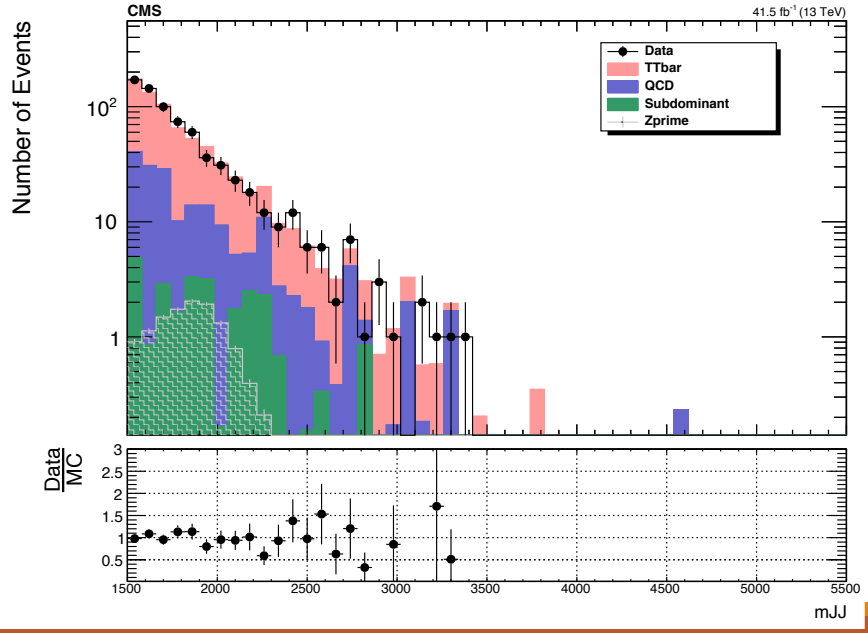
2016



2018

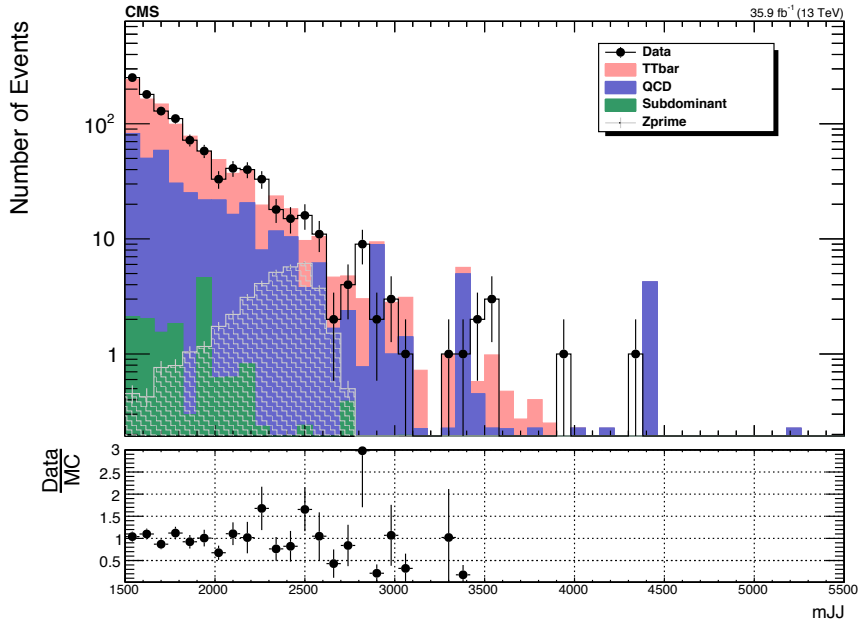


2017

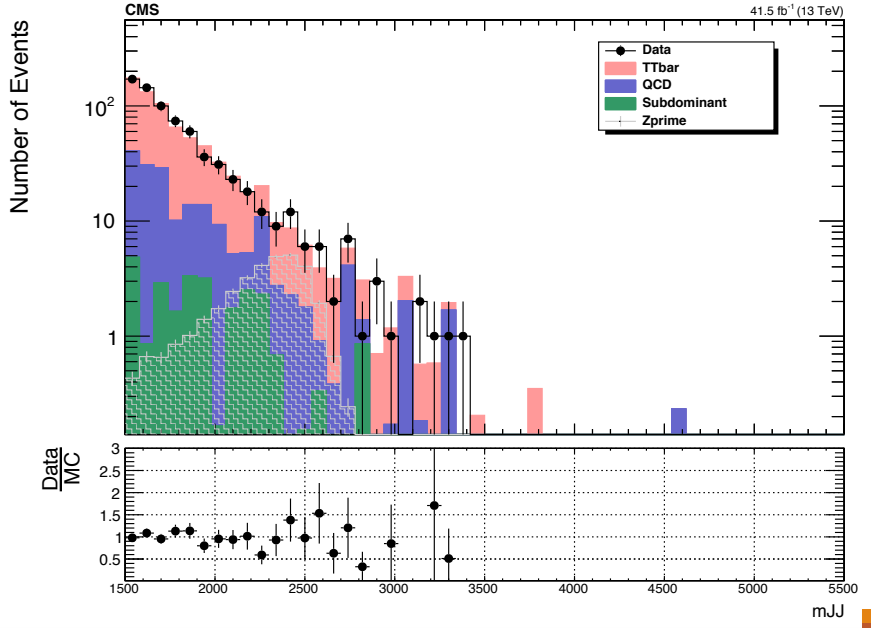


Stack Distributions Mz = 2.5TeV, w 1%

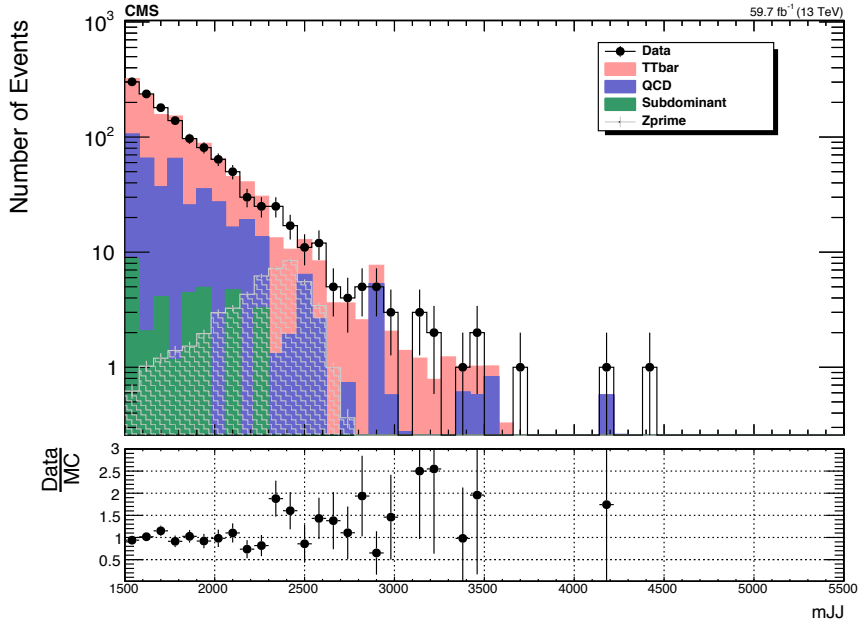
2016



2017

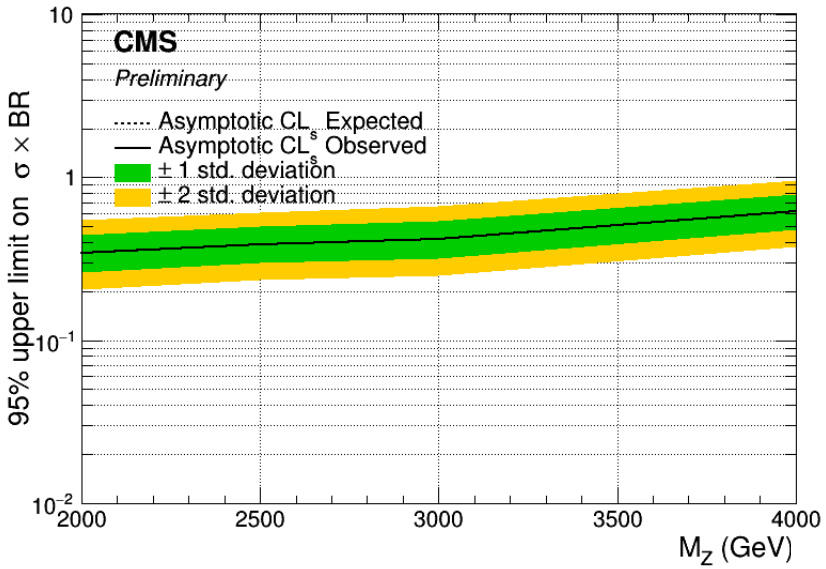


2018

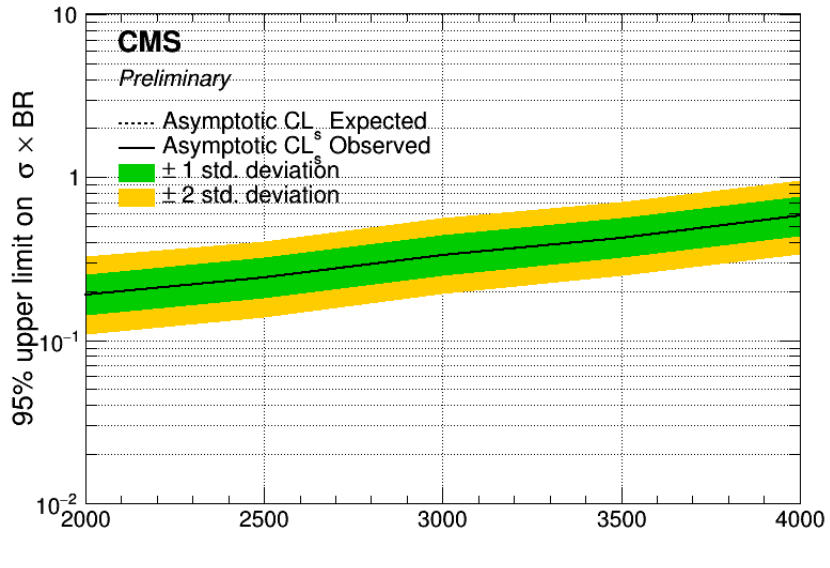


Asymptotic Limits width 1%

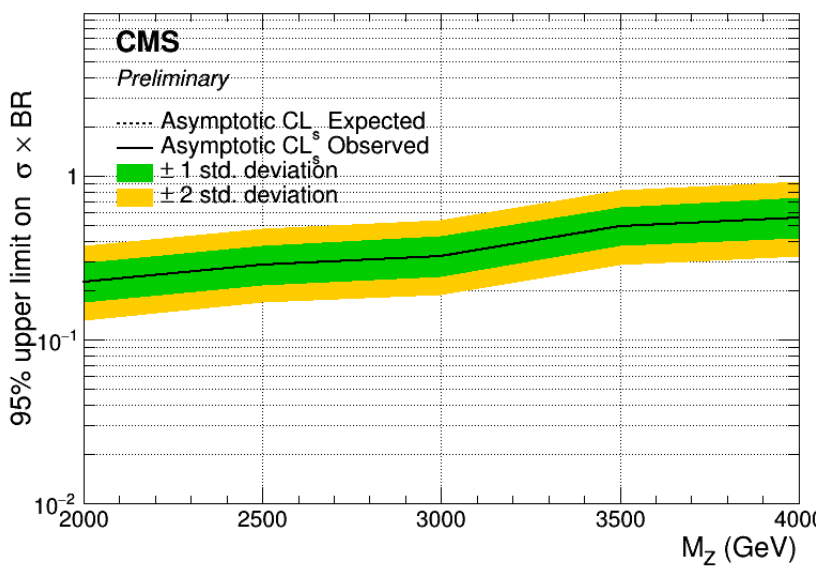
2016



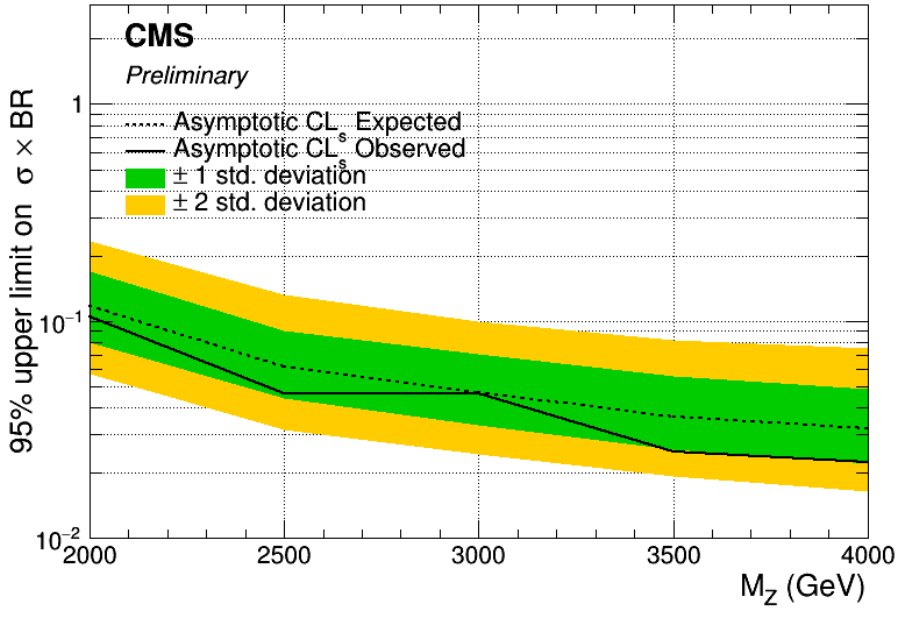
2017



2018

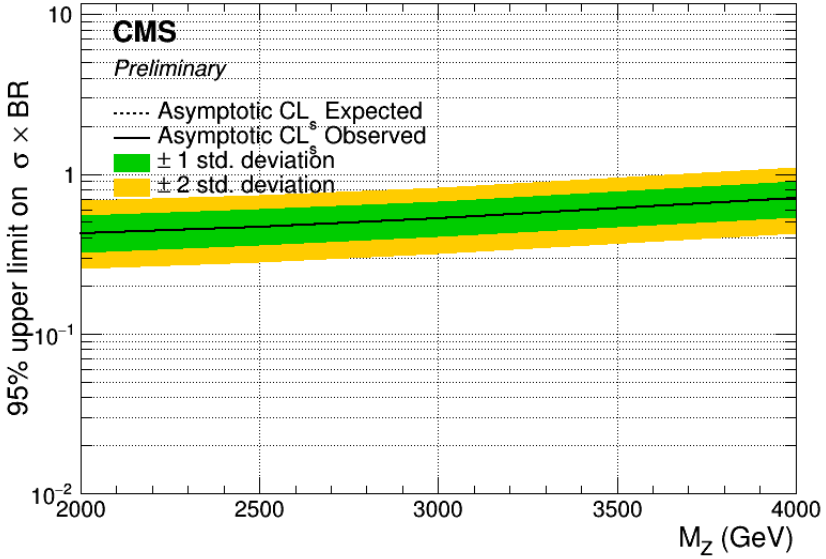


B2G-16-015

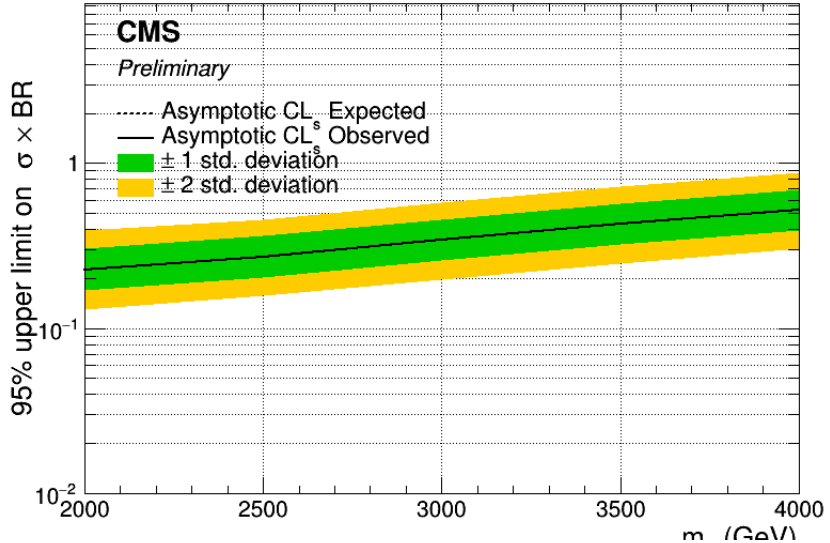


Asymptotic Limits width 10%

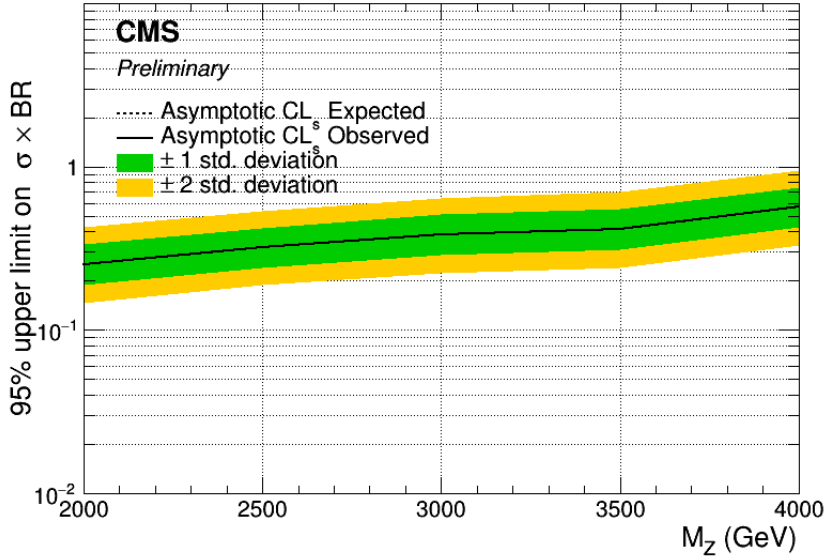
2016



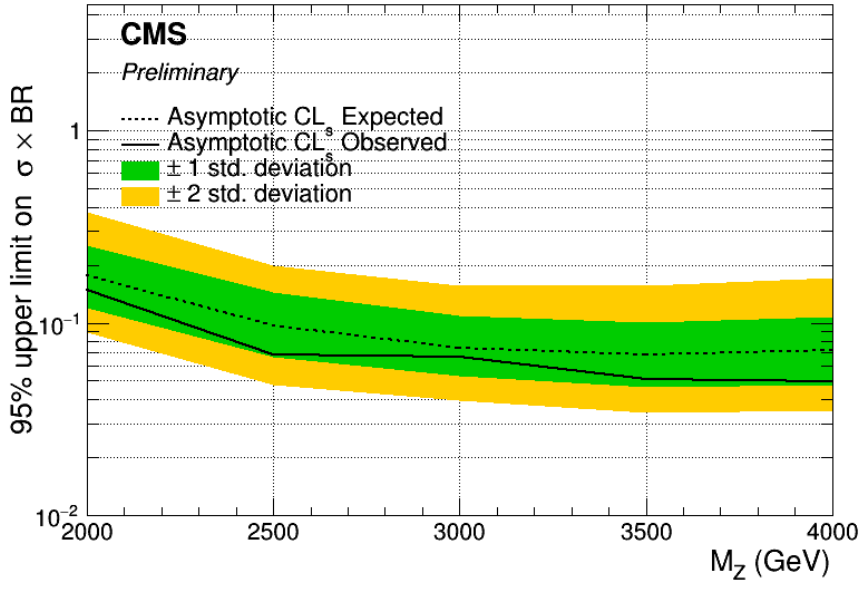
2017



2018

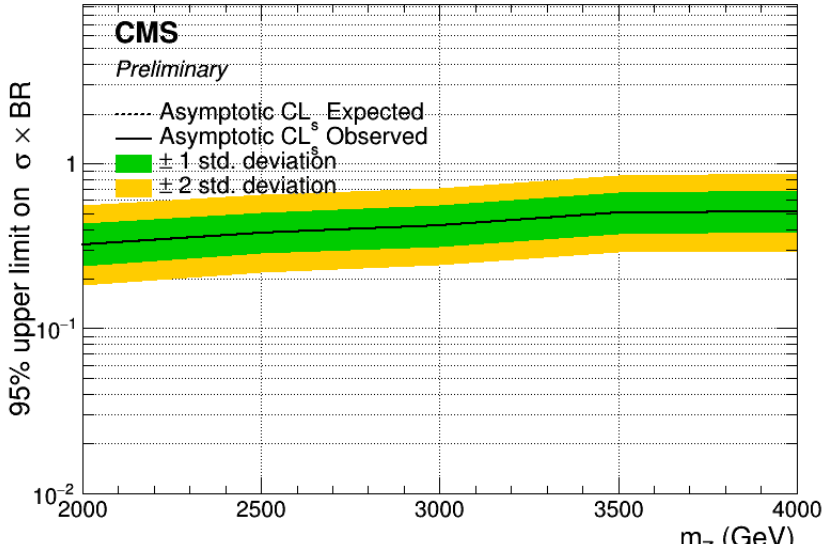


B2G-16-015

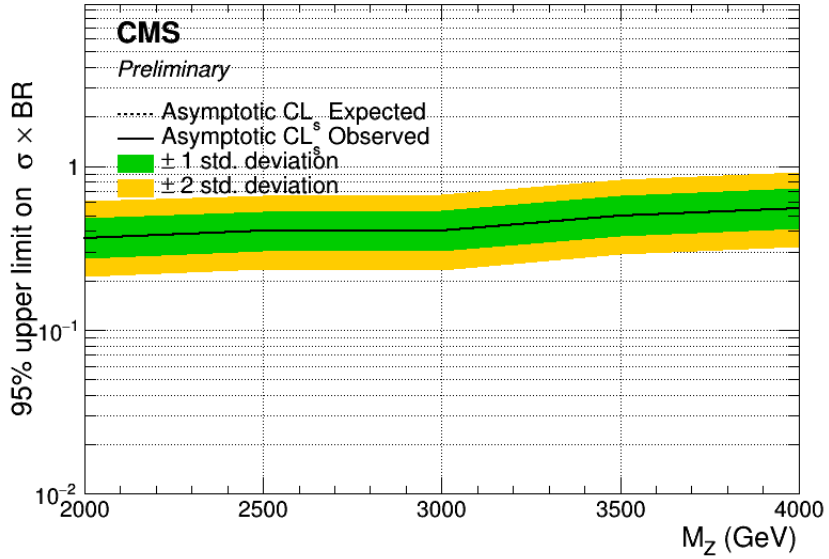


Asymptotic Limits width 30%

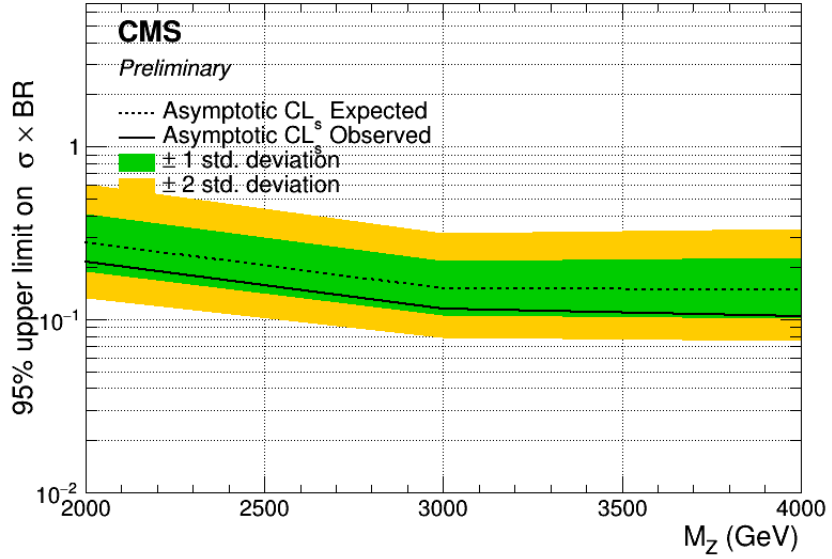
2017



2018



B2G-16-015



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

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

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:

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