HEP NTUA
Top Angular Report

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Summary

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

- Contamination
- Closure tests (qcd shape)
- R_{yield} as transfer factor from SR to SR_c where the measurement is performed

- Signal: S(x) for χ distribution (ttbar)
- Stack histograms: ($m_{Z'}$ 2, 2.5TeV and widths 1%, 10%)
  - Data vs MC (qcd scaled with k-factor to data)
  - TTbar scaled with signal strength
  - This plot can serve also as prefit distribution

- Postfit distribution ($m_{Z'}$ 2, 2.5TeV and widths 1%, 10%)
- Asymptotic Limits (Brazilian plots)

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 $N_{SR(1.5TeV)} = R^{1TeV\rightarrow1.5TeV}_{yield}\,\boldsymbol{x}\,N^{QCD}_{SR(1TeV)} = R^{1TeV\rightarrow1.5TeV}_{yield}\,\boldsymbol{x}\,R^{SR_A\rightarrow SR}_{yield}\,\boldsymbol{x}\,N^{QCD}_{SR_A}$

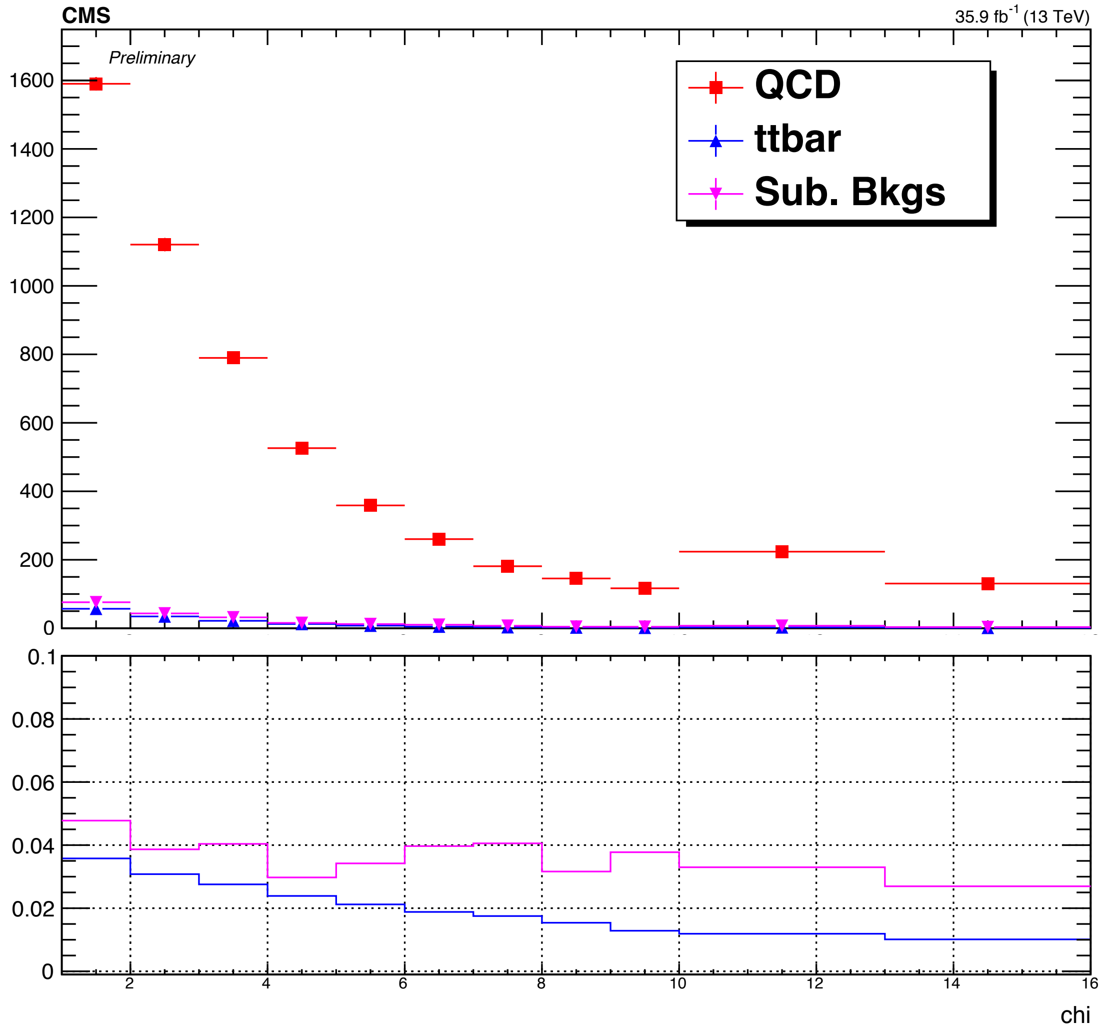
- The variable of interest here: $x_{reco} \rightarrow \chi$
- 1.5 TeV refers to the mJJ cut

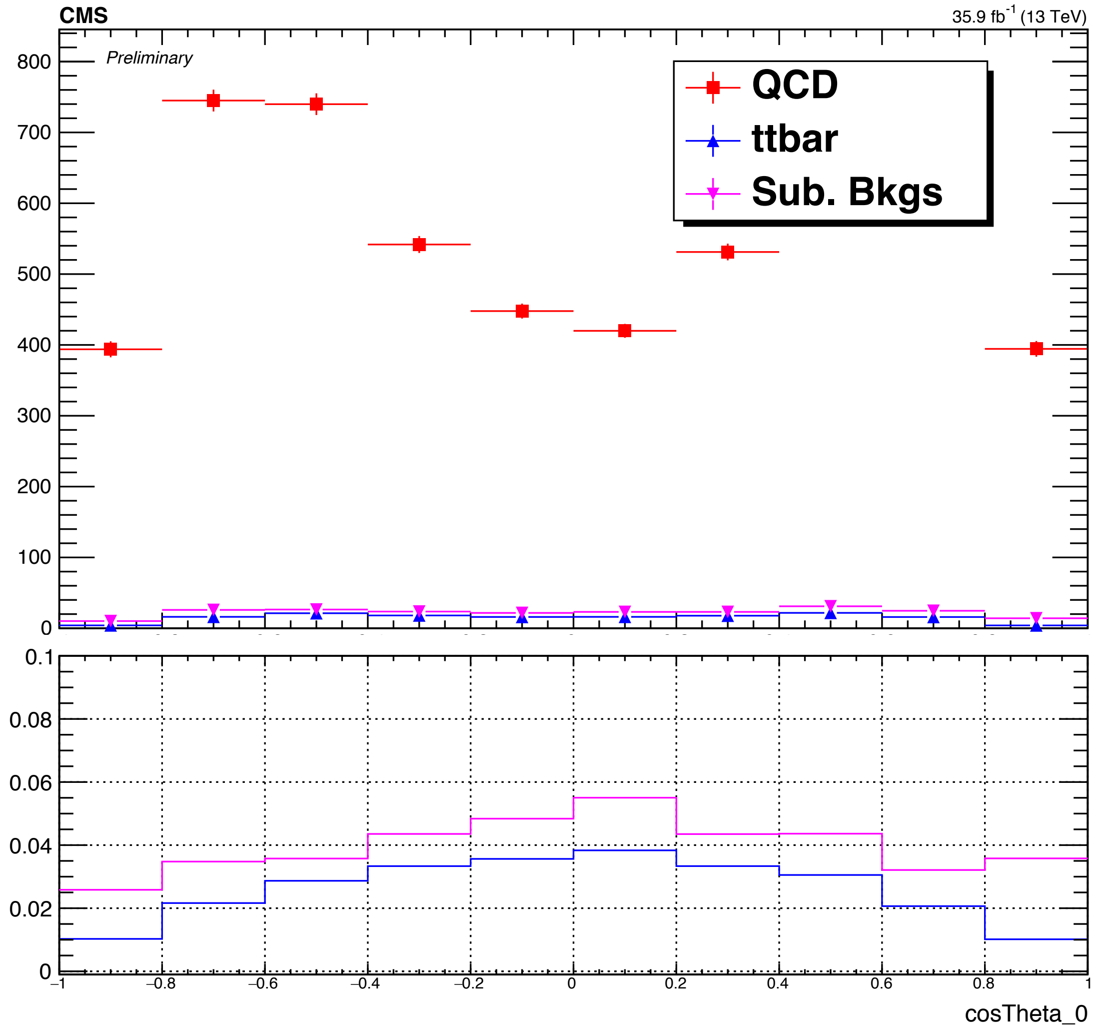
- We deploy a fit in the Signal Region (2btag) to extract the N^{fit}_{QCD} in SRA (mJJ > 1TeV)

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

Contamination Plots in New SR

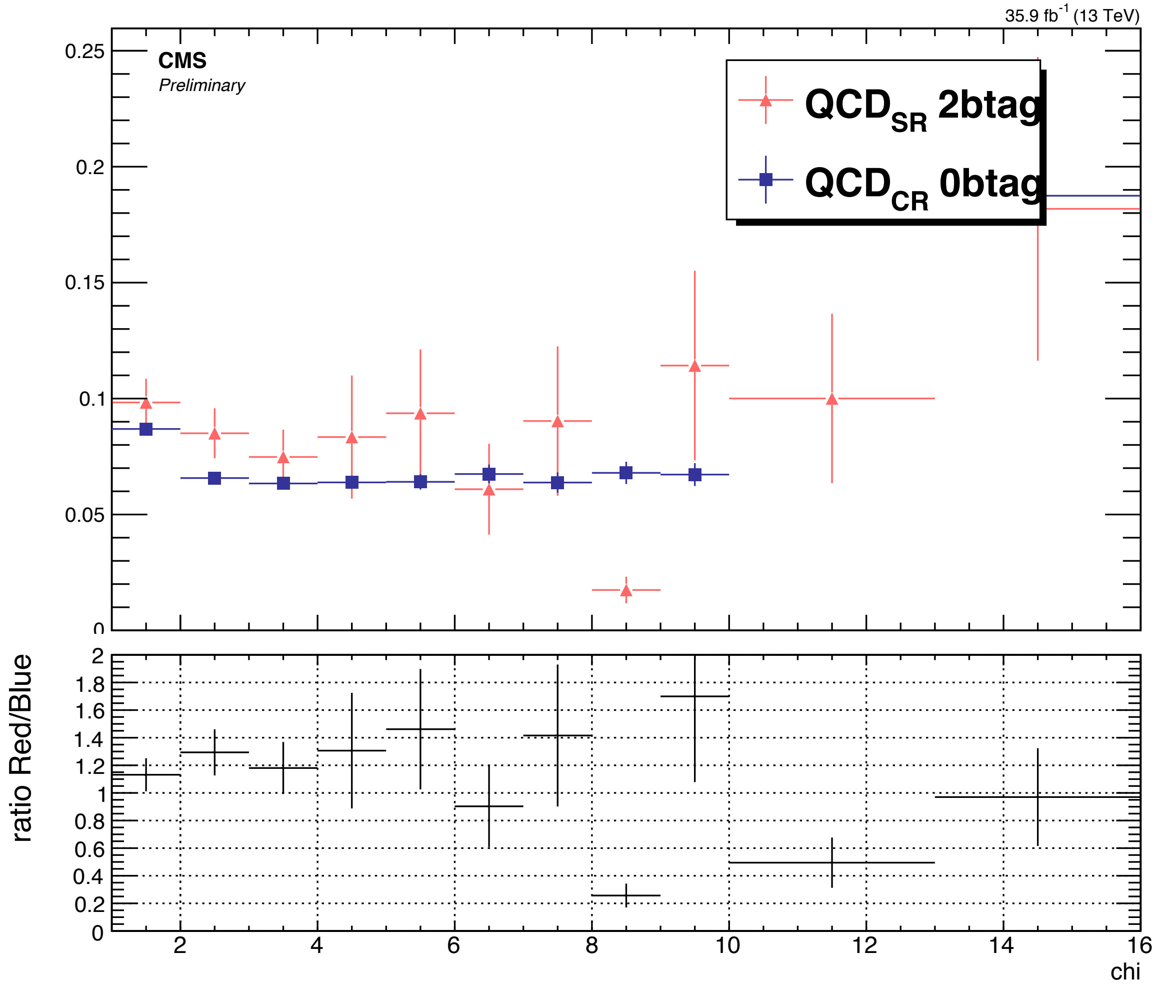
mJJ > 1.5 TeV

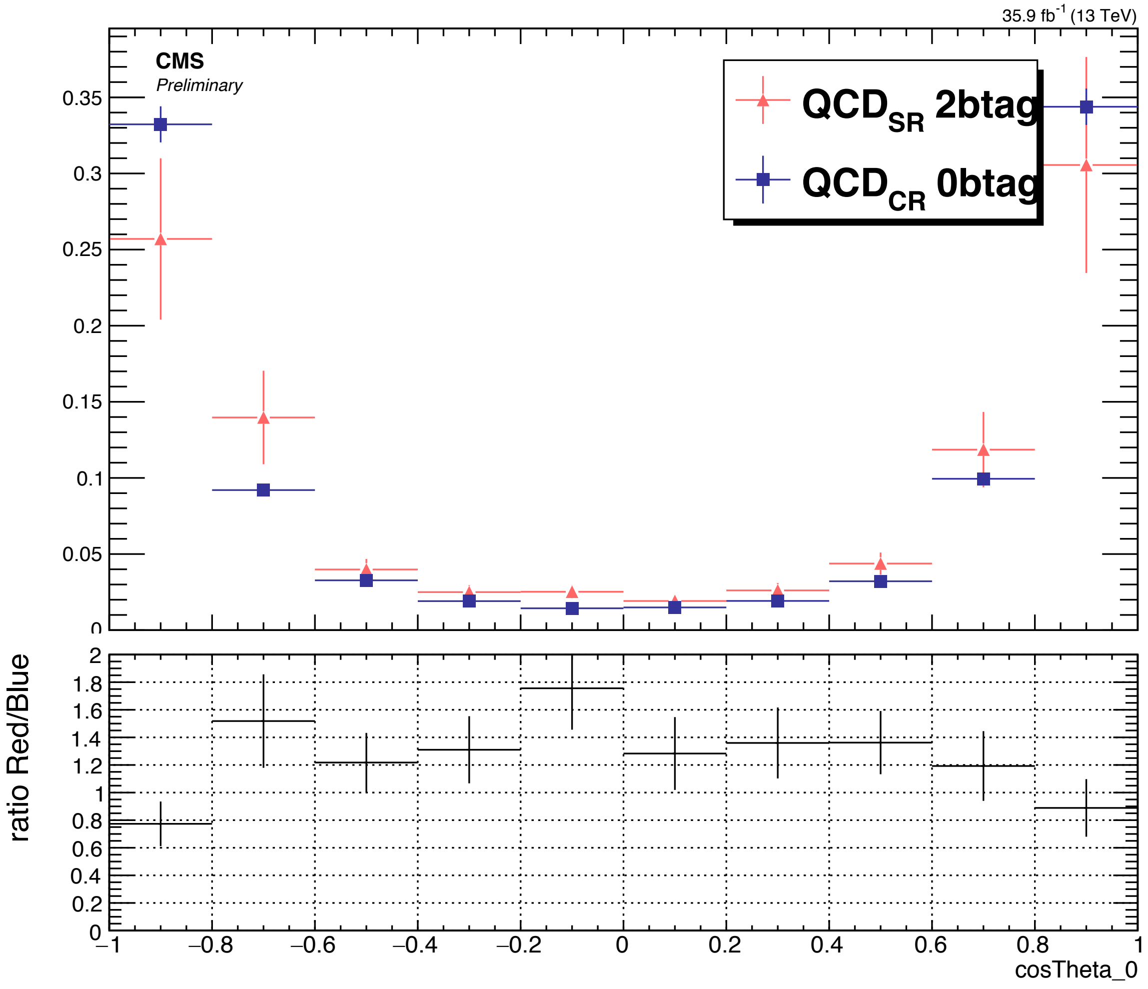




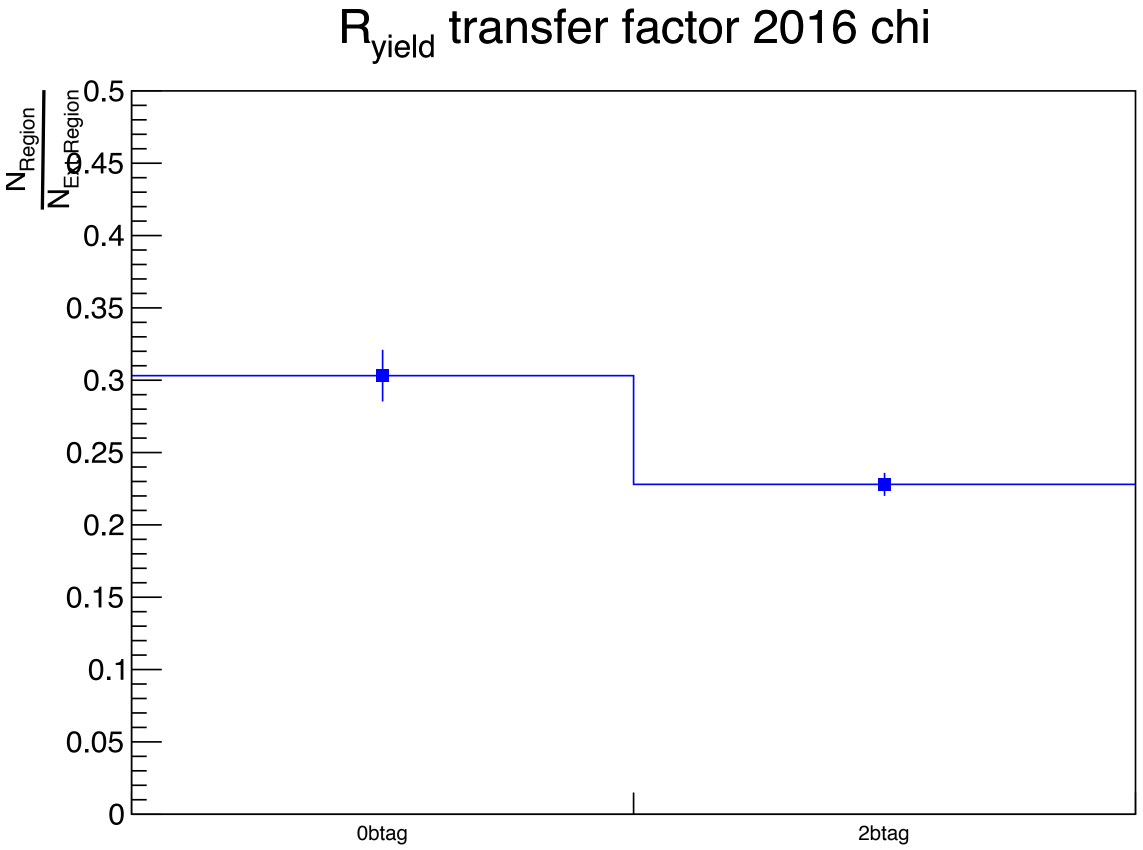
Closure Tests in New SR (CR)

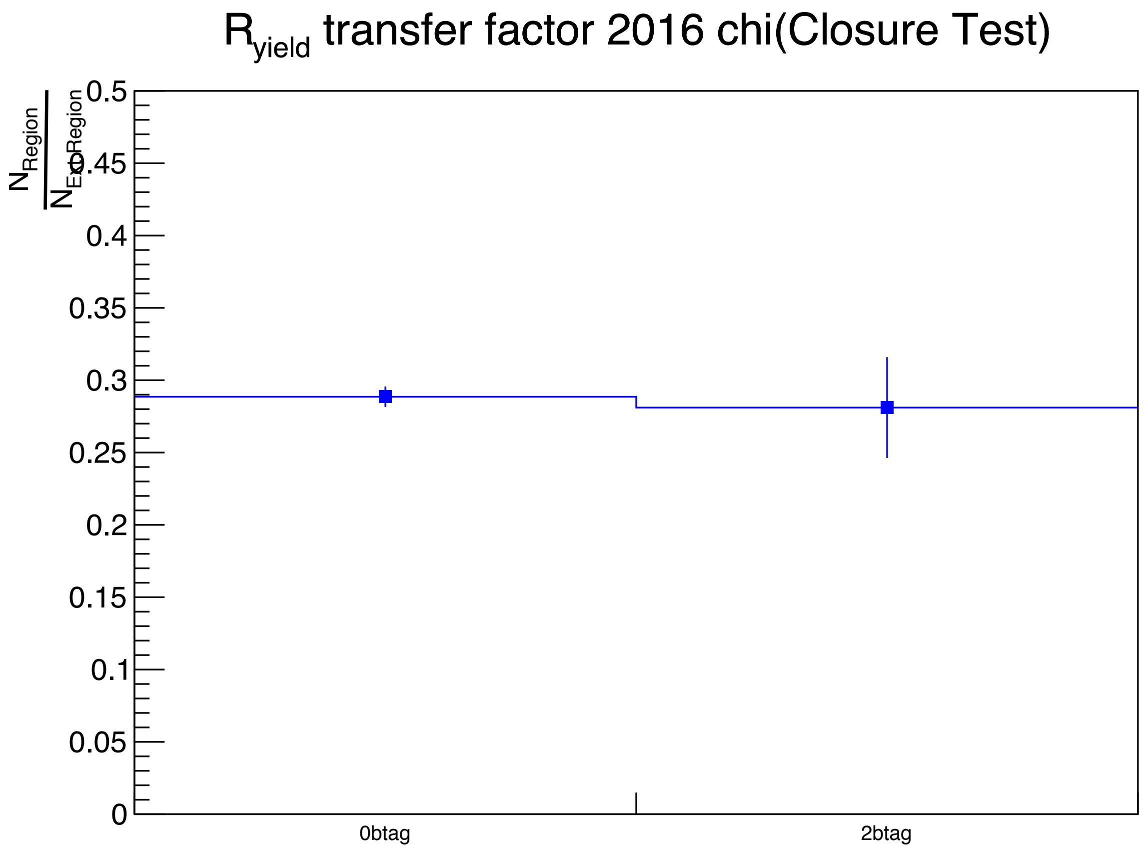
mJJ > 1.5 TeV





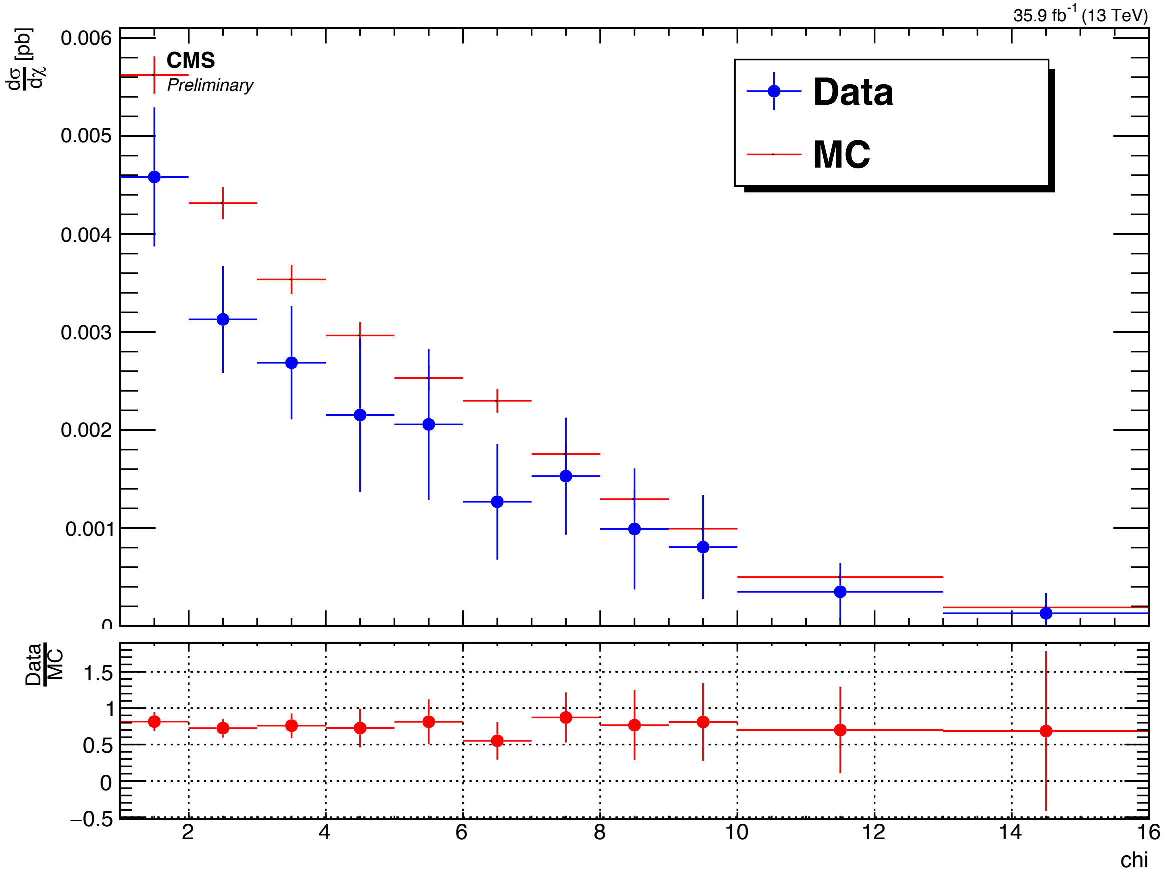
Ryields (with closure test) from mJJ > 1TeV region → 1.5TeV Signal Region

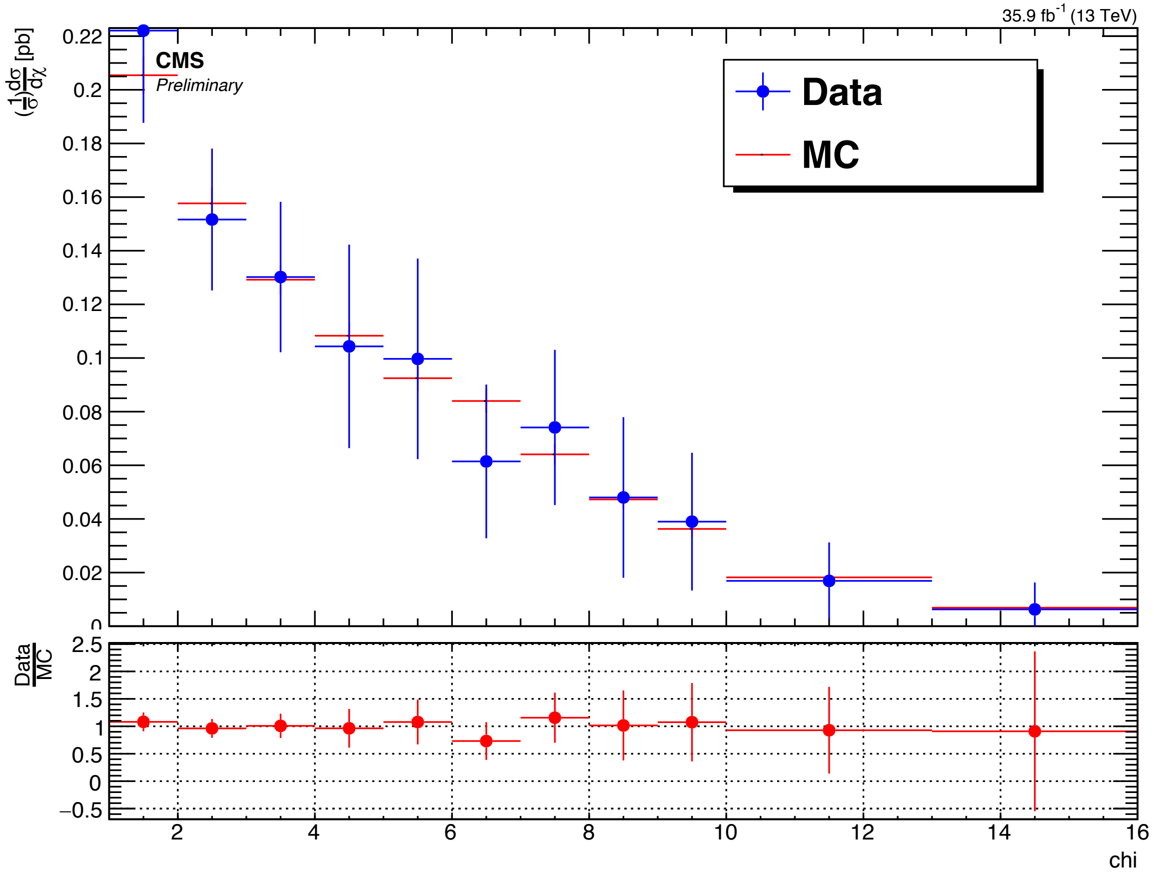




Angular Distributions

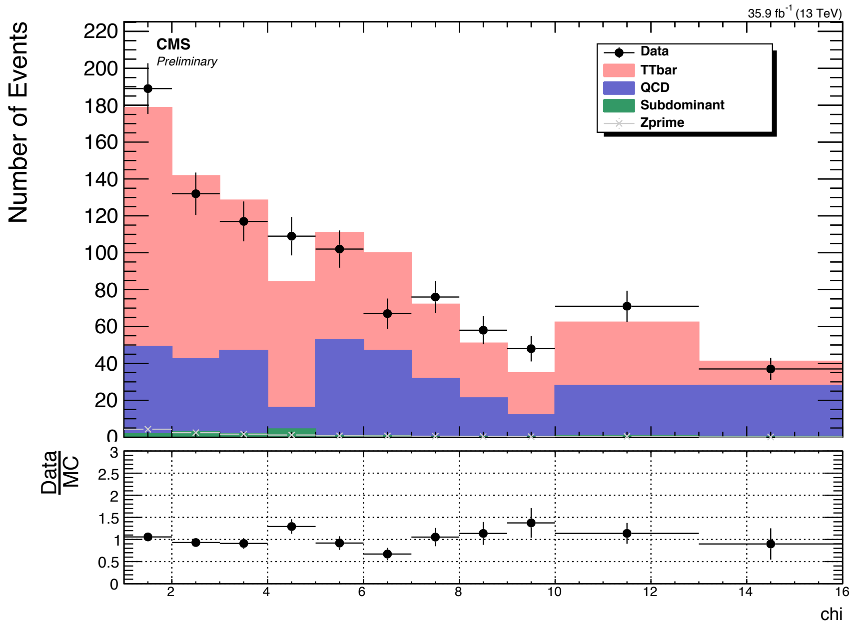
mJJ > 1.5 TeV



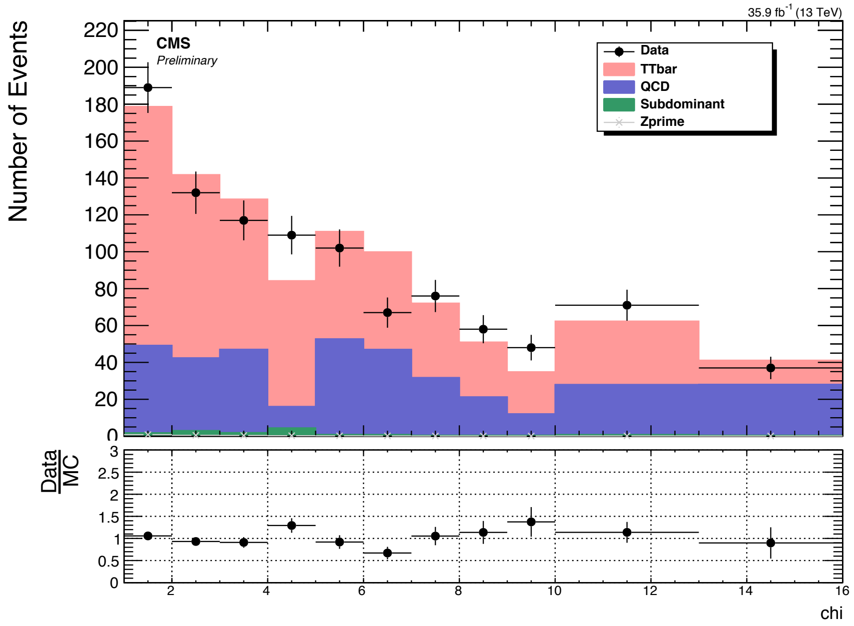


Angular Distributions (Prefit)

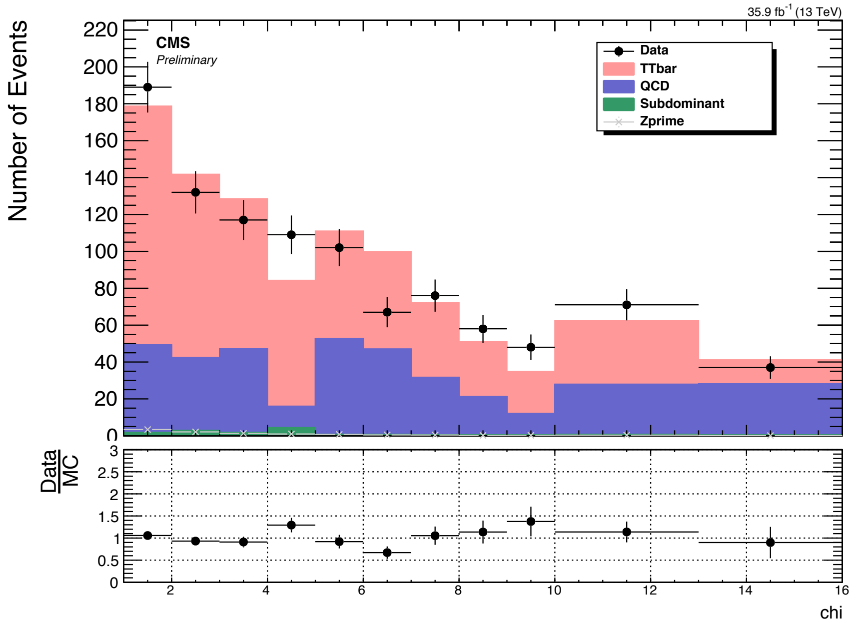
$M_{z'}$ =2000, w = 1%



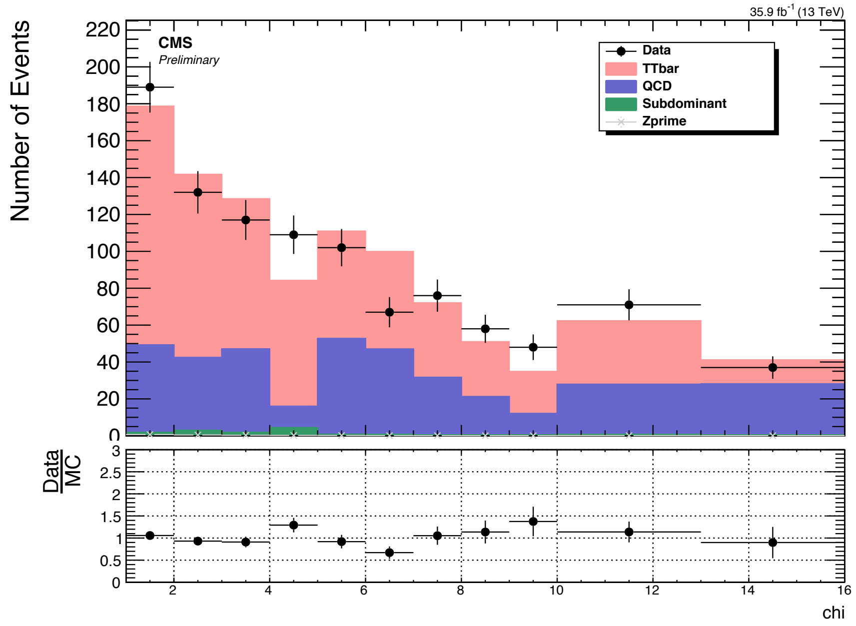
$M_{z'}$ =2500, w = 1%



$M_{z'}$ =2000, w = 10%

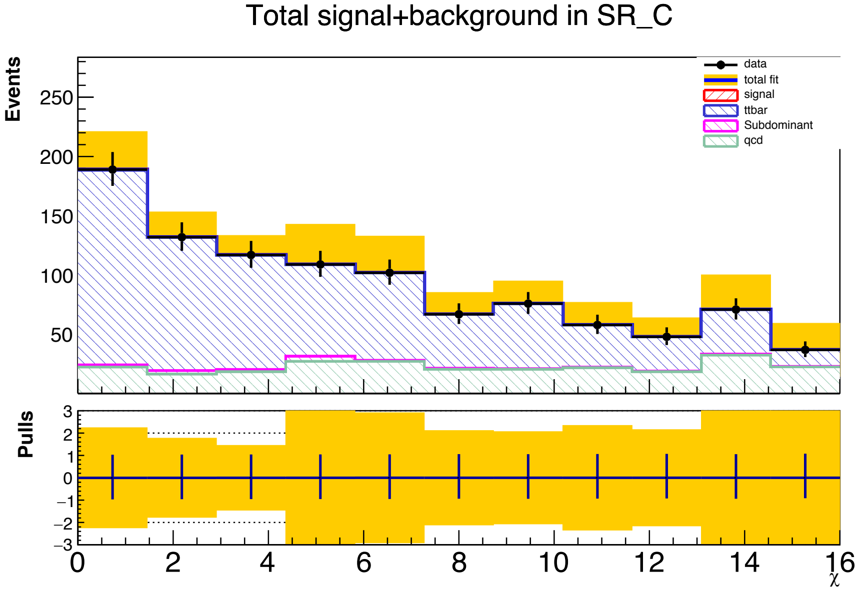


$M_{z'}$ =2500, w = 10%

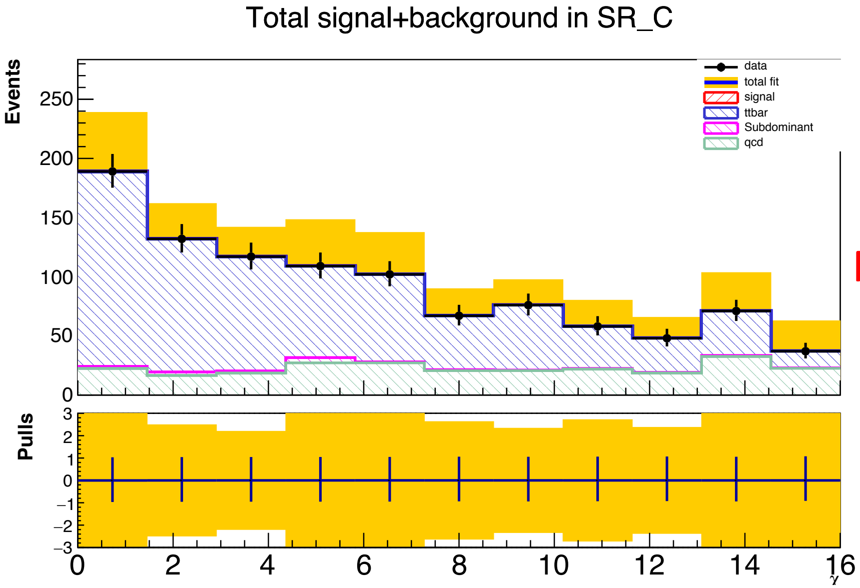


Angular Distributions (PostFit)

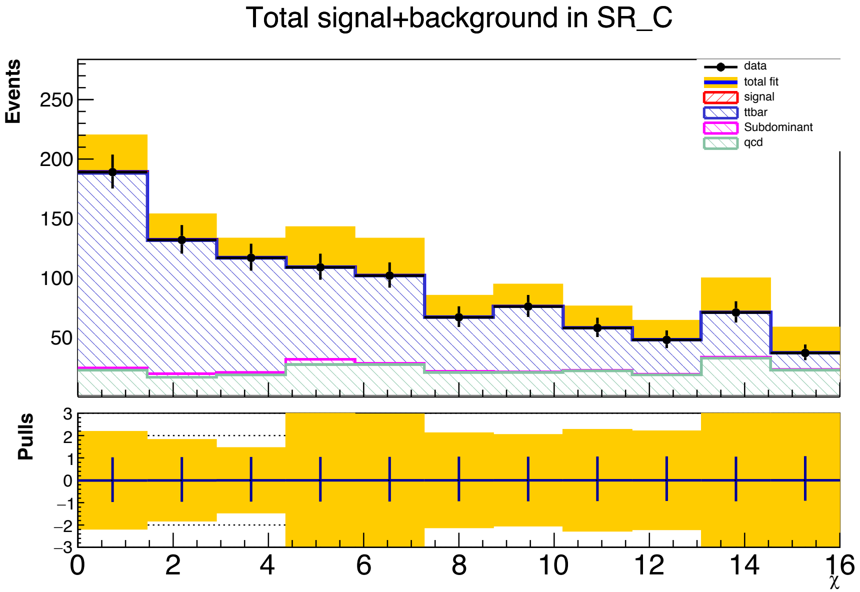
$M_{z'}$ =2000, w = 1%



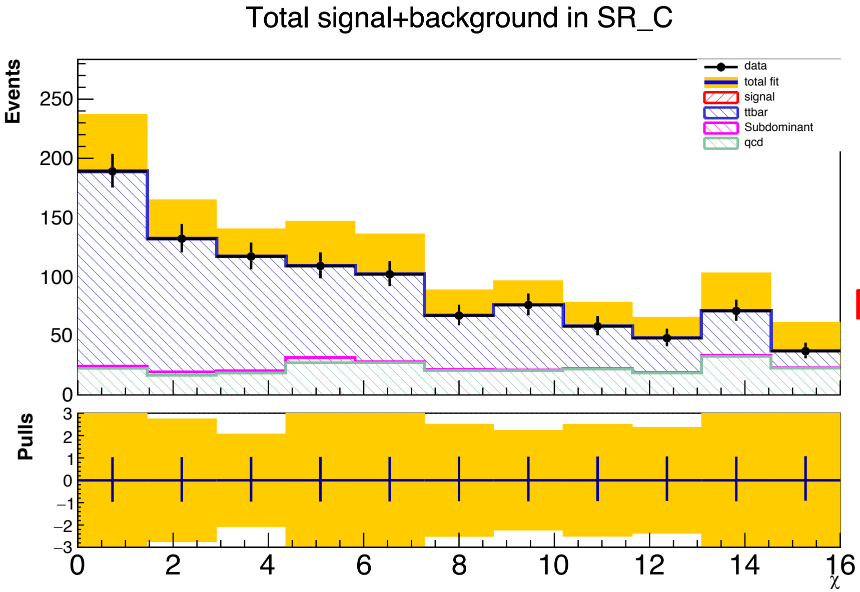
$M_{z'}$ =2500, w = 1%



$M_{z'}$ =2000, w = 10%



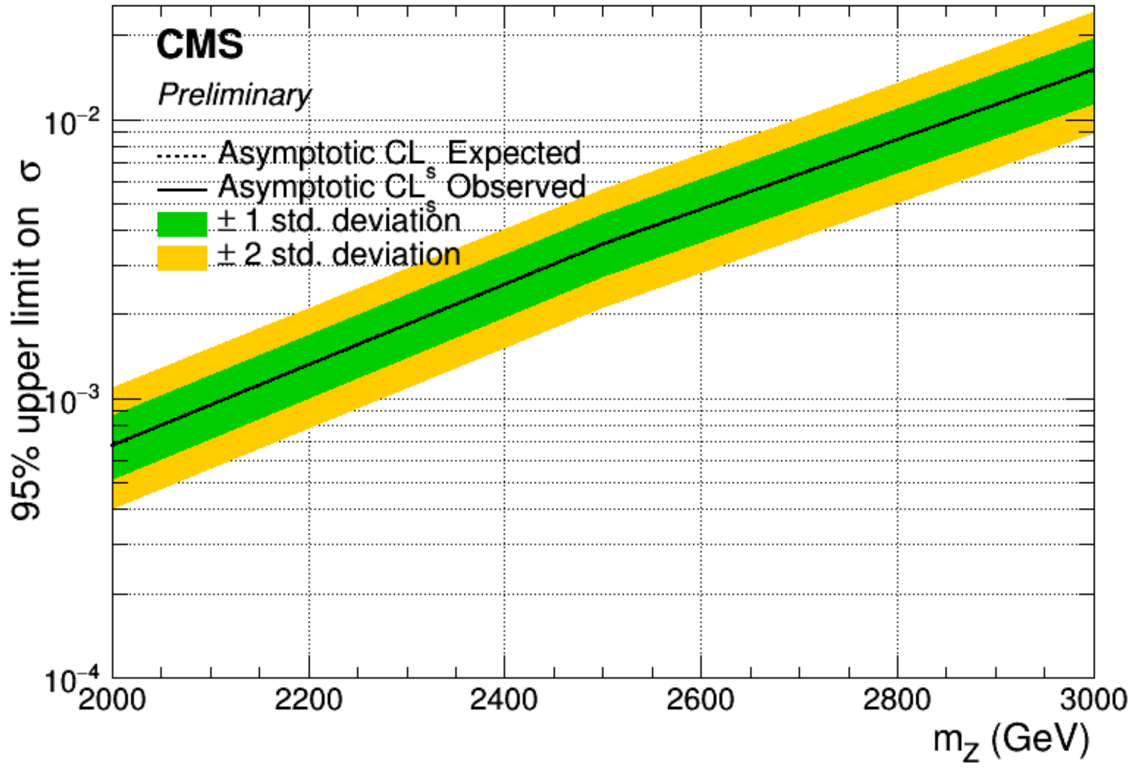
$M_{z'}$ =2500, w = 10%

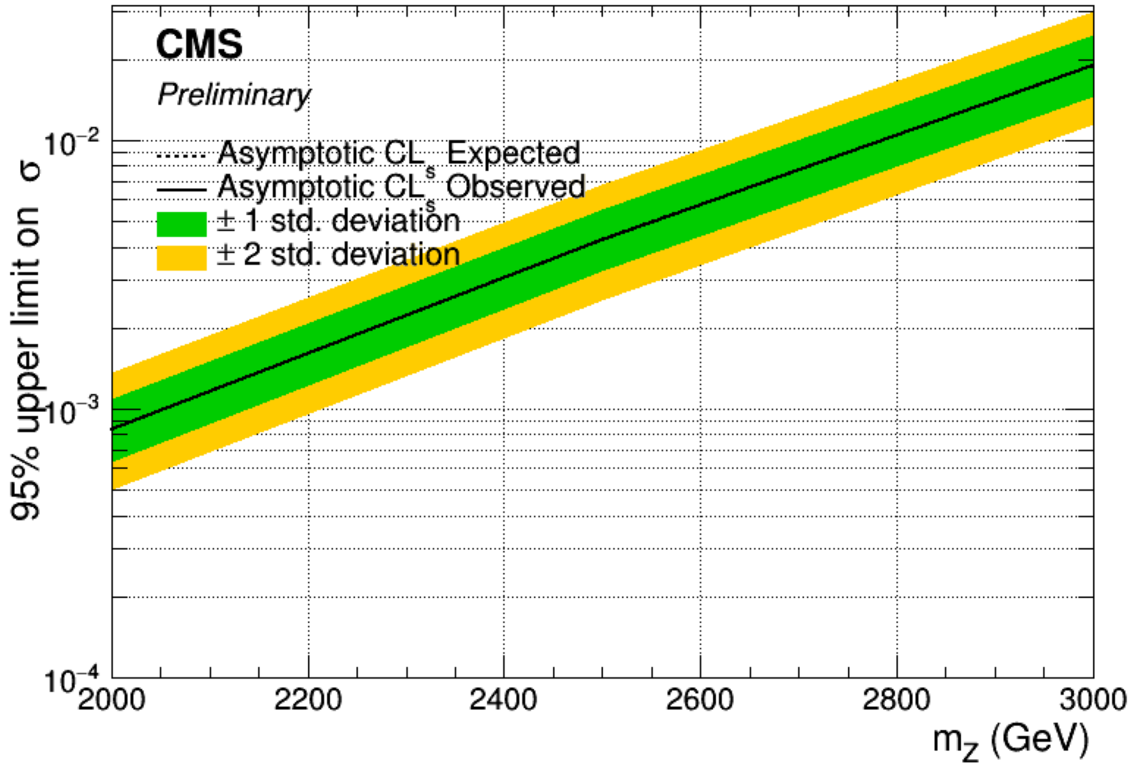


Angular Distributions (Brazilian Plot)

Assymptotic limits for M Z’: 2000, 2500, 3000:

- Width 1% (left) and 10% (right)





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 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:

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