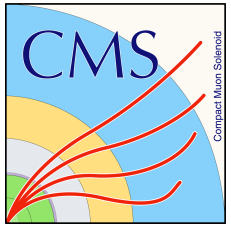
# HEP NTUA
# Top Angular Report

# 4/12/2020

George Bakas




# 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 + mJJ > 1.5TeV

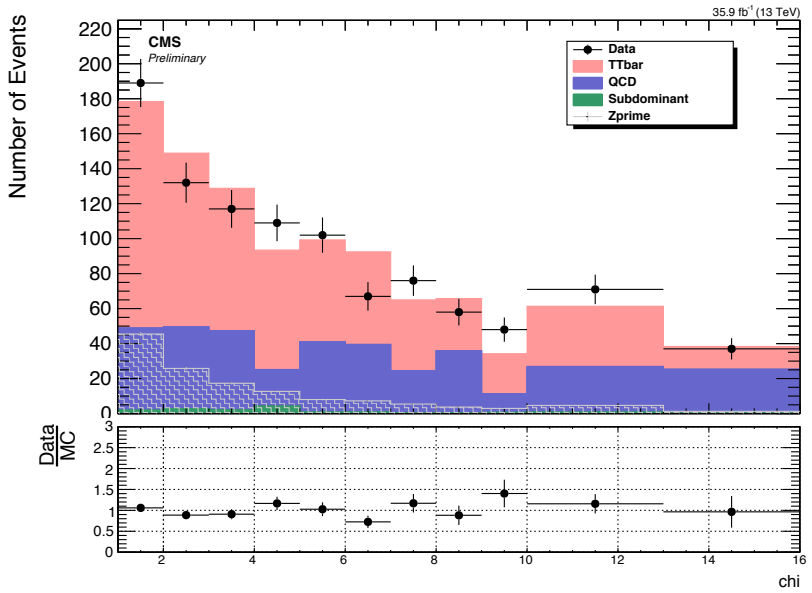
  - Using the new XSEC → Expected yield > 0!
    - 2017: M: 3TeV and 3.5 TeV → 0 expected yield while M: 4TeV has ~ 15 events..

  - 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

  - Asymptotic Limits (Brazilian plots) for 2016, 2018

# Angular Distributions (Prefit) 2016

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

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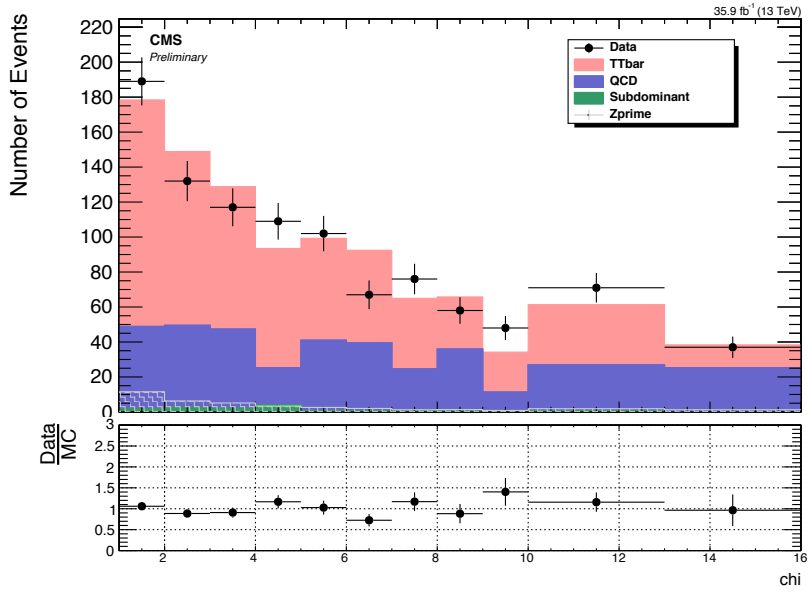


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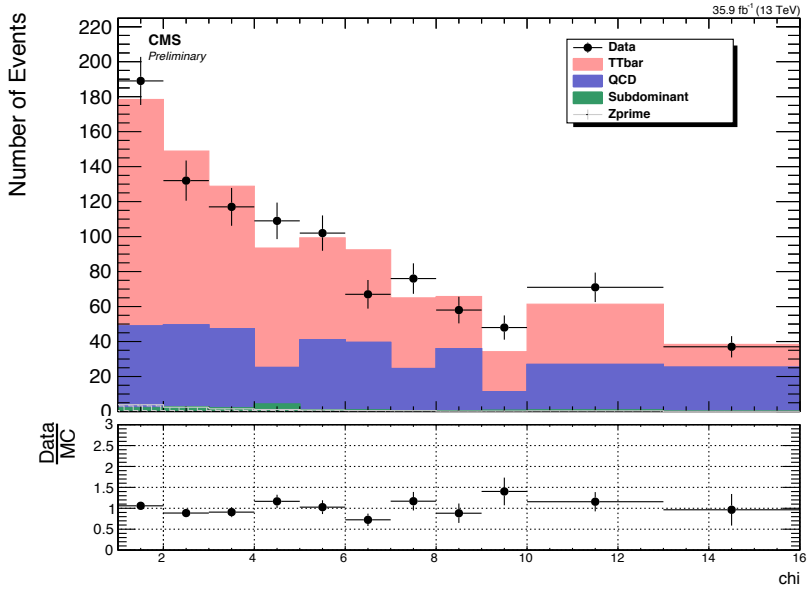


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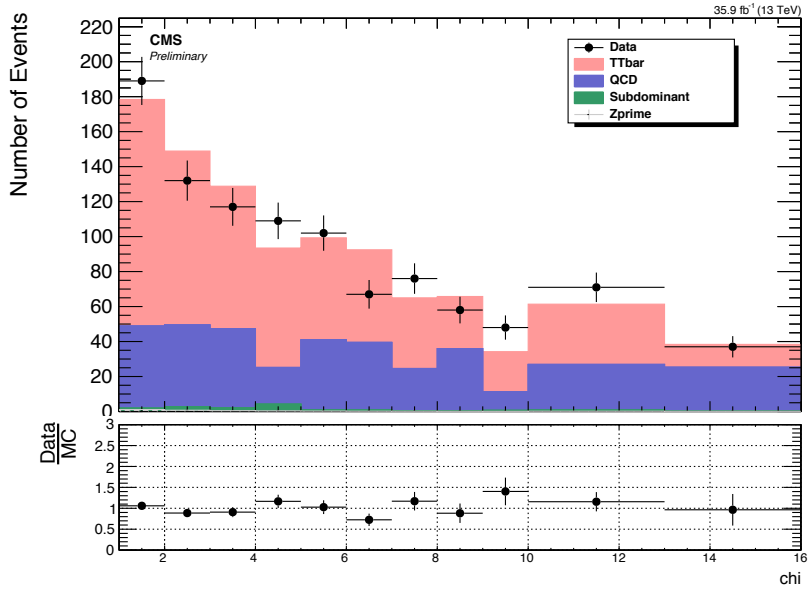

# Angular Distributions (Prefit) 2018

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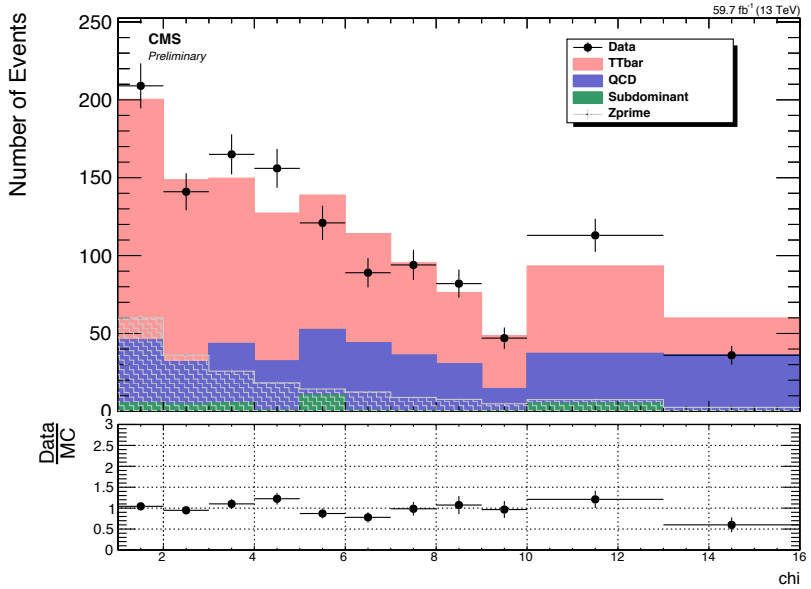


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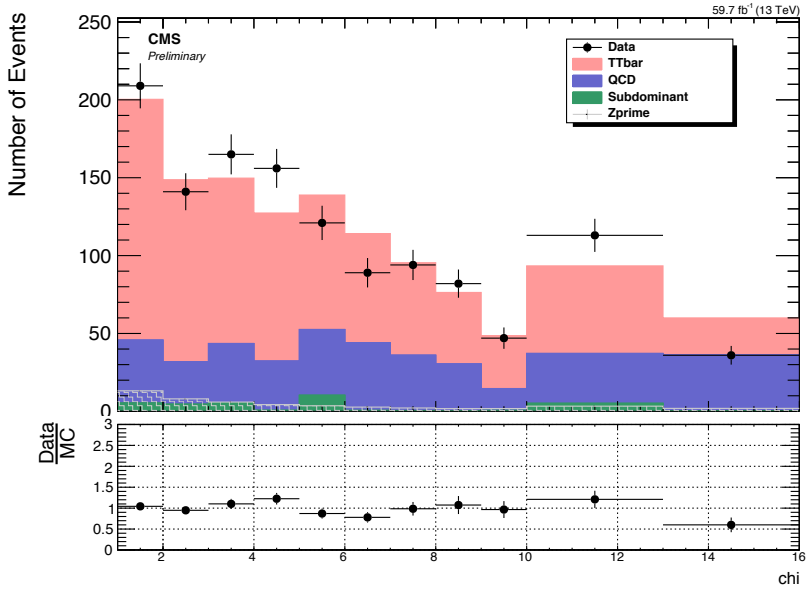


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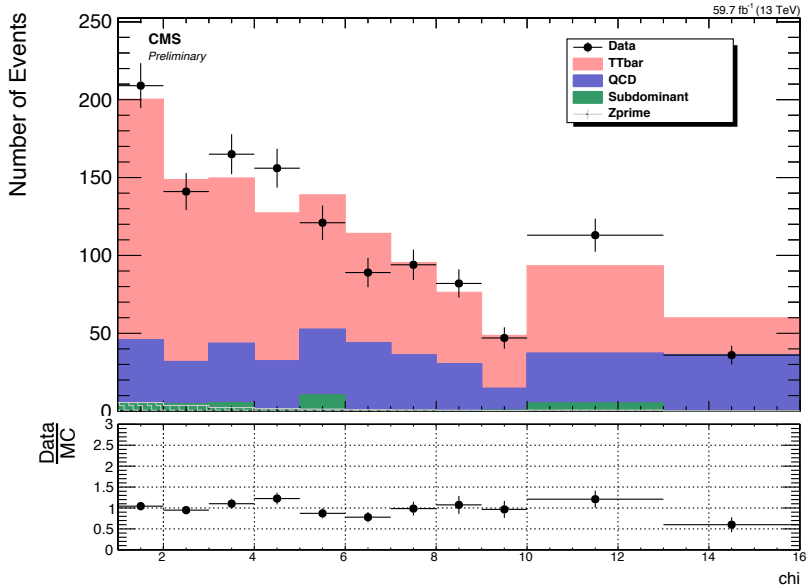


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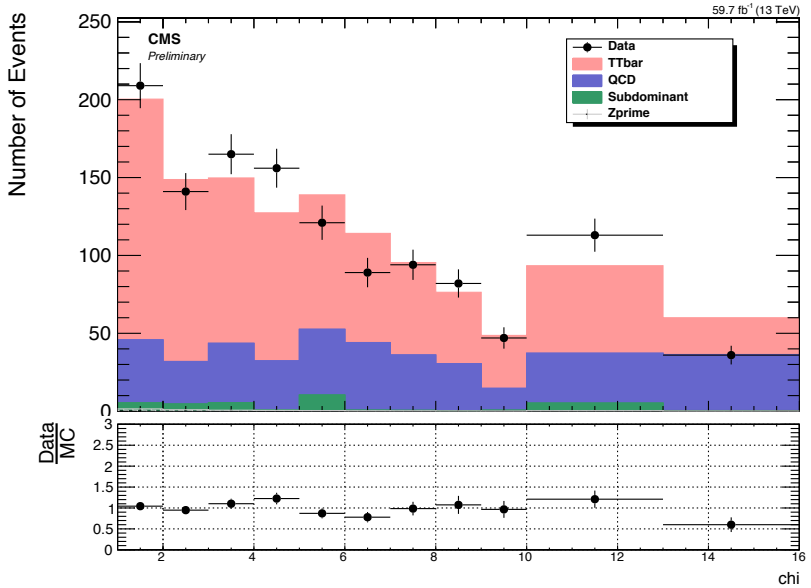
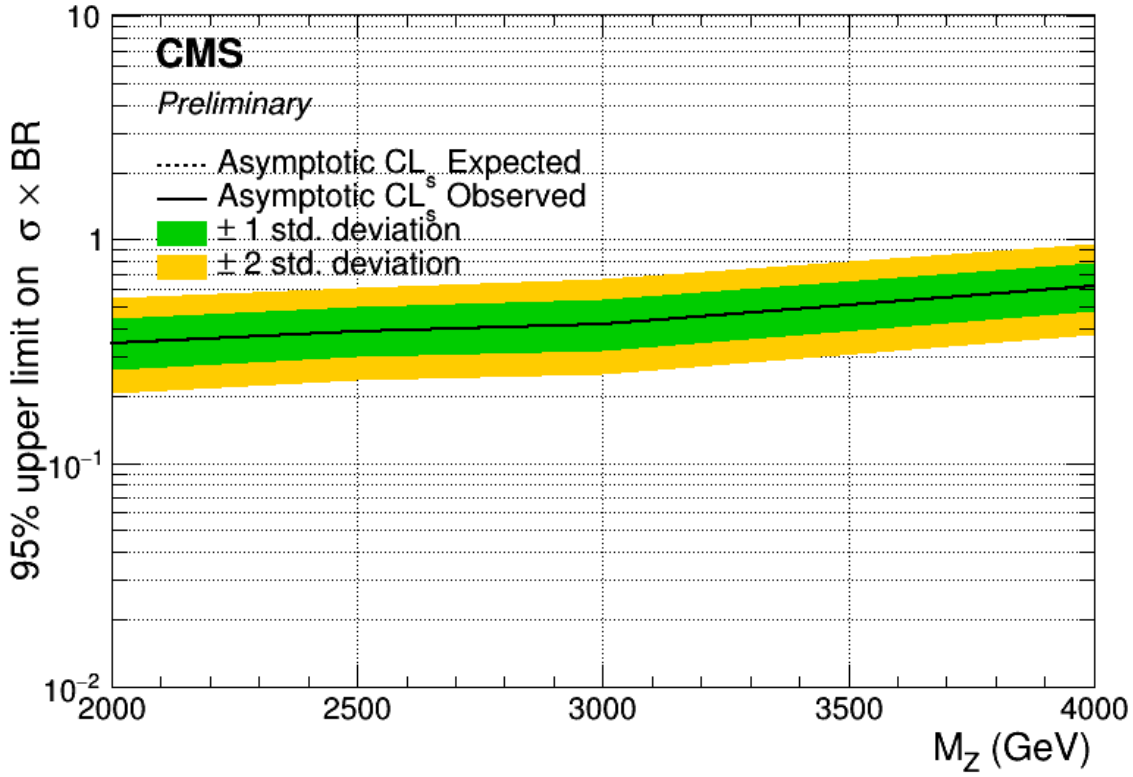
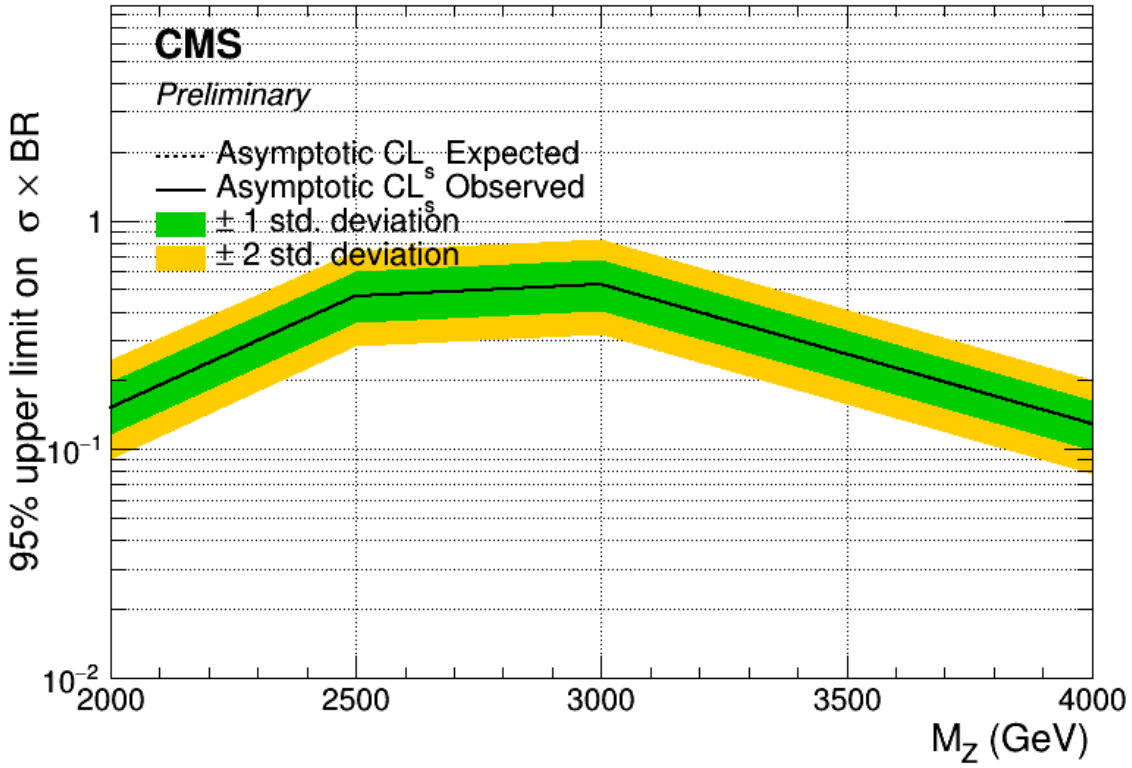


# Assymptotic Limits 2016

Width = 1%




Width = 10%



# Assymptotic Limits 2018

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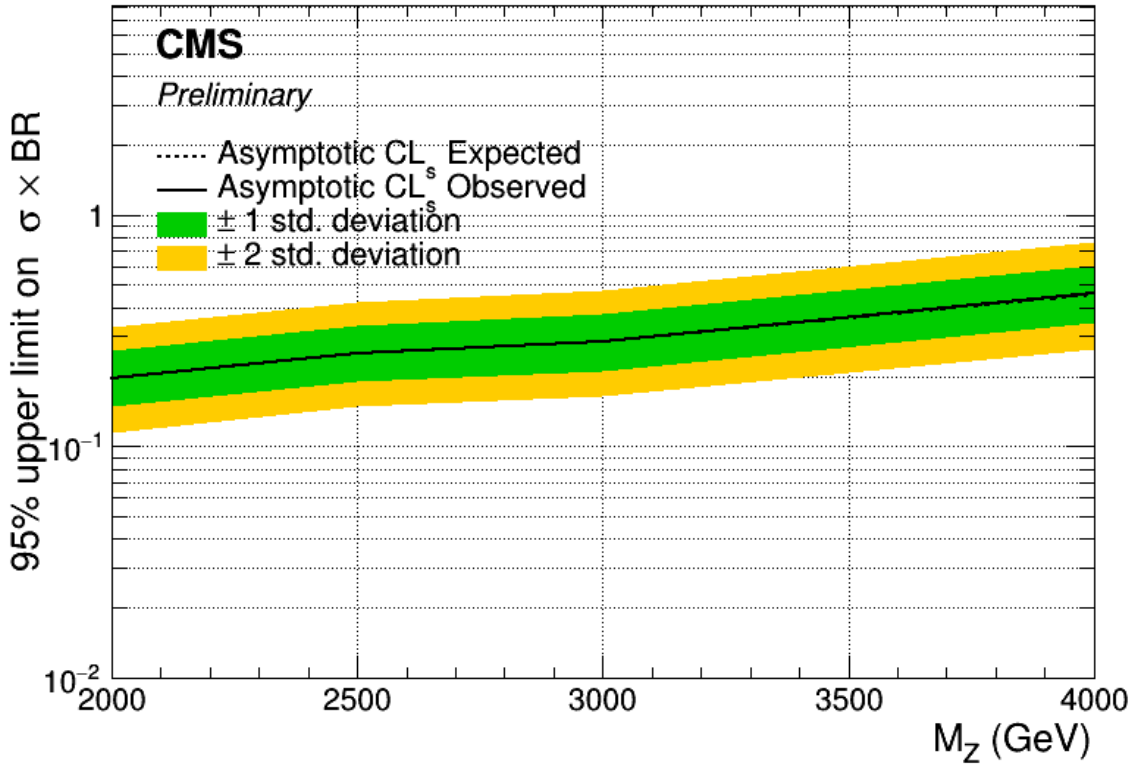


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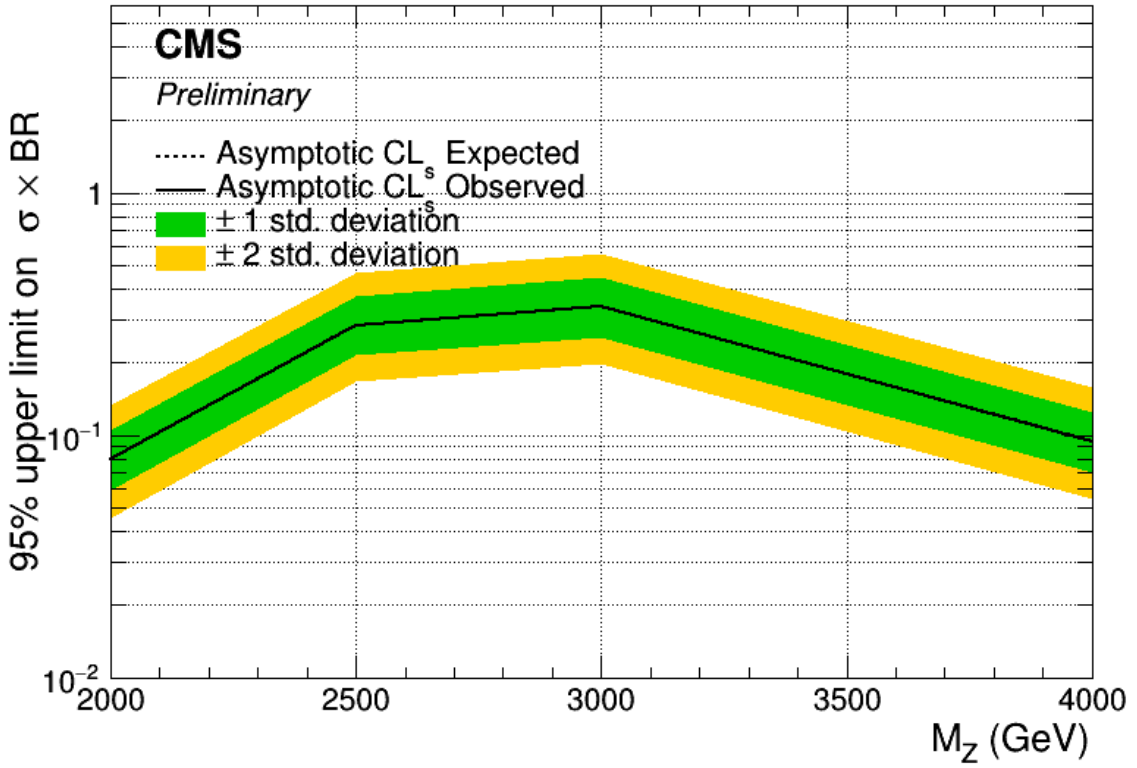

# BACKUP

## 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:

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

# Angular Distributions (Prefit) 2017

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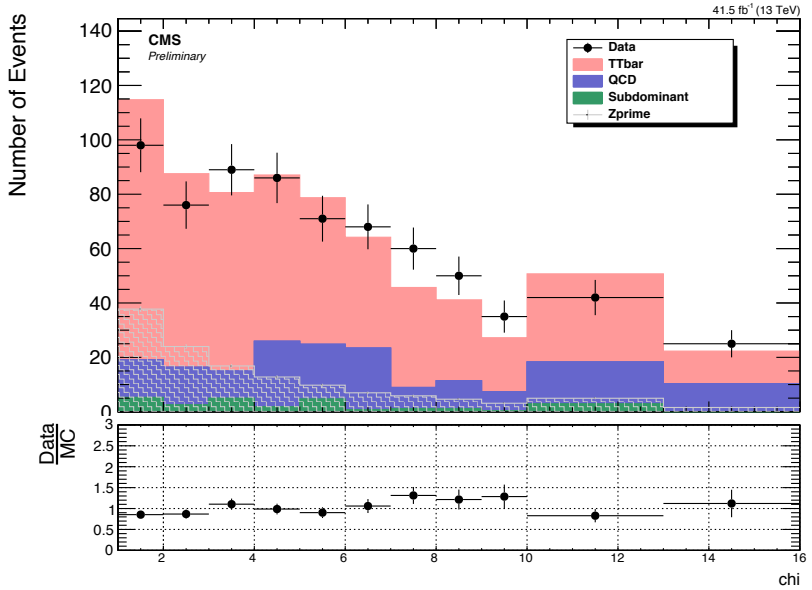


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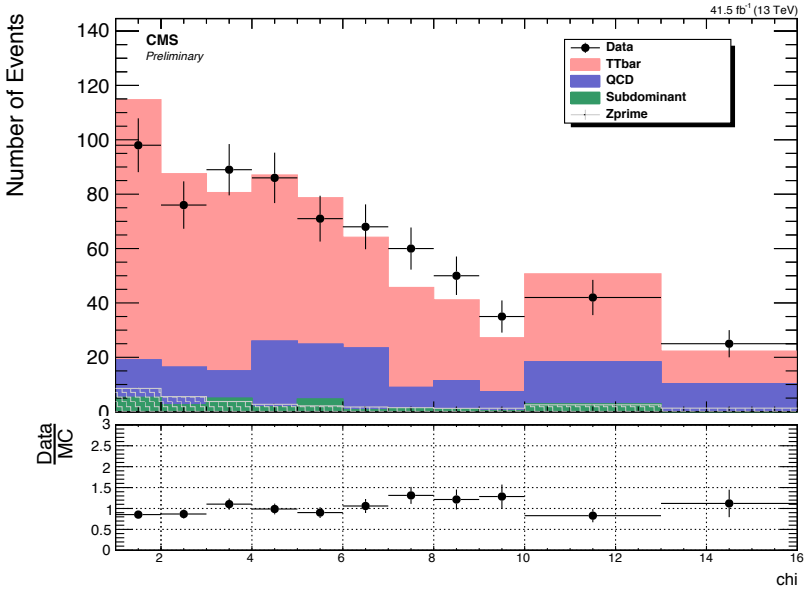


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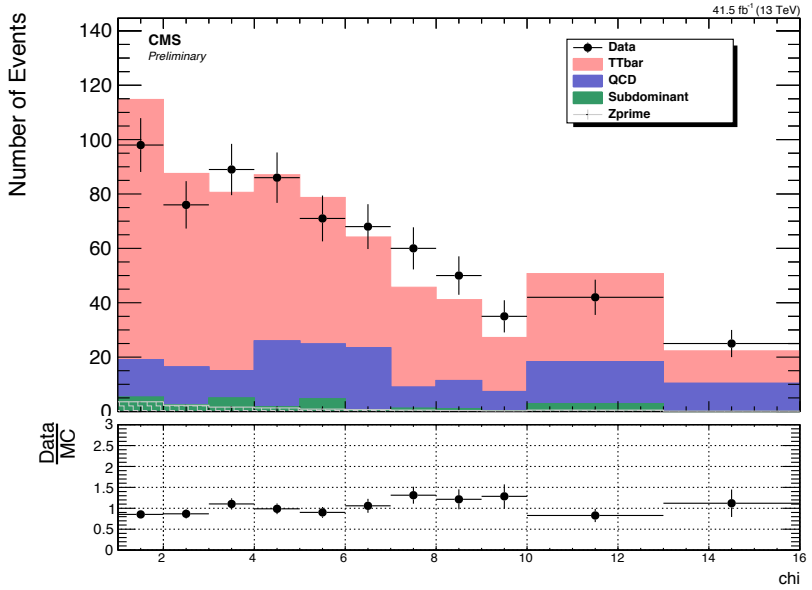


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