

LLP short Update

Control region ntuples - 2016 run era

v4_central_2016miniAOD_short_SignalAndControl/Control1Muon/

Preselections:

- ▶ Triggers
HLT_DoubleJet90_Double30_TripleBTagCSV_p087_v ||
HLT_QuadJet45_TripleBTagCSV_p087_v
- ▶ Filter requirements have to be fulfilled
- ▶ nCHSJets ≥ 4
- ▶ No isVBF requirement
- ▶ Has to have exactly one muon with tight WP (no electrons)
- ▶ Lepton + MET transverse mass > 100 GeV
- ▶ Jets $p_T > 30$ GeV, $|\eta| < 2.4$
- ▶ HT > 100 GeV
- ▶ Signal is not matched to gen particles

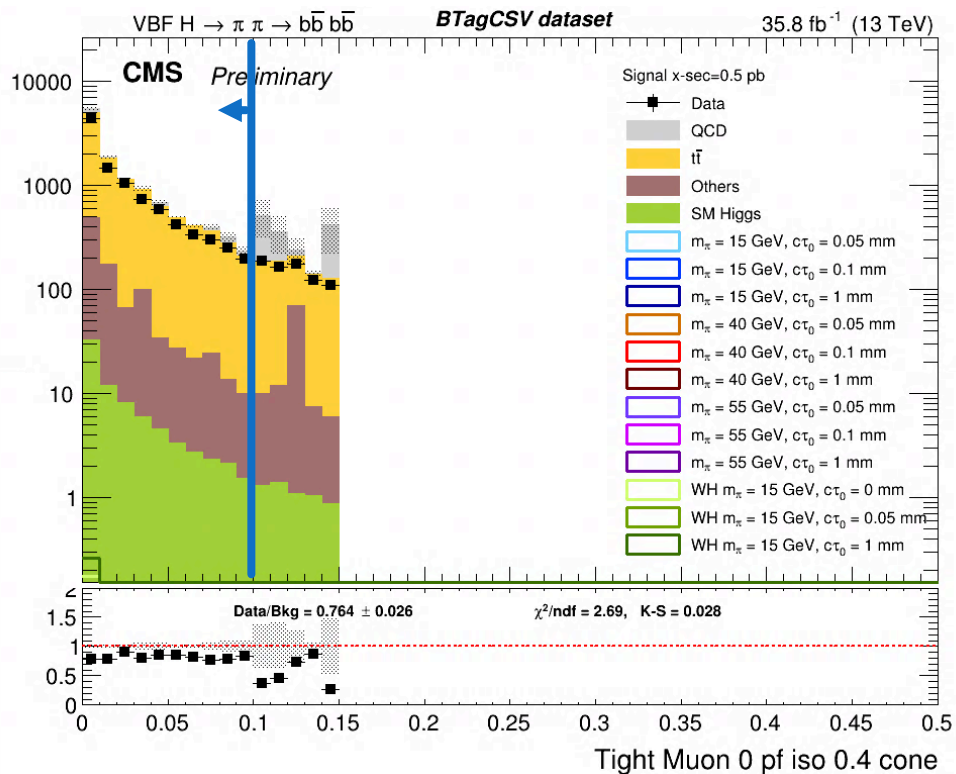
Signal and Data:

- ▶ BTagCSV dataset Run B - H
- ▶ Twin Higgs model VBFH and WH production mode

Background:

- ▶ QCD
- ▶ TTbar
- ▶ SM Higgs:
 - ZH- H \rightarrow bb; Z \rightarrow QQ/LL/NuNu
 - VBFH - H \rightarrow bb and H \rightarrow 4b
 - W \pm H - H \rightarrow bb; W \rightarrow QQ/LNu
 - ttH - H \rightarrow bb
 - bbH - H \rightarrow bb
 - ggH - H \rightarrow bb
- ▶ Others:
 - Dibosons: WW, WZ, ZZ
 - Single top: tW, s- and t-channel
 - WJets: WToQQ, WToLNu
 - DYJets: ToQQ

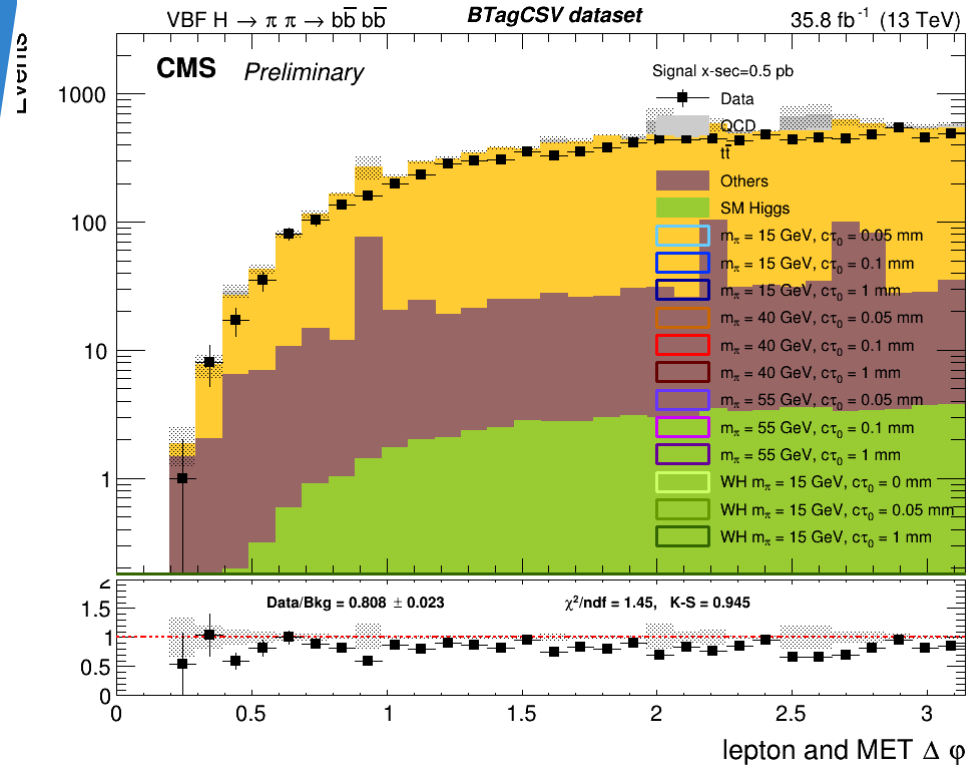
New selection applied



Cut in PF isolation in 0.4 around the tight WP muon

→ Removes QCD events with high weights.

Alternative to remove QCD?



Try to remove QCD events with high weights.

→ Use a cut in $\Delta\phi$ between lepton and MET?

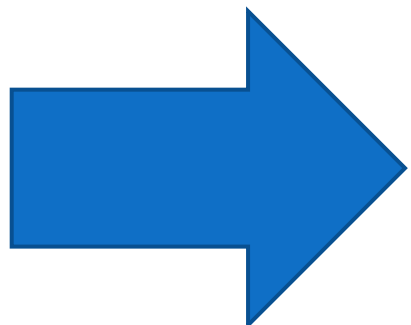
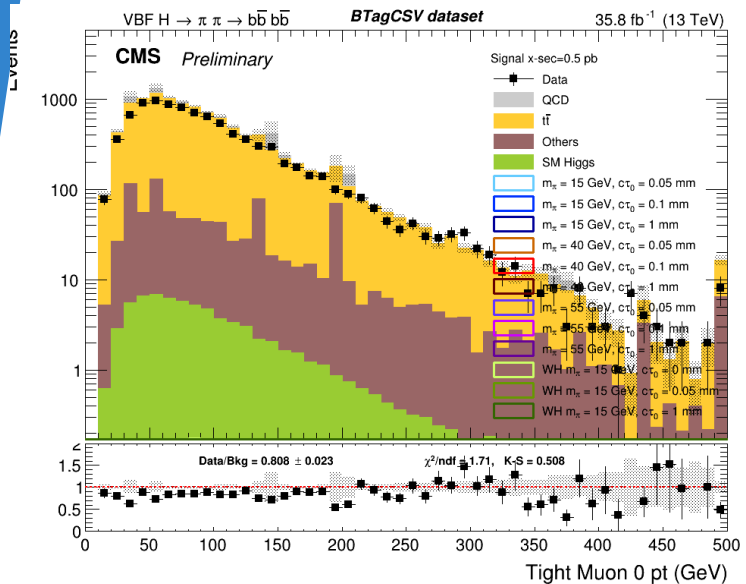
→ $\Delta\phi < 2.0$ could work, but that would remove also a lot of background in general...

Different Scale Factors

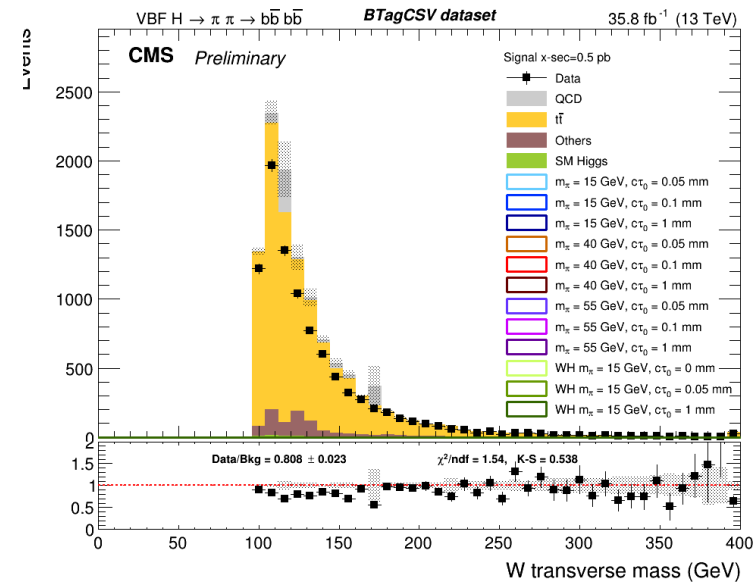
Applied only once at a time!

Muon correction

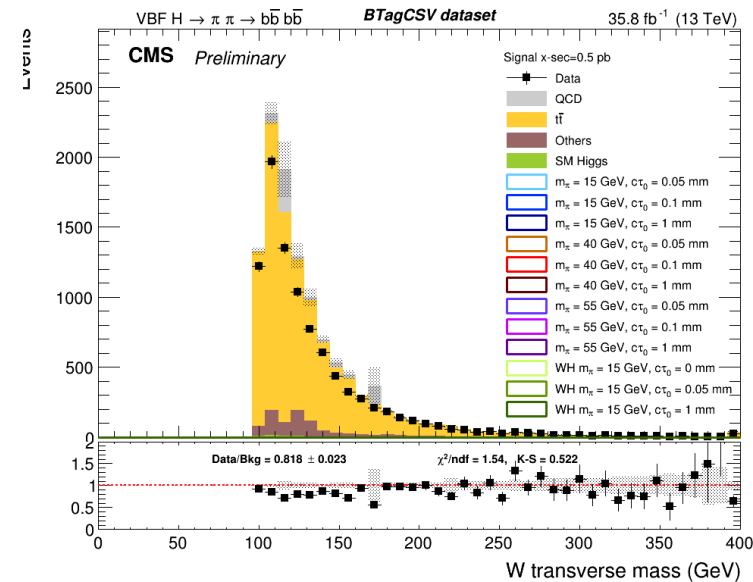
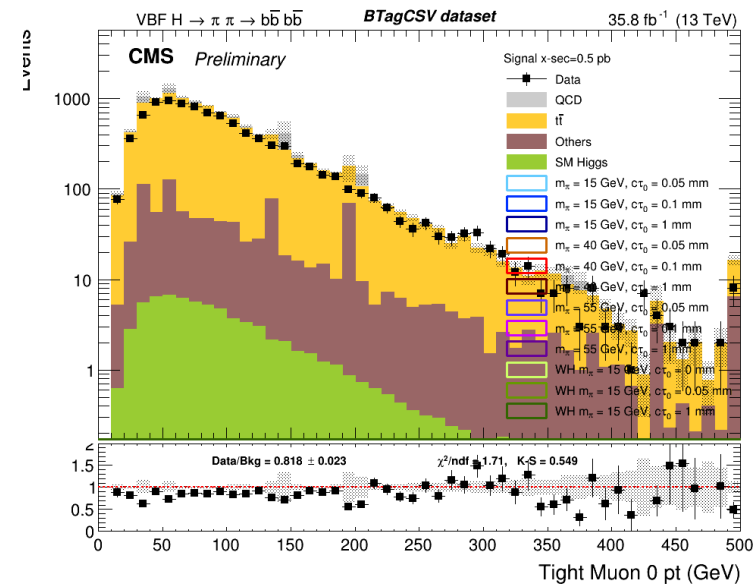
No extra weight applied:



Overall ~1% effect

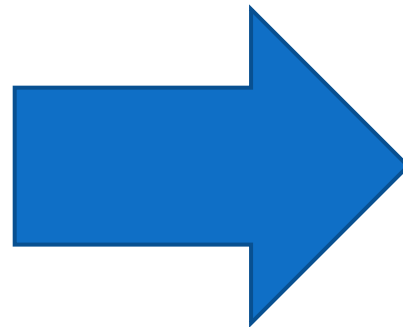
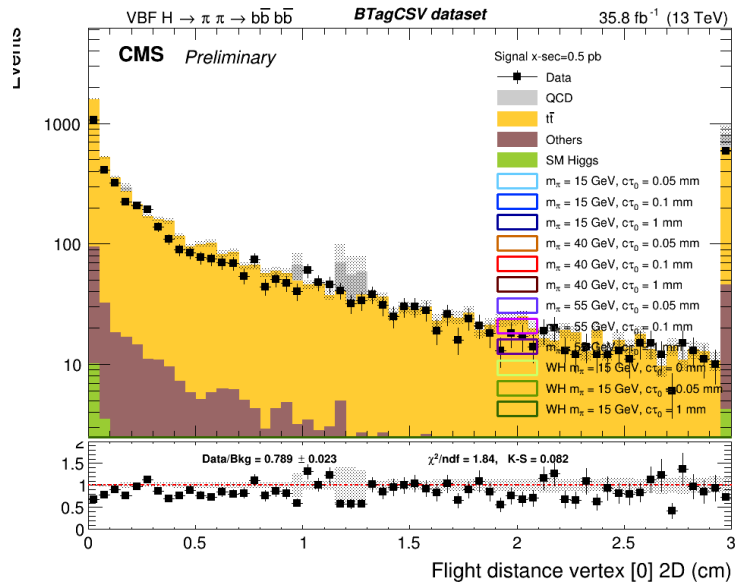
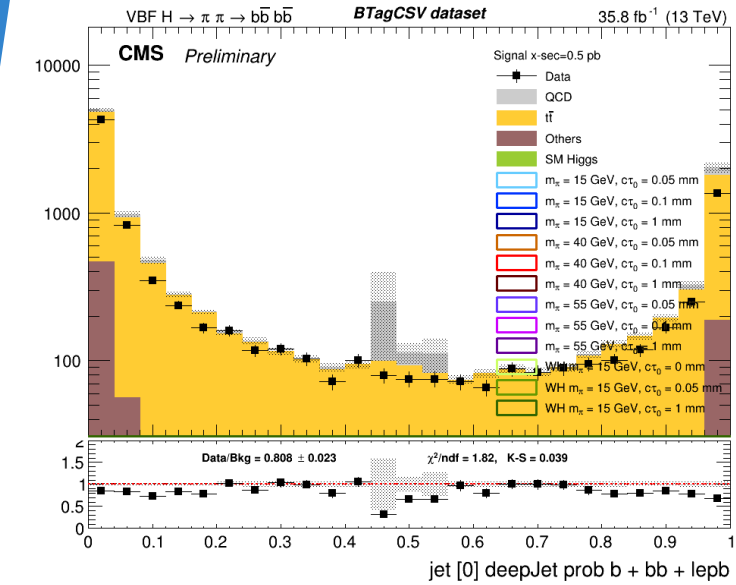


Muon weight for ID and ISO:



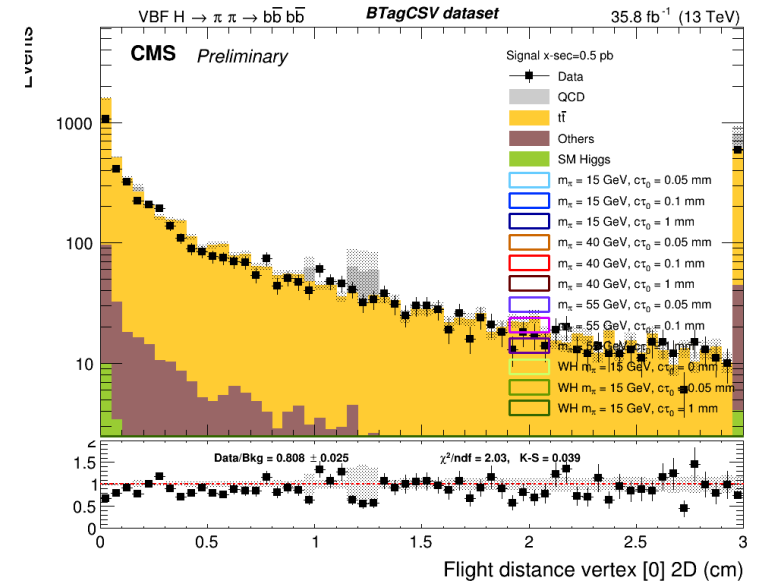
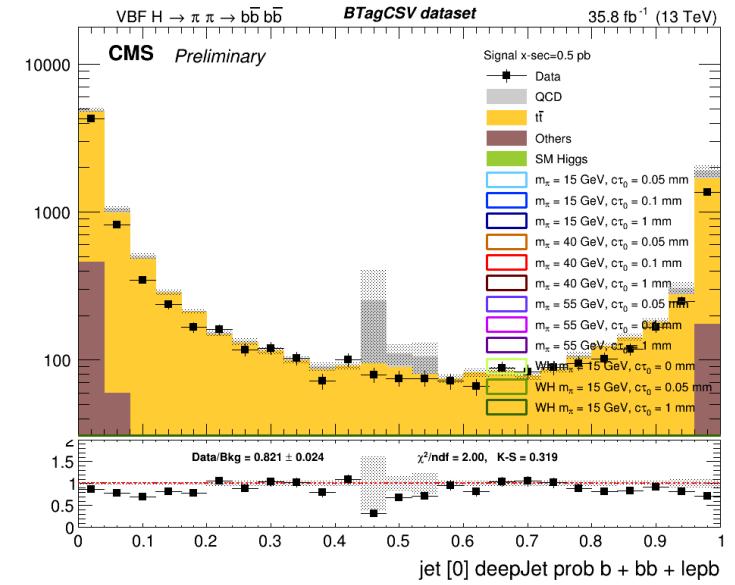
b-tag correction

No extra weight applied:



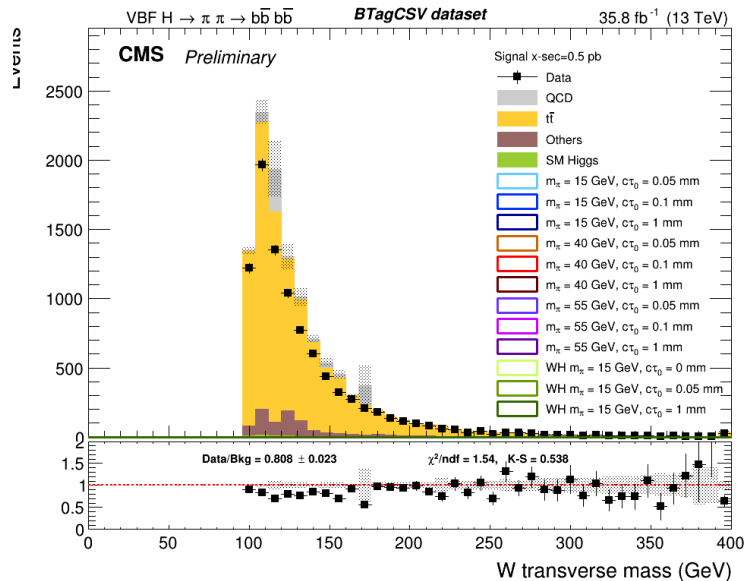
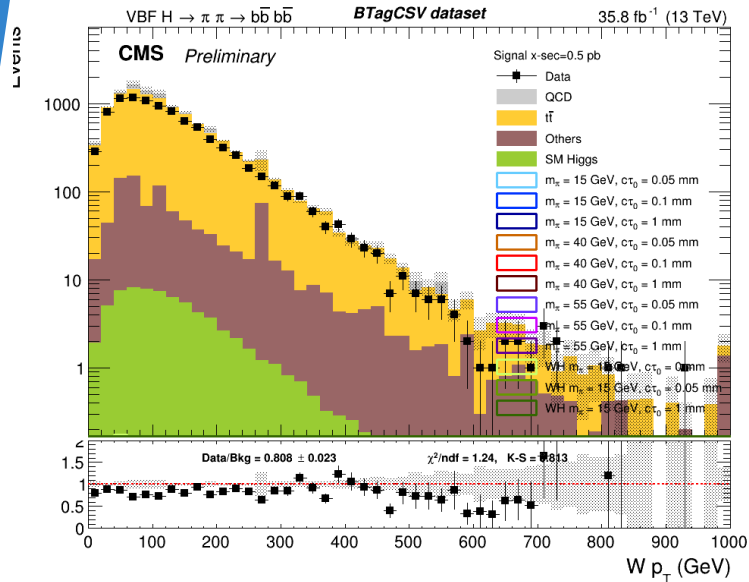
Overall ~2% effect

Central b-tag weight:

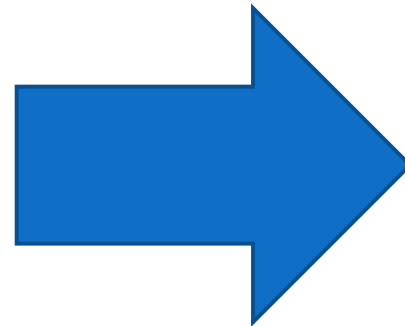
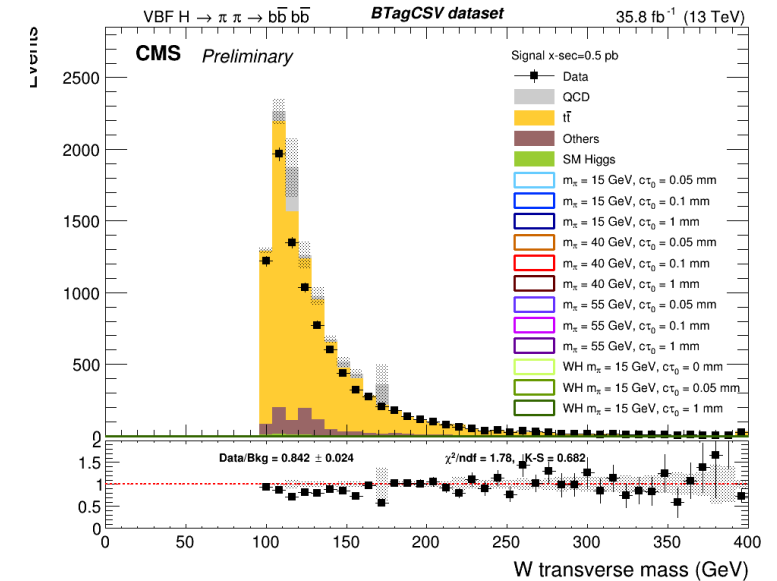
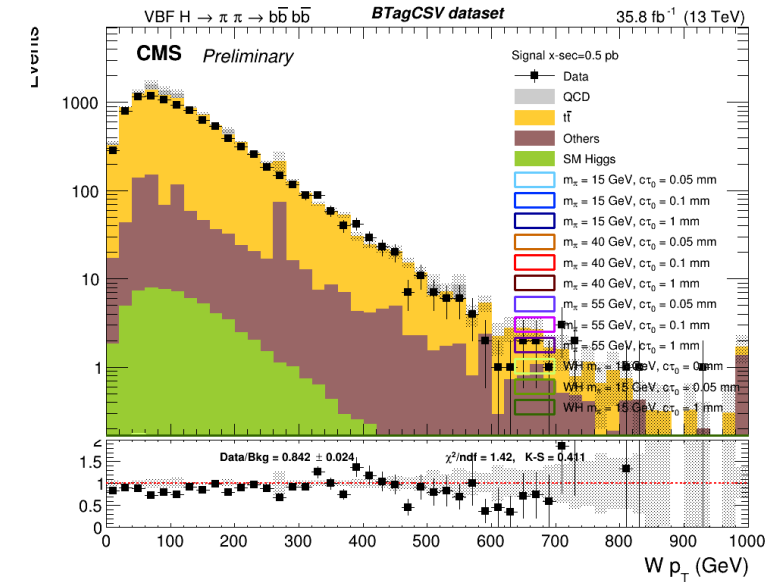


Top p_T reweighting

No extra weight applied:



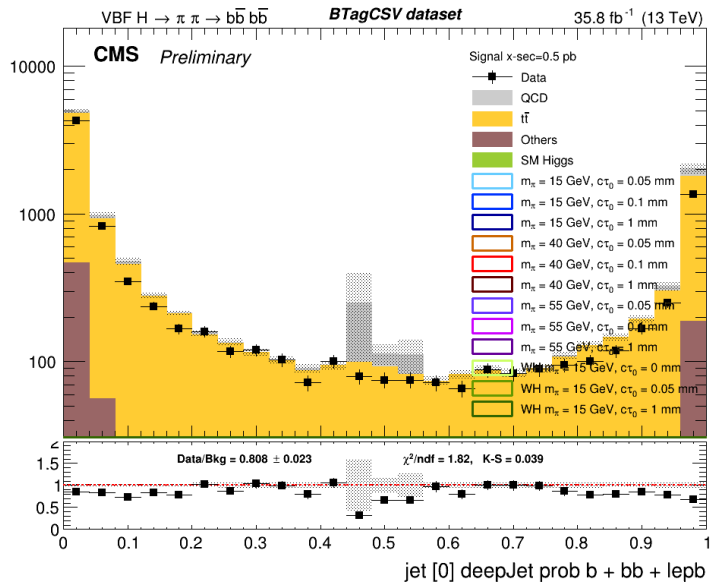
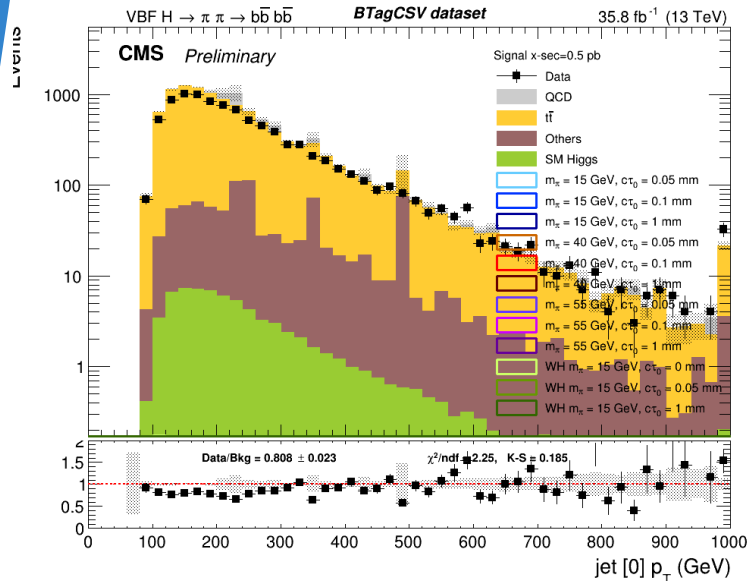
top p_T weight:



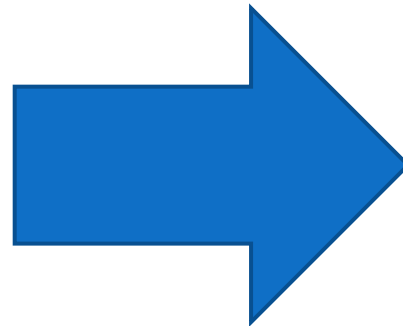
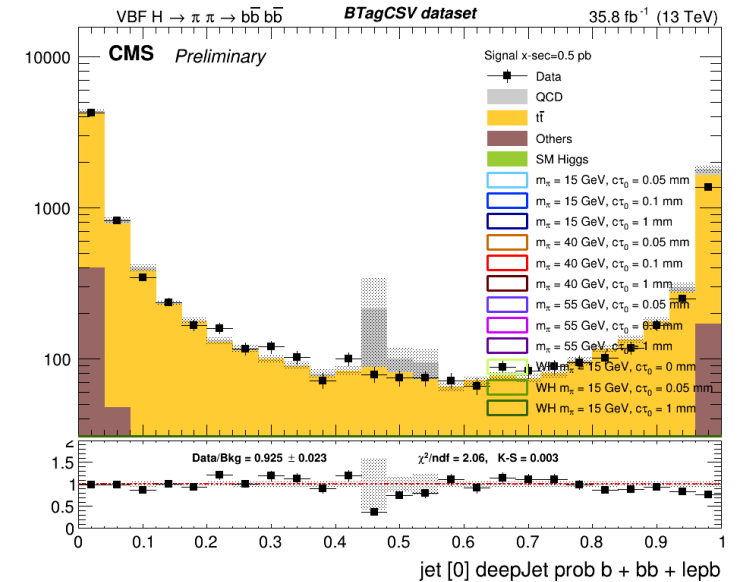
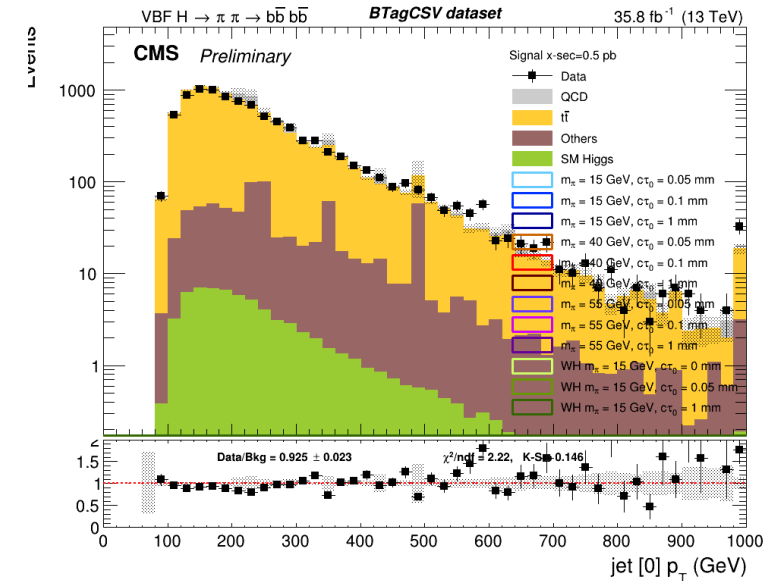
Overall ~4% effect
 Normally used to
 compensate soft top p_T
 \rightarrow MC has higher top p_T
 than data

Trigger corrections

No extra weight applied:



Trigger weight:

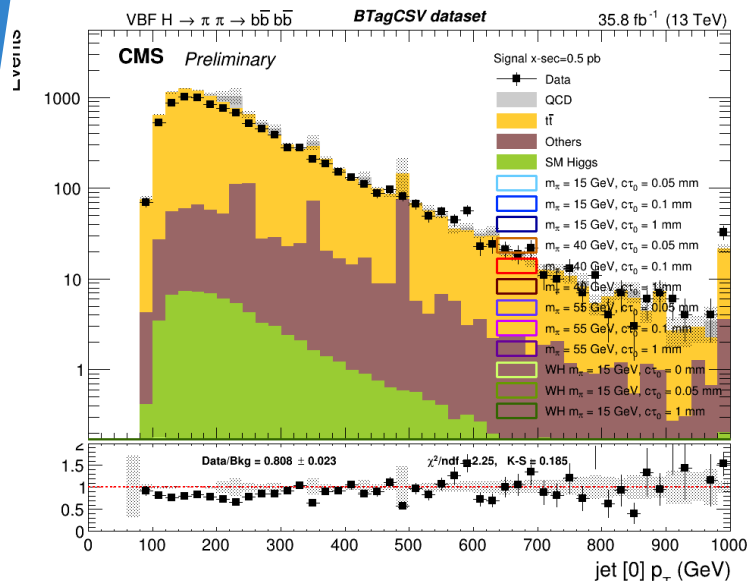


Overall ~10% effect
 Calculated first efficiency
 for each filter, combined
 for all filters together.
 Done for both triggers
 and taken events into account
 that fired both triggers (backup)

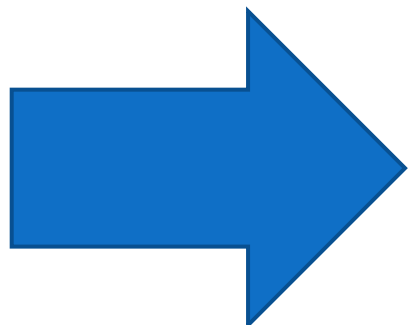
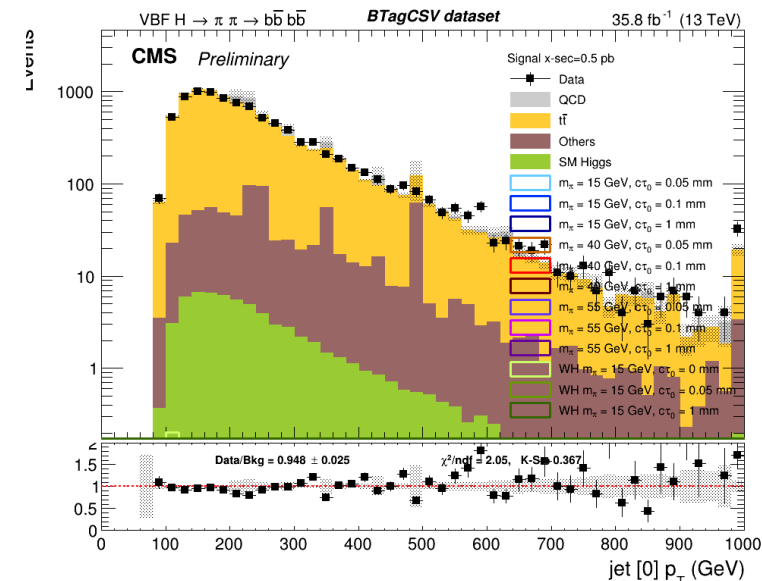
Combination of Scale Factors

Trigger and b-tag corrections

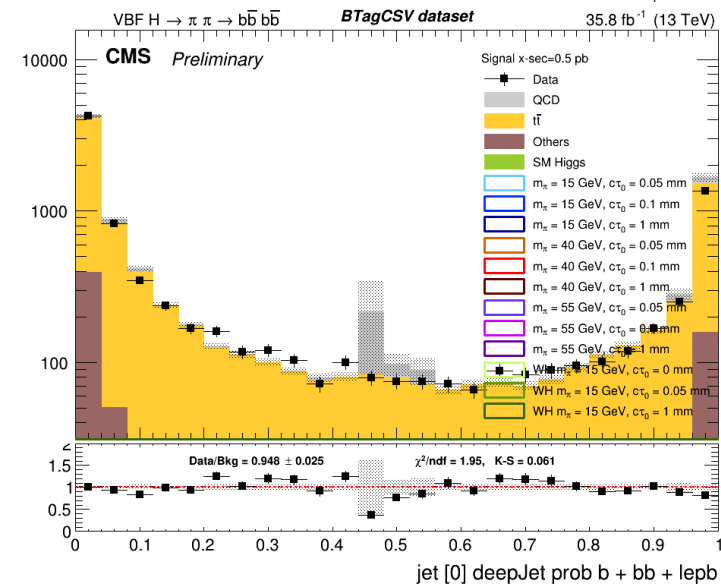
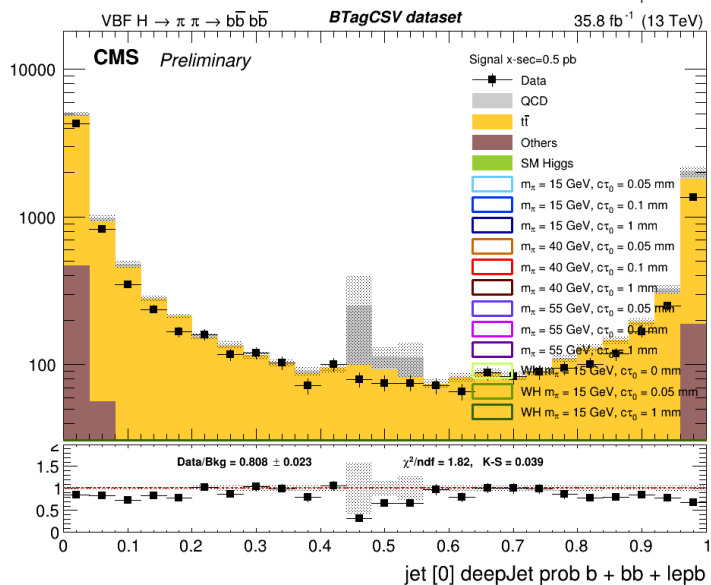
No extra weight applied:



Trigger and b-tag weight:

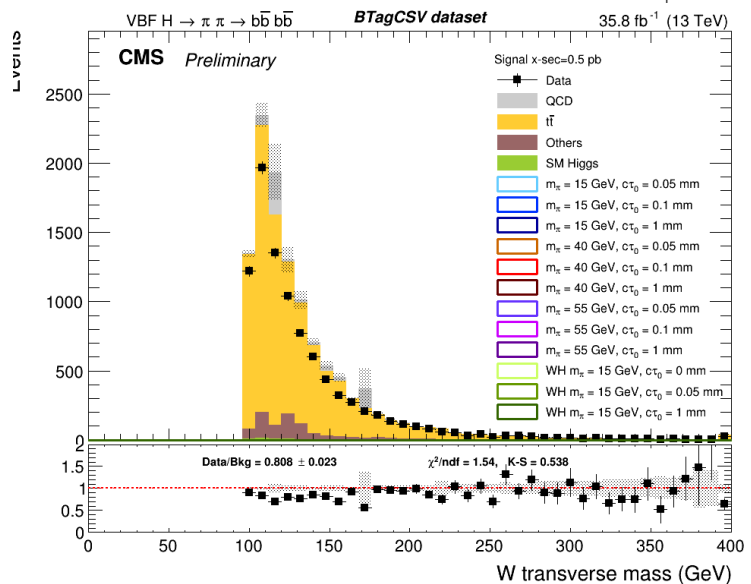
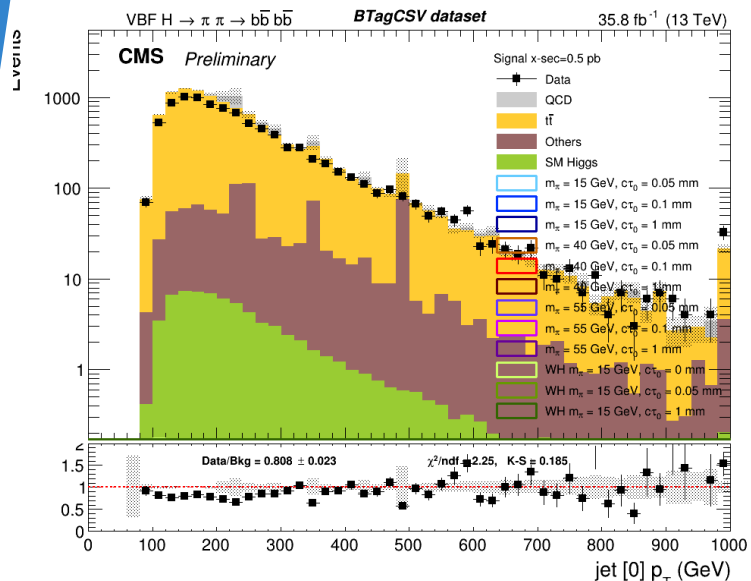


Overall ~15% effect

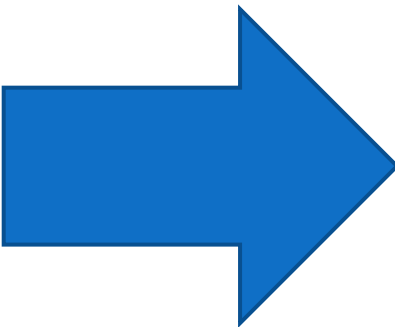
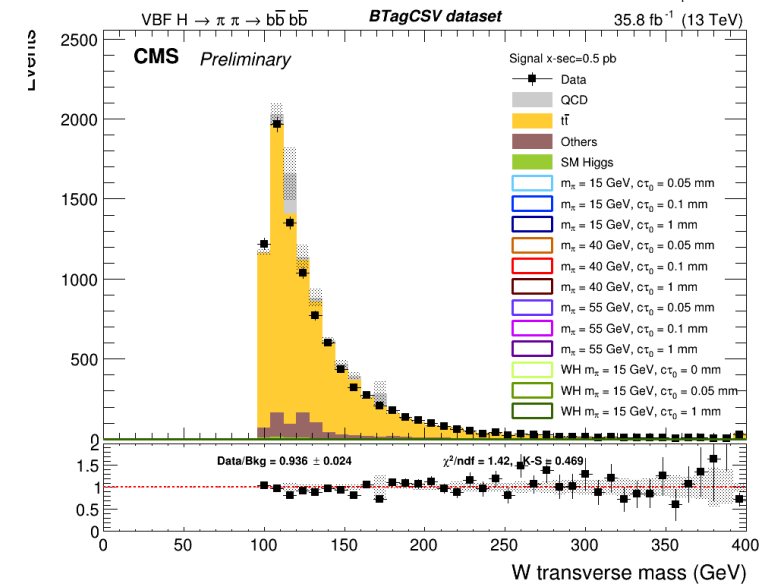
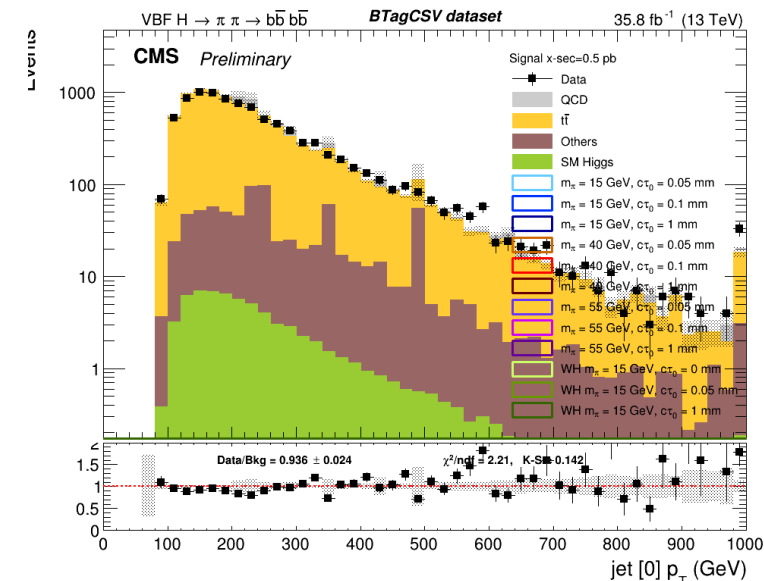


Trigger and lepton corrections

No extra weight applied:



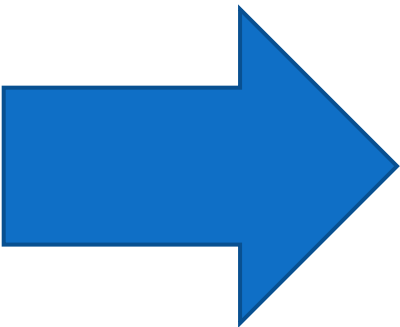
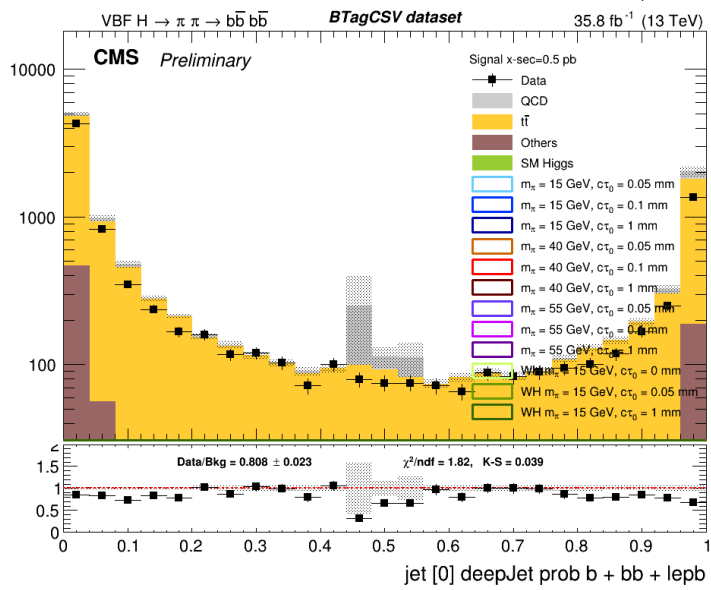
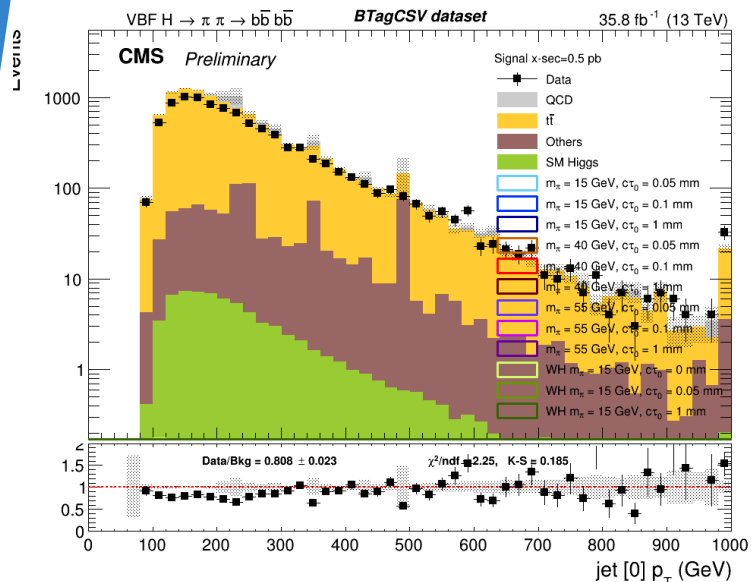
Trigger and lepton weight:



Overall ~14% effect

b-tag and lepton corrections

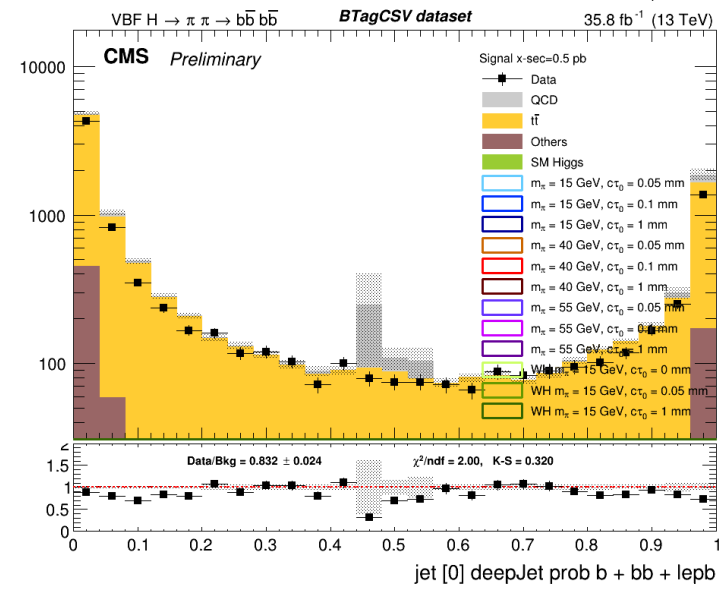
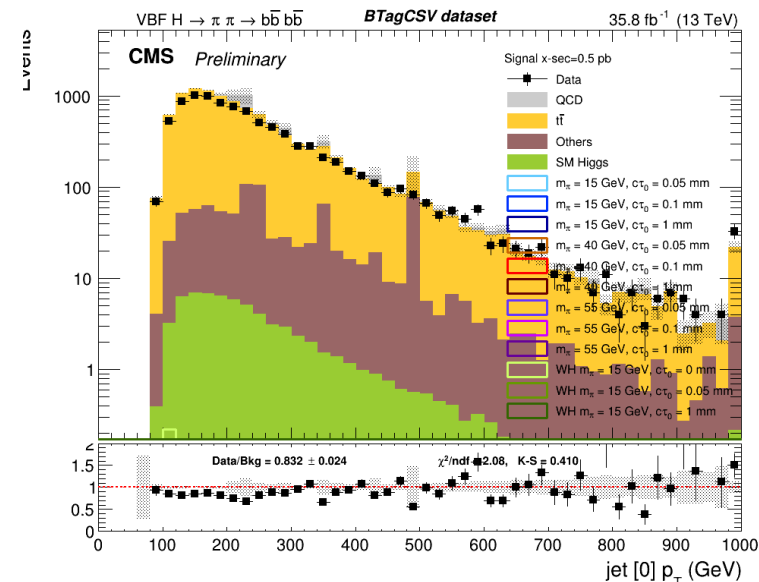
No extra weight applied:



Overall ~3% effect

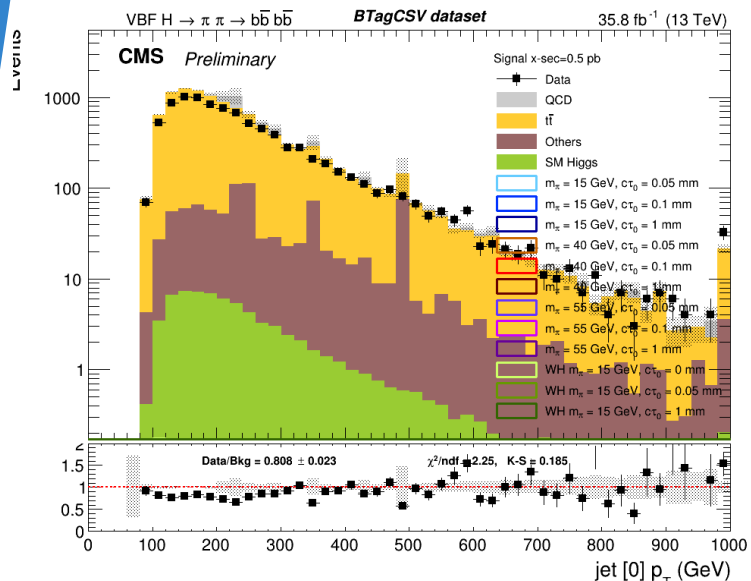
More plots in backup!

b-tag and lepton weight:

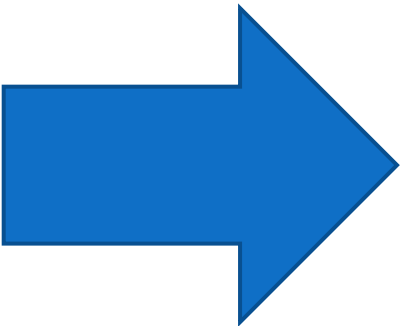
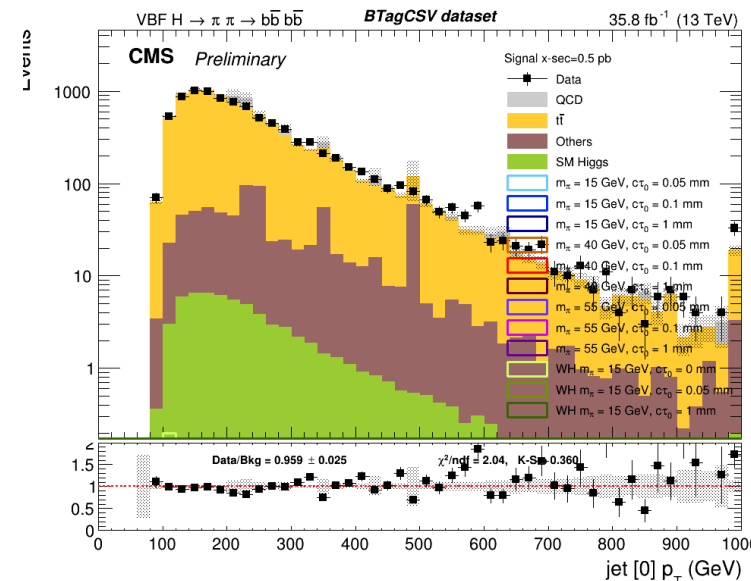


Trigger, b-tag and lepton corrections

No extra weight applied:

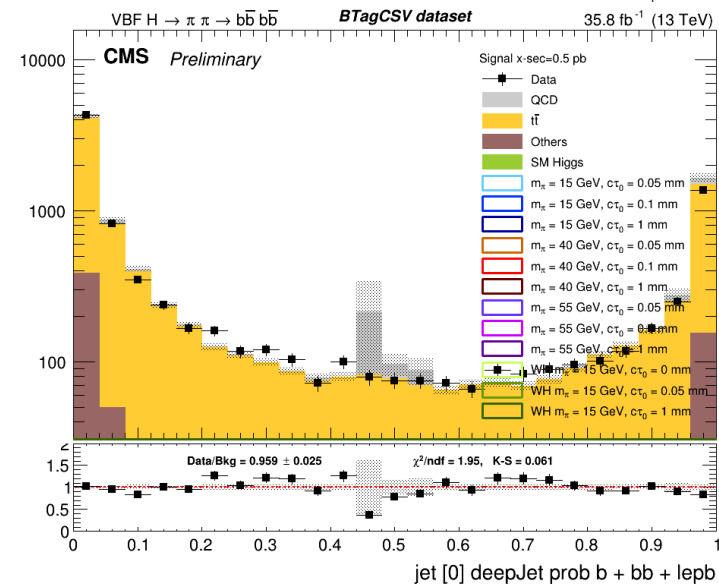
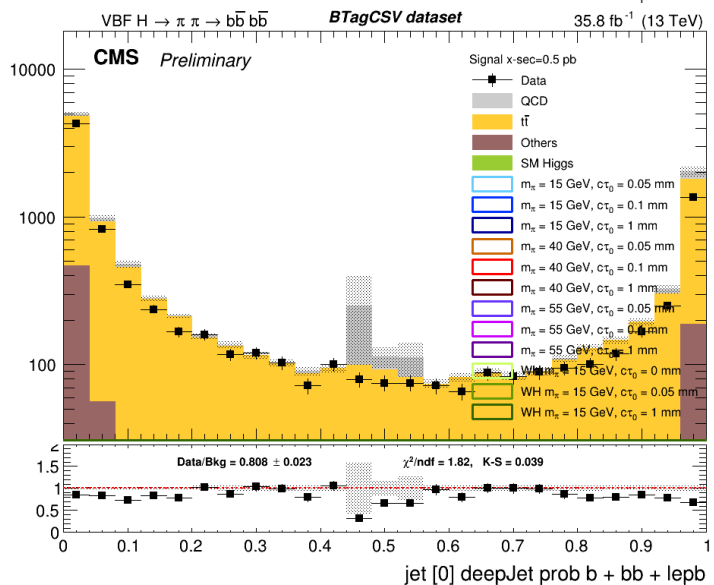


Trigger, b-tag and lepton weight:



Overall ~16% effect

More plots in backup!



The background features abstract, overlapping geometric shapes in various shades of blue, ranging from light sky blue to deep navy blue. These shapes are primarily located on the right side of the frame, creating a modern, layered effect. The rest of the background is plain white.

Backup

Trigger efficiency calculation

HLT_DoubleJet90_Double30_TripleBTagCSV_p087_v (double90)

HLT_QuadJet45_TripleBTagCSV_p087_v (quad45)

Efficiency:

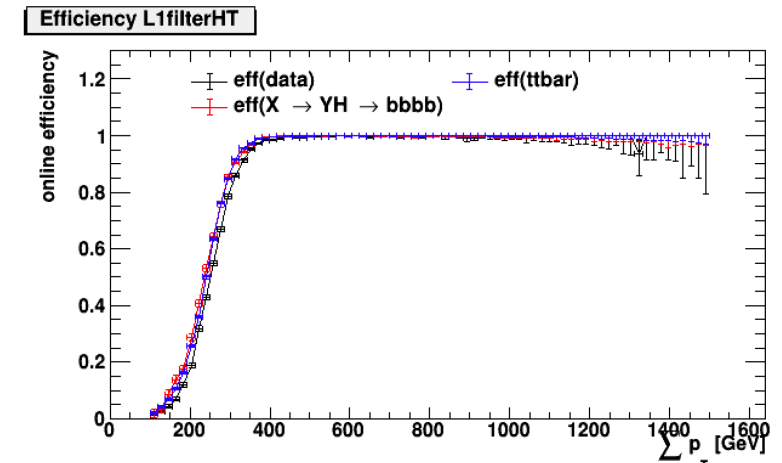
- ▶ Take efficiency per filter with relevant variable of event *
- ▶ Special b-tag filter: efficiency of four leading deepJet jets calculated

```
return effJet0 * effJet1 * effJet2 * effJet3 +
(1-effJet0) * effJet1 * effJet2 * effJet3 +
effJet0 * (1-effJet1) * effJet2 * effJet3 +
effJet0 * effJet1 * (1-effJet2) * effJet3 +
effJet0 * effJet1 * effJet2 * (1-effJet3);
```

- ▶ Efficiency of Trigger: Multiply all filter efficiencies
- ▶ Efficiency for AND of both triggers: $eff = eff_{double90} + eff_{quad45} - eff_{AND}$
with $eff_{AND} = eff_{double90} * eff'_{quad45}$, where eff'_{quad45} is the efficiency of trigger quad45 over sample of events passed the double90 trigger

Scale Factor:

$$SF = \frac{eff_{data}}{eff_{MC}}$$

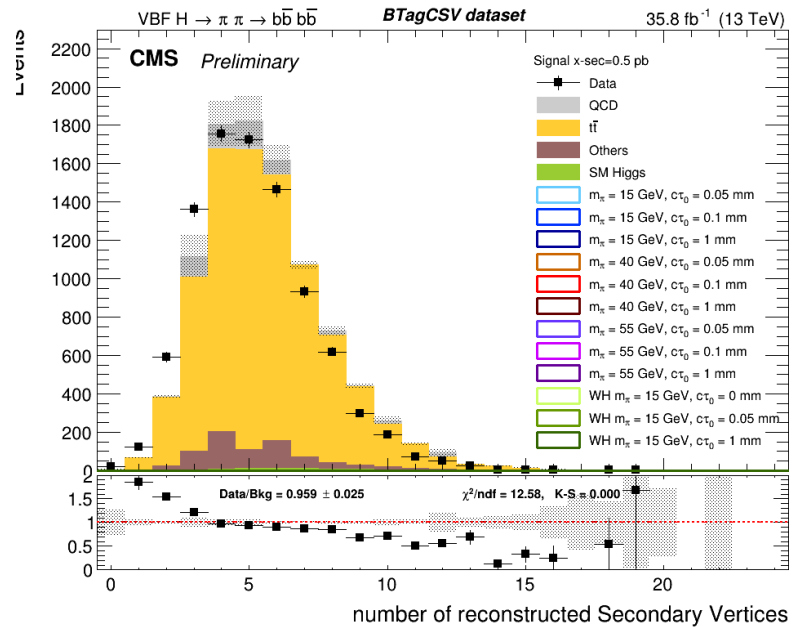
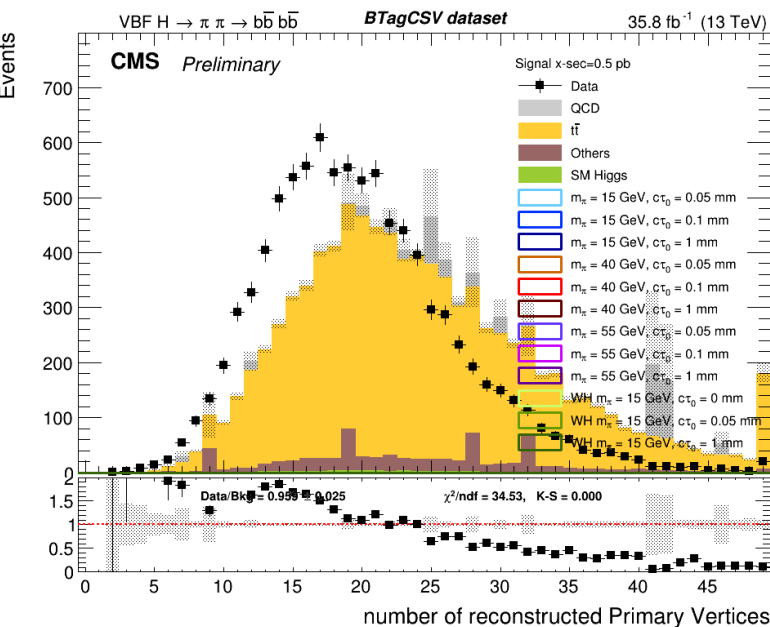
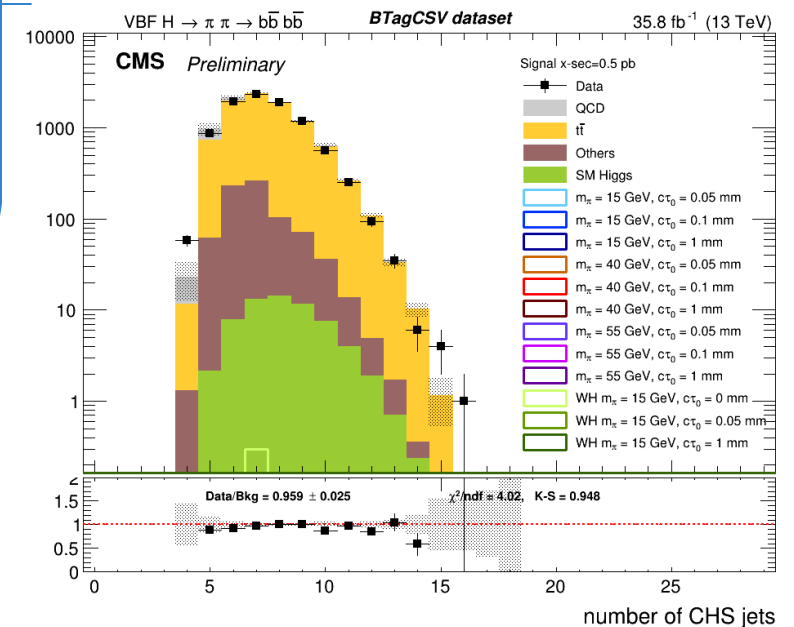
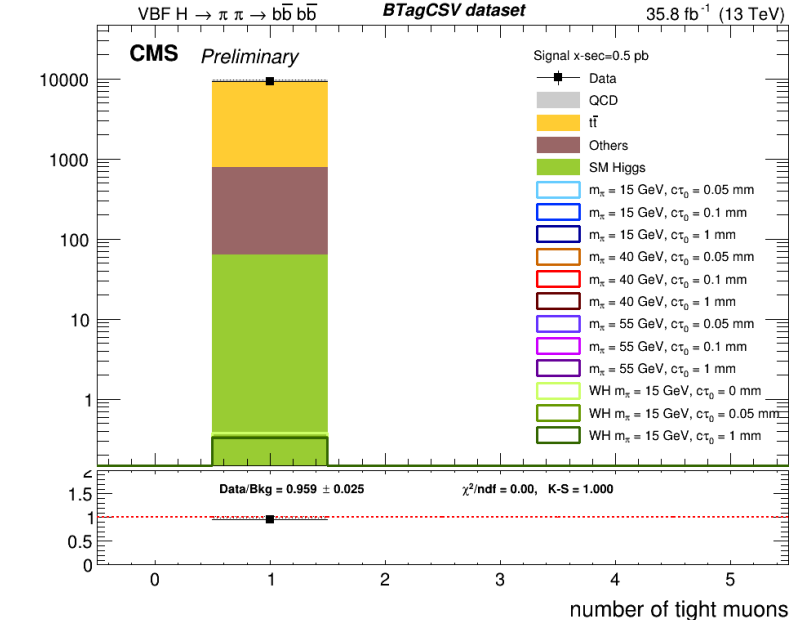
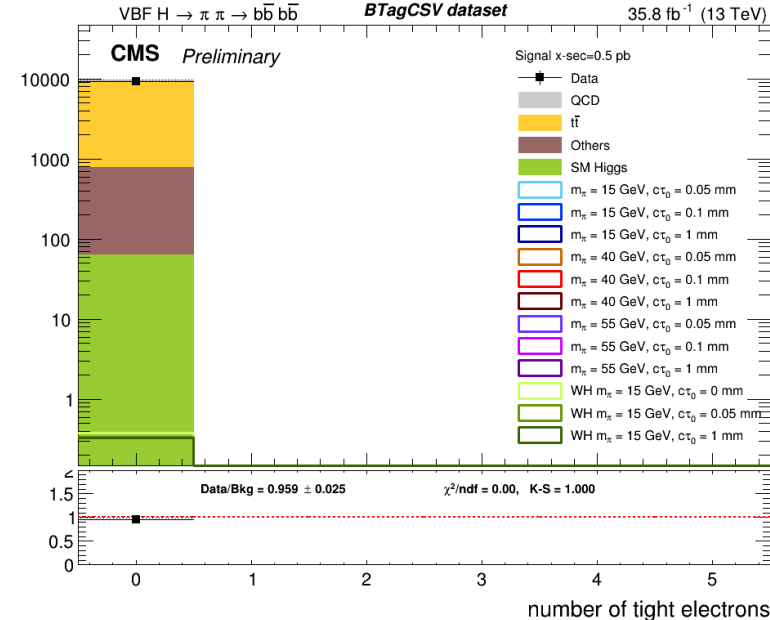
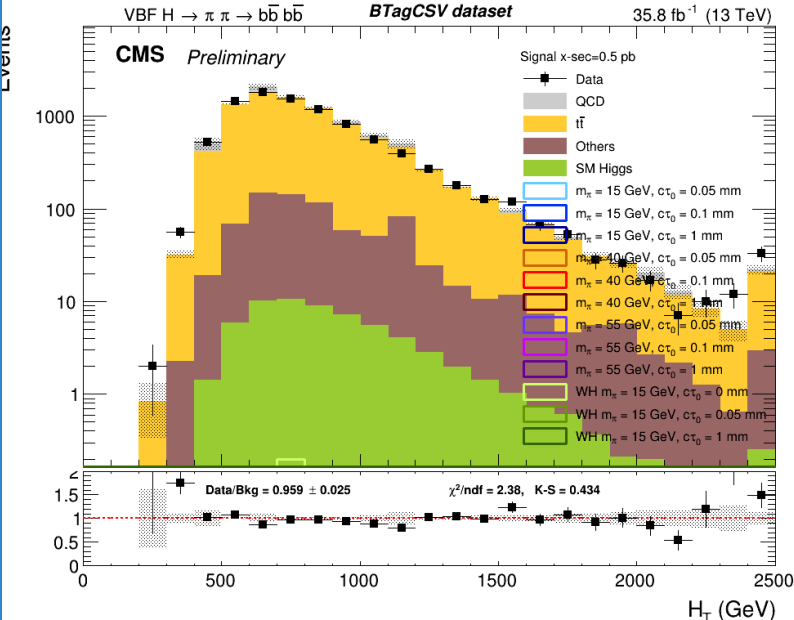


* (from repo: https://github.com/fravera/bbbbAnalysis/blob/mlBranch/data/TriggerEfficiency_Fit_2016.root)

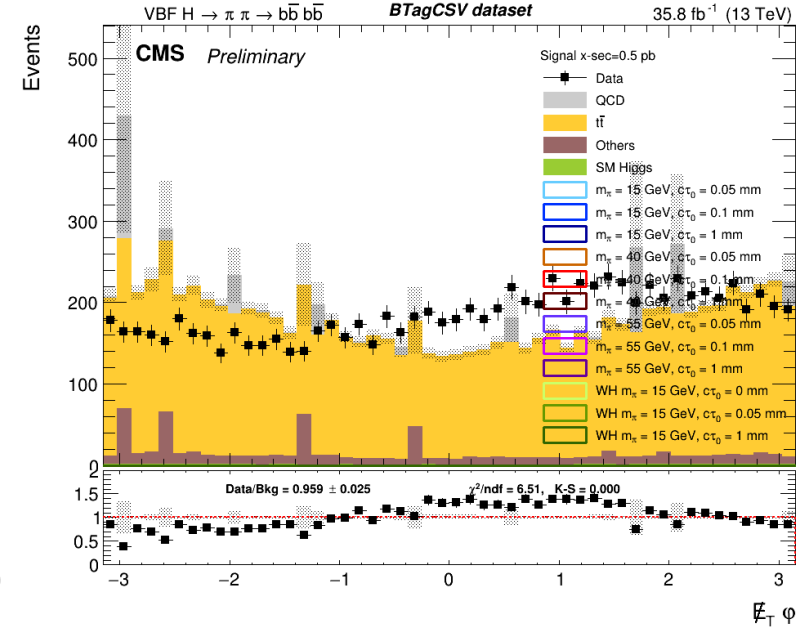
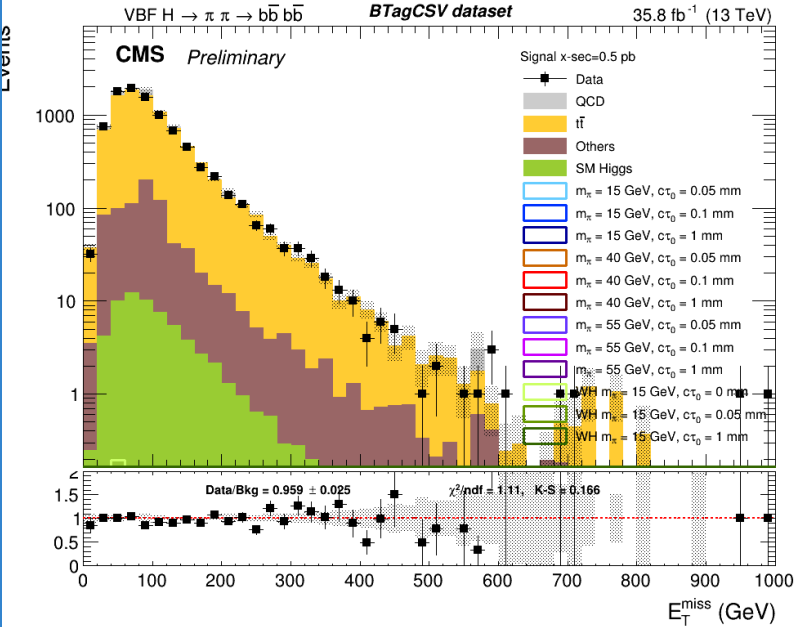
SF for b-tagging

- ▶ Different methods available
- ▶ Two big categories: with or without event reweighting
- ▶ Use either efficiency, hence WP information, or do a discriminant shape correction
- 1d) B-tagging discriminant shape calibration using event weights with a tag-and-probe method
 - „If you are interested in using the whole b-tagging discriminant distribution in your analysis, e.g. using b-tagging variables to separate single and background, then this method is for you.“

Trigger, b-tag and lepton corrections

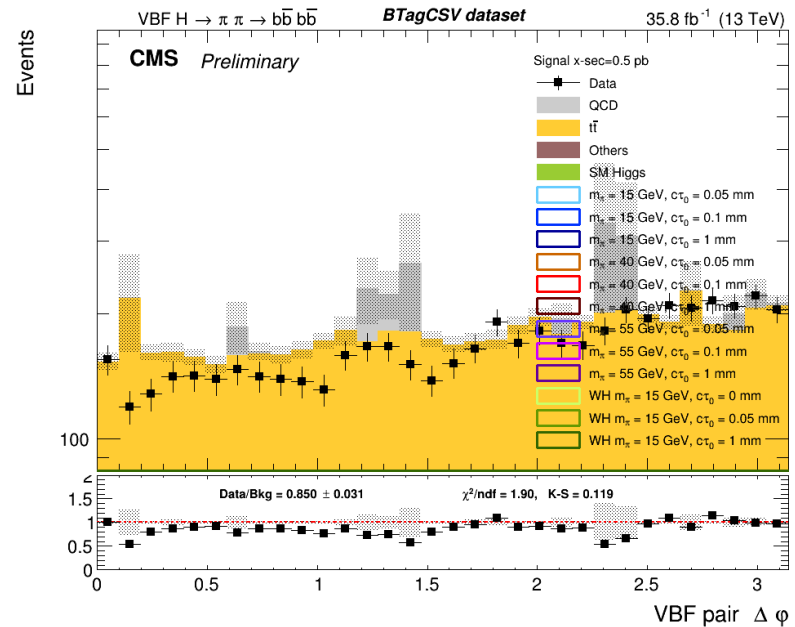
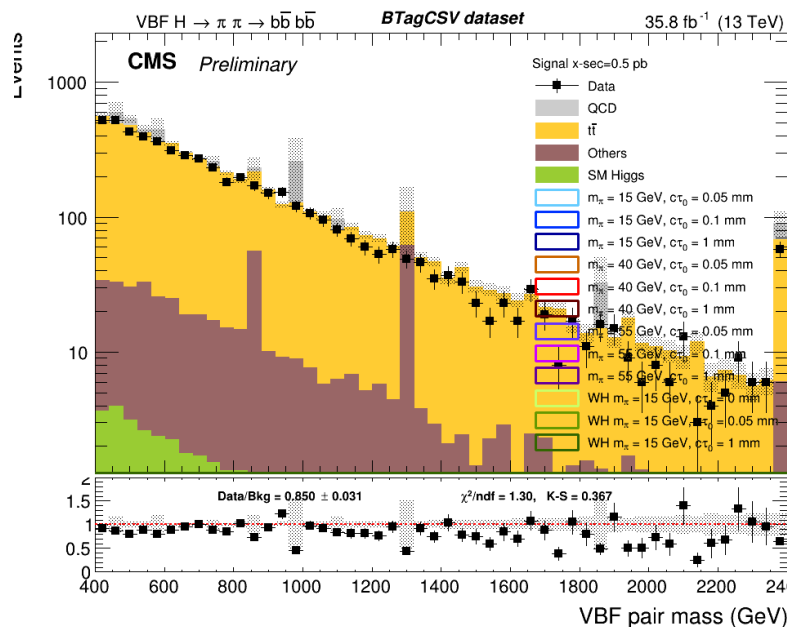
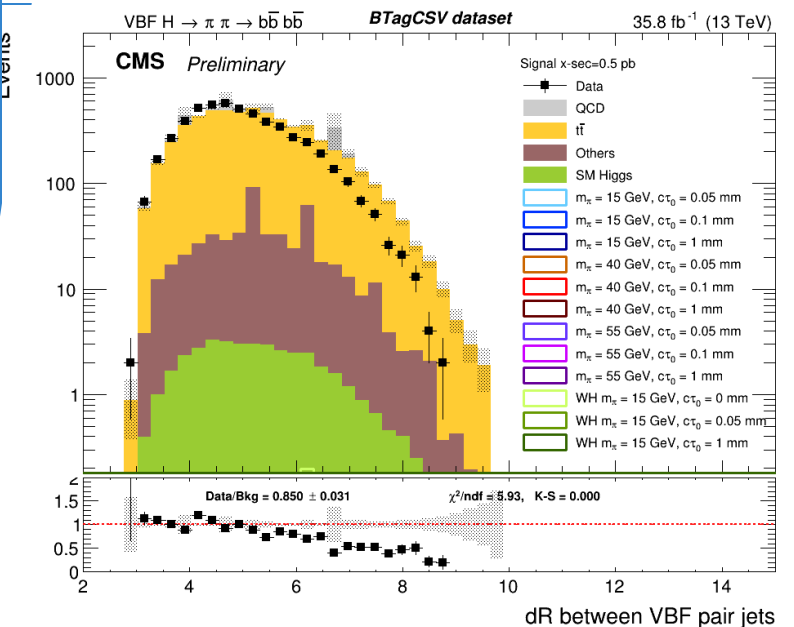
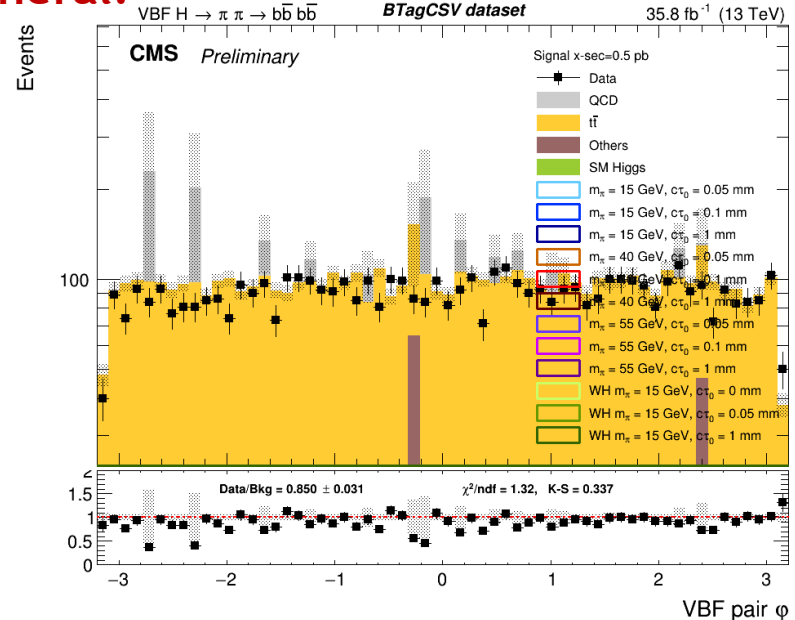
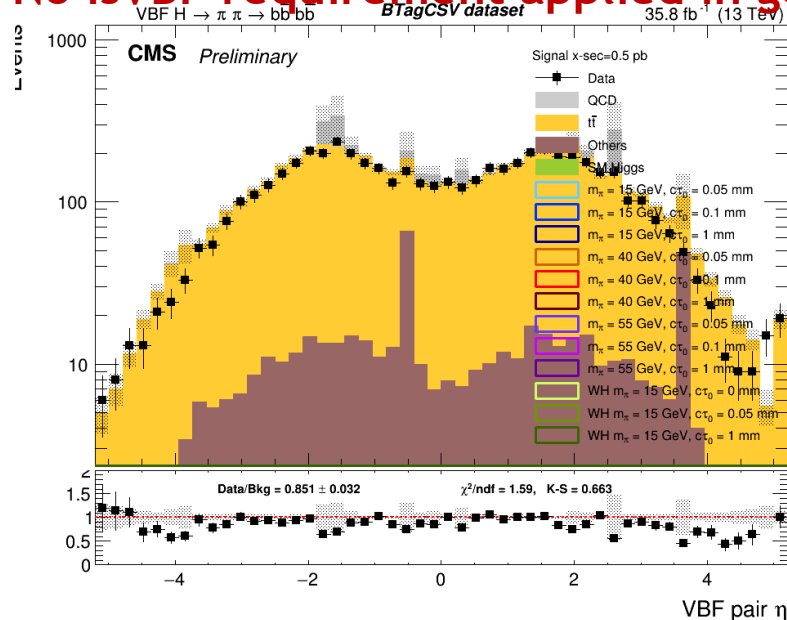
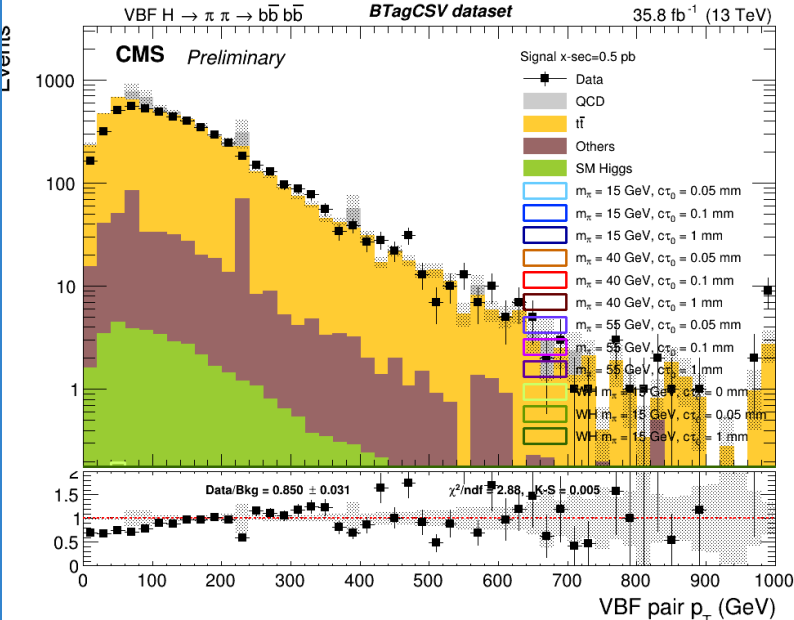


Trigger, b-tag and lepton corrections

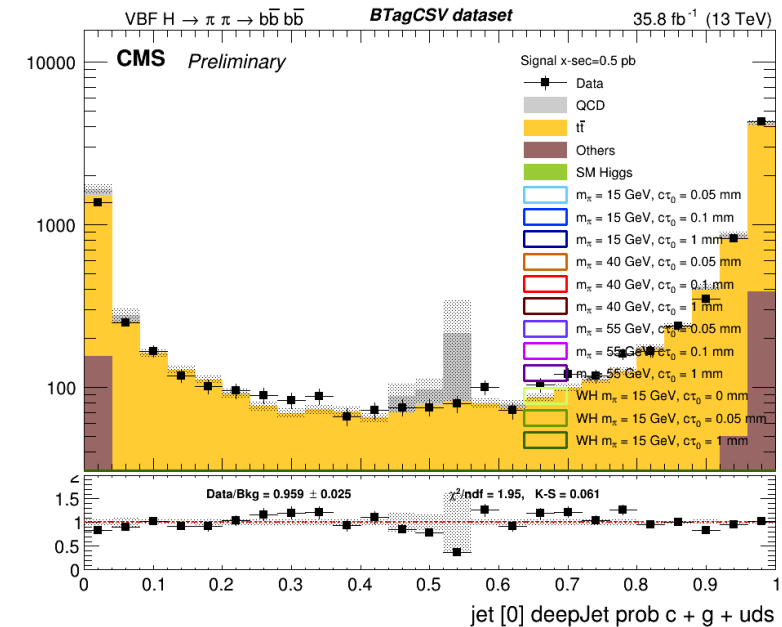
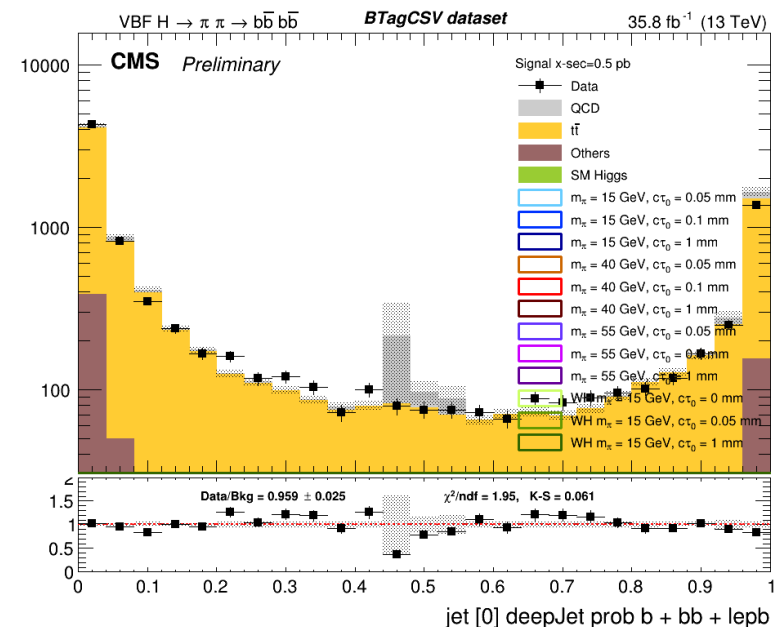
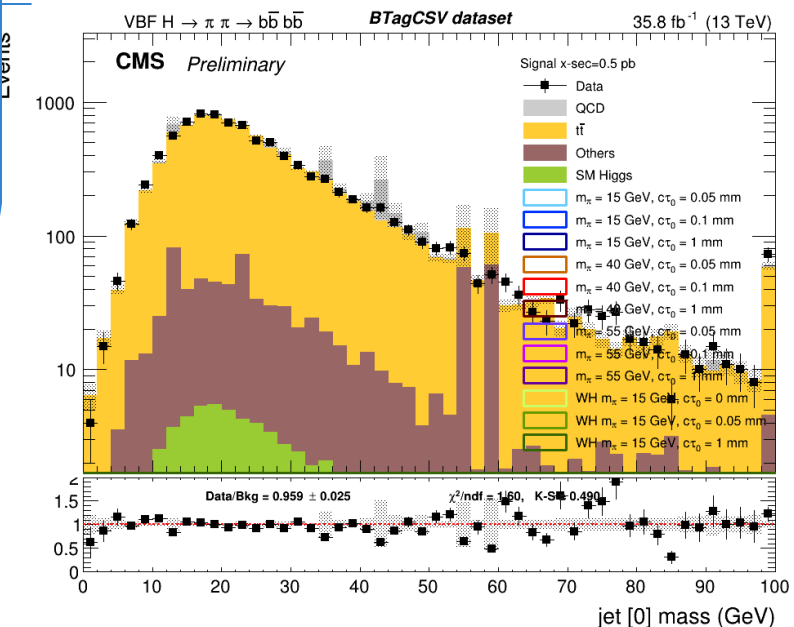
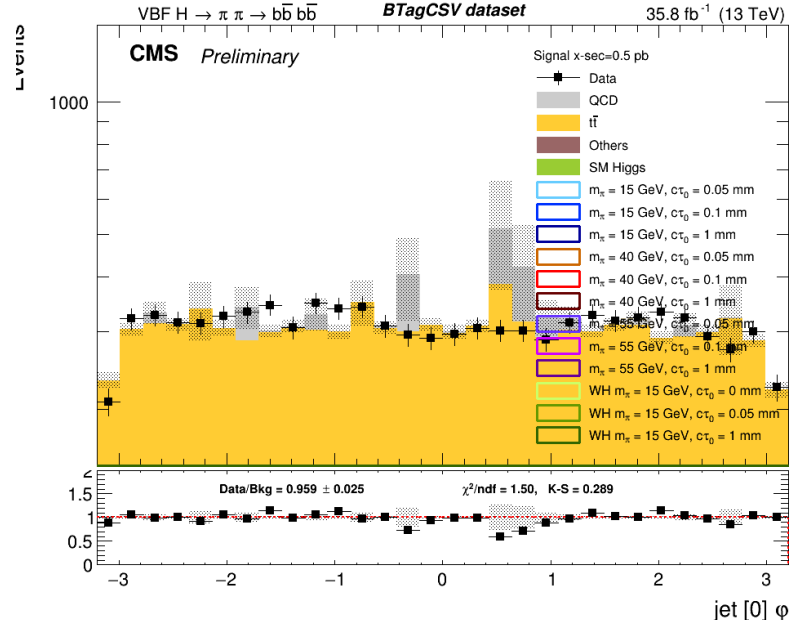
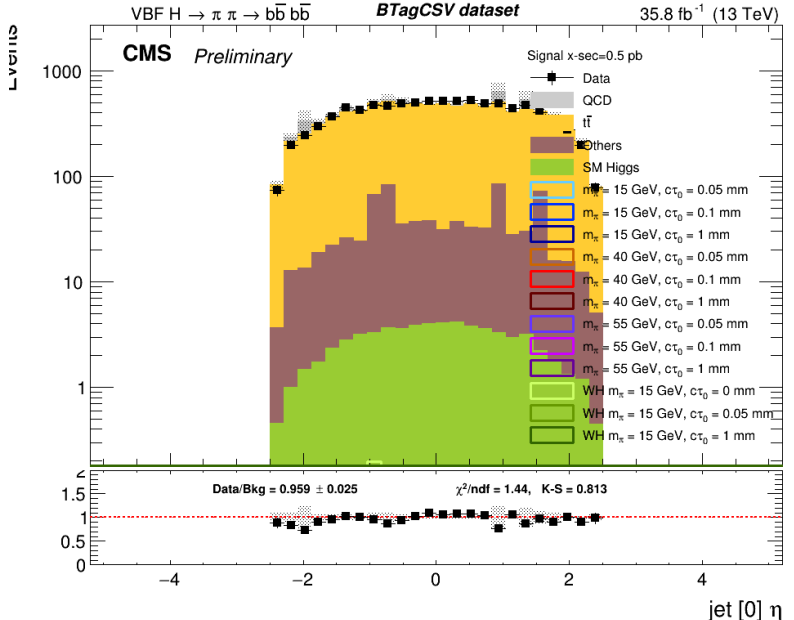
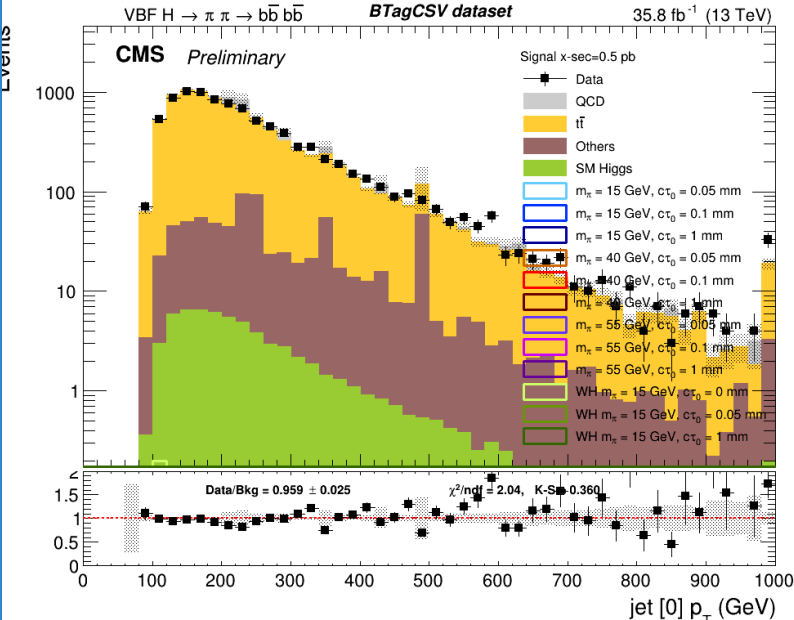


Trigger, b-tag and lepton corrections

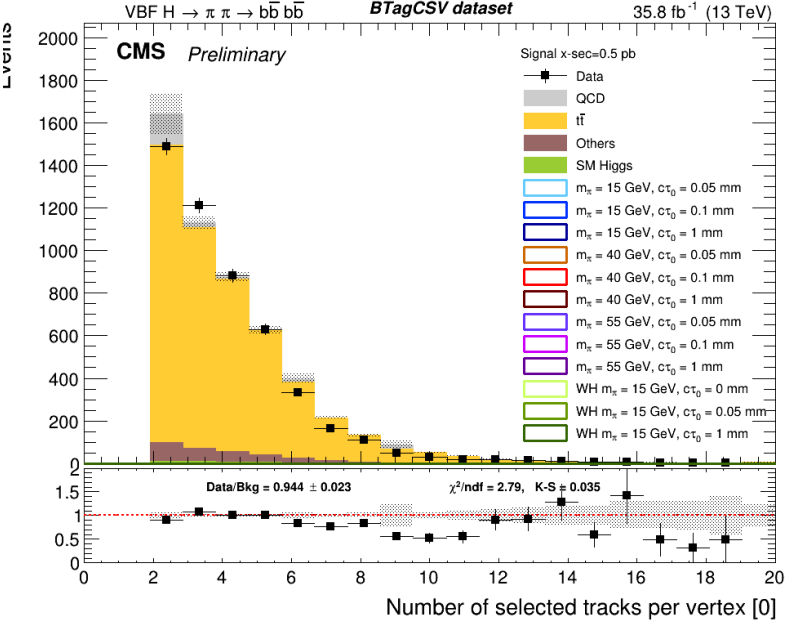
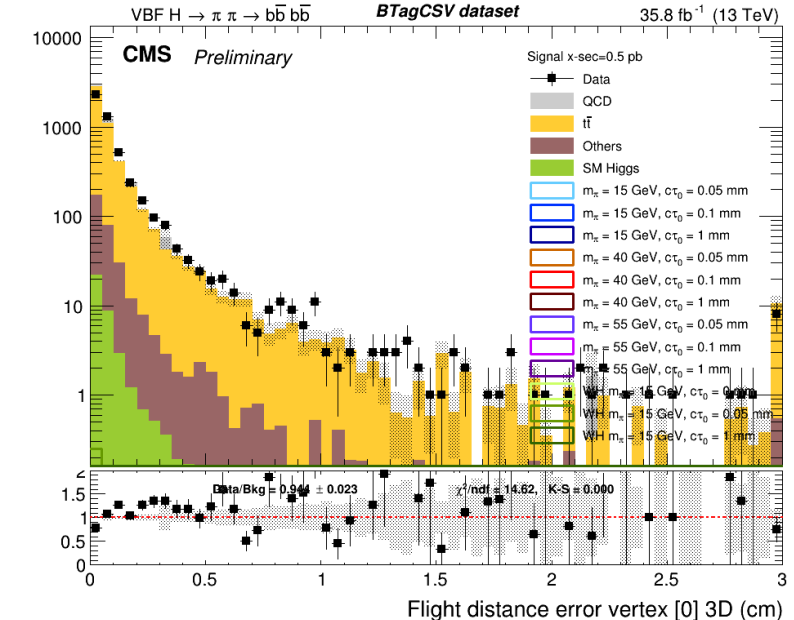
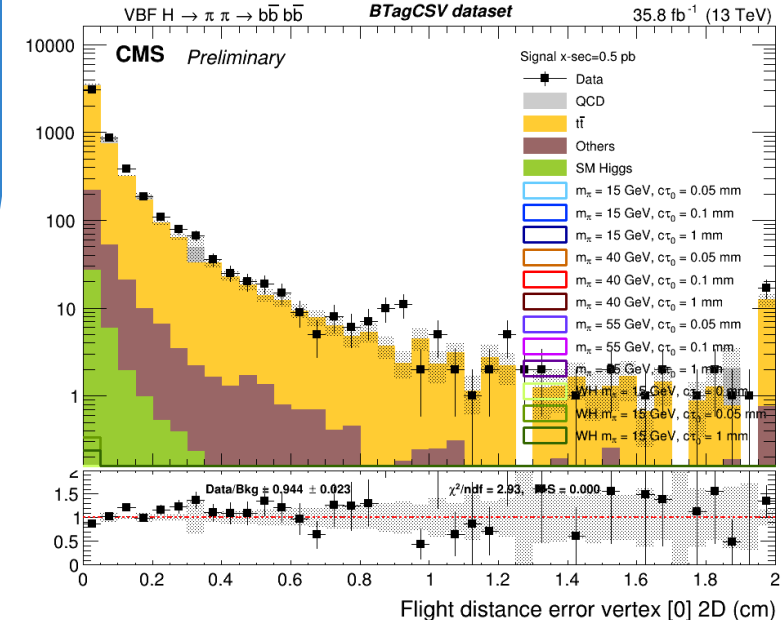
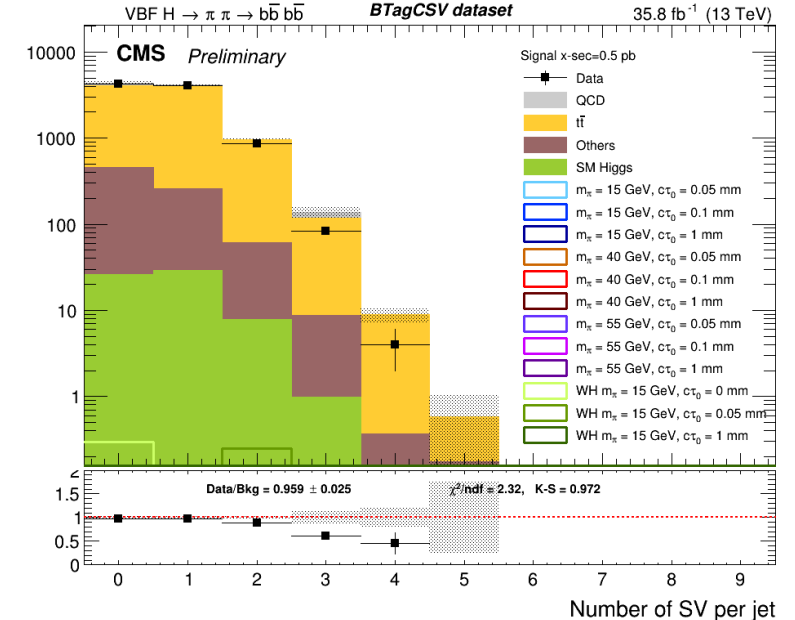
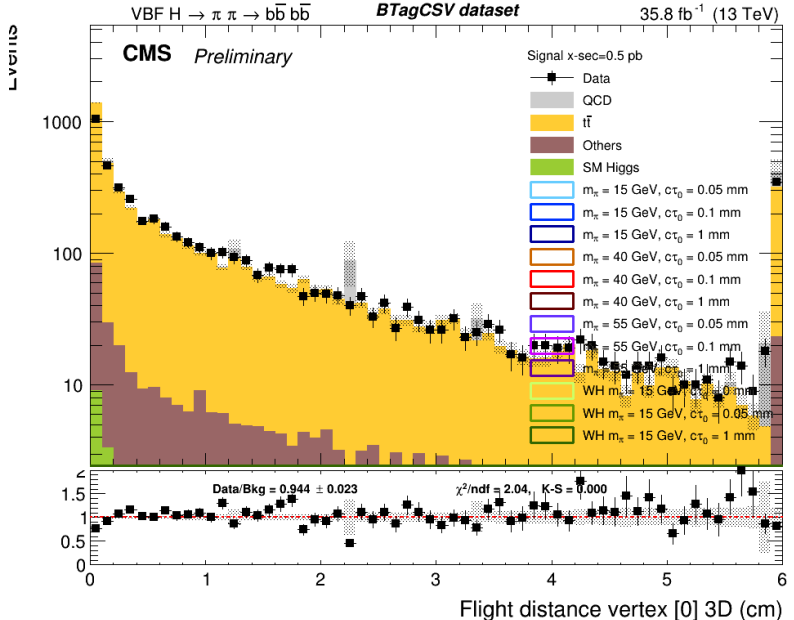
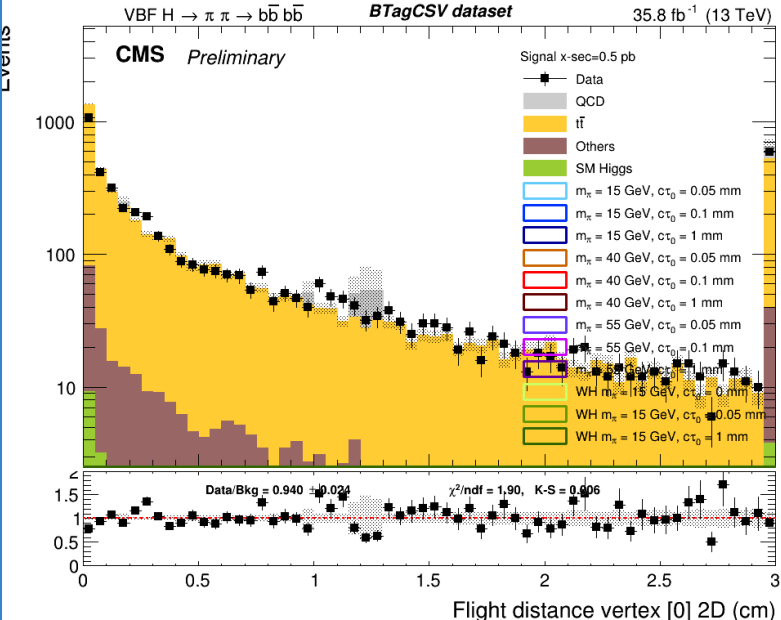
No isVBF requirement applied in general!



Trigger, b-tag and lepton corrections



Trigger, b-tag and lepton corrections



Trigger, b-tag and lepton corrections

