

# ttHbb Semi-Leptonic Fake-Leptons estimation

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# Status

- ttH: fake-leptonsのstudyをしている
  - triggeを追加
  - METの分布がおかしい  
→mumuのeventを持ってきてMETを確認してみた
  - pileup reweightingはこれから (muの分布確認中)
  
- ttH: 6j2bのstudyを今週中に進める
  
- QT: localでROSモニタリングコードを動かすためのデバッグ中
  - エラーの原因がISサーバーにアクセスするクラスにある。  
(local: ISサーバーを使わない⇔ヒストグラムやデータの管理が一緒のクラスで行われている)
  - Nickにメールして確認中

# Technical Information

## AnalysisTop-2-3-20 + TTHbbLeptonic-02-03-20-01

- GRL / GOODCALO
- TRIGDEC →
- LEP\_N == 1
- TRIGMATCH
- JET CLEAN LOOSEBAD

### **Trigger for 50ns**

- HLT\_e24\_lhmedium\_iloose\_L1EM20VH
- HLT\_e60\_lhmedium
- HLT\_mu20\_iloose\_L1MU15
- HLT\_mu50

### **Jet Object Selection**

- $p_T > 25\text{GeV}$
- $|\eta| < 2.5$
- $JVT > 0.64$  if  $[p_T < 50\text{GeV} \ \&\& \ |\eta| < 2.4]$
- AntiKt4TopoEM
- btagging MV2C20 77%OP.

### **Lepton Object Selection**

- $p_T > 25\text{GeV}$
- $|\eta| < 2.4$  && veto LAr-crack region
- $ID_{el} = \text{TightLH with isol.}$
- $ID_{el,loose} = \text{LooseLH w/o isol.}$
- $ID_{mu} = \text{Tight with isol.}$
- $ID_{mu,loose} = \text{Loose w/o isol.}$

# Dataset

## - mc15\_13TeV & DAOD\_TOPQ1 derivation -

■ **ttbar** 410000.PowhegPythiaEvtGen

nonallhad

■ **sg-top** 410011-14.PowhegPythiaEvtGen

Wt-ch + t-ch

■ **Wjets** 361100-05.PowhegPythia8EvtGen

enu + munu + taunu

└─> > *also prepare 361300-29,361333-71.Sherpa for MC-modeling*

■ **Zjets** 361106-08.PowhegPythia8EvtGen

ee + mumu + tautau

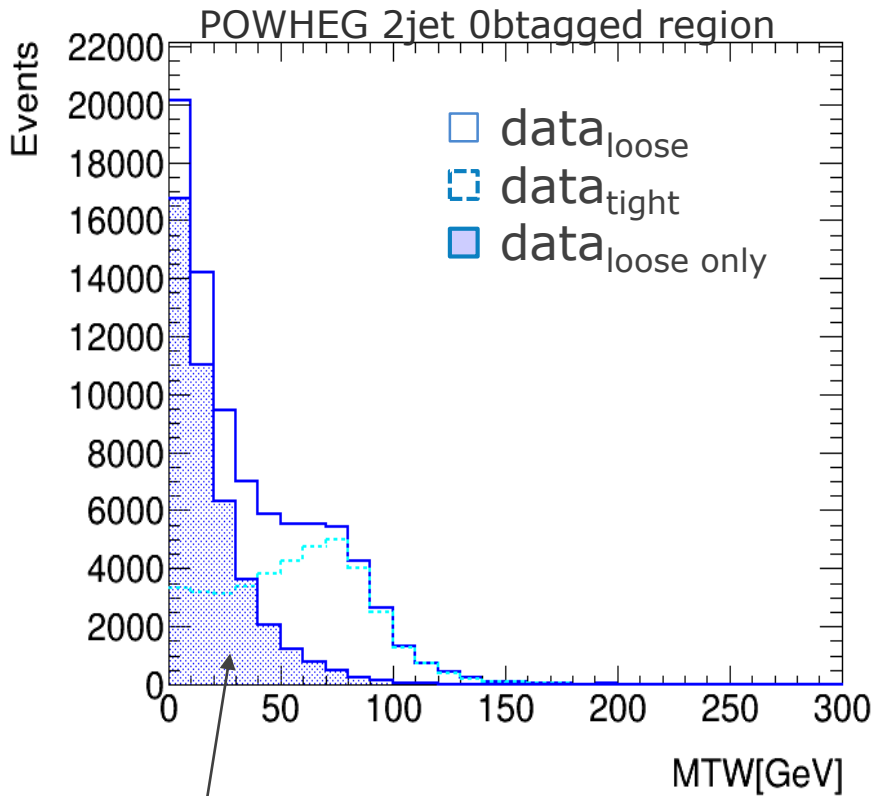
## - data15\_13TeV & DAOD\_TOPQ1 derivation -

■ **periodA-C ( $\sim 85 \text{ pb}^{-1}$ )** 00266904-00272531

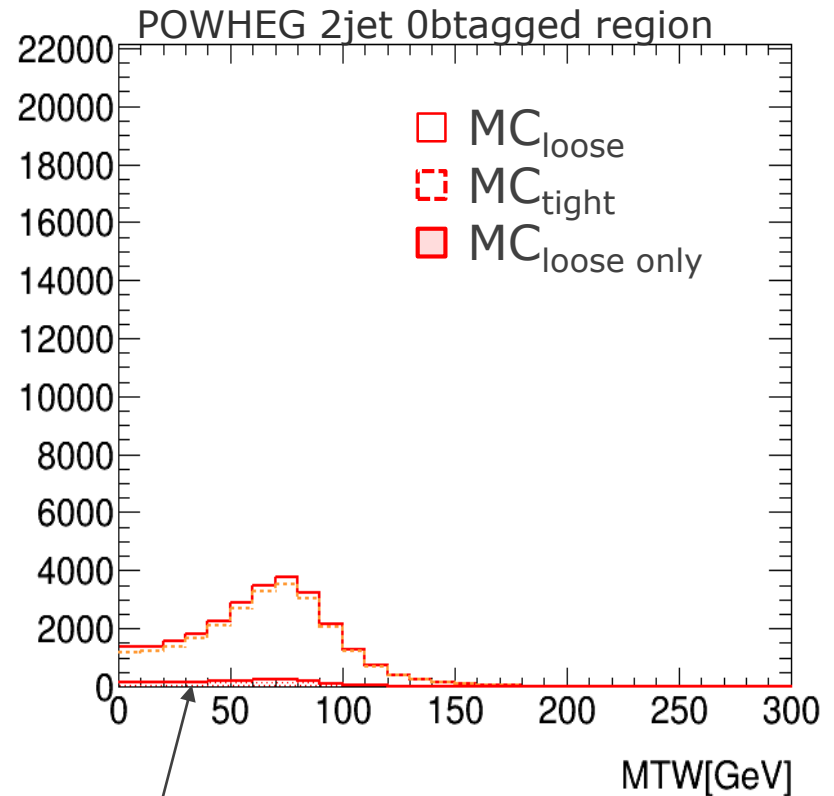
# Fake-Lepton Template

Using MTW distribution for each jetbin and bjetbin

$$\text{fake-lepton}_{\text{template}} = \text{data}_{\text{loose only}} - \text{MC}_{\text{loose only}}$$



$$\text{data}_{\text{loose only}} = \text{data}_{\text{loose}} - \text{data}_{\text{tight}}$$



$$\text{MC}_{\text{loose only}} = \text{MC}_{\text{loose}} - \text{MC}_{\text{tight}}$$

# Fake-Lepton and Wjets SF

Chi-square bin-by-bin fitting

$SF_{Wjets} \times Wjets_{tight} + SF_{fake} \times fake_{template}$  to

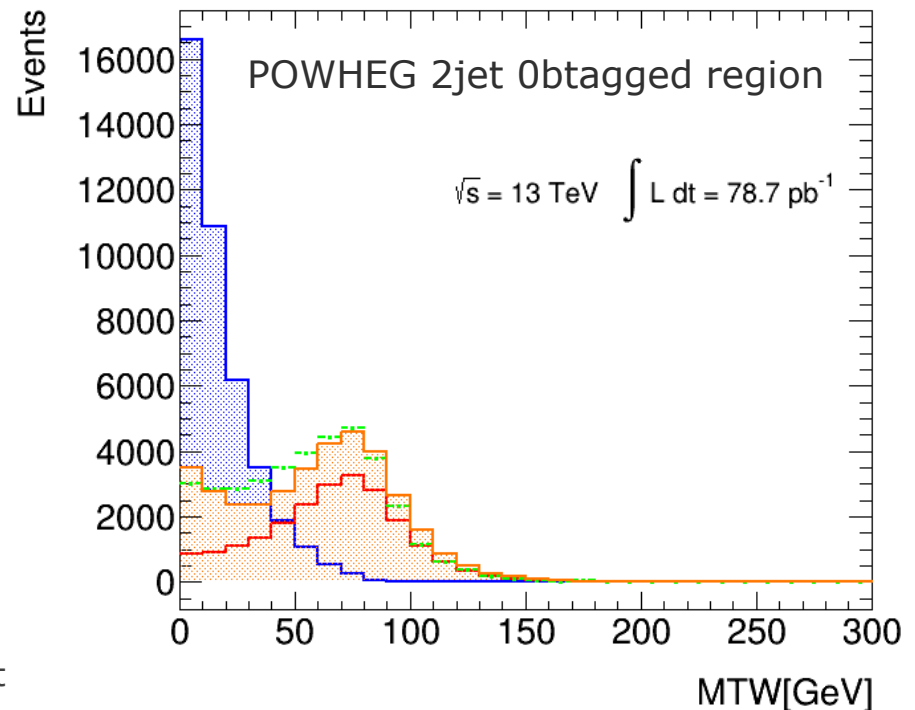
$data-MC(\text{but not } Wjets)_{tight} : data(fake+Wjets)$  using TMinuit

■  $fake_{template}$

■  $Wjets_{tight}$

■  $data-MC(\text{but not } Wjets)_{tight}$

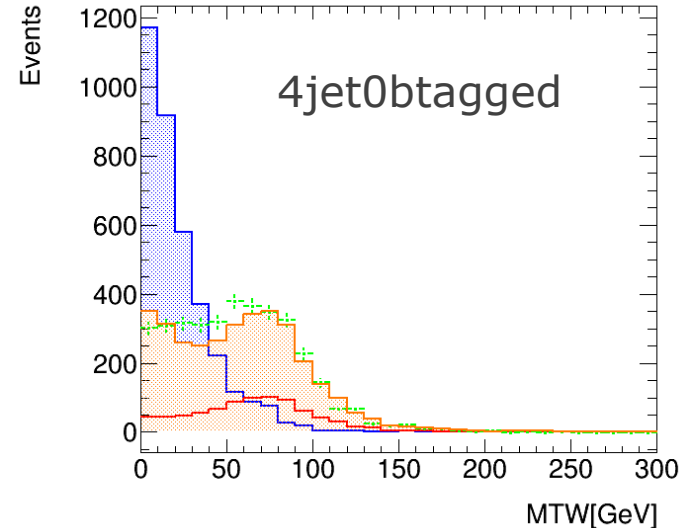
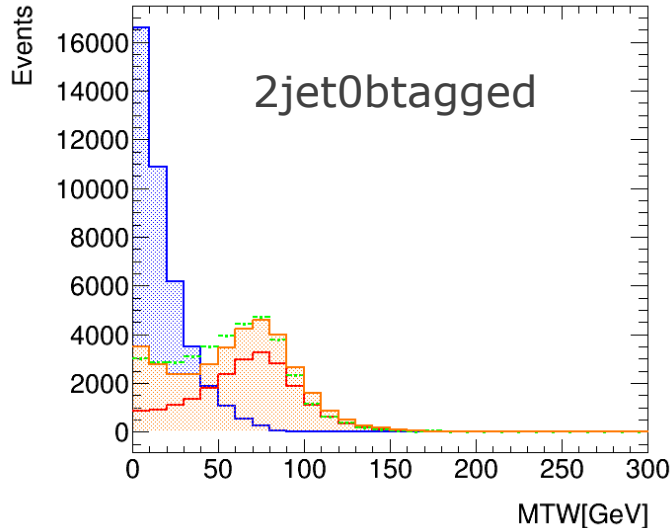
■  $1.404 \times Wjets_{tight} + 0.137 \times fake_{template}$



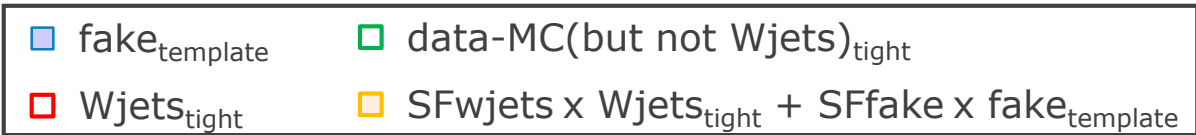
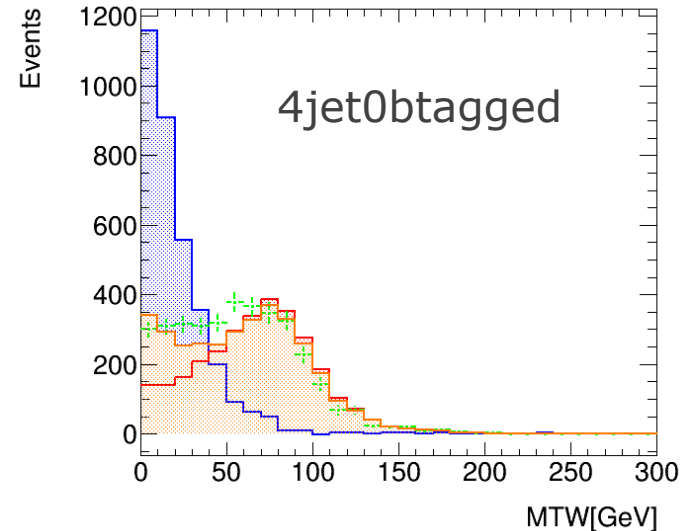
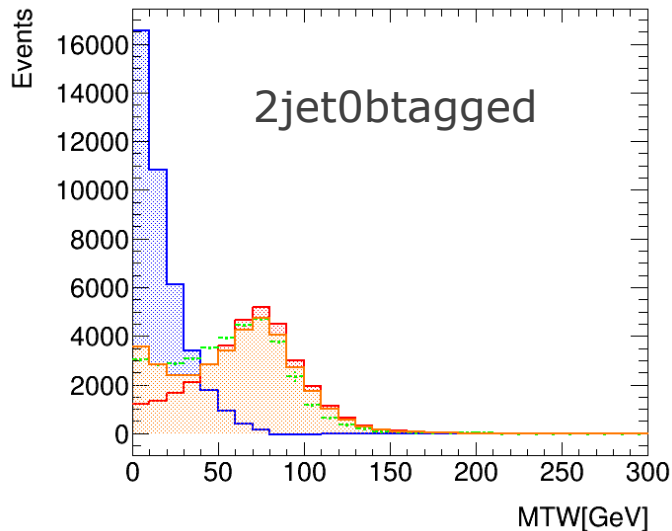
# MTW Distributions for SFs

mu-ch

Powheg  
Pythia



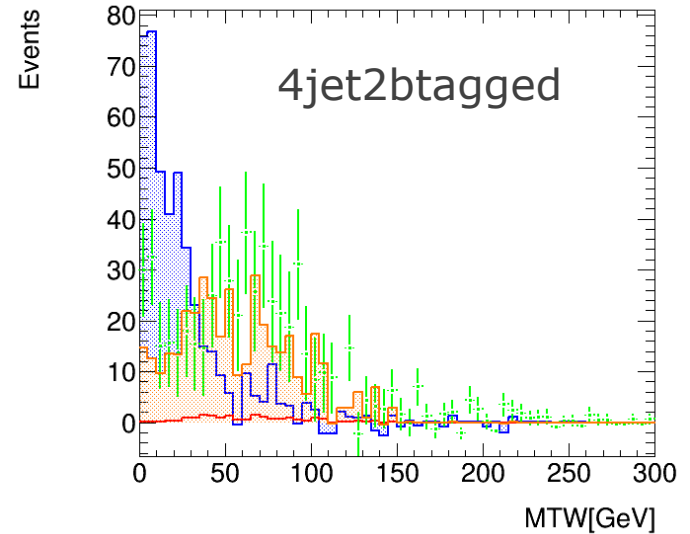
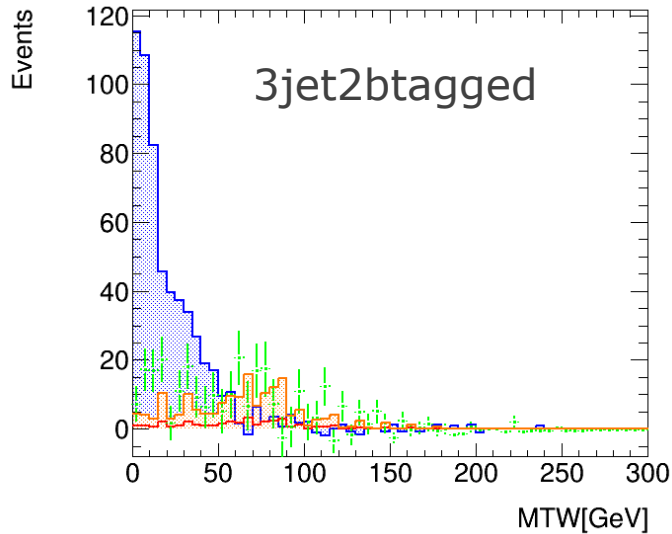
Sherpa



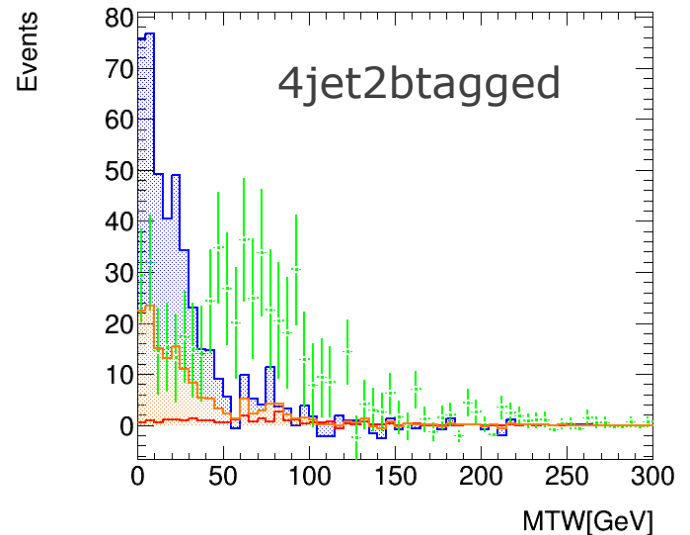
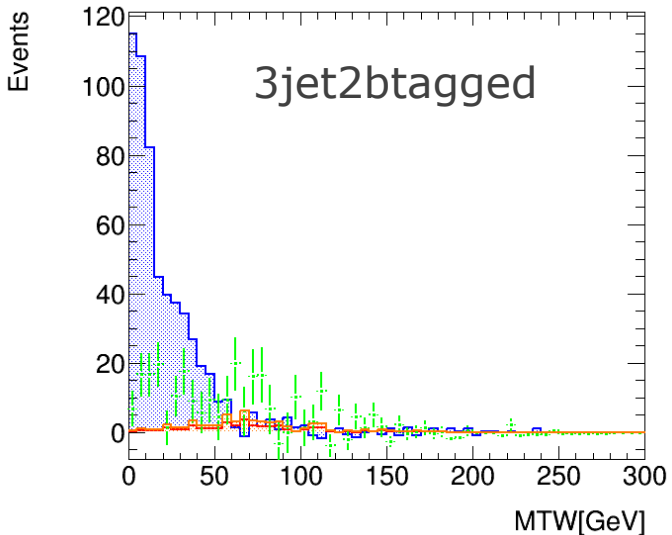
# MTW Distributions for SFs

mu-ch

Powheg  
Pythia



Sherpa



Due to the low statistics with 2btagged region,  
W peak are not and SFs are not reliable... :



# Determined SFs

muon ch only w/o trigger  
(electron ch is now in going)

## PowhegPythia

Jetbin	bjetbin	SF in fake	SF in Wj
0	0	0.173	0.919
1	0	0.165	0.950
1	1	0.103	1.159
2	0	0.137	1.523
2	1	0.100	1.968
2	2	0.008	3.331
3	0	0.149	2.331
3	1	0.074	3.200
3	2 incl.	$1.23 \times 10^{-9}$	4.931
4 incl.	0	0.175	3.631
4 incl.	1	0.119	5.150
4 incl.	2 incl.	0.142	18.380

## Sherpa

Jetbin	bjetbin	SF in fake	SF in Wj
0	0	0.152	1.011
1	0	0.159	1.017
1	1	0.100	1.567
2	0	0.145	1.069
2	1	0.100	1.618
2	2	0.058	1,226
3	0	0.165	1.054
3	1	0.073	1.590
3	2 incl.	0.015	2.271
4 incl.	0	0.177	1.103
4 incl.	1	0.139	1.355
4 incl.	2 incl.	0.336	3.735

SF of the Wjets increases at higher jet multiplicity events in POWHEG. This must be because of POWHEG mis-modeling.

# Determined SFs with Trigger

## Sherpa w/o trigger

## Sherpa with trigger

Jetbin	bjetbin	SF in fake	SF in Wj
0	0	0.152	1.011
1	0	0.159	1.017
1	1	0.100	1.567
2	0	0.145	1.069
2	1	0.100	1.618
2	2	0.058	1,226
3	0	0.165	1.054
3	1	0.073	1.590
3	2 incl.	0.015	2.271
4 incl.	0	0.177	1.103
4 incl.	1	0.139	1.355
4 incl.	2 incl.	0.336	3.735

#jets	#btags	lepton	fake SFs	wjets SFs
inclusive		mujets	0.151661	0.961206
0	0btag	mujets	0.152575	0.96018
1	0btag	mujets	0.168198	0.932575
1	1btag	mujets	0.105965	1.3507
2	0btag	mujets	0.145721	0.969178
2	1btag	mujets	0.110329	1.3155
2	2btag	mujets	0.098742	2.33265e-07
3	0btag	mujets	0.175302	0.911054
3	1btag	mujets	0.0976796	1.1444
3	2btag	mujets	1.22714e-08	1.69949e-09
4	0btag	mujets	0.202462	0.895054
4	1btag	mujets	0.147982	0.48877
4	2btag	mujets	1.84637e-08	7.12659e-10

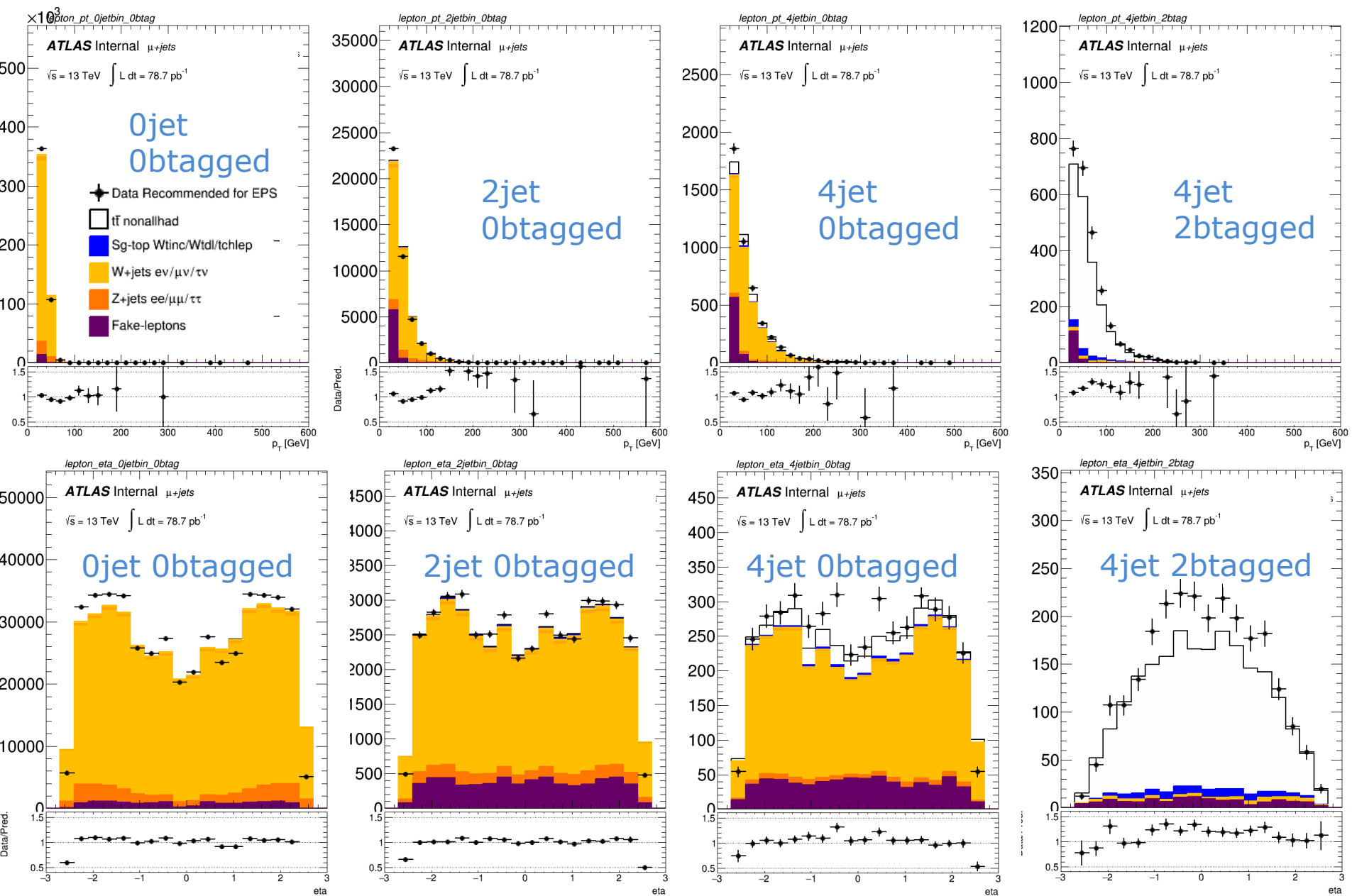
WjetsのSFが1に近づいた。

2btagged領域では全くうまくfitできなくなった。

: 統計が増えるのを待つ・MMでの見積もりをやってみる

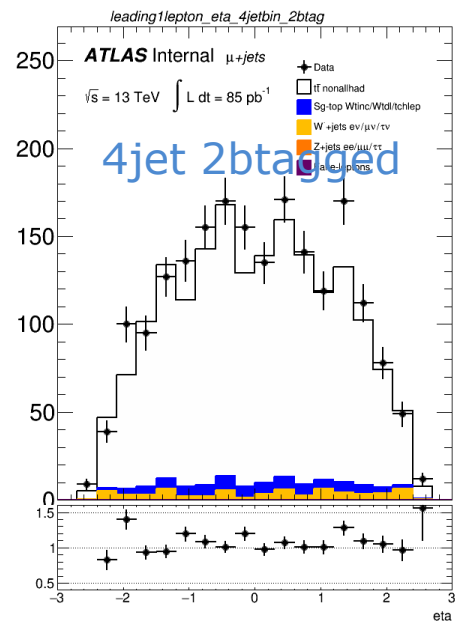
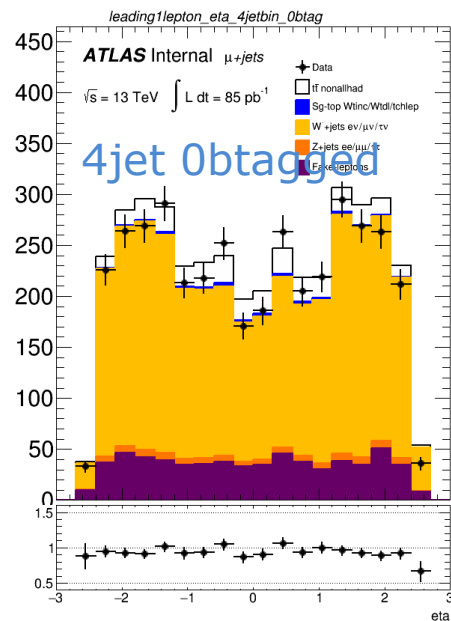
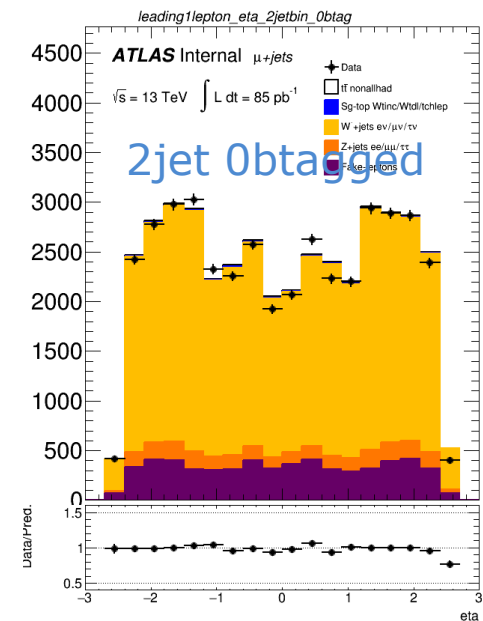
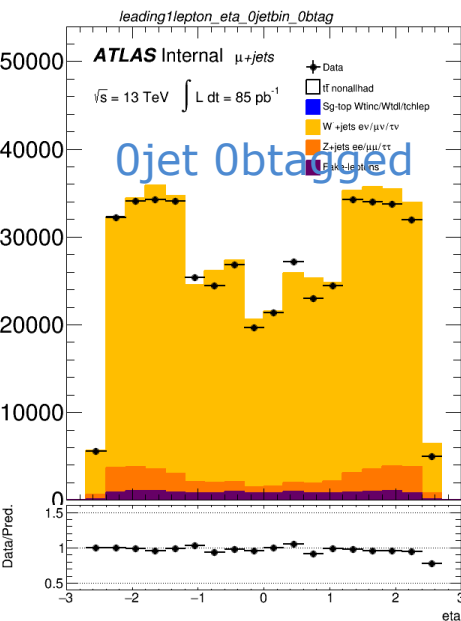
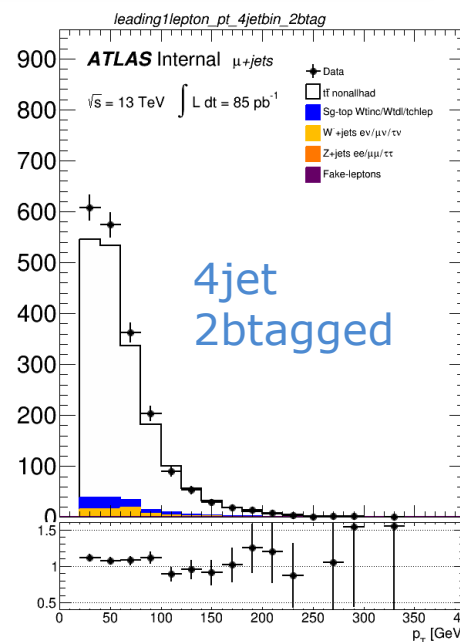
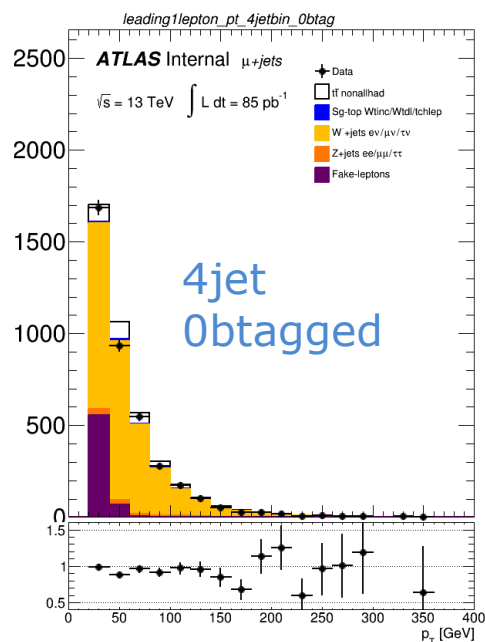
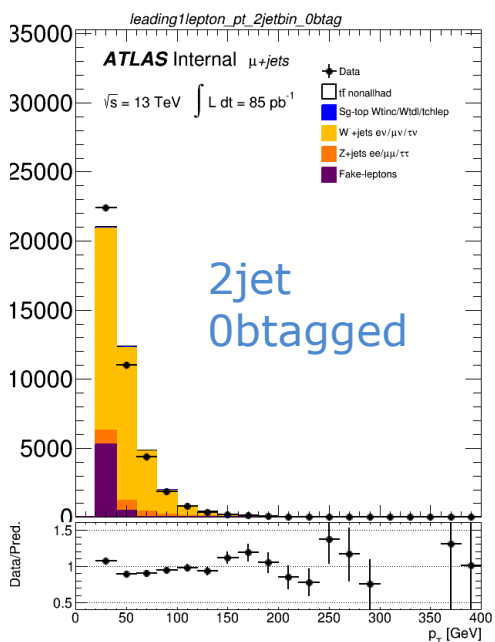
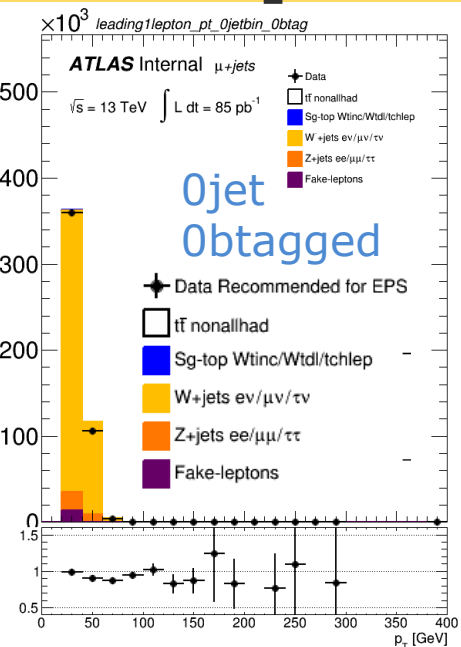
# MC-Data Comparison with SF<sub>fake</sub> only lepton w/o trig.

mu-ch, Wmunu:Sherpa  
weight = lep\*bttag\*mc



# MC-Data Comparison with SF<sub>fake</sub> only lepton w/ trig.

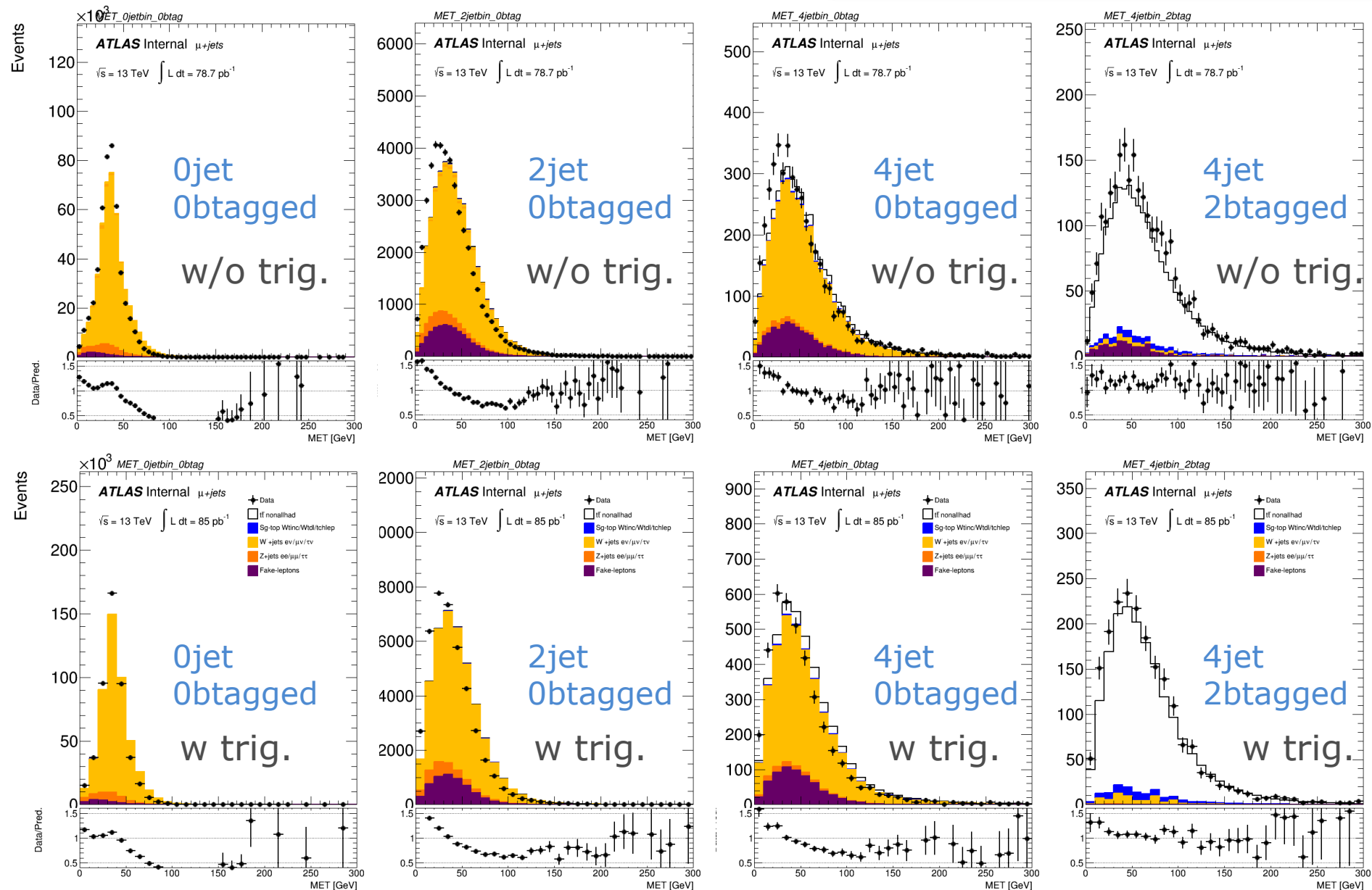
**mu-ch, Wmunu:Sherpa**  
weight = lep\*bttag\*mc



# MET

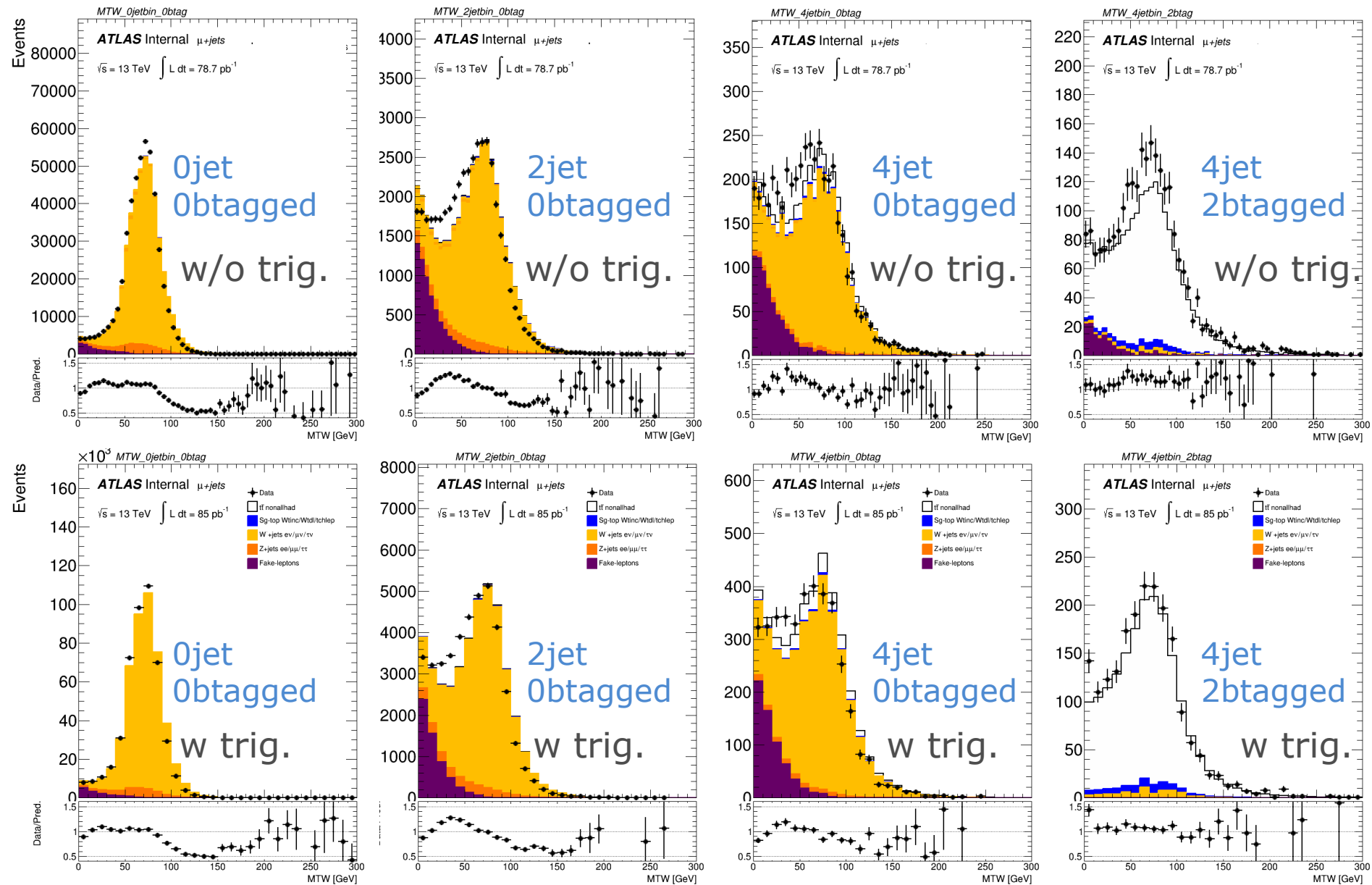
data/pred.にスロープがある  
→low METの一致が特に悪い

mu-ch, Wmunu:Sherpa  
weight = lep\*bttag\*mc



# MTW

mu-ch, Wmunu:Sherpa  
weight = lep\*bttag\*mc



# Di-leptonic Selection

## Using Top-Physics Recommendation (default in AnalysisTop)

- GRL / GOODCALO
- TRIGDEC →
- LEP\_N  $\geq 2$
- TRIGMATCH
- JET CLEAN LOOSEBAD

### **Trigger for 50ns: same as semilep**

- HLT\_e24\_lhmedium\_loose\_L1EM20VH
- HLT\_e60\_lhmedium
- HLT\_mu20\_loose\_L1MU15
- HLT\_mu50

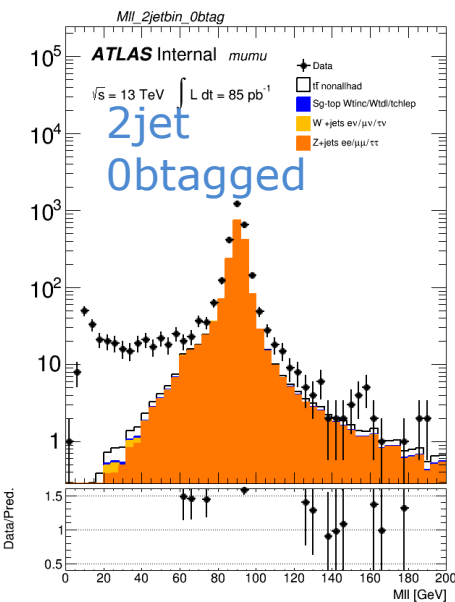
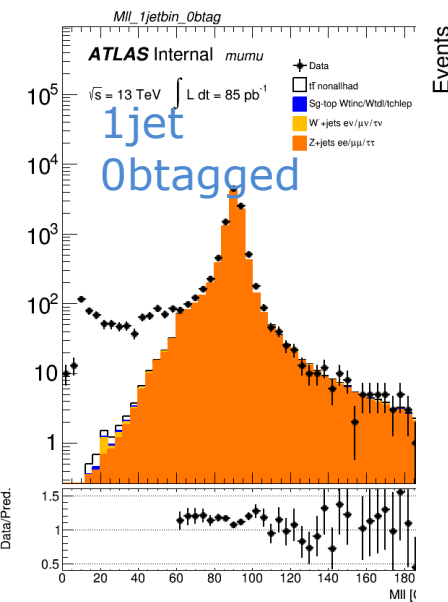
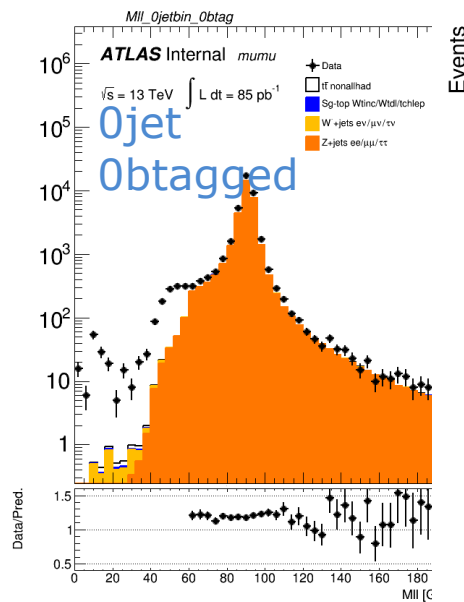
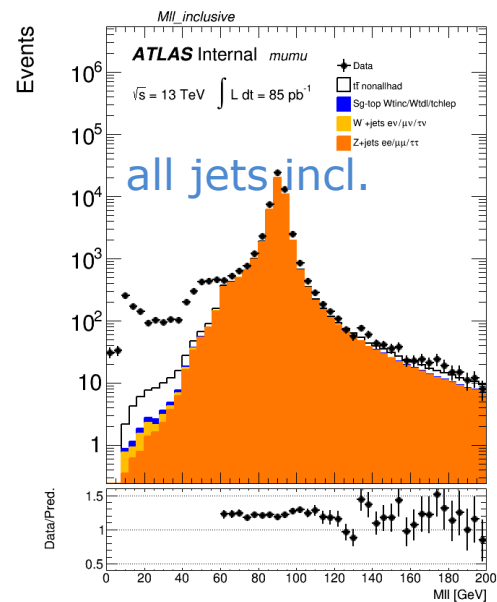
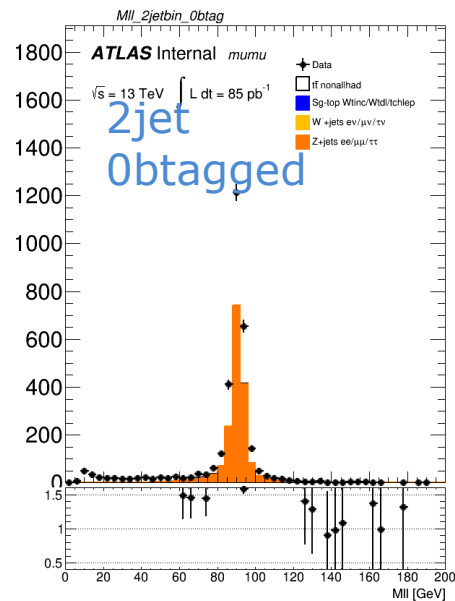
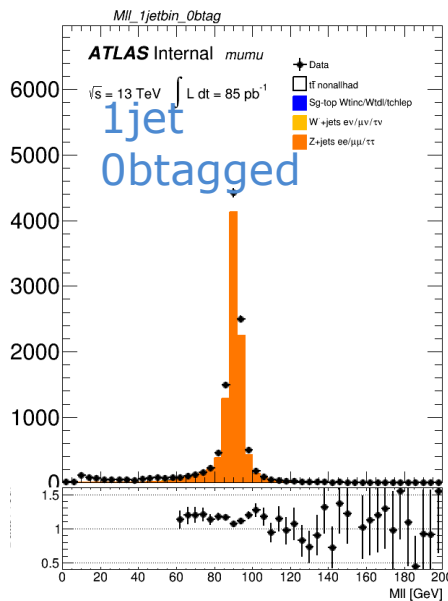
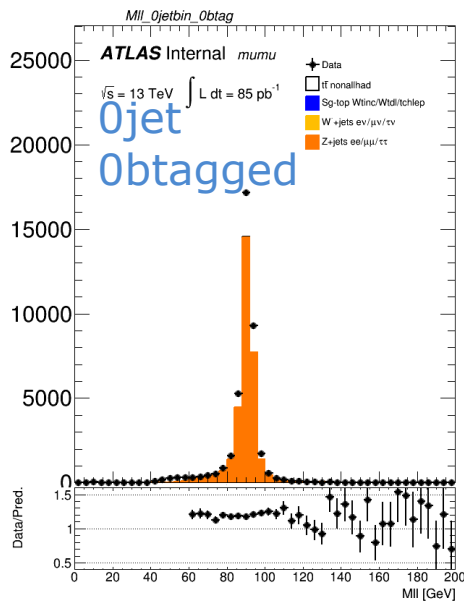
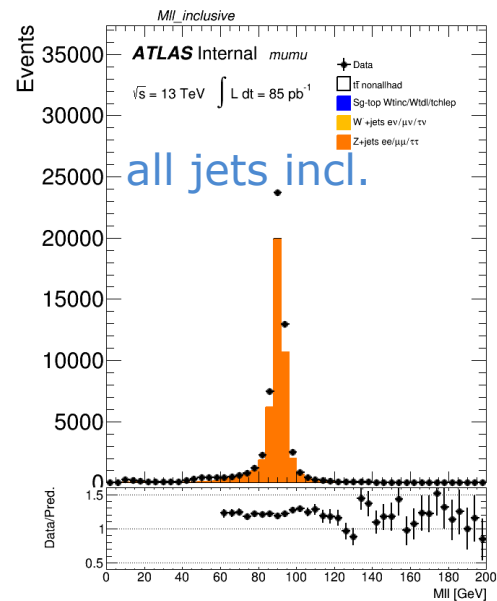
### **Jet Object Selection**

- $p_T > 25\text{GeV}$
- $|\eta| < 2.5$
- $JVT > 0.64$  if  $[p_T < 50\text{GeV} \ \&\& \ |\eta| < 2.4]$
- AntiKt4TopoEM
- btagging MV2C20 77%OP.

### **Lepton Object Selection**

- leading  $p_T > 25\text{GeV}$
- sub-leading  $p_T > 15\text{GeV}$
- $|\eta| < 2.4$  && veto LAr-crack region
- $ID_{el} = \text{TightLH with isol.}$
- $ID_{el,loose} = \text{LooseLH w/o isol.}$
- $ID_{\mu} = \text{Tight with isol.}$
- $ID_{\mu,loose} = \text{Loose w/o isol.}$

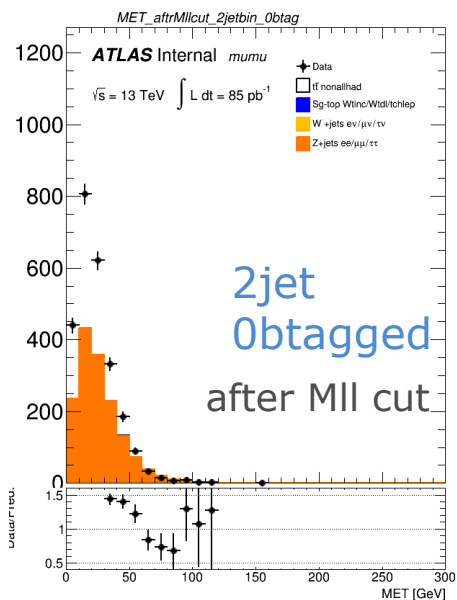
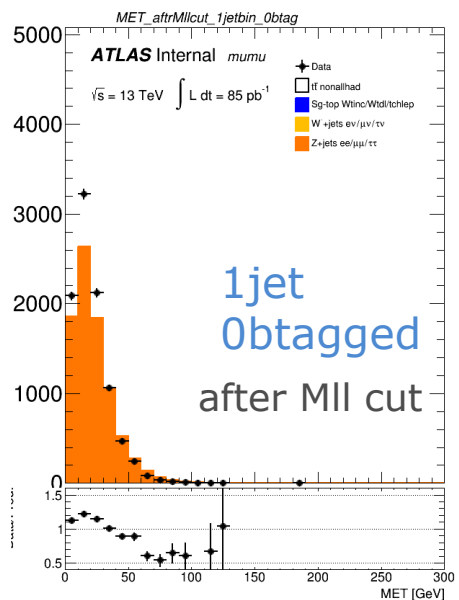
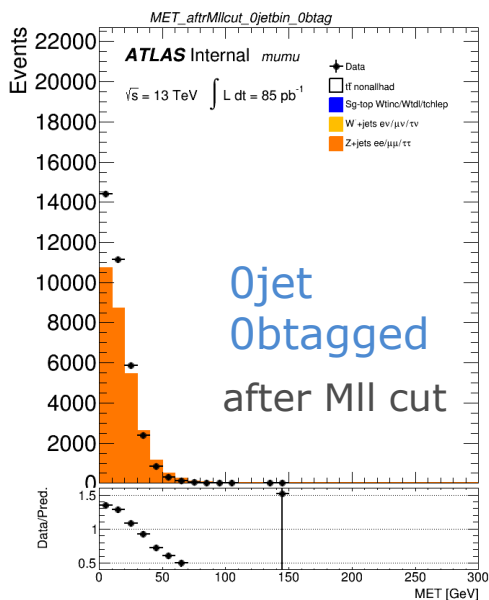
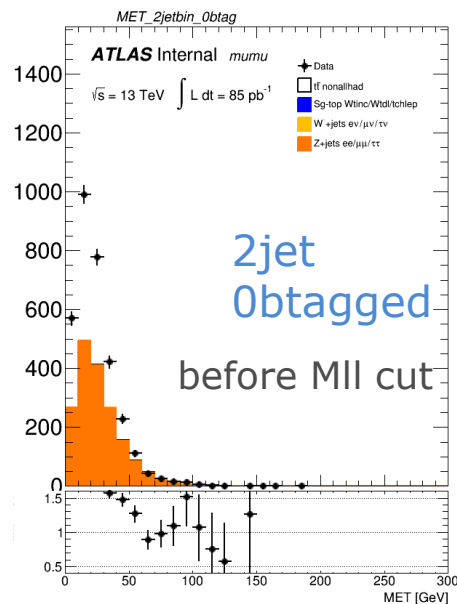
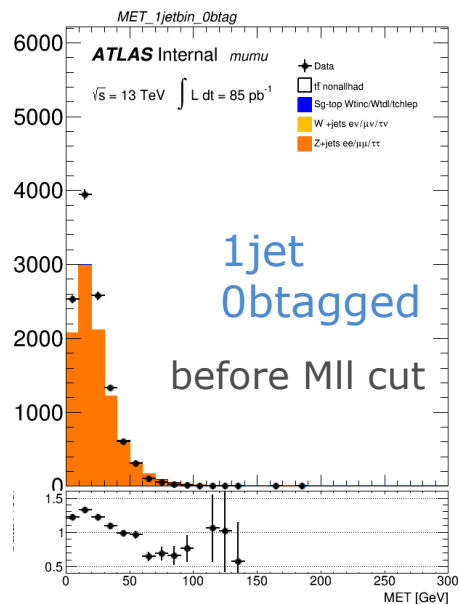
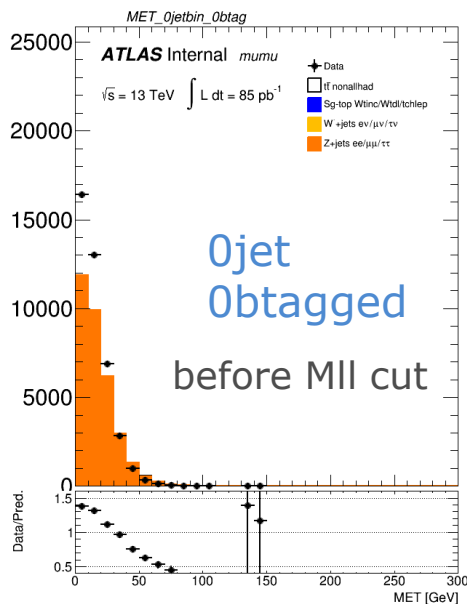
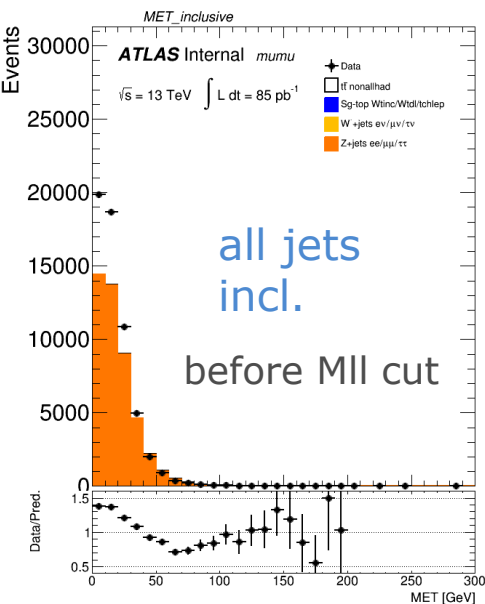
- processed with / without  $M_{ll} = 80 \sim 100\text{GeV}$





# MET w/ tirtg.

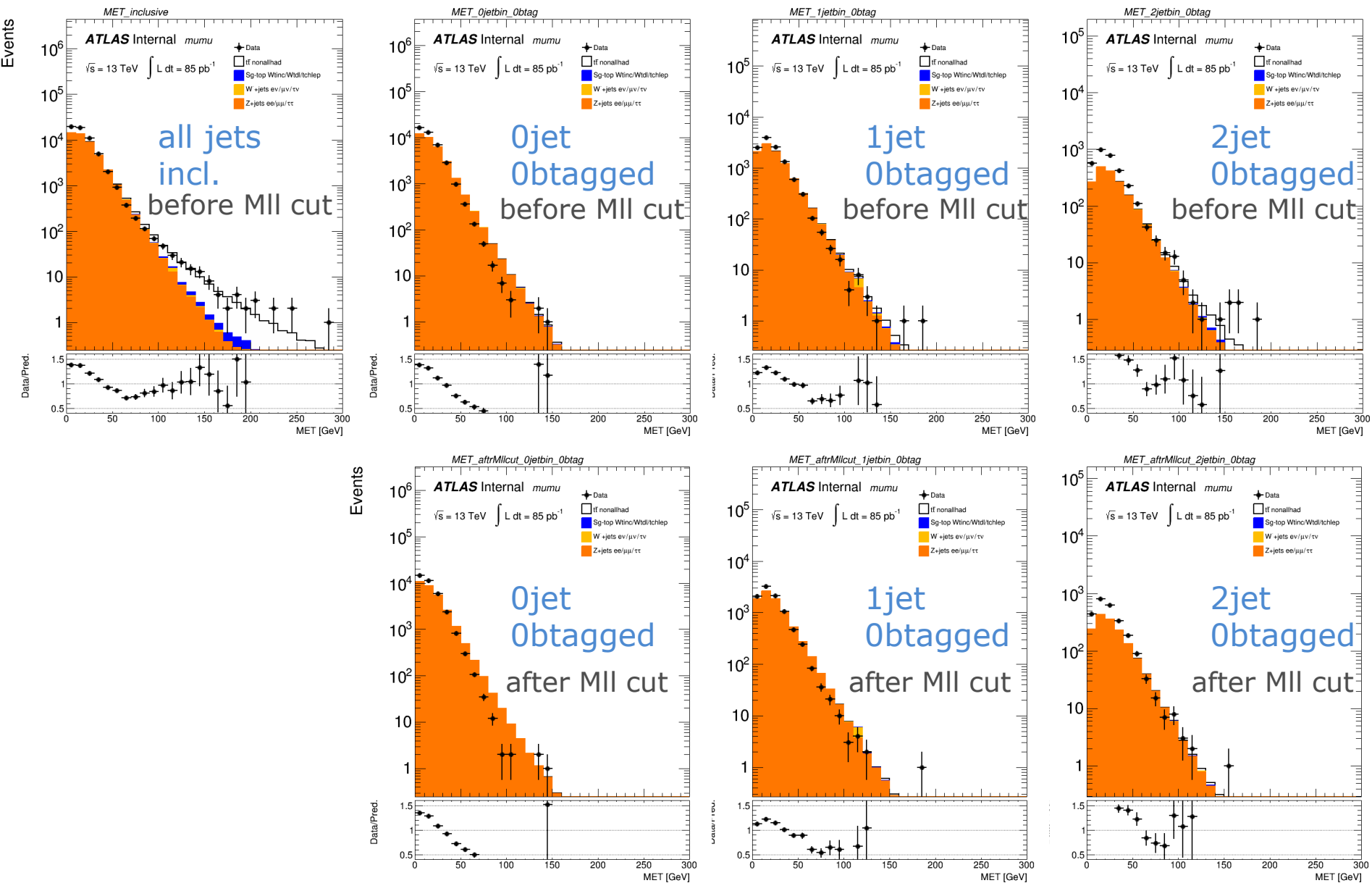
mu-ch, Wmunu:Sherpa  
weight = lep\*bttag\*mc



METスロープある

# MET w/ tirtg.

mu-ch, Wmunu:Sherpa  
weight = lep\*btarg\*mc



# Summary

- **tthbb needs looser signal-region**  
⇒ **looser fake estimation are needed.**
- **Good agreement of MC/data as first comparison with fake(QCD) estimate.**
  - Fakes were estimated using the MTW simply.
  - Electron channel analysis is now in going.
  - It is better to use Sherpa or multi-leg generators for Wjets-MC.
  - MET has a slope in the Data/MC ratio.
    - MET recalculation = "FinalTrk" (using PVSoftTrkCore)