Top Partner Search

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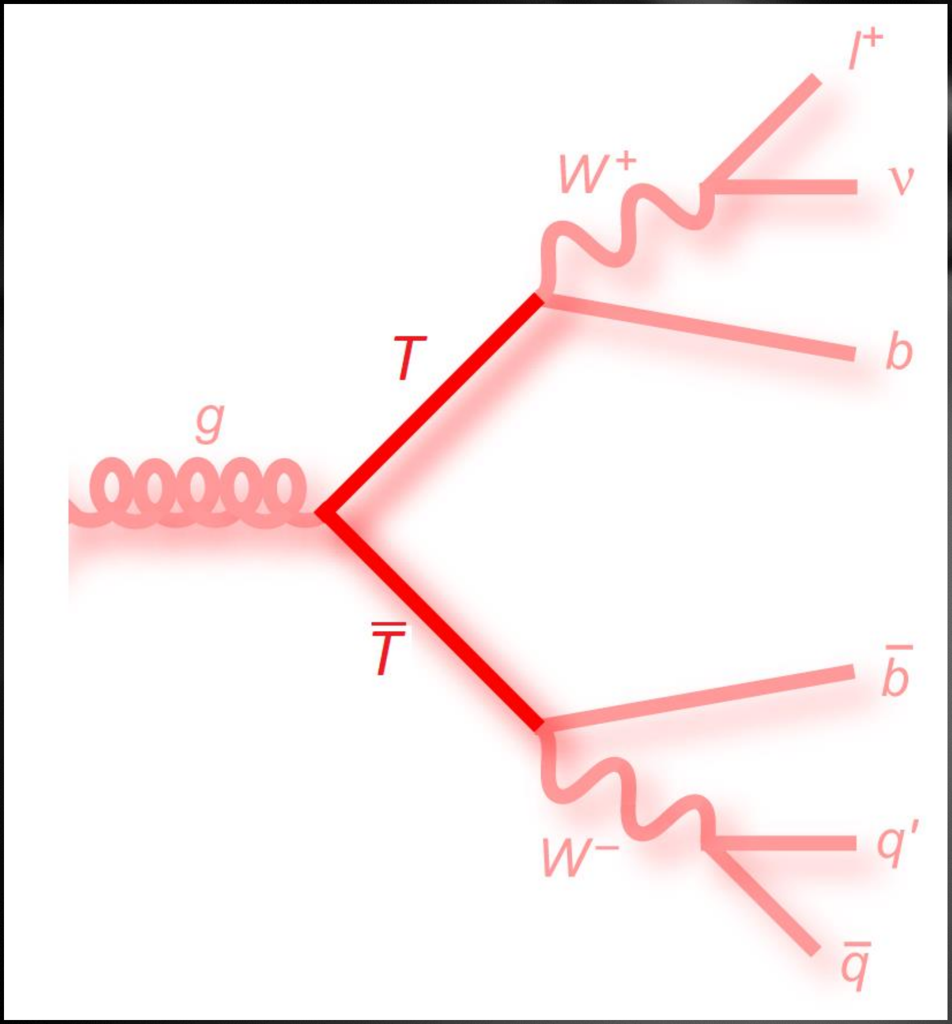
T→Wb @13 TeV

Background Samples:

- $t\bar{t}$
- W + jets
- Z + jets
- Singletop

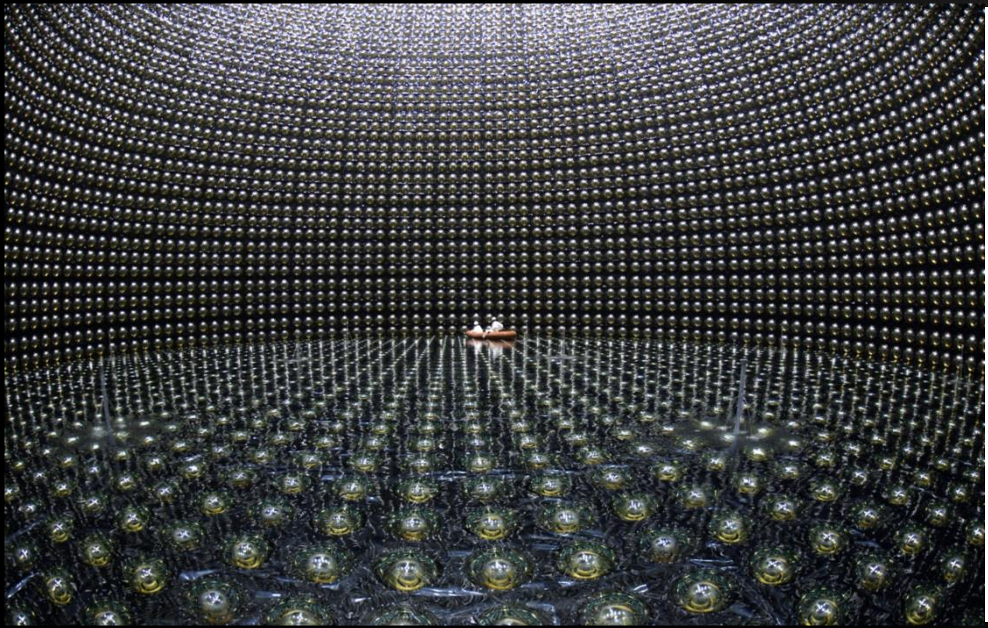
Signal Samples:

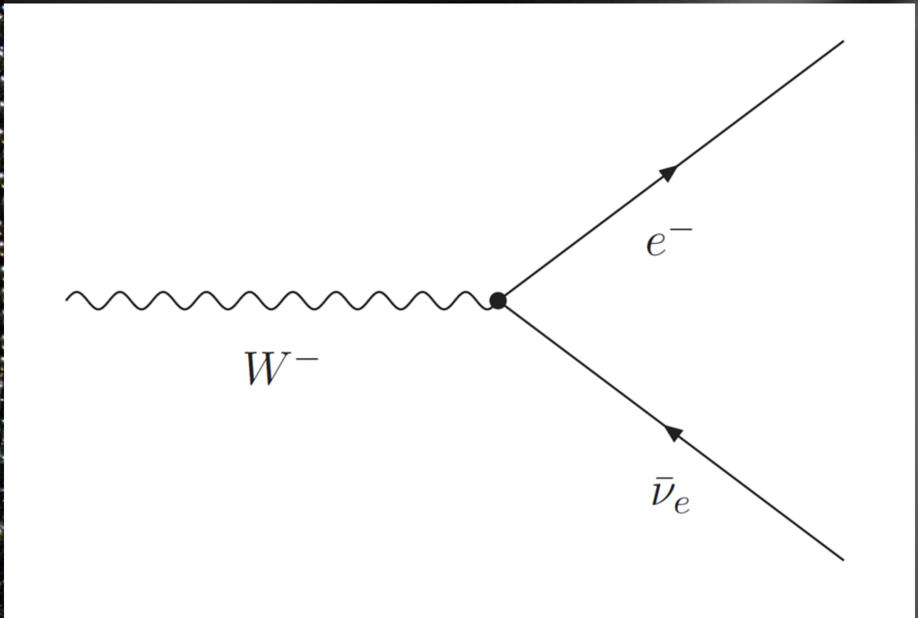
- 700 GeV
- 900 GeV
- 1100 GeV



Neutrino Reconstruction

Neutrinos can't be detected by the ATLAS detector, but we can still piece them back together





Reconstruction Equations

$$p_x = p_T \cos\phi$$
$$p_y = p_T \sin\phi$$
$$\mu = \frac{{M_W}^2}{2} + p_{x,\nu} p_{x,l} + p_{y,\nu} p_{y,l}$$
$$a = \frac{\mu p_{z,l}}{{E_l}^2 - {p_{z,l}}^2}$$
$$b = \frac{{E_l}^2 E_{T,miss}^2 - \mu^2}{{E_l}^2 - {p_{z,l}}^2}$$
$$p_{z,\nu} = a \pm \sqrt{a^2 - b}$$

With MET, MET Phi, lepton information and what we know about the W boson, reconstruct the undetected Neutrino.

Currently analyzing six different methods to handle the case where the neutrino solution(s) is/are complex.

Compare how their reconstructions compare with truth

Reconstruction Methods

"Real Only": $p_{z,\nu} = \mathrm{Re}\left(a \pm \sqrt{a^2 - b}\right)$

"Colinear": $\eta_\nu = \eta_l \mid \phi_\nu = \phi_l$

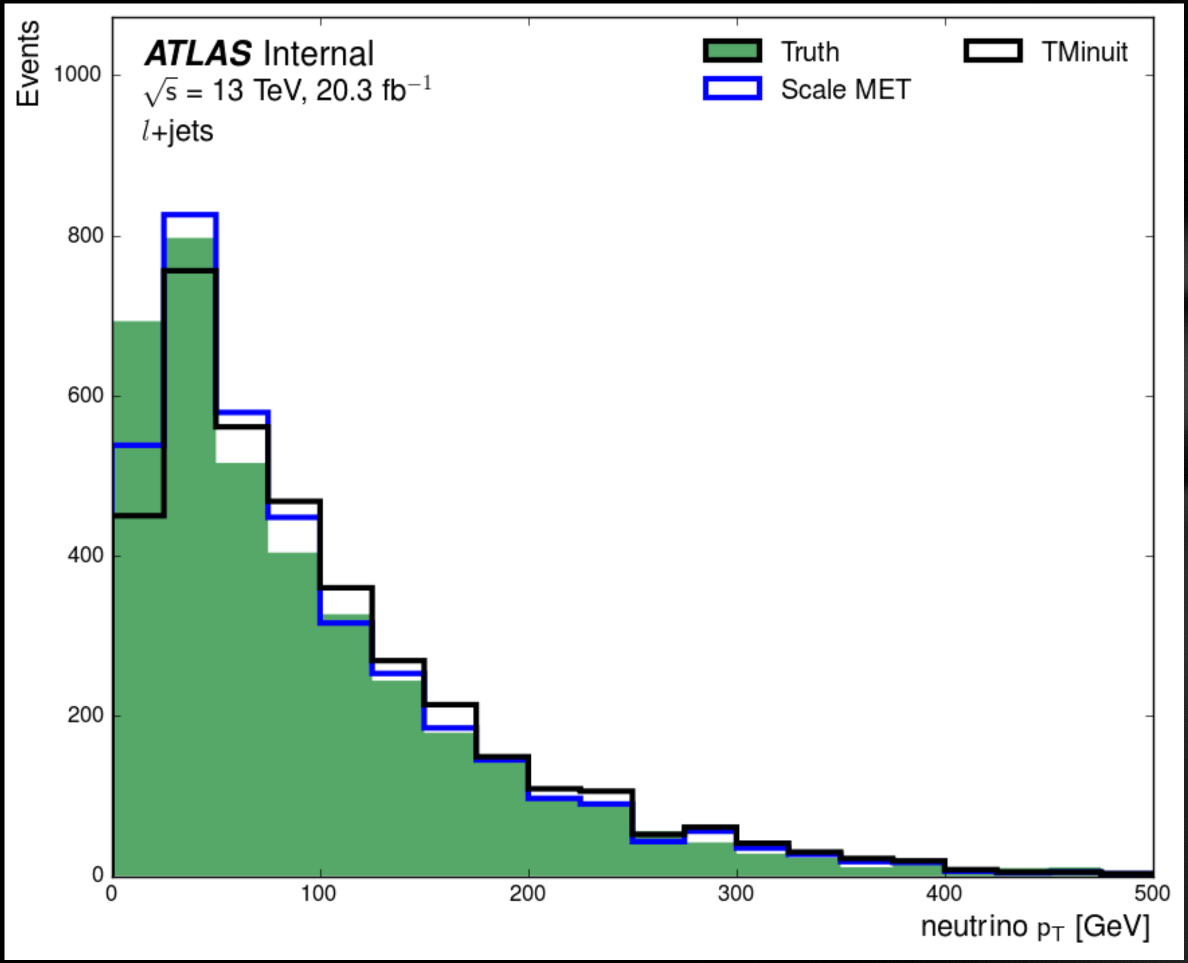
"modColinear": $\eta_\nu = \eta_l \mid \phi_\nu = \phi_{miss}$

"TMinuit": Scale back $E_{T,miss}$ with TMinuit. The goal is to minimize difference between reconstructed M_W and standard M_W.

"Rotation": Rotate ϕ_{miss} until the solution is real.

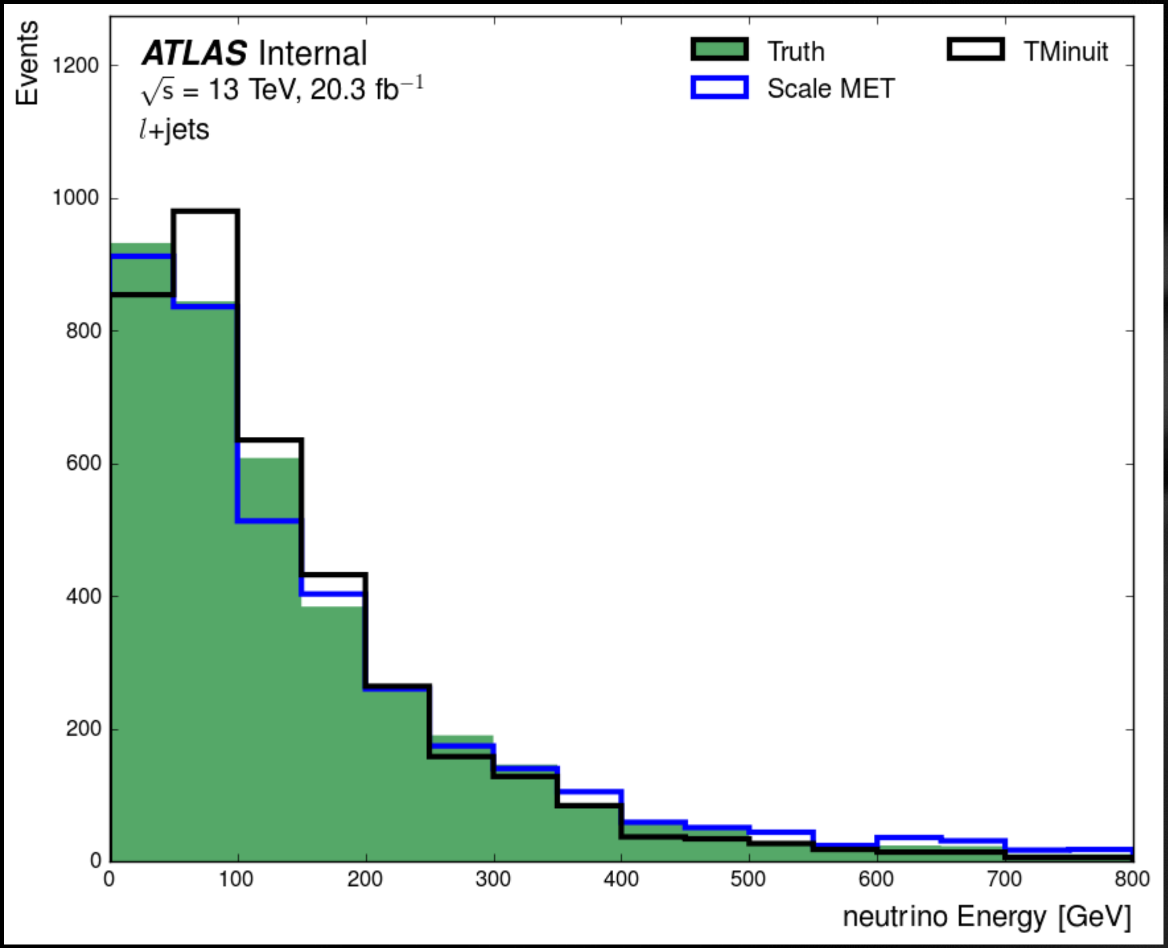
"scaleMET": Scale back $E_{T,miss}$ until the solution is real.

Neutrino Pt Distribution



Resolution		
Reco	Mean	Std Dev
scaleMET	3.68	62.98
TMinuit	12.31	85.75

Neutrino Energy Distribution



Resolution		
Reco	Mean	Std Dev
scaleMET	27.65	197.74
TMinuit	-10.21	152.19

Conclusions

- TMinuit and scaleMET are the best reconstruction methods
- Neither clearly superior with respect to distance from truth
- Choose TMinuit since it is a faster method

Cut Optimization

How do we choose our events?

Goal is to create "Signal Region":

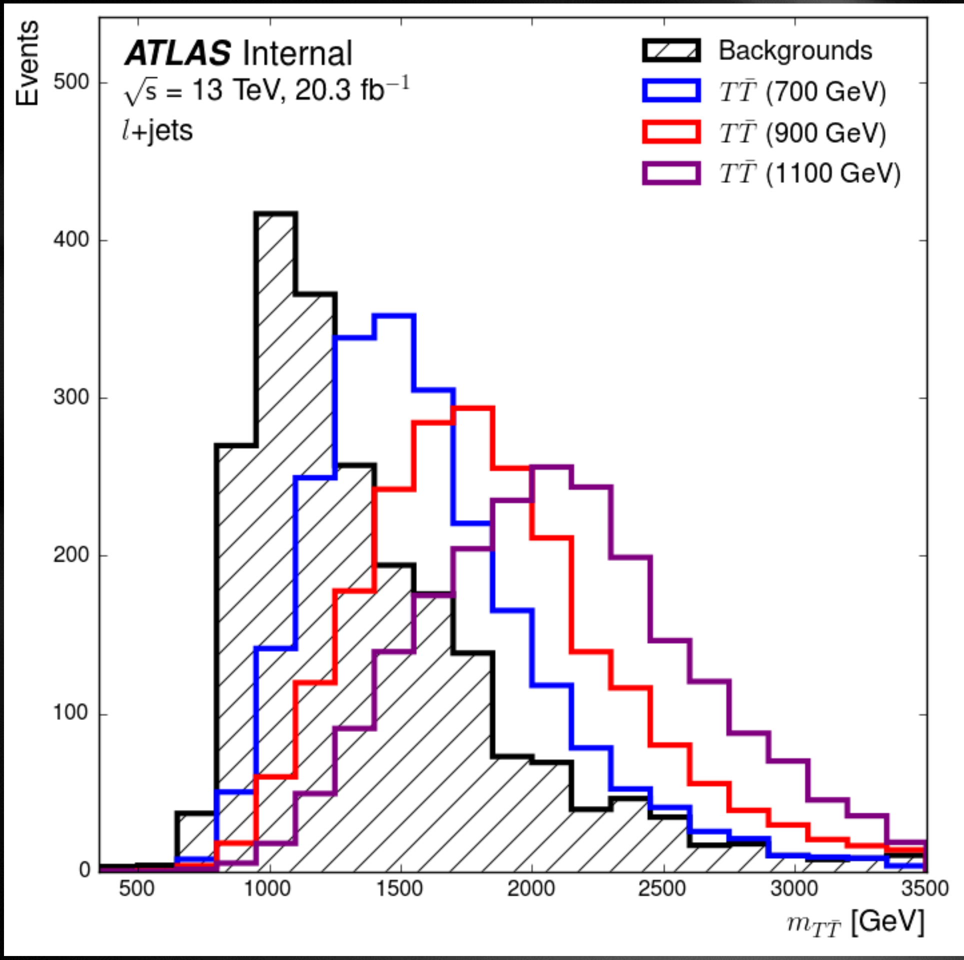
- Signal: $T\bar{T}$ events
- Background: non- $T\bar{T}$ events that pass selection.
- Make sure background doesn't drown out signal

Maximize Significance

Minimize Statistical Uncertainty

$$\Sigma^2 = \frac{{Y_S}^2}{Y_S + Y_B}$$

(Significance Eqn)



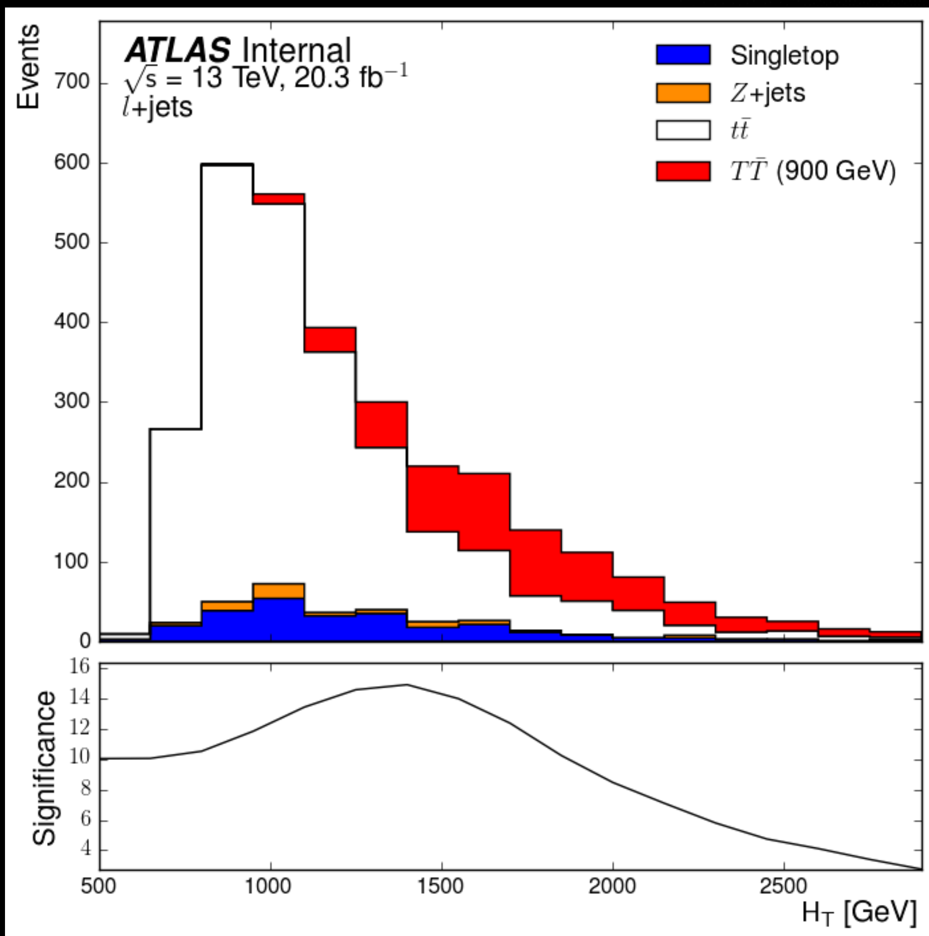
8 TeV Cuts

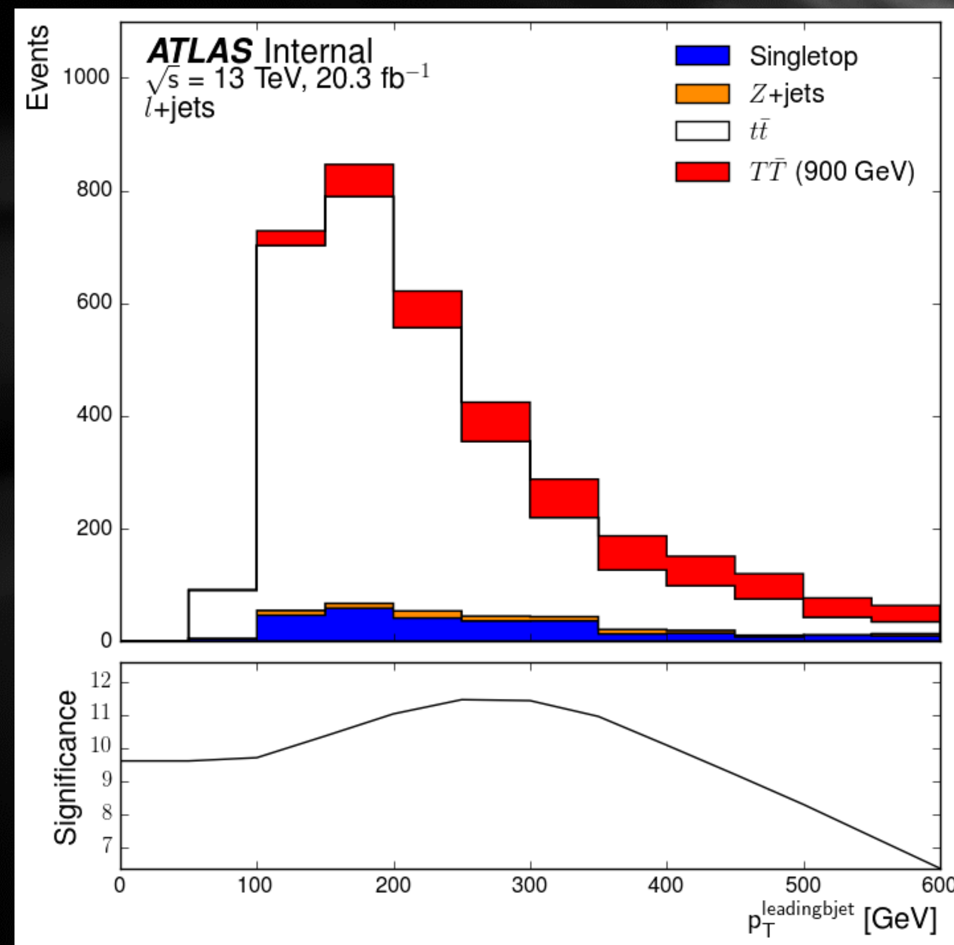
Table 3: Summary of event selection requirements for this analysis.

Selection	Requirements
Preselection	One electron or muon
	$E_{\mathrm{T}}^{\mathrm{miss}} > 20$ GeV, $E_{\mathrm{T}}^{\mathrm{miss}} + m_{\mathrm{T}} > 60$ GeV
	≥ 4 jets, ≥ 1 b-tagged jets
loose selection	Preselection
	≥ 1 W_{had} candidates
	$H_{\mathrm{T}} > 800$ GeV
	$p_{\mathrm{T}}(b_1) > 160$ GeV, $p_{\mathrm{T}}(b_2) > 110$ GeV (type I) or $p_{\mathrm{T}}(b_2) > 80$ GeV (type II)
	$\Delta R(\ell, \nu) < 0.8$ (type I) or $\Delta R(\ell, \nu) < 1.2$ (type II)
tight selection	*loose* selection
	$\min(\Delta R(\ell, b_{1,2})) > 1.4$, $\min(\Delta R(W_{\mathrm{had}}, b_{1,2})) > 1.4$
	$\Delta R(b_1, b_2) > 1.0$ (type I) or $\Delta R(b_1, b_2) > 0.8$ (type II)
	$\lvert m_{\mathrm{reco}}^{\mathrm{lep}} - m_{\mathrm{reco}}^{\mathrm{had}} \rvert < 250$ GeV (type I)

Linear Method

- "N-1" approach, perform all cuts except for the one being plotted
- Analyze significance curve





TMVA Method

- Optimize several different cuts at once.
- Iterates through different levels of signal efficiency and measures significance.

```
--- CutsGA                   : -------------------------------------------------
--- CutsGA                   : Cut values for requested signal efficiency: 0.91
--- CutsGA                   : Corresponding background efficiency       : 0.219705
--- CutsGA                   : Transformation applied to input variables : None
--- CutsGA                   : -------------------------------------------------
--- CutsGA                   : Cut[ 0]:   0.0557273 < DeltaR_lepnu <=     3.06343
--- CutsGA                   : Cut[ 1]:      626159 <            HT <= 1.63625e+07
--- CutsGA                   : Cut[ 2]:       34421 <   bjet_pt[0] <= 1.44751e+06
--- CutsGA                   : Cut[ 3]:     18377.4 <   bjet_pt[1] <= 1.00036e+06
--- CutsGA                   : -------------------------------------------------
--- CutsGA                   : -------------------------------------------------
--- CutsGA                   : Cut values for requested signal efficiency: 0.92
--- CutsGA                   : Corresponding background efficiency       : 0.234776
--- CutsGA                   : Transformation applied to input variables : None
--- CutsGA                   : -------------------------------------------------
--- CutsGA                   : Cut[ 0]:    0.103538 < DeltaR_lepnu <=      3.1077
--- CutsGA                   : Cut[ 1]:      615972 <            HT <= 1.60016e+07
--- CutsGA                   : Cut[ 2]:     25967.4 <   bjet_pt[0] <= 1.30178e+06
--- CutsGA                   : Cut[ 3]:     18653.9 <   bjet_pt[1] <=      939408
--- CutsGA                   : -------------------------------------------------
--- CutsGA                   : -------------------------------------------------
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--- CutsGA                   : Cut[ 1]:      603608 <            HT <= 2.31869e+07
--- CutsGA                   : Cut[ 2]:     30394.5 <   bjet_pt[0] <= 1.29352e+06
--- CutsGA                   : Cut[ 3]:       18828 <   bjet_pt[1] <=  1.0212e+06
--- CutsGA                   : -------------------------------------------------
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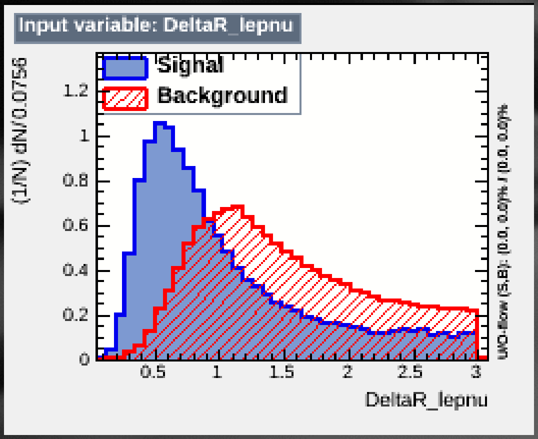
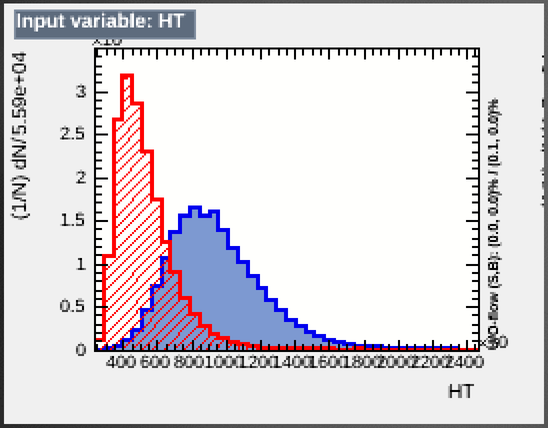
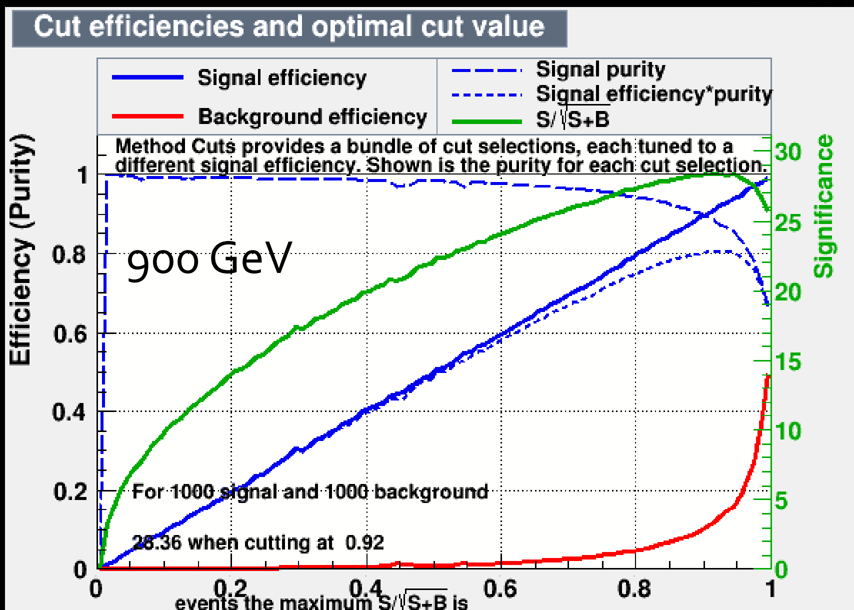
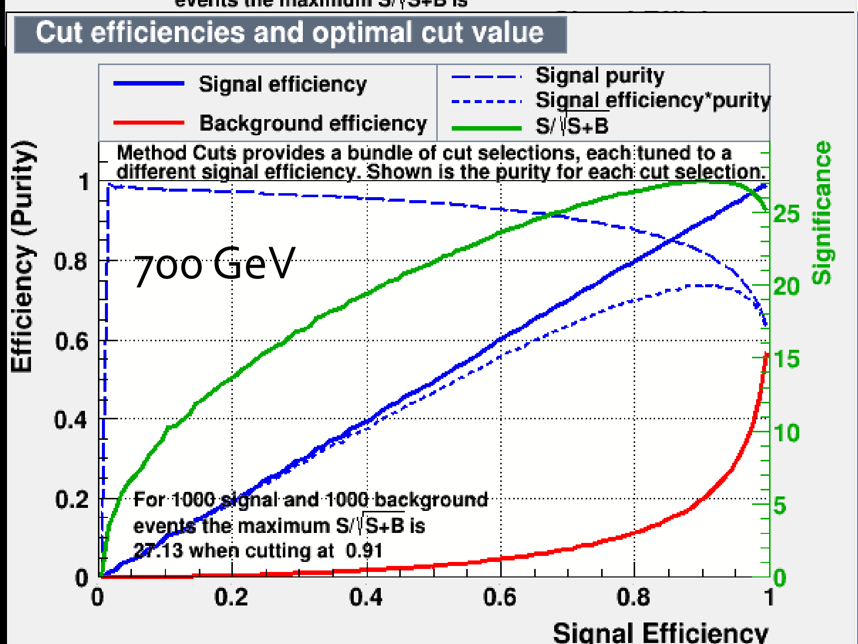




Significance Plots



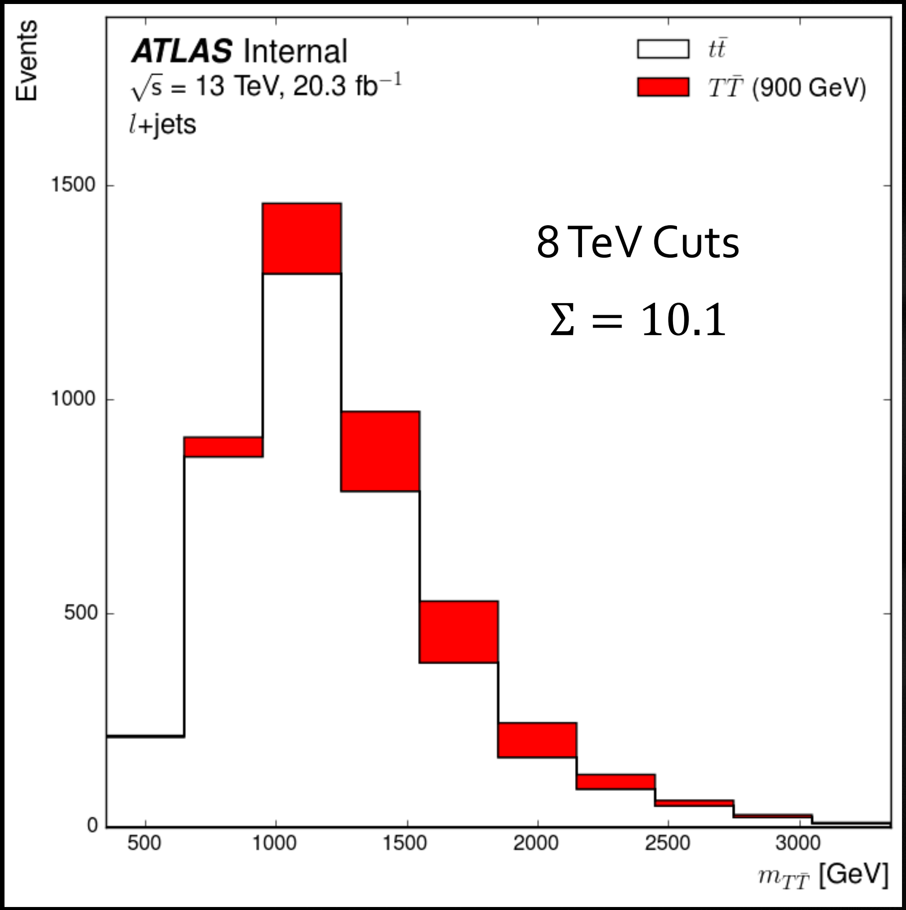


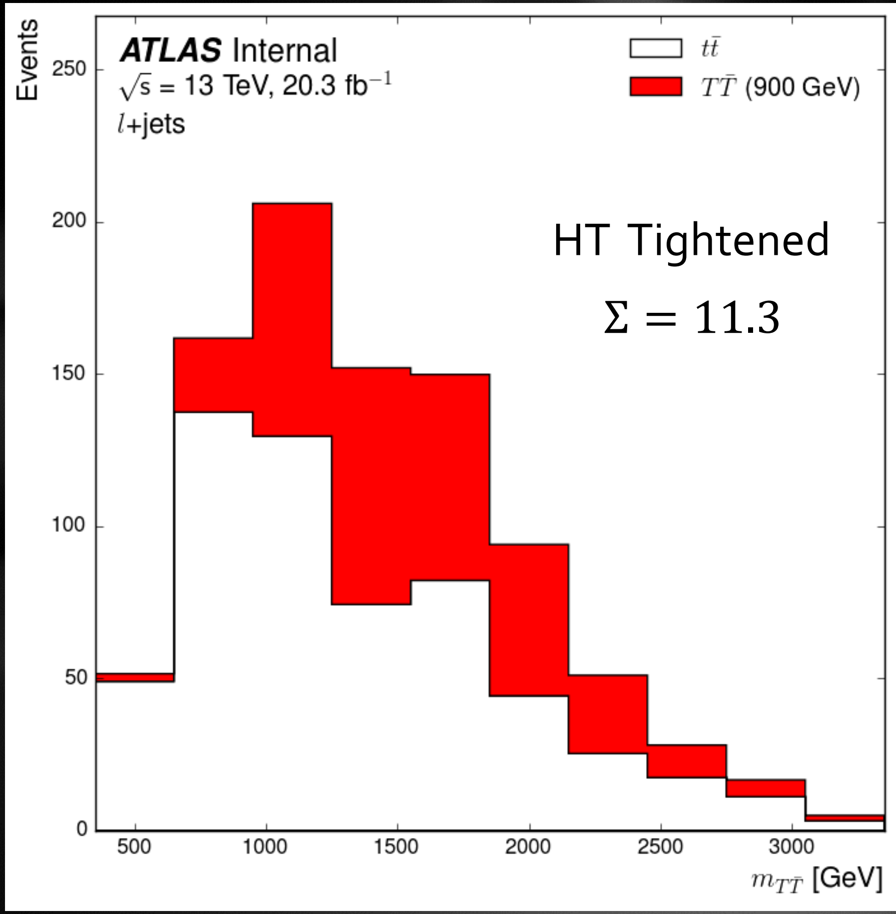
: ---
: Cut values for requested signal efficiency: 0.92
: Corresponding background efficiency : 0.132506
: Transformation applied to input variables : None
: ---
: Cut[0]: 0.0478034 < DeltaR_lepnu <= 3.03565
: Cut[1]: 698542 < HT <= 1.61862e+10
: Cut[2]: 55725.3 < bjet_pt[0] <= 1.64192e+06
: Cut[3]: 13795.2 < bjet_pt[1] <= 1.22079e+06
: ---

: ---
: Cut values for requested signal efficiency: 0.91
: Corresponding background efficiency :

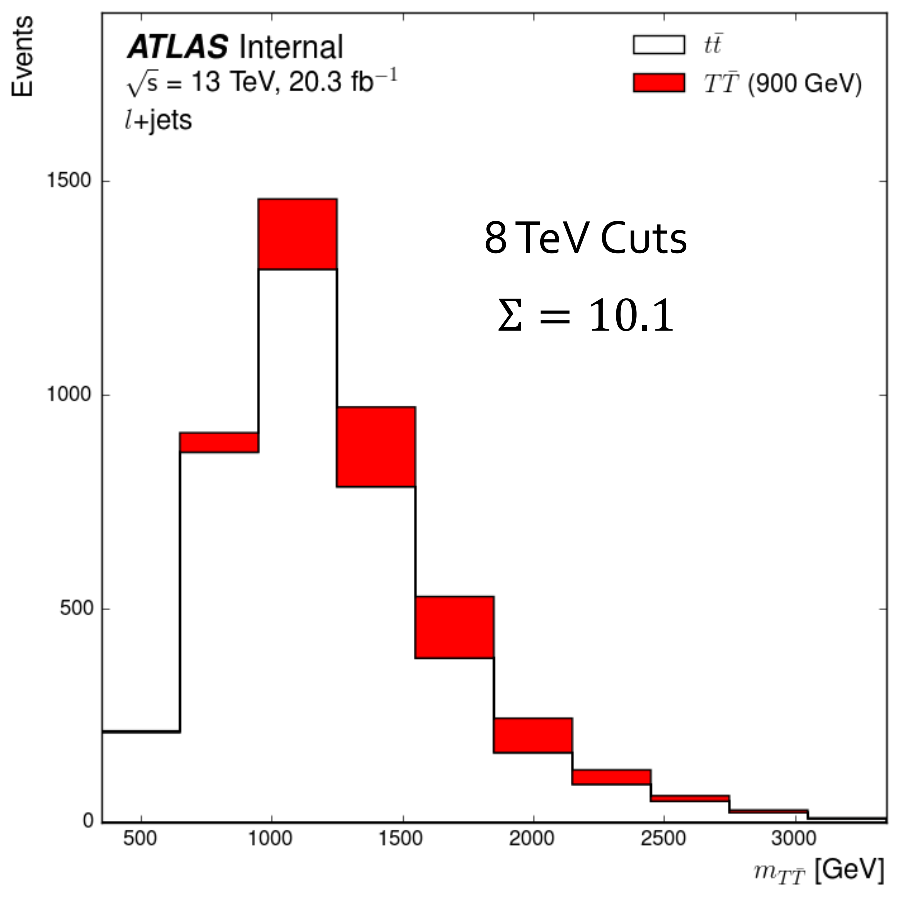
: Transformation applied to input variables : None
: ---
: Cut[0]: 0.0557273 < DeltaR_lepnu <= 3.06343
: Cut[1]: 626159 < HT <= 1.63625e+07
: Cut[2]: 34421 < bjet_pt[0] <= 1.44751e+06
: Cut[3]: 18377.4 < bjet_pt[1] <= 1.00036e+06
: ---

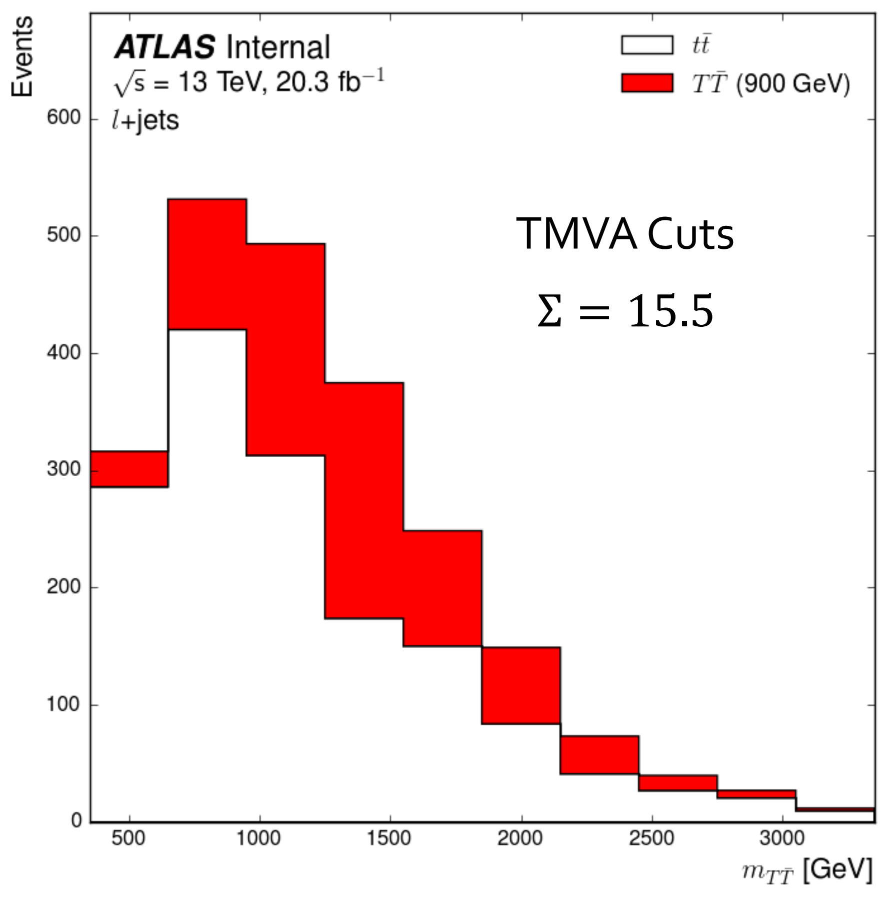
Cut Results: $H_T \rightarrow 1400$ GeV



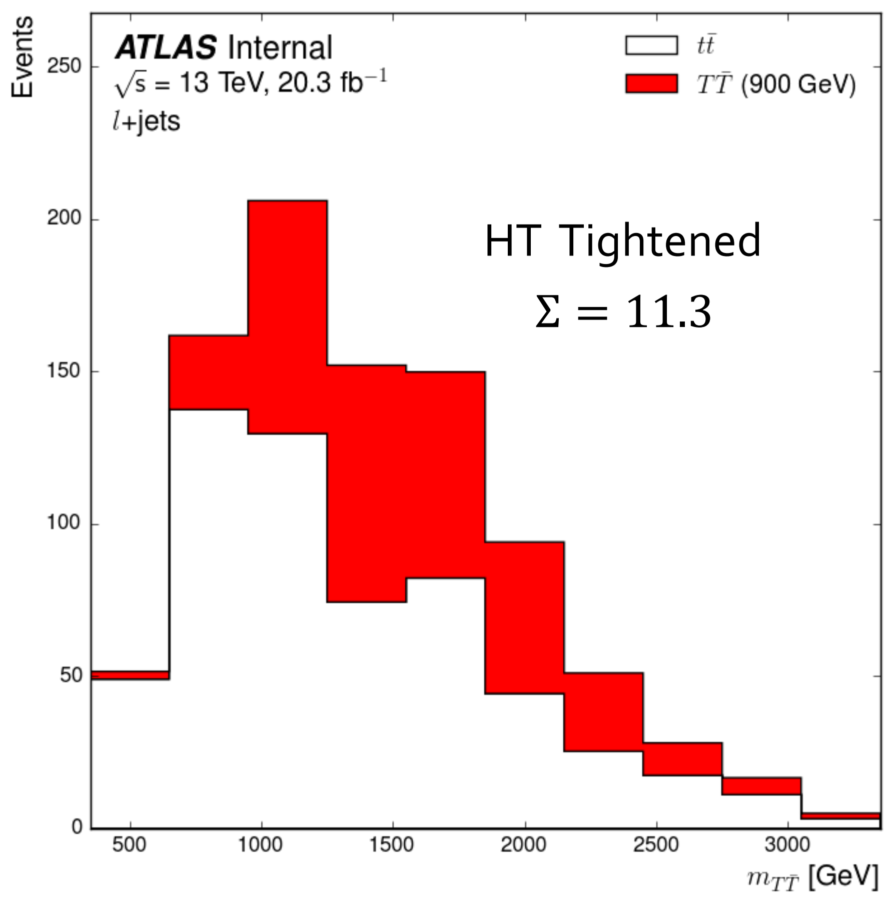


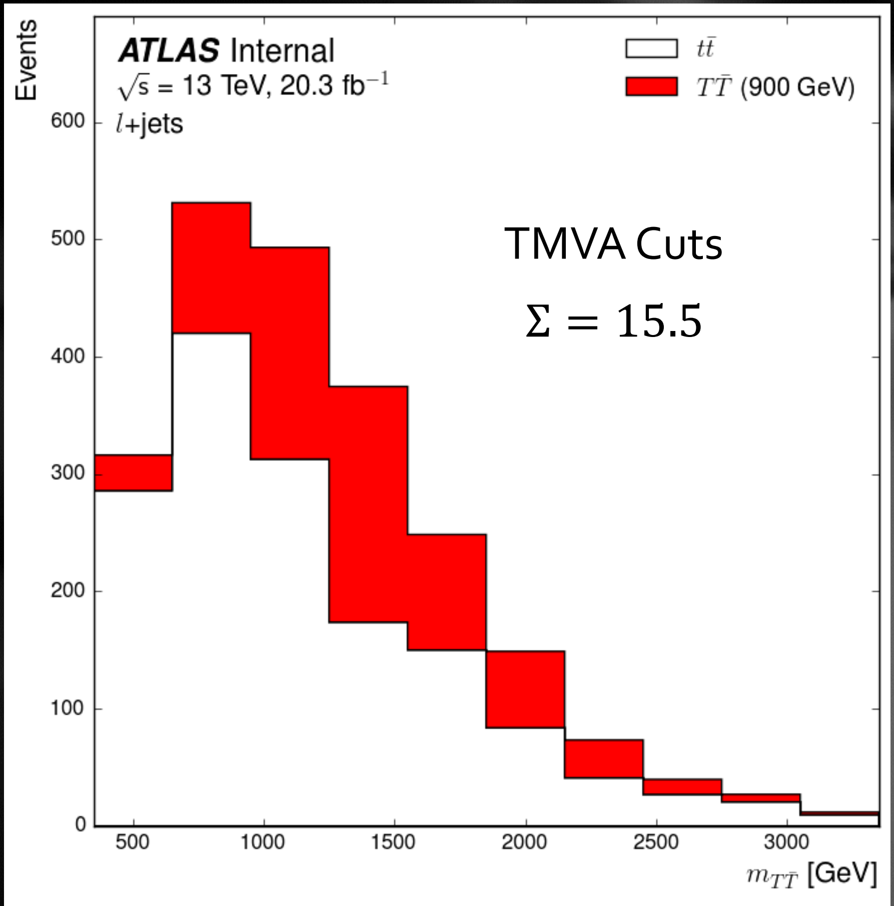
Cut Results: TMVA Selection



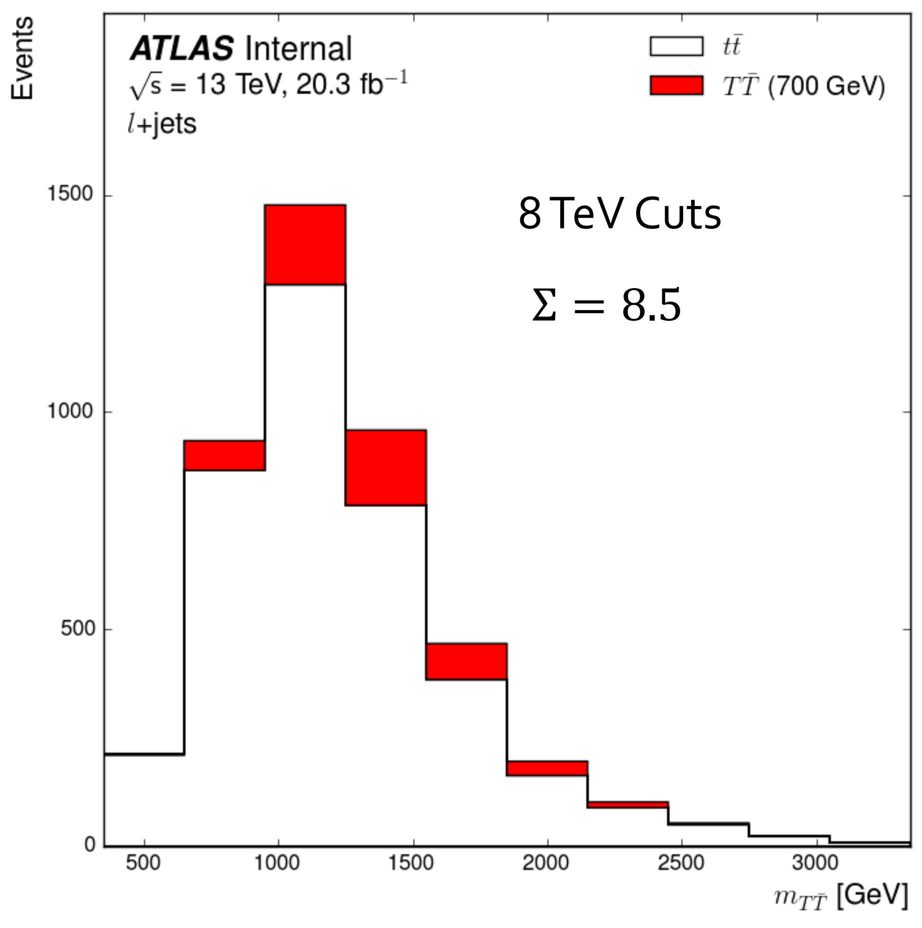


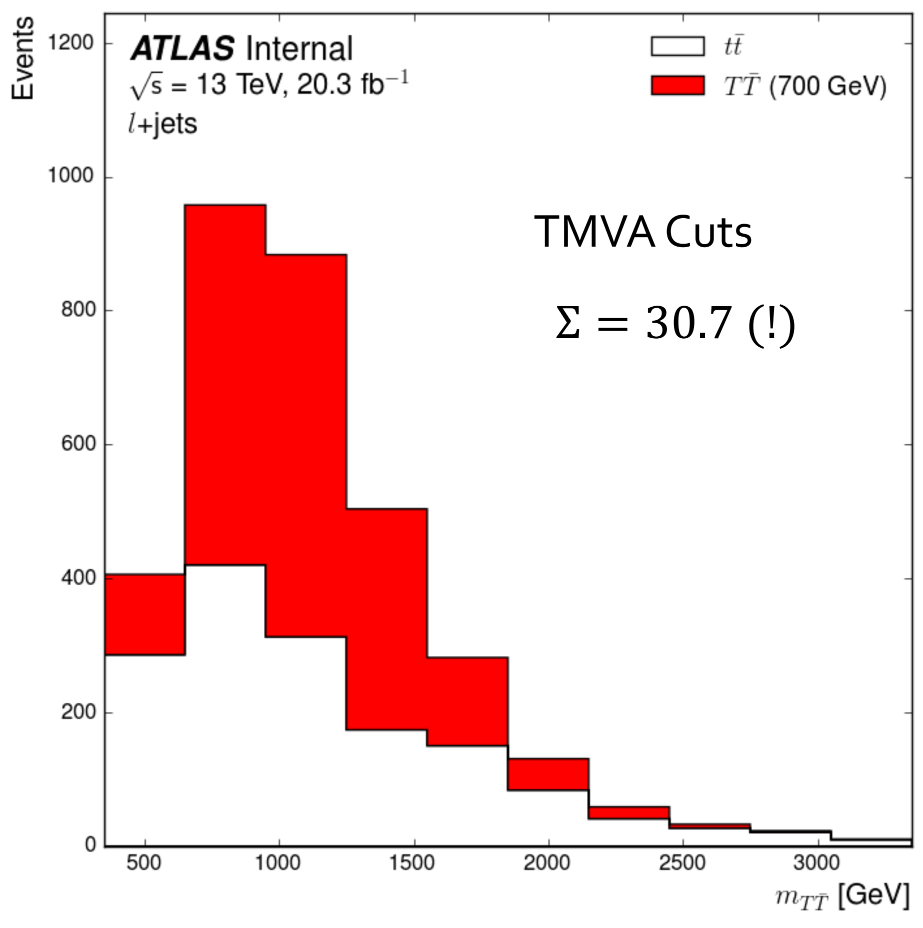
Cuts Comparison





TMVA Selection on 700 GeV





PyDataMC

ROOT ntuple → json → Matplotlib Plots

Now available at:

/afs/cern.ch/work/b/bmagy/public/PyDataMC

addData.py | info.py | json2hist.py | root2json.py | run_json2hist.py

```
'''
Created:       1 February 2015
Last Updated:  8 April 2015

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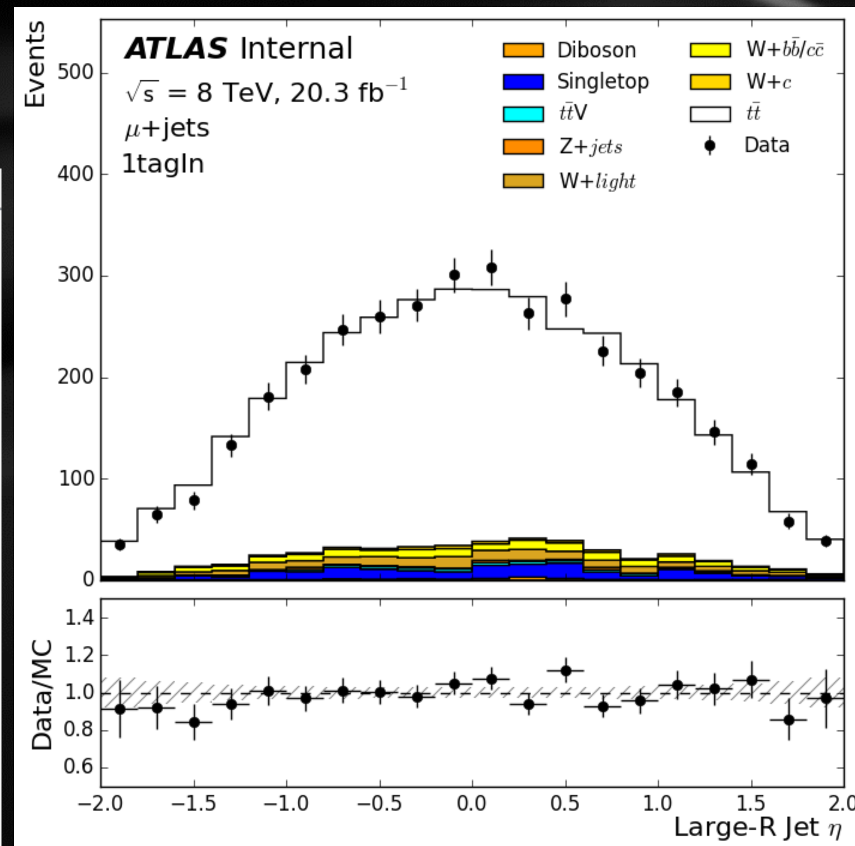
Contains the DataMCPlotter function

To run (recommended):
import json2hist.py # Do not execute this file!

'''

import os
import sys
import matplotlib
matplotlib.use('Agg') # Force matplotlib to not use any Xwindows backend.
from matplotlib import rc
from matplotlib import pyplot as plt
from matplotlib import gridspec
os.environ['PATH'] = os.environ['PATH']+':/usr/texbin'
rc('text', usetex=True)
rc('font', family='sans-serif')
fontProperties = {'family':'sans-serif','sans-serif':['Helvetica']}
```



Cultural Activities





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