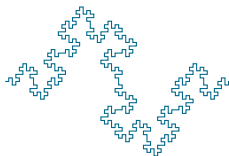


# Hadronic Top Reconstruction

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# PRELIMINARY SELECTION

- ▶ **Rho Requirement.** ( $0 < \text{rho}_{\text{var}} < 40$ )
- ▶ **At Least Four Jets.** ( $\text{npfjets30} \geq 4$ )
- ▶ **At Least One b-tag.** ( $\text{nbtags}_{\text{ssv}} \geq 1$ )
- ▶ **One muon**  $p_T > 30$   $\eta < 2.1$
- ▶  $\cancel{E}_T > 50$
- ▶ **Isolated Track Veto.**

MC Samples:

```
/tas/vimartin/SingleLepton2011/output/V00-04-13/  
ttsl_smallTree.root  
tt dl_smallTree.root
```

# RECONSTRUCTION

$$t\bar{t} \rightarrow Wb Wb \rightarrow \ell b jjb$$

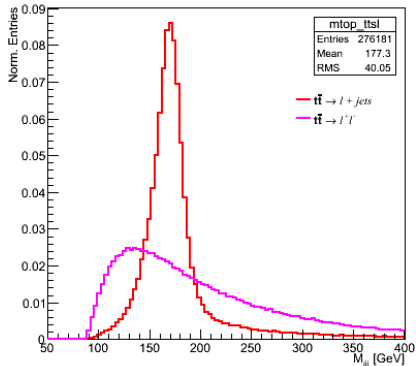
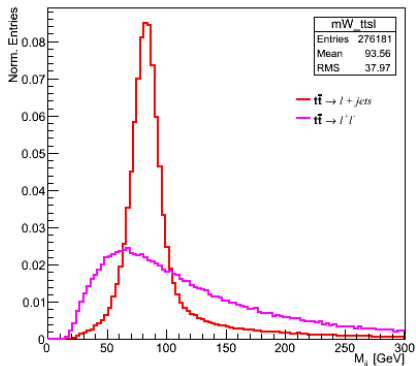
I will call “b jets” to those that come from the b’s in the decay above.

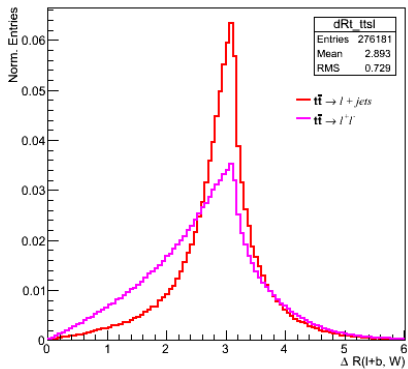
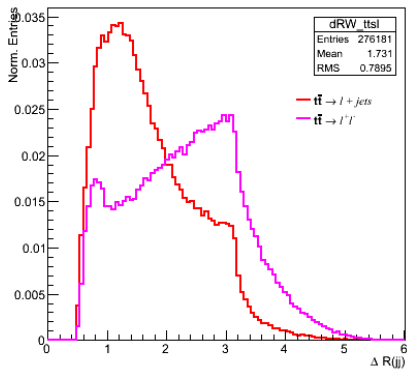
Take six jets and make all possible four jet combinations, then constraint the W mass  $M_{jj} = M_{W_{PDG}}$ , and finally cut on the following variables:

- ▶ **“b jets” more b-tagged than W jets.** (bcsvjet)
  - ▶ 1[00]1 Good    0[00]0 Good    0[01]0 Bad
  - ▶ 2[10]1 Good    0[10]2 Bad    1[02]1 Bad
- ▶  $p_T$
- ▶  $M_{jj}, M_{jjj}$  W and Top Mass (before and after the constraint).
- ▶  $\Delta R(jj), \Delta R(W, \ell + \mathbf{b})$
- ▶  $M(\ell, \mathbf{b})$  Invariant mass of the lepton plus one “b jets”

# MASS

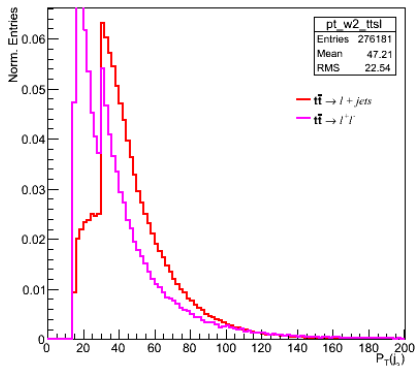
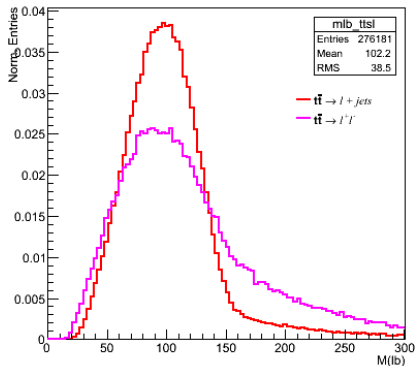
The red one includes a matching to the true MC.



$\Delta R$ 


# $M_{lb}$ & $p_T$

The step at 30 GeV is due to the preliminary cuts.



# EFFICIENCY

- ▶ Count all events that have at least one candidate after the selection divided by the number of events that passed the preliminary cuts.

$p_T$	$M_{jj}$	$M_{jjj}$	$\Delta R_{jj}$	$\Delta R_{W,\ell+b}$	$M_{\ell b}$	$\ell + \text{jets}$	$\ell^+ \ell^-$
1	50-120	140-200	2.5	1.5	150	75%	52%
20	50-120	140-200	2.5	1.5	150	68%	42%
30	50-120	140-200	2.5	1.5	150	54%	27%

- ▶ A more powerful discriminator can be done by combining all these variables, but we will keep it simple with just Square Cuts.

# SUMMARY

## **Preliminary selection needs to be loosen to further optimization.**

- ▶ Other jets that don't form the candidate are the ones that meet the b-tag or  $p_T$  requirement.
- ▶ Replace preliminary b-tag and  $p_T$  requirement. And include it in the combinatorics:
  - ▶ Require at least one of the b jets to be *b-tagged*.
  - ▶ Require less  $p_T$  for the jets. ( At least for the W jets)
  - ▶ It could be 30 GeV for the b-jets and 25 GeV for the W jets.
- ▶ Probably It will require produce the babies again.
- ▶ With all this possible cut combinations, we need a criteria to select the working point.



# MASS CONSTRAINT

Starting from,

$$M_W^2 = (E_1 + E_2)^2 - (p_1 + p_2)^2$$

we will correct the magnitude of the momentum,

$$p_1^\mu \rightarrow k_1 p_1^\mu \quad p_2^\mu \rightarrow k_2 p_2^\mu$$

the  $W$  mass changes to,

$$\begin{aligned} M_W^2 \rightarrow M_{W_{PDG}}^2 &= (k_1 E_1 + k_2 E_2)^2 - (k_1 p_1 + k_2 p_2)^2 \\ &= k_1^2 m_1^2 + k_2^2 m_2^2 + k_1 k_2 (M_W^2 - m_1^2 - m_2^2) \end{aligned}$$

We can solve  $k_2$  in terms of  $m_1, m_2, M_{W_{PDG}}$  and minimize,

$$\left( \frac{k_1 p_1}{\sigma_{p_1}} \right)^2 + \left( \frac{k_2 p_2}{\sigma_{p_2}} \right)^2 = \left( \frac{k_1}{u(p_1, \eta_1)} \right)^2 + \left( \frac{k_2}{u(p_2, \eta_2)} \right)^2$$

$u$  is the uncertainty in the Jet Energy Scale. This will find the smallest  $p$  correction.