Generating WbWb process with a jet veto

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Reminder: H→WW

- Signature

  2 leptons, missing transverse energy and **jet veto**

- No mass peak reconstruction

  => need good background control

- Main backgrounds

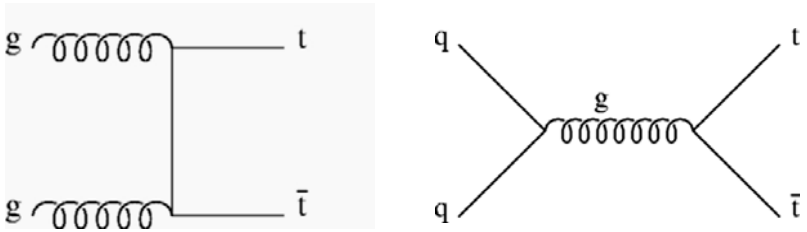
  1. WW→lνlν (remove with leptons angular correlation)
  2. Top production (WbWb as final state)

     (remove with jet veto)

here: study top background !

How to generate top background ?

- ~90% of the total cross section: resonant ttbar



generate with **PYTHIA**

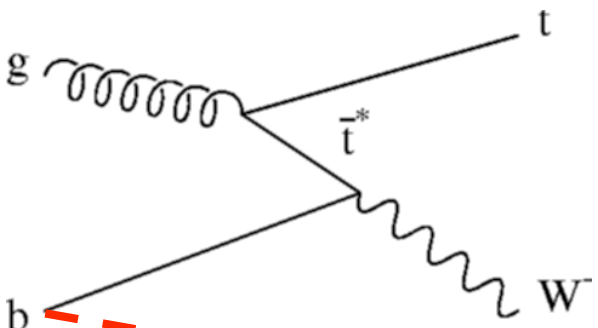
- ~10% one off-shell top:

This fraction increases after JET VETO

Pythia: assumes massless virtual top…

“wrong” kinematics

=> use **TOPREX** (2→2 process)



From gluon splitting

Additional soft b in final state from showering

Alternative way to generate top background

- Use MadGraph to generate WbWb final states full matrix elements (2→4 processes)

  (ttbar: 2→2(+top decays!), Wtb 2→3 and interferences !)

Compare:

1) ttbar + Wt(b) (Pythia+Toprex)

with

2) WbWb (MadGraph)

Apply Higgs selection: effect of **jet veto**

Compare ttbar + Wt(b) with WbWb

	ttbar Pythia	Wt(b) Toprex	WbWb MadGraph
$\sigma \times BR$	52000 fb	6000 fb	60600 fb
Kin. cuts	870 fb	130 fb	980 fb
Jet veto	30 fb	20 fb	20 fb
cuts on p_t	3.5 fb	3 fb	2 fb

Signal
(after all cuts)
24 fb (m_H=165 GeV)

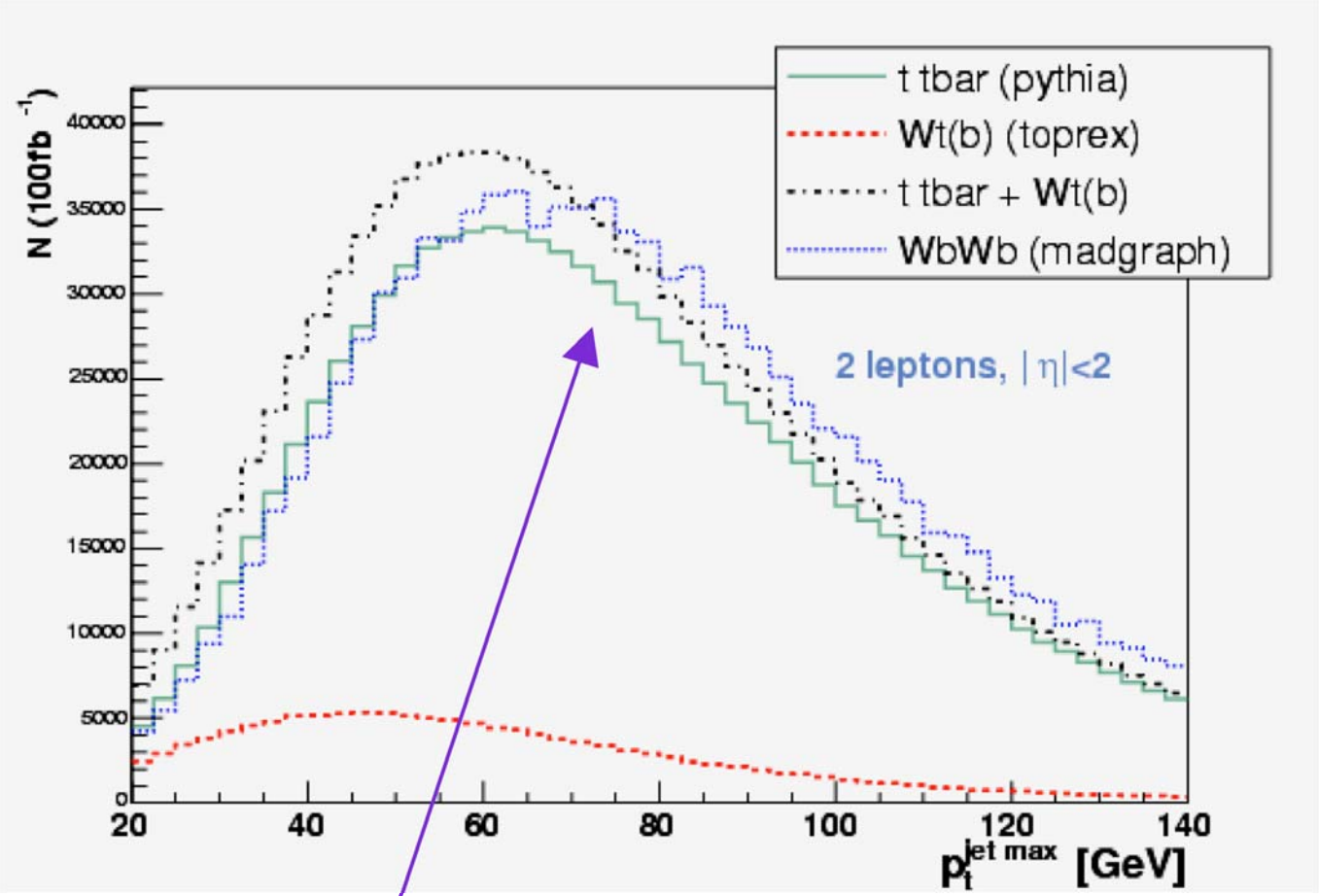
Background
WW : 10 fb
Total
16.5 fb (Pythia,Toprex)
12 fb (MadGraph)

Where does the factor 3 (2.5) come from ?

Kin. cuts: 2 iso. leptons, $|\eta_{lep}| < 2$, $E_T^{miss} > 20$ GeV, $m_{ll} < 35$ GeV, $\phi_{ll} < 45$
Jet veto: No jet with $p_t < 30$ GeV, $|\eta| < 4.5$
Cuts on p_t: 35 GeV < P_t^{lep} max<50 GeV and P_t^{lep} min > 25 GeV

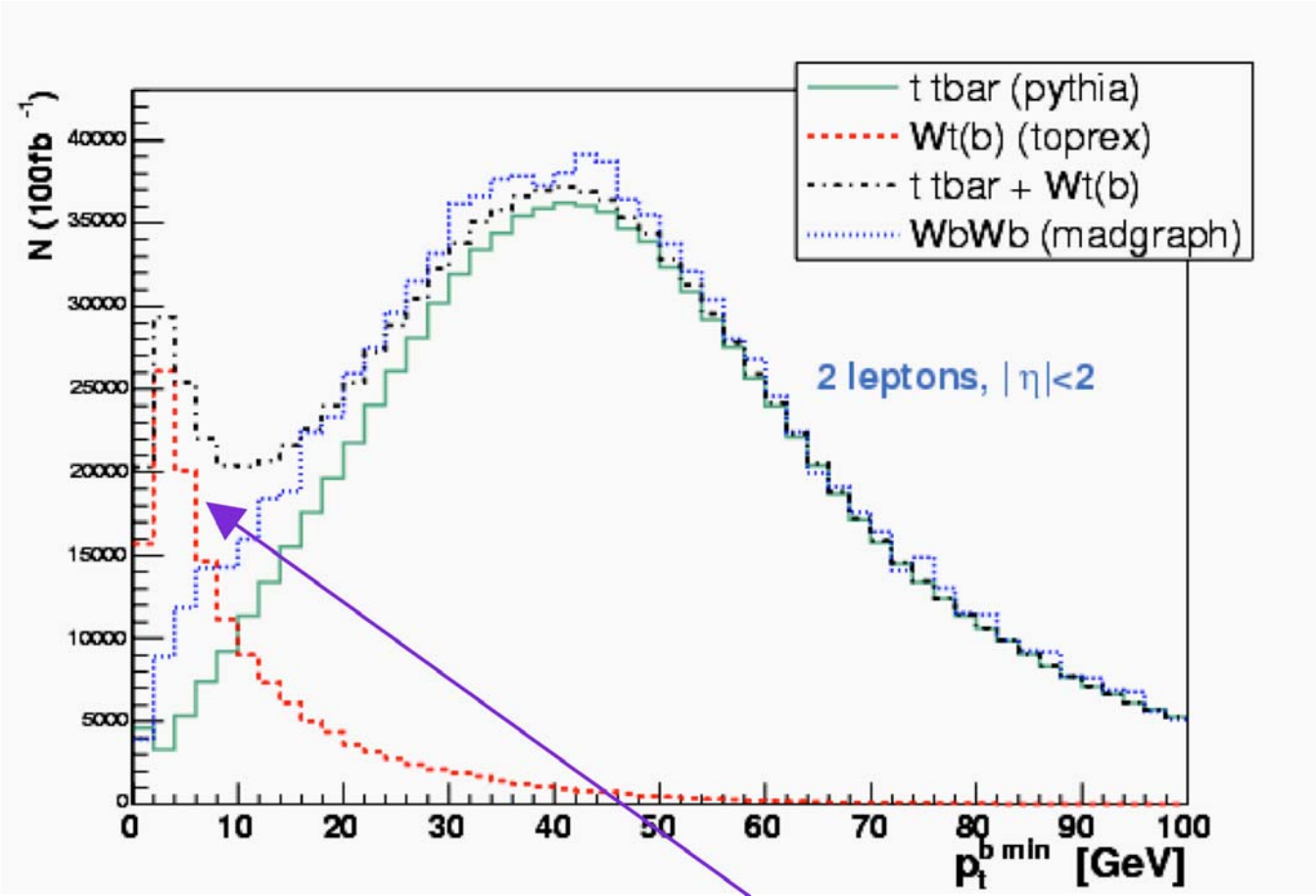
Why does the jet veto create such a difference ?

Study the **jet** "reconstructed" from particle tree



MadGraph has a harder spectrum

The generated p_t spectrum of the b quark from the shower



Wt(b) is much softer in MadGraph than in Toprex

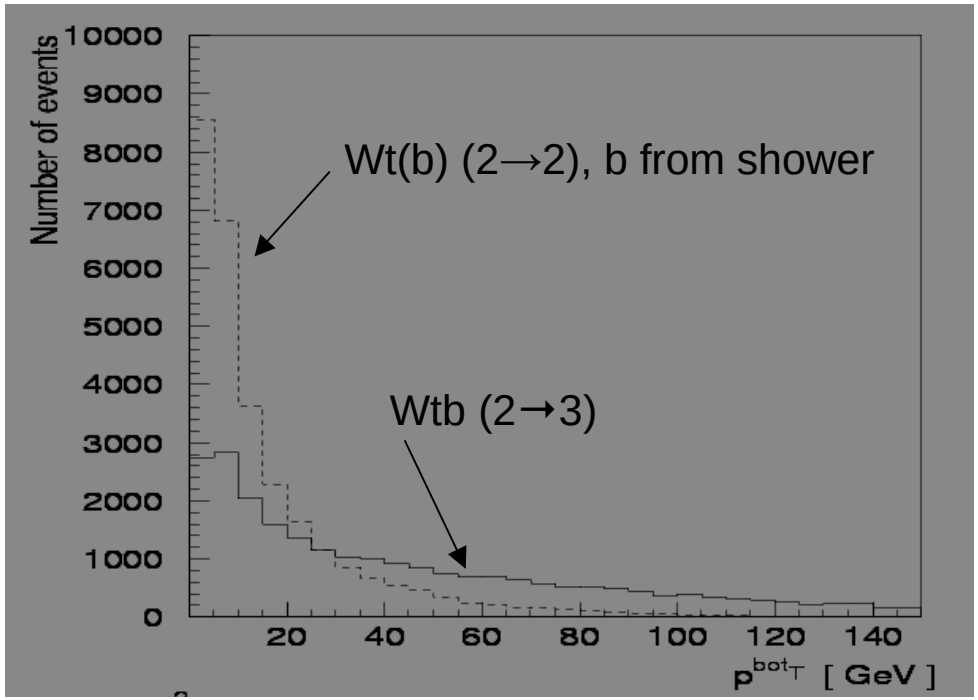
Compare the two Wtb contributions

Madgraph 2→3 process

Toprex 2→2 + additionnal b from shower

} **leads to different kinematics**

CompHEP simulation, similar to MadGraph



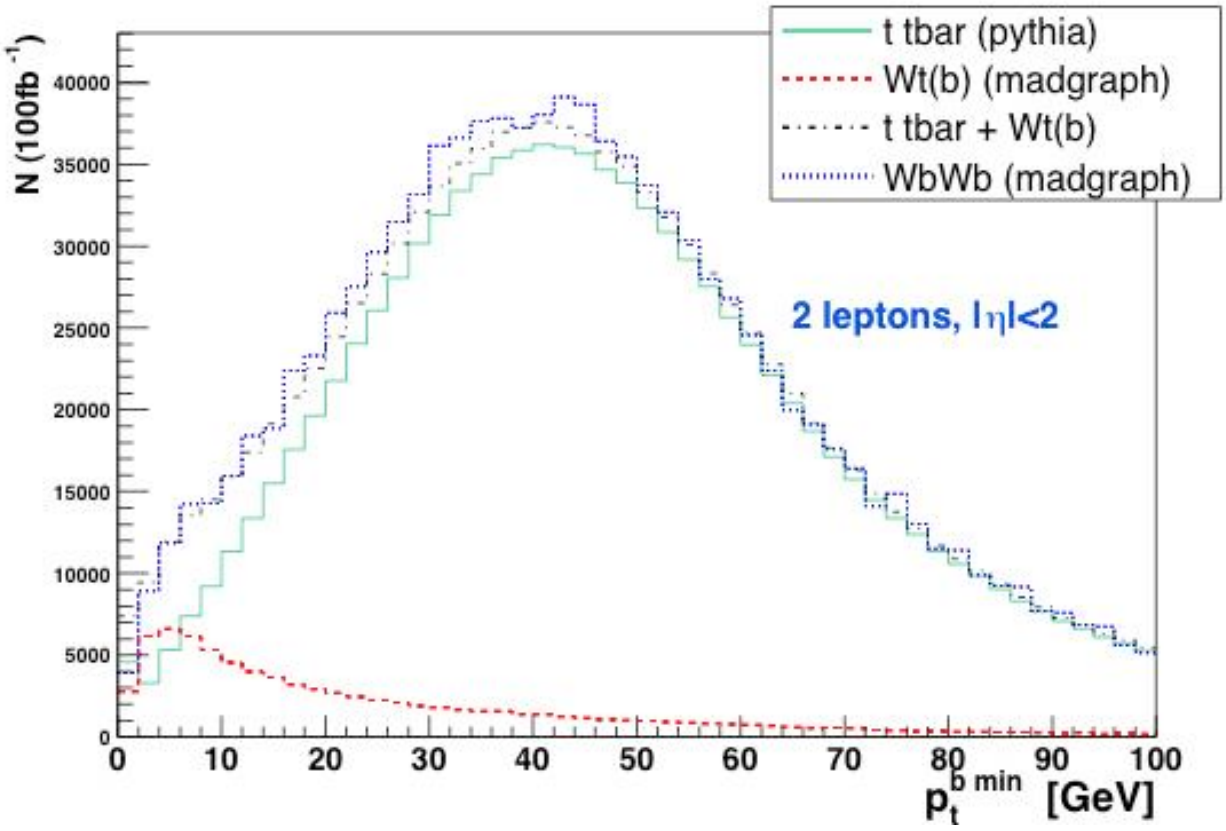
[Belyaev, Boos, Phys. Rev. D63, 2001]

2→2 process (Toprex) looks less 'physical': bad description of the high p_t region

Prescription Simulate Wtb with MadGraph 2→3 process

(F. Maltoni) (no solid matching prescription for Wt and Wtb yet)

Madgraph with full WbWb matrix elements, taking out ttbar-onshell contributions (not gauge invariant !)



In this case, Wtb after all cuts: **0.7fb** (ttbar: 3.5fb))
Toprex+ttbar: 3fb + 3.5fb

To discuss !

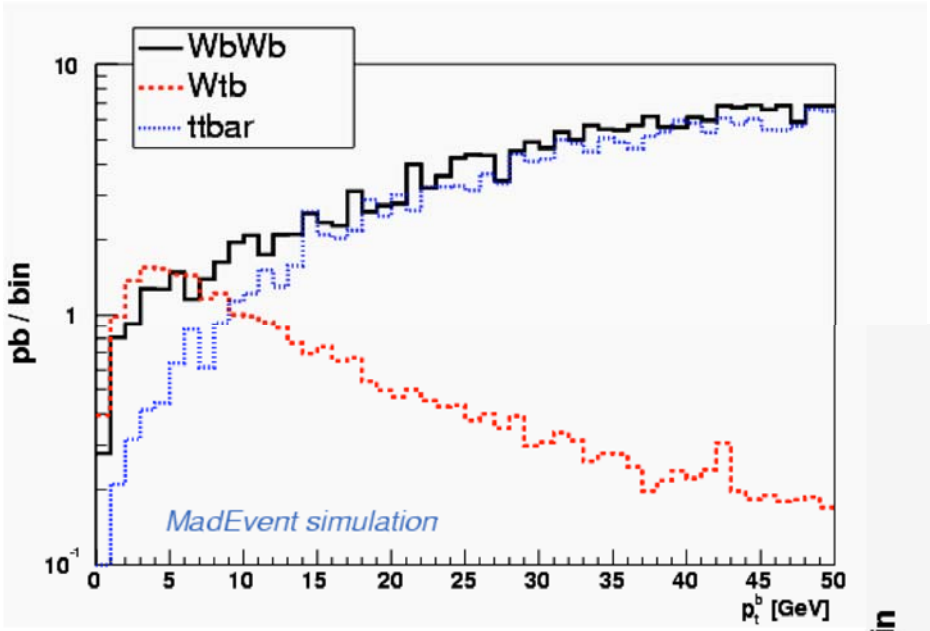
- LO scale uncertainty on Wt(b) process
- **NLO** correction for **Wtb ?**
- Effect of the spin correlations

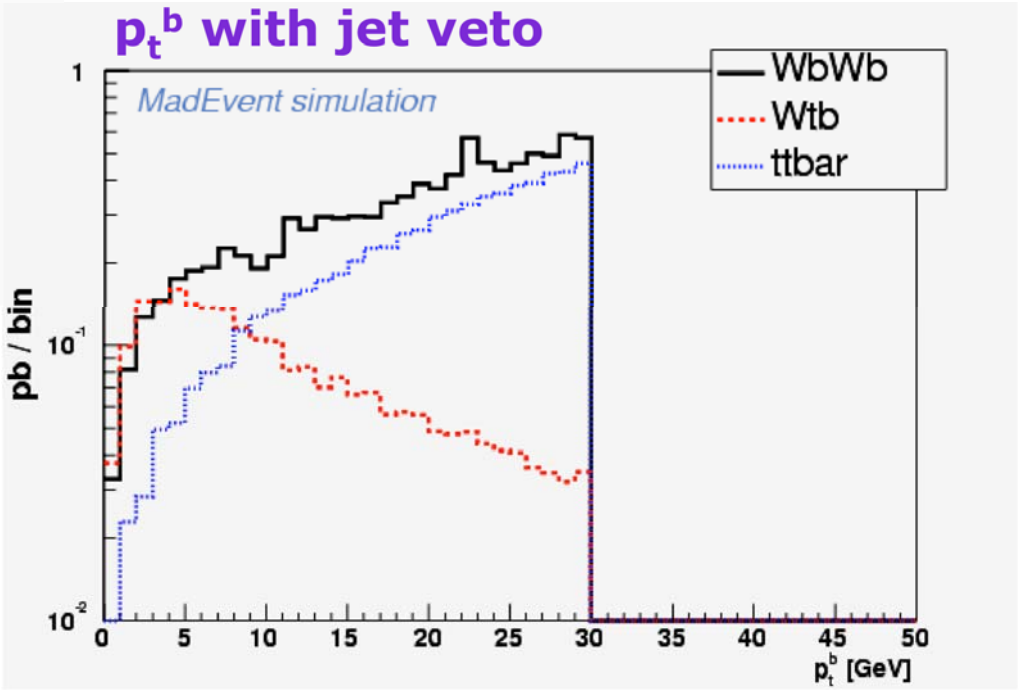
- ... etc ...

Backup slides

Difference does not come from interferences/double counting

WbWb ≈ tt + Wtb (when 3 processes simulated with MadGraph)





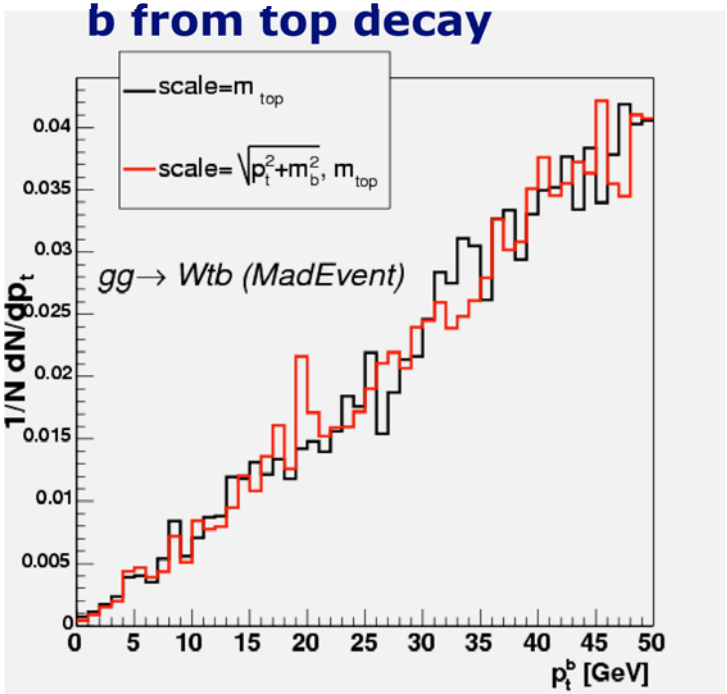
Important scale uncertainties on Wtb

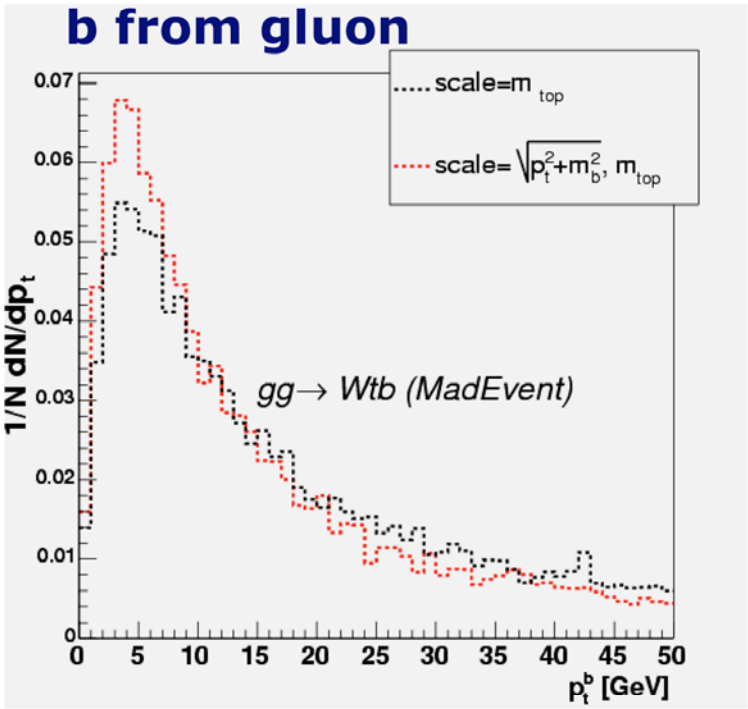
cross section $_{LO}$ (scale = m_T^b, m_{top}) ≈ 2 · cross section $_{LO}$ (scale = m_{top})

⇒Take the inclusive NLO calculation for Wt to normalize (K≈1.4)

[calculation: Zhu hep-ph/0109269]

But variation in p_t shape for b not from top:

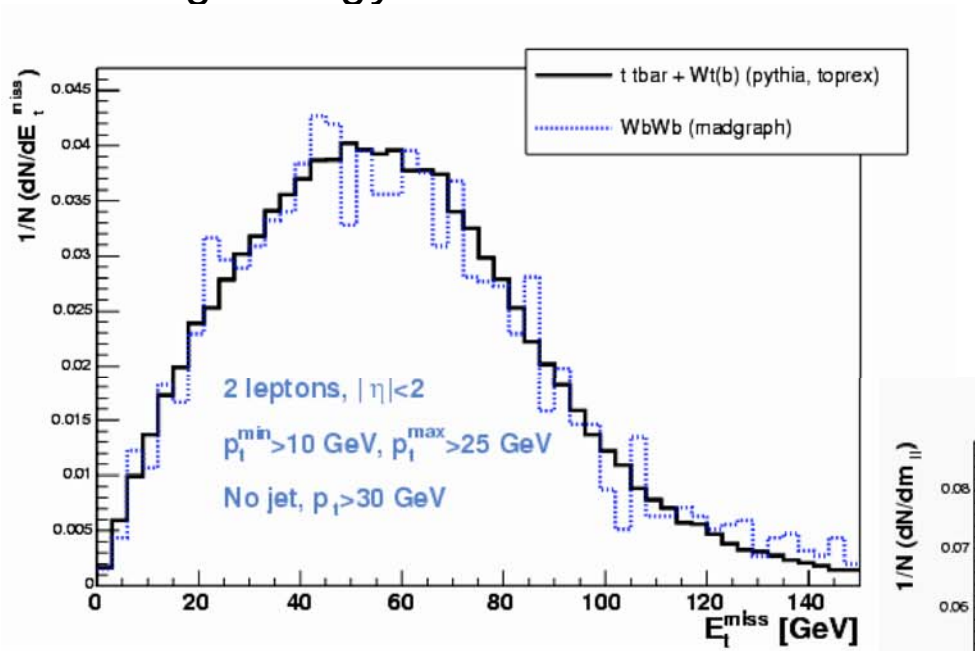




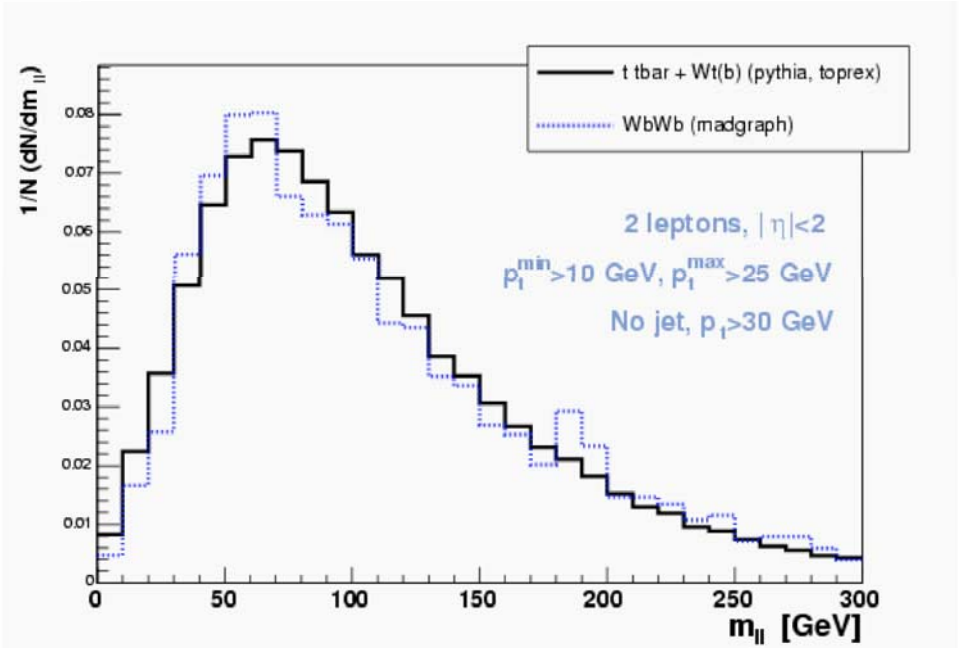
Chose m_{top} as scale for simulation with MadGraph

Other kinematic variables look similar

Missing energy



Di-lepton invariant mass



Angle between the leptons in transverse plane