Reconstruction of $t \rightarrow bl\nu$

- The idea is (try to) to improve the reconstruction of the top decaying as $t \rightarrow bl\nu$
  - To increase the efficiency for signal
  - Can something be done about the neutrino longitudinal momentum?
  - An improvement would benefit several analysis: ttH, single top, …
- First of all: why is there no neutrino solution for many events?
  - Try to classify failed events according to why they failed
  - This is only just starting: don't expect much

Monte Carlo sample

- Samples 5340 and 5341 from Lorenzo (thanks!) and the the ttH($\rightarrow$bb) wiki
  - ttH $\rightarrow$ (bjj) (blν) bb; m_H = 120 GeV

- Some questions:
  - What filter was used
  - Should I be able to see W$\rightarrow\tau\nu$?
  - What are the lepton and jet collections?
    - Some guesswork was required
    - TJet? AFEl/AFMu? Something else?
    - Got some answers, in the meantime. For reference: AF means AtlFast, TJets are tagged cone jets with R_{cone}=0.4

- Still, this allowed a quick start!...

- No solution if $\xi<0$
- After a lepton is found, typically 60-70% of events have p_Z^{ν} solutions
- Most likely, most errors due to mis-measured E_T^{miss} and ϕ (azimuthal angle between lepton and neutrino)
  - This can be seen by expanding errors contributing to Δ
- But other things can be responsible:
  - off-shell W
  - Mis-identified lepton
  - Other sources of missing ET
- 10% of events gave no solution if using true ETmiss with expressions for p_Z^{ν}
- 4.7% of events give no solution if using true neutrino p_T!!!

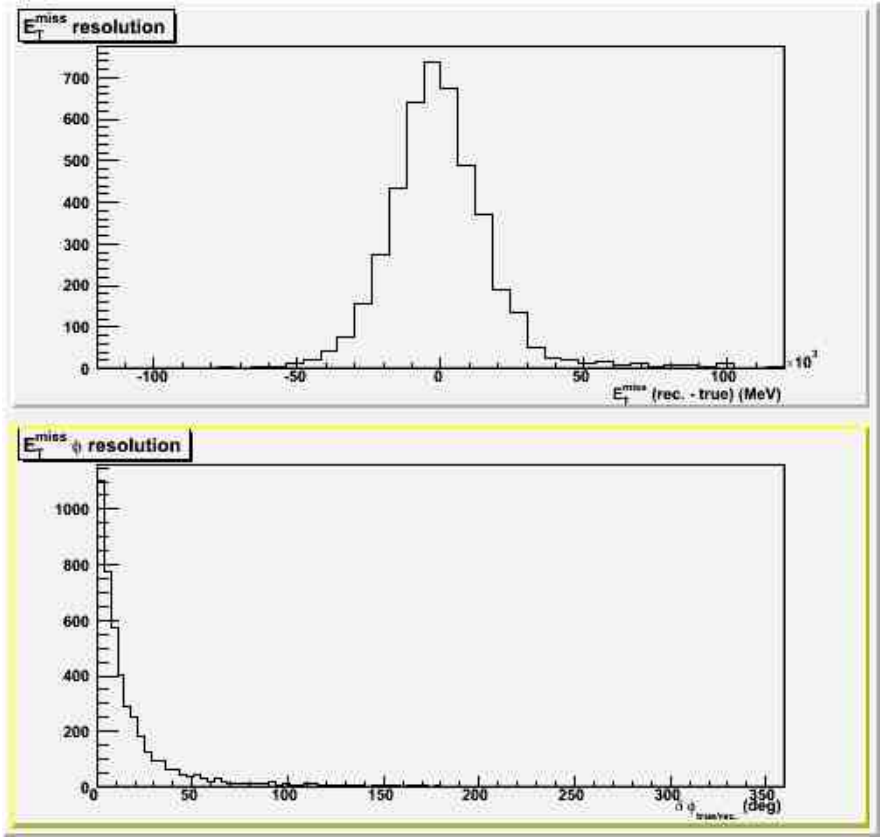
$$p_Z^{\nu} = \frac{p_{Z,l}\Delta \pm E_l\sqrt{\Delta^2 - 4p_{Z,\nu}^2 p_{Z,l}^2}}{2p_{T,l}^2} = \frac{p_{Z,l}\Delta \pm E_l\xi}{2p_{T,l}^2}$$

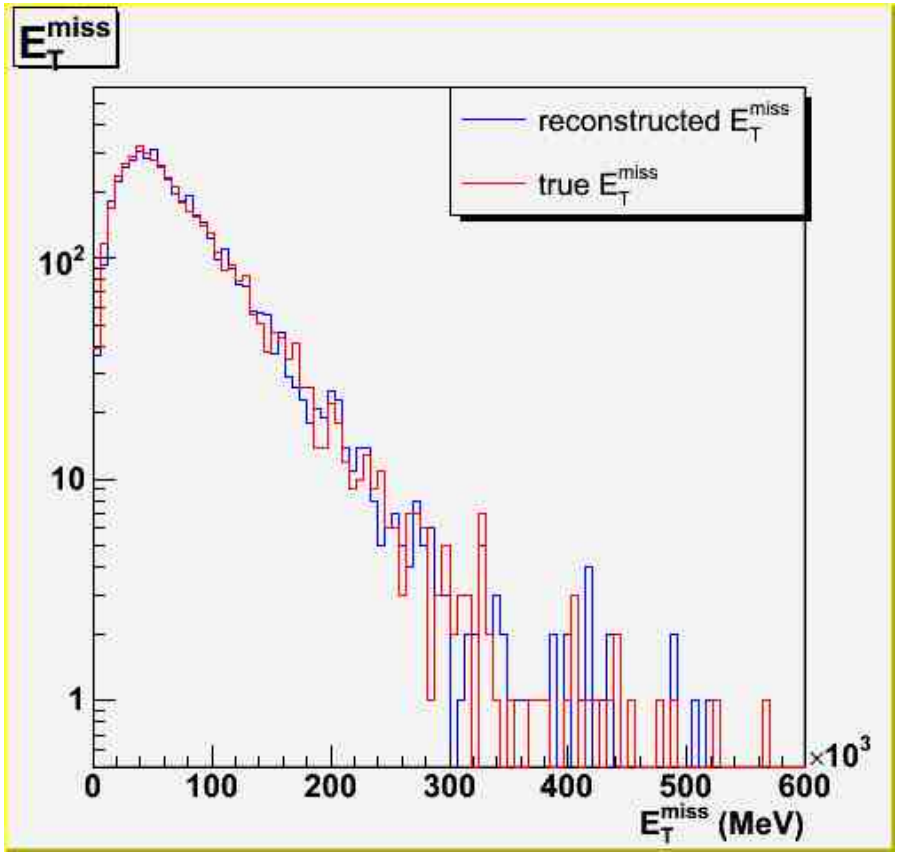
$$\xi = \Delta^2 - 4p_{Z,\nu}^2 p_{Z,l}^2$$

$$\Delta = m_W^2 + 2p_{T,l}\, p_{T,\nu} \cos\phi$$

events with $W\rightarrow\nu\tau$	0
e/μ outside η of 2.5	85
p_T<20(e)/15(μ) GeV	222
p_T^{ν}<0.5 ETmiss	86
$\phi(\nu/ETmiss)>90^o$	328
$\lvert m_W-80.4\rvert>6.3$GeV	155
No b-jet match	3

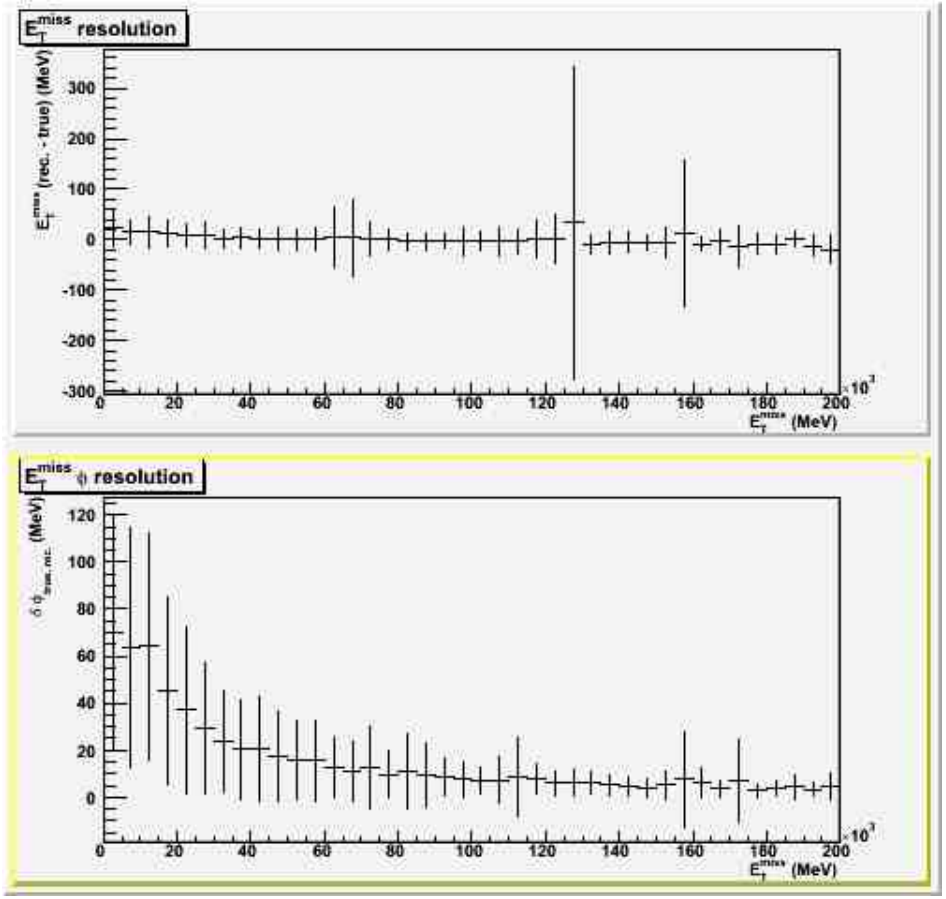
Missing E_T

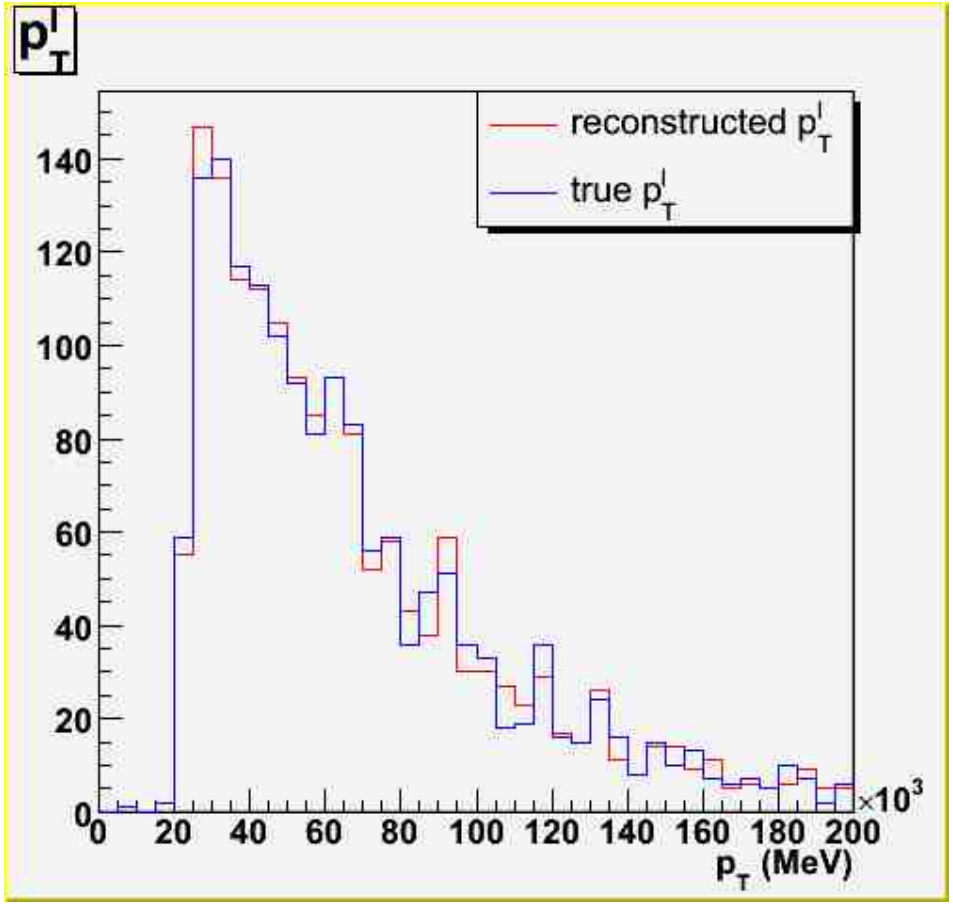




- Should look at new ntuples from Lorenzo for more detailed E_T^{miss} info

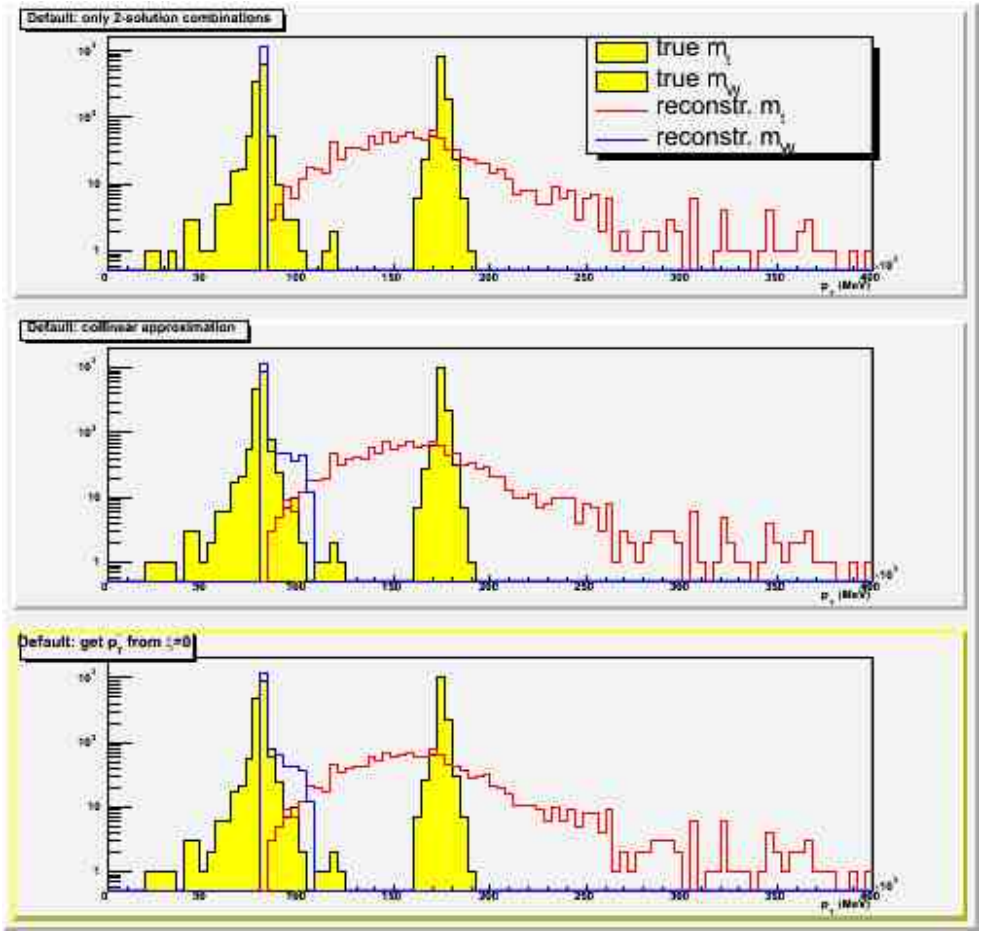
E_T^{miss}: quite large error in angle for low E_T^{miss}
Lepton: require 1 e/μ over 25/20 GeV; no other leptons above 10GeV





- Other methods can be used to recover some of the lost p_Z^ν
- "Collinear approximation":

  $p_Z^\nu = p_Z^l$
- Assume the ξ becomes negative due to uncertainty in measured quantities because it's small
  1. Since it is small anyway, set ξ=0 and get p_Z^ν
  2. Use this p_Z^ν in the rest of the expression
- This doesn't seem silly, since E_T^{miss} could come from other sources…
  - Not much improvement, but (very) slightly better than collinear approx



$$p_Z^\nu = \frac{p_{Z,l}\Delta \pm E_l\sqrt{\Delta^2 - 4p_{Z,\nu}^2 p_{T,l}^2}}{2p_{T,l}^2}$$

4500 events (mH=120GeV)	Default (2 p_Z^ν solutions)	Collinear approximation	ξ=0 method
Events with 1 t$\rightarrow$blν chain in truth	2496	2496	2496
Events with identified electron or muon & no background	1617	1617	1617
Events with p_Z^ν solutions	1149	1617	1617
|mW-80.4|<25GeV	1149	1418	1449
True b jet matches one reconstructed jet	1113	1378	1408
|mt-175|<30GeV	581	748	767