



JET/MET meeting, 9 May, 2001

Charged Higgs in tH^+ , $H^+ \rightarrow \tau\nu$

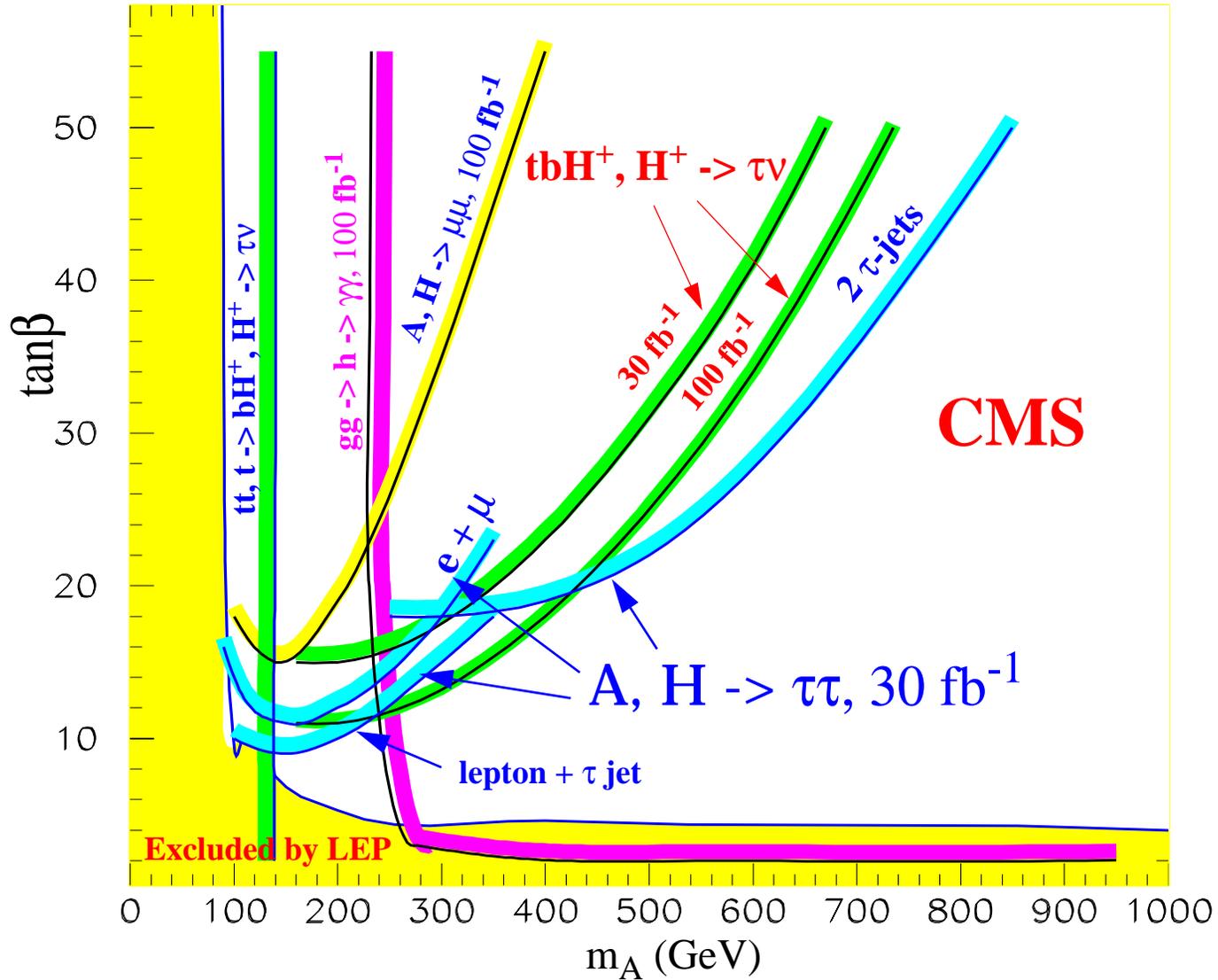
with ORCA

some **preliminary** results

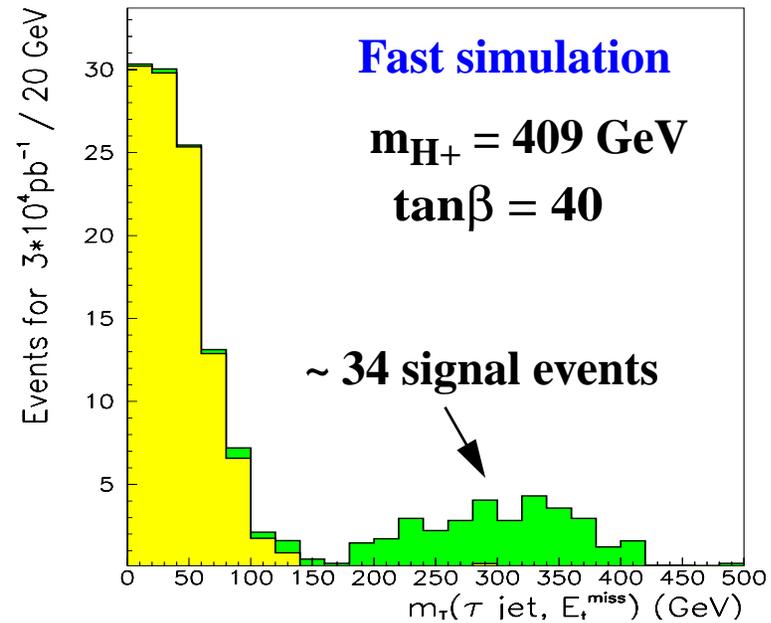
R. Kinnunen

Helsinki Institute of Physics

5 σ contours for the main discovery channels at high $\tan\beta$



An almost background-free signal is expected in $m_T(\tau\text{-jet}, E_t^{\text{miss}})$ in hadronic tH^+ events (E_t^{miss} only from H^+)



Backgrounds from $t\bar{t}$, $W+\text{jet}$, Wtb with real τ 's

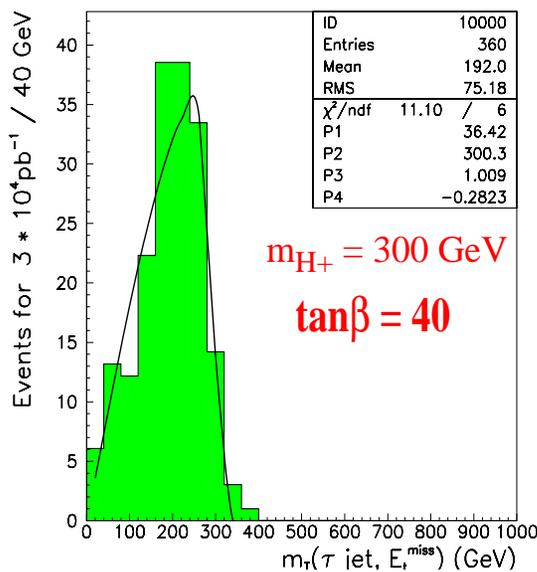
Strong suppression of backgrounds with the cut $p^{\pi^+} / E^{\tau\text{-jet}} > 0.8$ exploiting τ -polarization effects in $H^+ \rightarrow \tau\nu$ and $W^+ \rightarrow \tau\nu$

W and top reconstruction from jets with tagging the b from $t \rightarrow bW$ to ensure rejection of $W+\text{jets}$ and QCD jet backgrounds and to identify a hadronic event

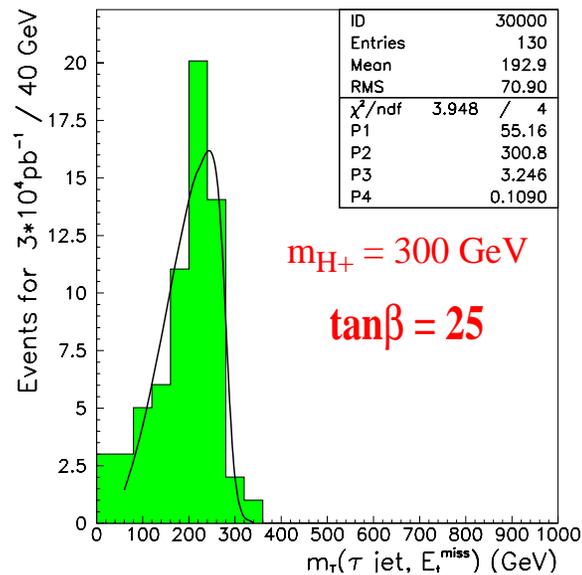
H⁺ mass determination from $m_T(\tau\text{-jet}, E_t^{\text{miss}})$

Fast simulation with CMSJET

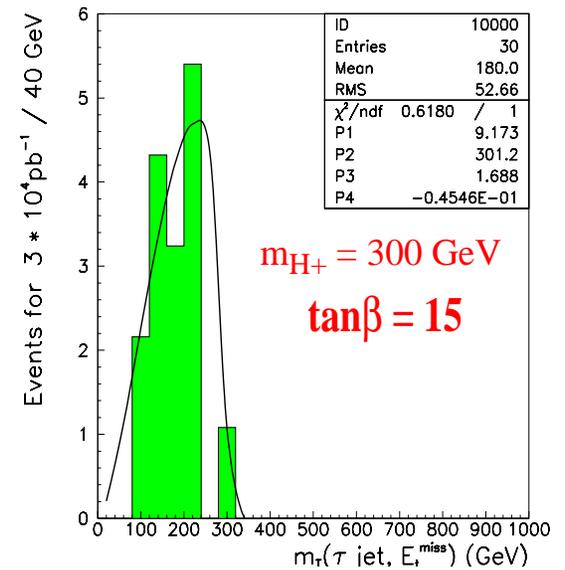
A 4-parameter fit of the form: $dN / dm_T \sim \int D(z) dz / \sqrt{M_{\text{fit}}^2 - m_T^2}$
 with $D(z) \sim z^\alpha (1-z)^\beta$, $z = p_t^{\tau\text{-jet}} / p_t^\tau$



$M_{\text{fit}} = 300.3 + 0.4 \text{ GeV}$



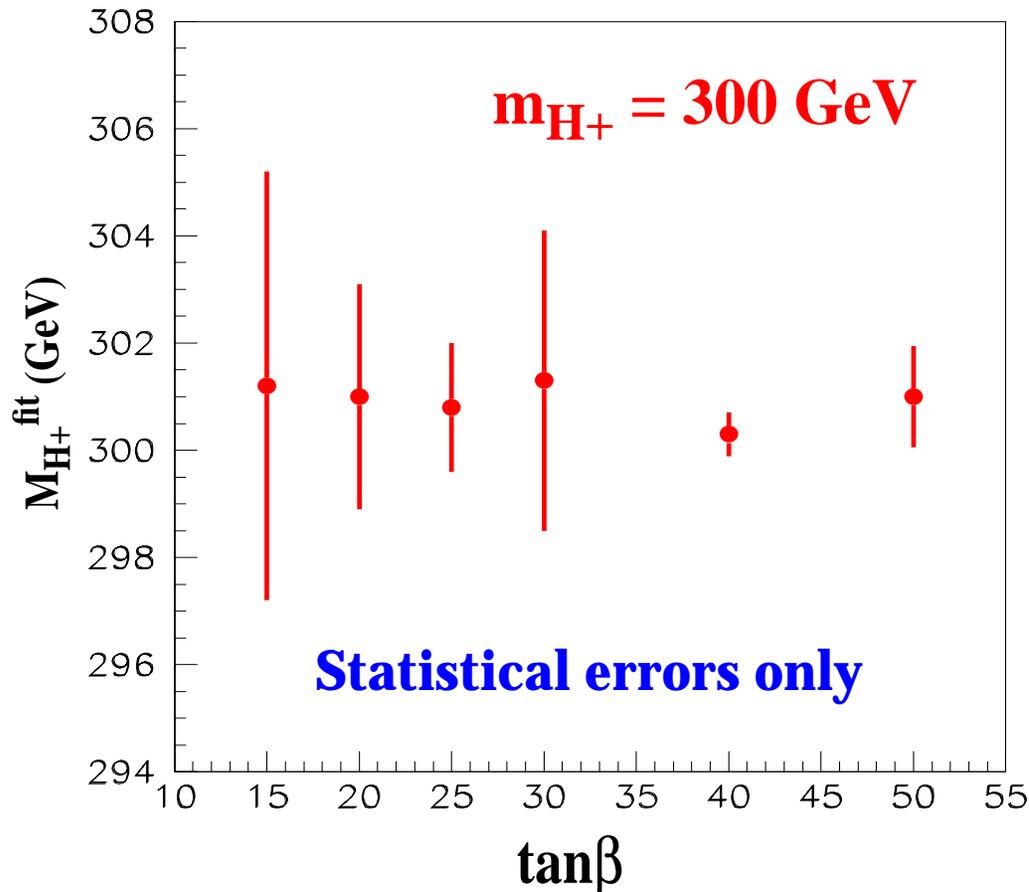
$M_{\text{fit}} = 300.8 + 1.2 \text{ GeV}$



$M_{\text{fit}} = 301.2 + 4.0 \text{ GeV}$

H^+ mass determination as a function of $\tan\beta$

in tbH^+ , $H^+ \rightarrow \tau\nu$



Systematic errors from
energy scale for jets and
 E_t^{miss} measurement

$W \rightarrow \tau\nu$ may be used
to determine the mass
scale of $m_T(\tau\text{-jet}, E_t^{\text{miss}})$
measurement

Data (OODigis) on FNAL User Federation:

- 10000 events for $m_{H^+} = 200 \text{ GeV}$, $L = 10^{34} \text{ cm}^2\text{s}^{-1}$
- 10000 events for $m_{H^+} = 400 \text{ GeV}$, $L = 10^{33} \text{ cm}^2\text{s}^{-1}$
- 10000 events for $m_{H^+} = 400 \text{ GeV}$, $L = 10^{33} \text{ cm}^2\text{s}^{-1}$

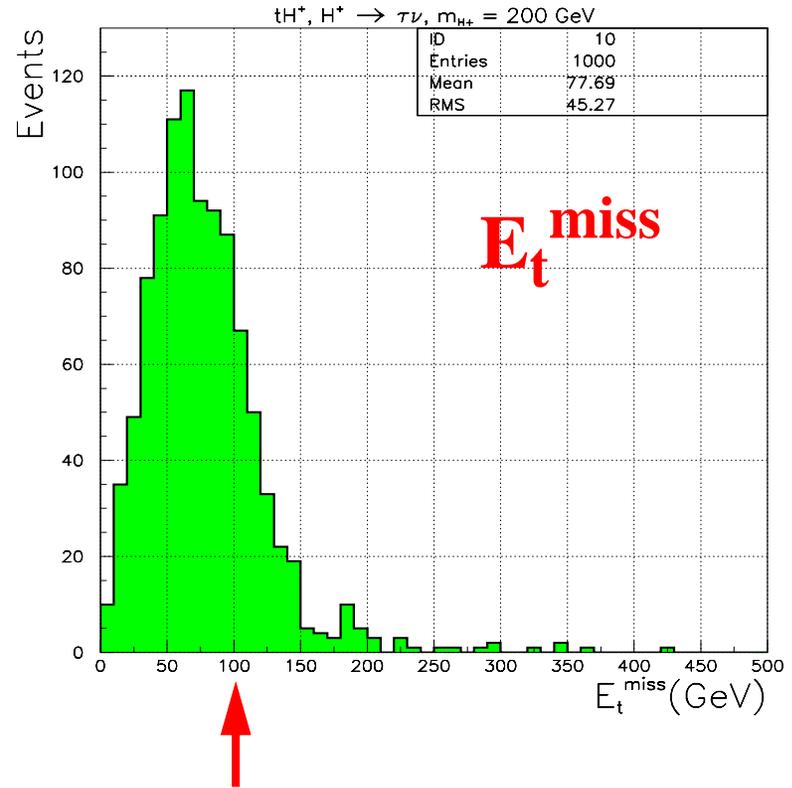
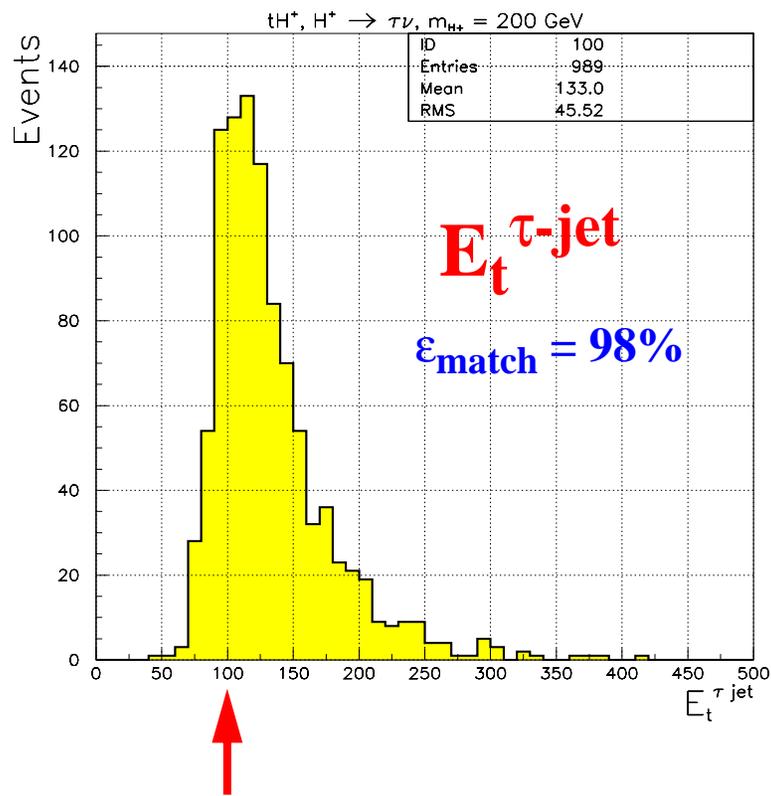
Algorithm (for the moment):

- ❖ Selection of τ - jet matching with generated $\tau \rightarrow$ hadrons
- ❖ Selection of b and q jets matching with the directions of generated quarks in $\text{top} \rightarrow b q \bar{q}$
- ❖ Generated tracks

Reconstructed $E_t^{\tau\text{-jet}}$ and E_t^{miss}

Jet reconstruction cone: $\Delta R = 0.4$ for τ jet

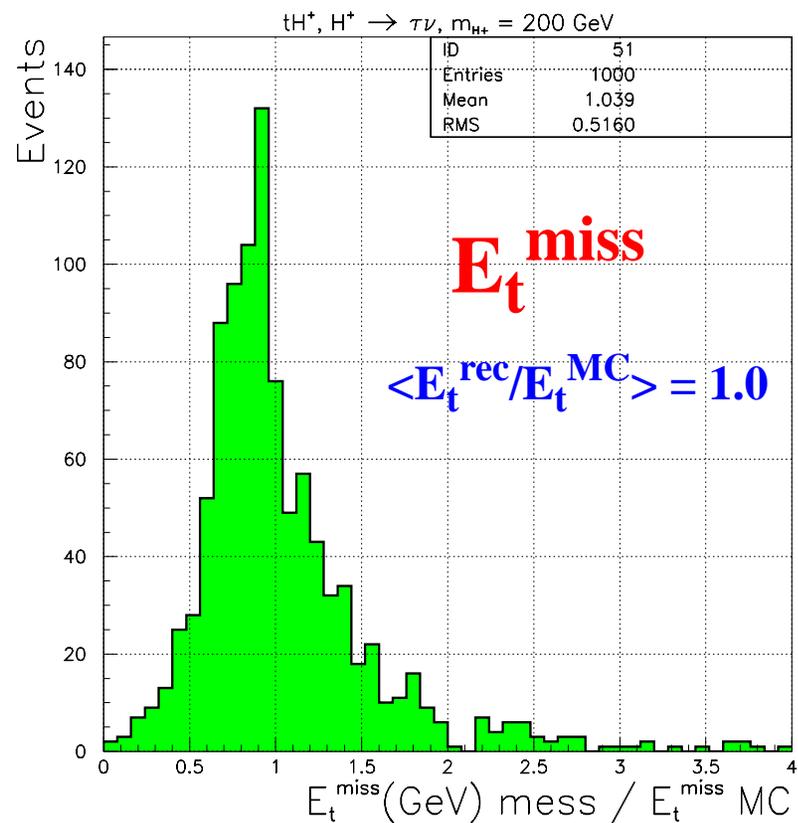
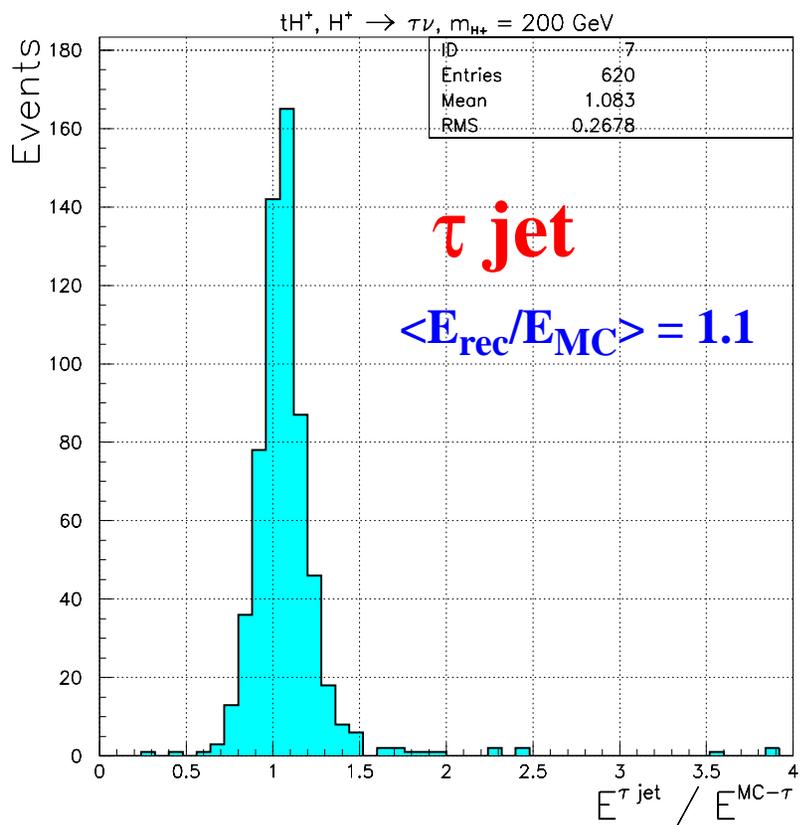
Matching cut: $\Delta R(\tau \rightarrow \text{hadrons, jet}) < 0.4$



Reconstructed / generated object

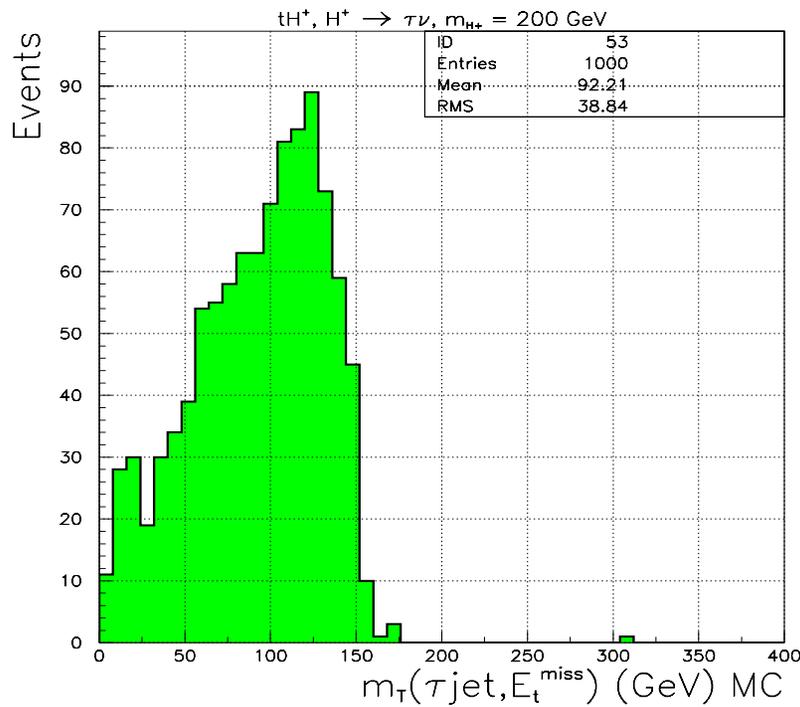
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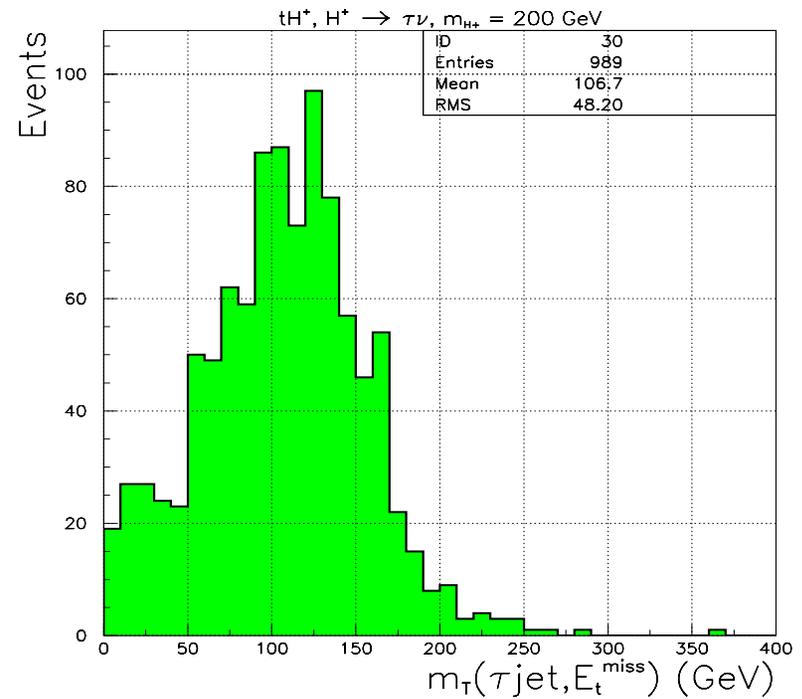
$m_T(E_t^{\tau\text{-jet}}, E_t^{\text{miss}})$, no cuts

Generated τ jet and E_t^{miss}



Reconstructed τ jet and E_t^{miss}

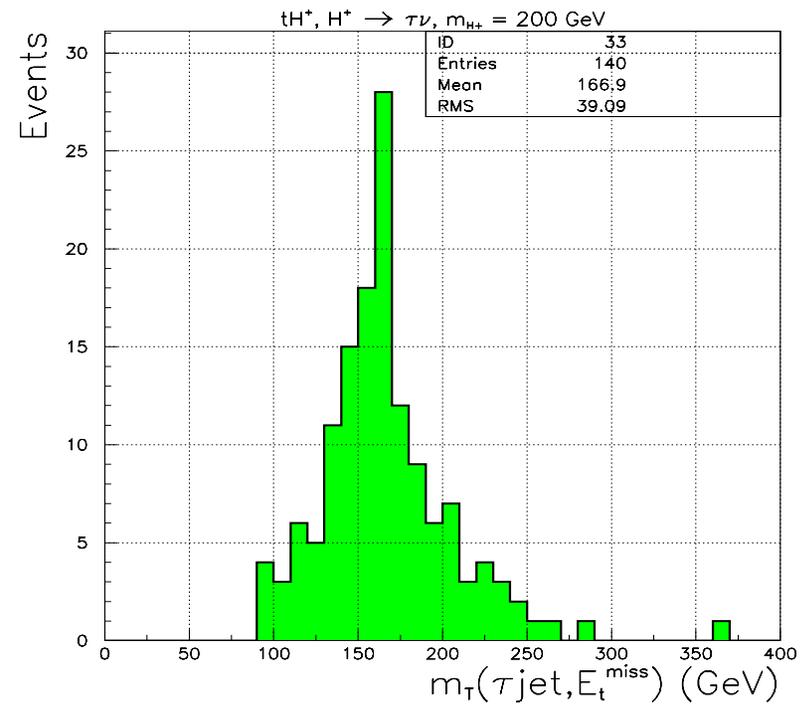
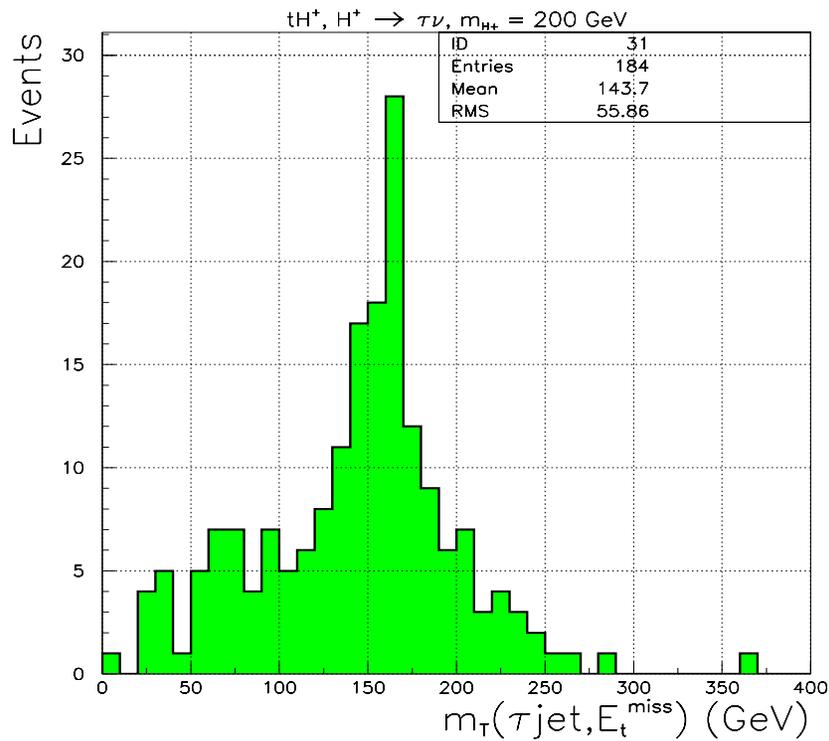
$\Delta R(\tau \rightarrow \text{hadrons, jet}) < 0.4$



Reconstructed $m_T(E_t^{\tau\text{-jet}}, E_t^{\text{miss}})$

$E_t^{\tau\text{-jet}} > 100 \text{ GeV}$, $E_t^{\text{miss}} > 100 \text{ GeV}$, $\Delta R(\tau \rightarrow \text{hadrons}, \text{jet}) < 0.4$

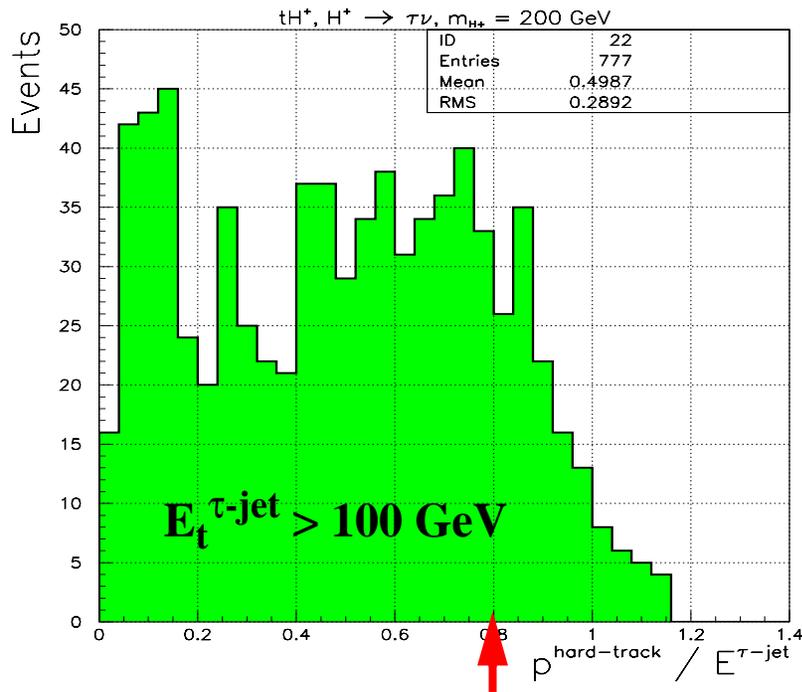
$\Delta\phi(E_t^{\tau\text{-jet}}, E_t^{\text{miss}}) > 60^\circ$



Fraction of τ jet energy carried by the leading pion

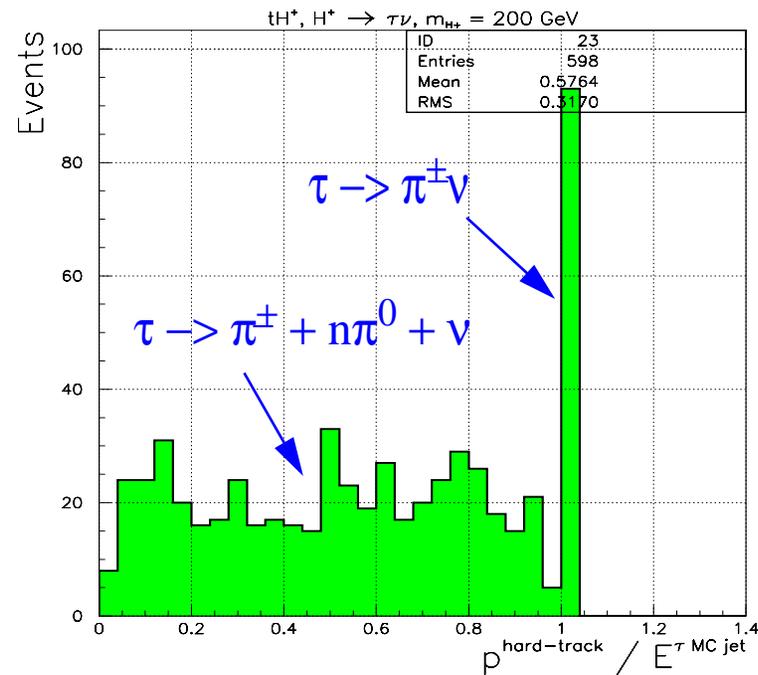
Polarization with TAUOLA, all hadronic τ decay modes, MC tracks

Reconstructed τ jet



Efficiency for $p^\pi / E^{\tau\text{-jet}} > 0.8$:
efficiency in fast simulation:

Generated τ jet

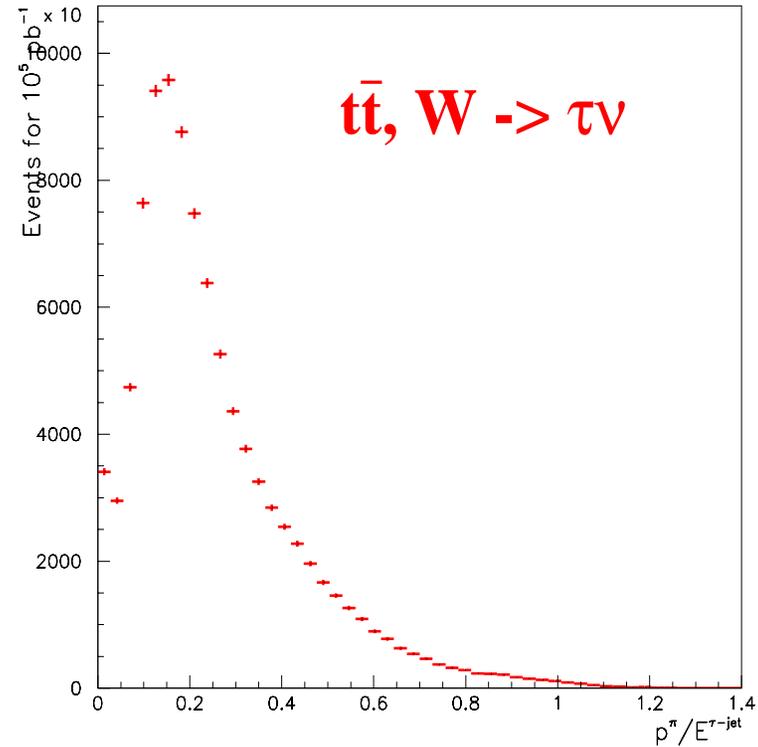
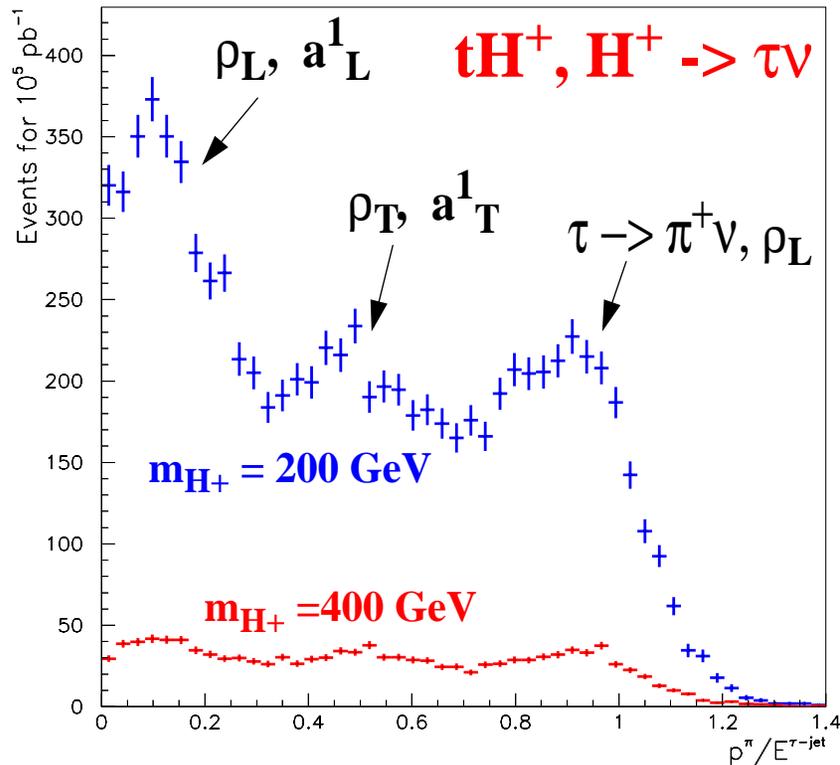


17% (pile-up ...)
26%

Fraction of τ -jet energy carried by a single pion

τ decay with TAUOLA, all hadronic τ decay channels included

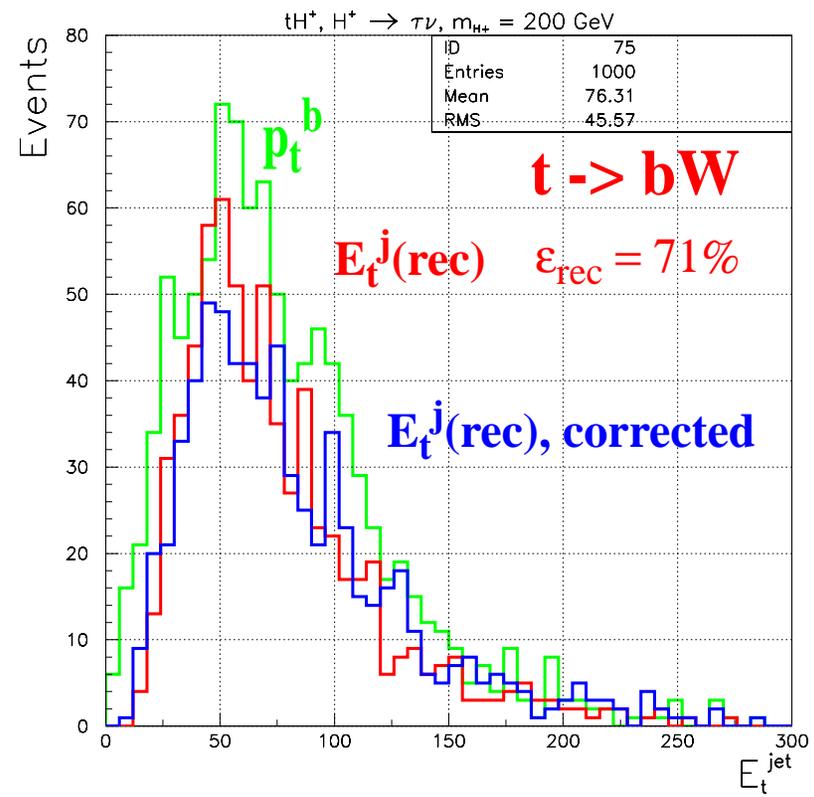
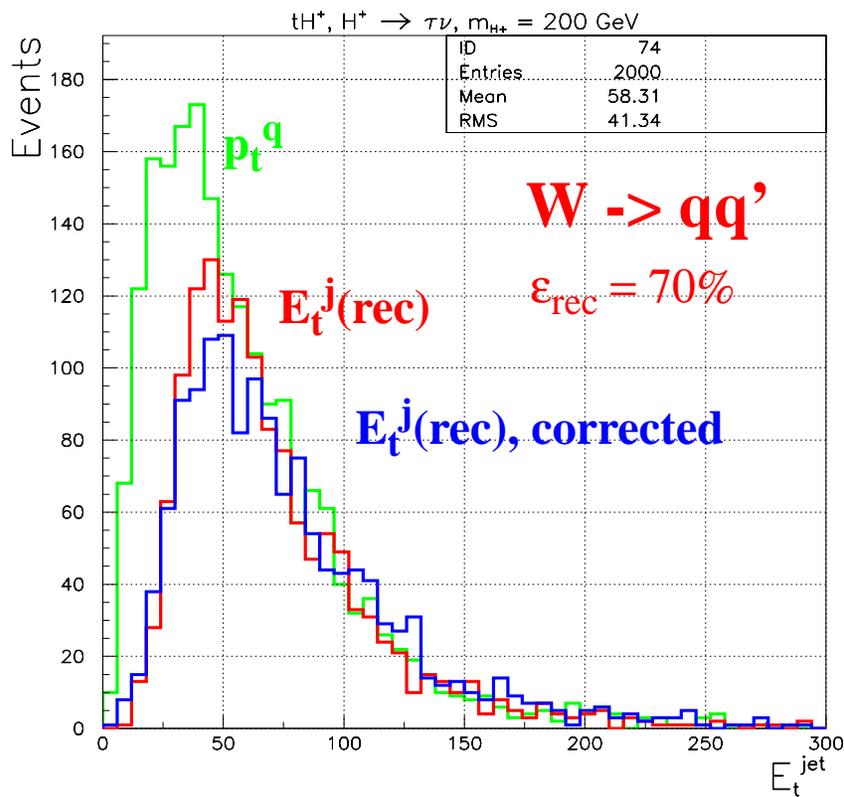
τ -jets reconstructed with CMSJET, $E_t^{\tau\text{-jet}} > 100$ GeV



Jets from W and top

jet reconstruction cone = 0.5

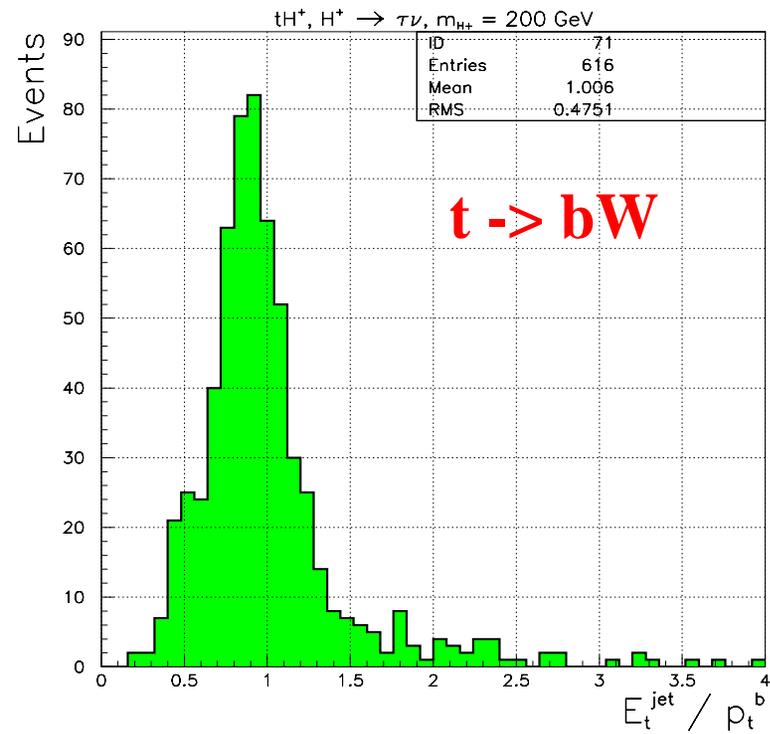
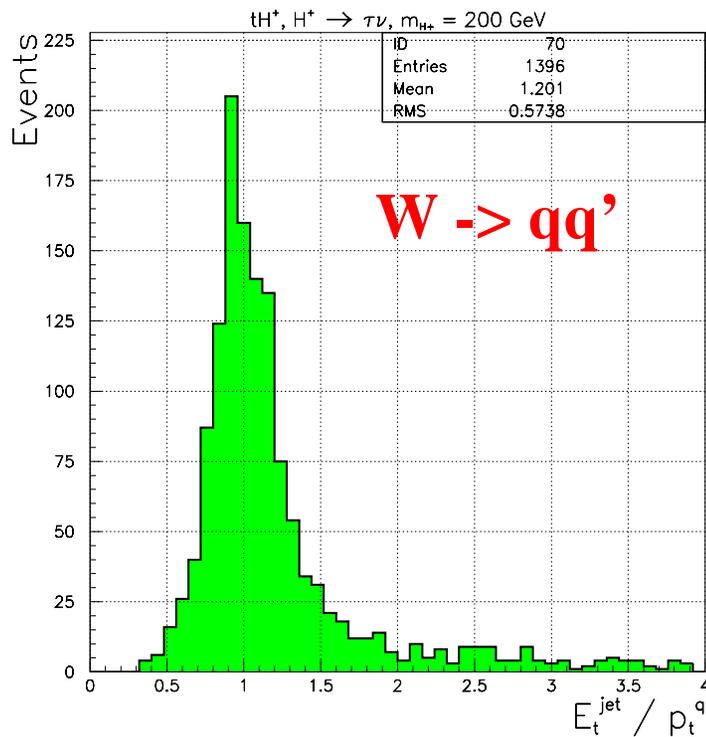
Jets with best matching with $W \rightarrow qq'$ and $t \rightarrow bqq'$, $\Delta R(\text{jet}, q) < 0.4$



Jets from W and top

Reconstructed / generated object

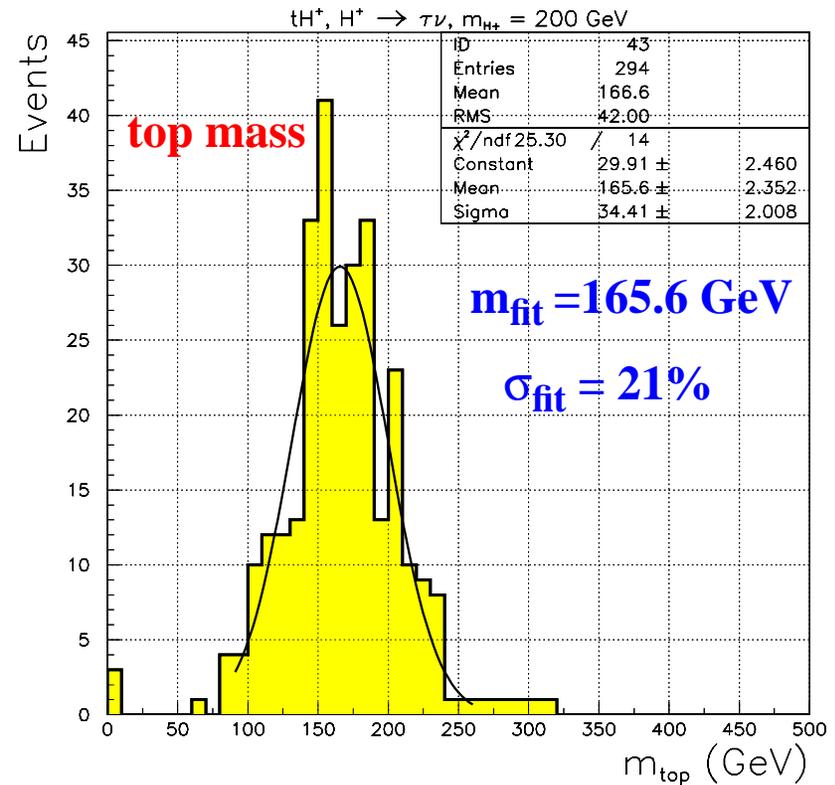
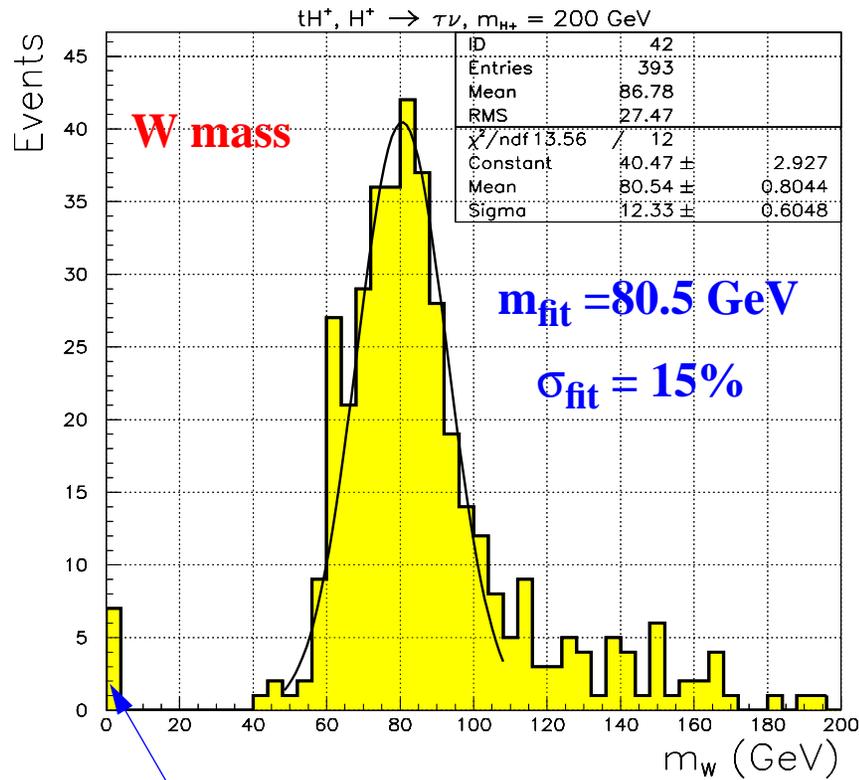
$$\Delta R(\text{jet}, q) < 0.4$$



W and top reconstruction, no jet energy corrections

jet reconstruction cone = 0.5, $E_t^{\text{jet}} > 30$ GeV

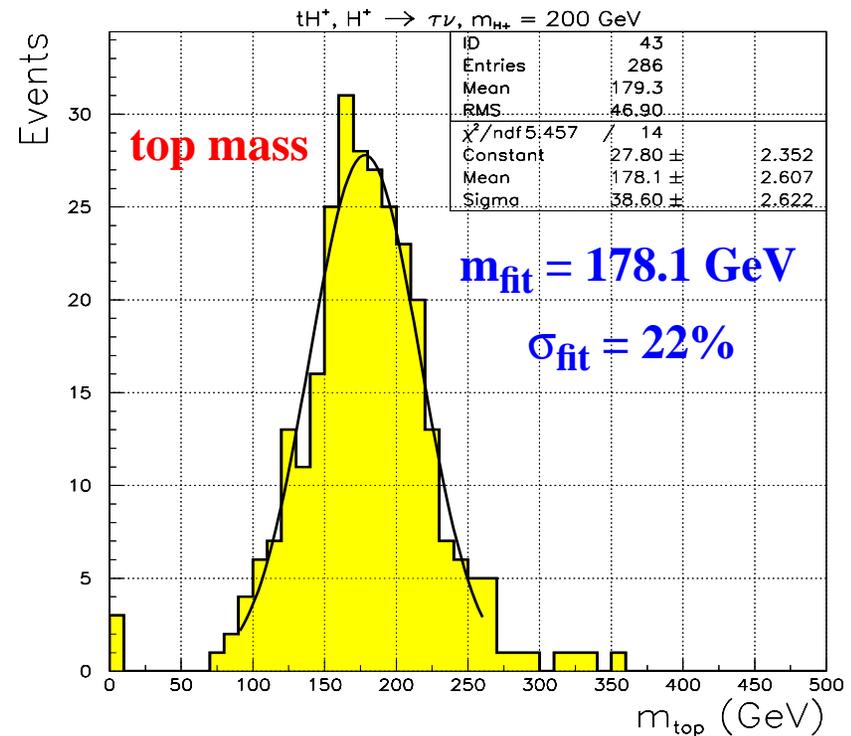
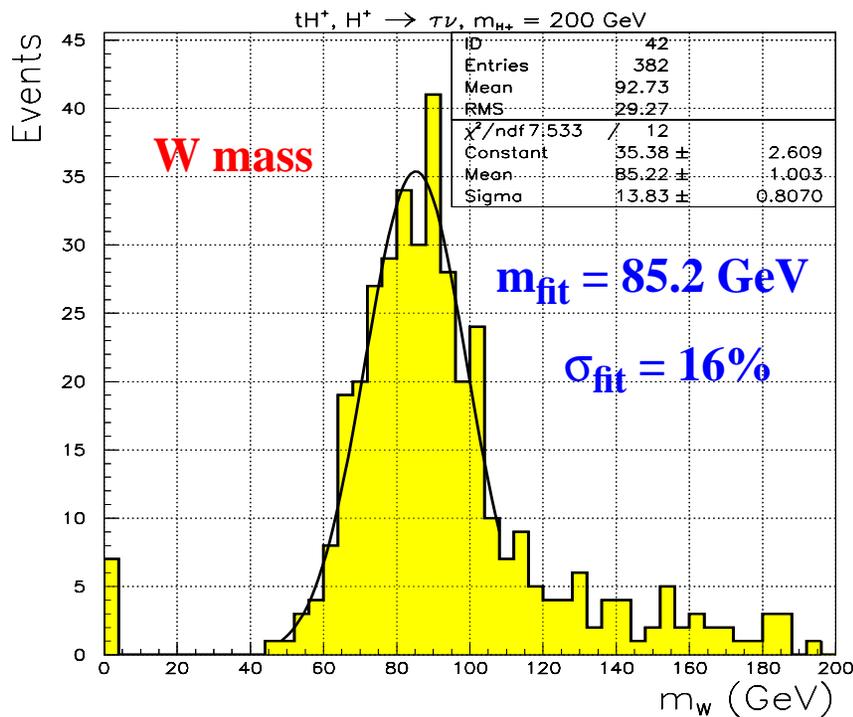
Jets with best matching with $W \rightarrow qq'$ and $t \rightarrow bqq'$, $\Delta R(\text{jet}, q) < 0.4$



W and top reconstruction with jet E_t corrections for $10^{34}\text{cm}^2\text{s}^{-1}$

jet reconstruction cone = 0.5, $E_t^{\text{jet}} > 30$ GeV

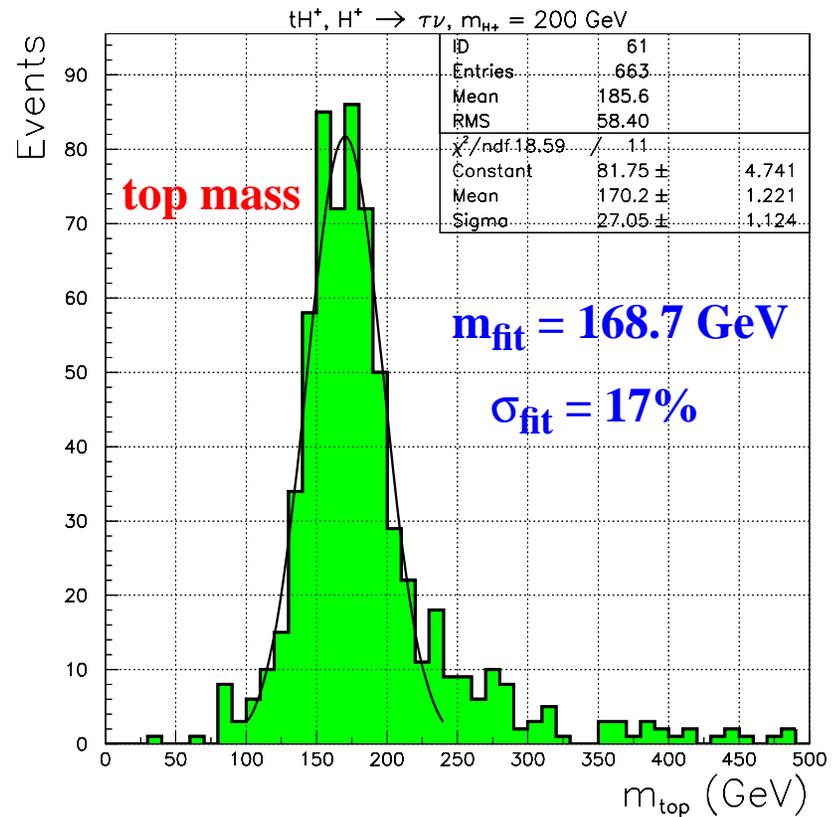
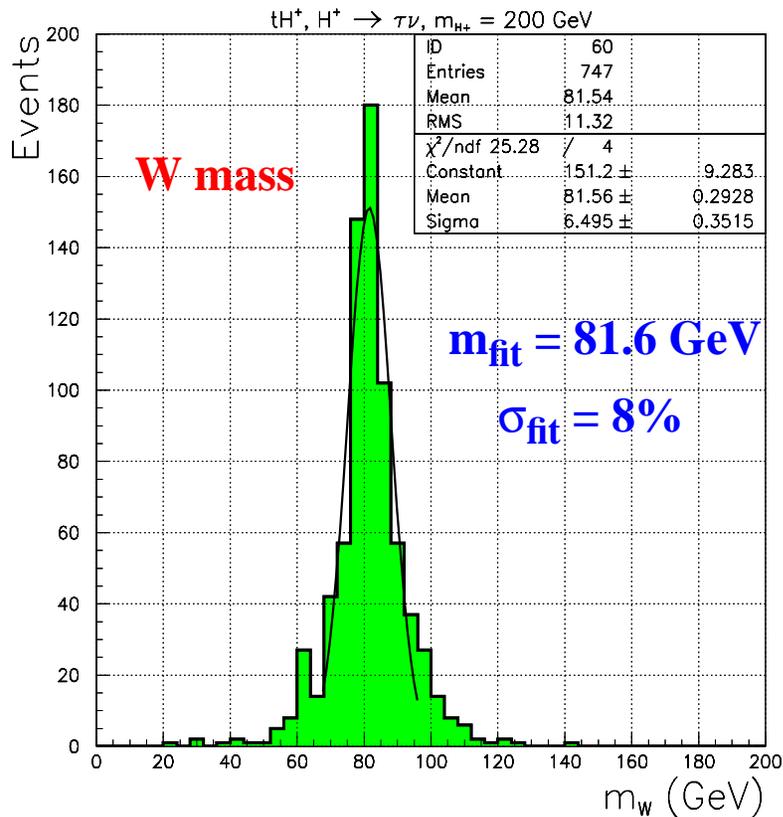
Jets with best matching with W \rightarrow qq' and t \rightarrow bqq', $\Delta R(\text{jet}, q) < 0.4$



W and top reconstruction, no jet energy corrections

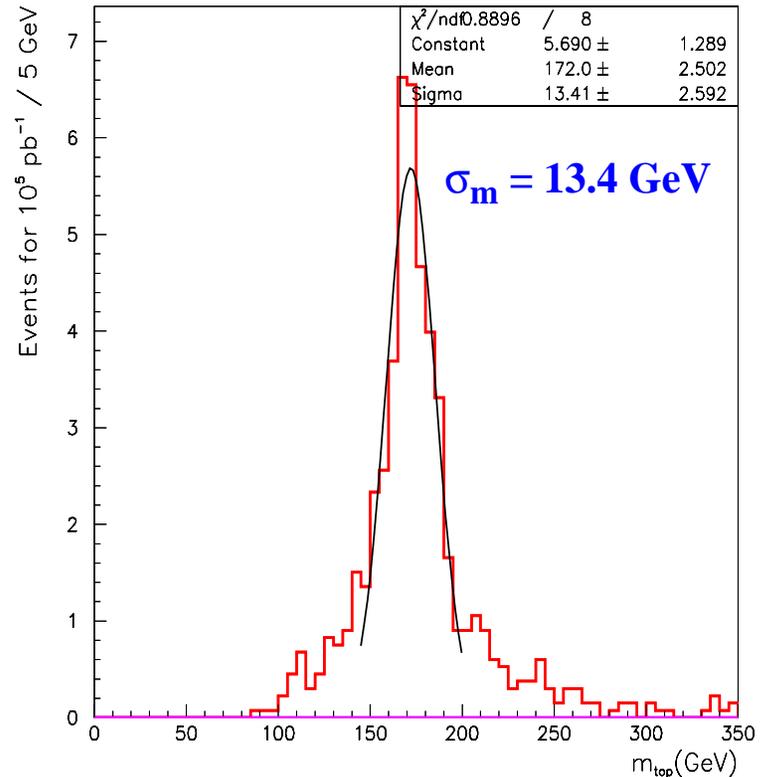
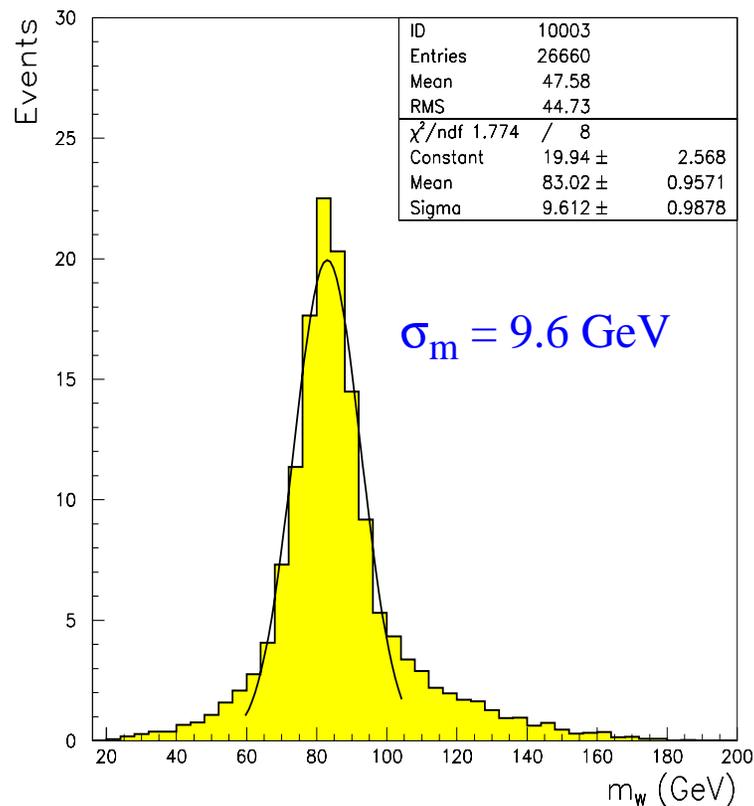
jet reconstruction cone = 0.5, $E_t^{\text{jet}} > 30$ GeV

Jet selection minimizing $(m_{j_1j_2} - m_W)$ and $(m_{j_1j_2j_3} - m_{\text{top}})$
including all jets not assigned to τ



Top and W mass with CMSJET

Reconstructed minimizing $(m_{jjj} - m_{\text{top}})^2 + (m_{jj} - m_W)^2$
pileup of 2 minimum bias events superimposed



Conclusions

First preliminary results from ORCA simulation:

- The Jacobian structure of $m_T(\tau\text{-jet}, E_t^{\text{miss}})$ is preserved for $m_{H^+} = 200$ GeV and for high luminosity!**
- W and top mass resolution not improved with the present jet energy corrections (for gluon jets)**