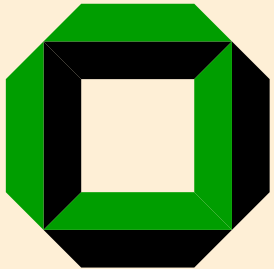


Single Top - Improvements

On behalf of the Single Top Analysis Group

F. Canelli, C. Ciobanu, S. Budd, T. Junk, Y. Kemp,
Th. Müller, S. Richter, B. Stelzer, W. Wagner,
Jeannine Wagner, T. Walter

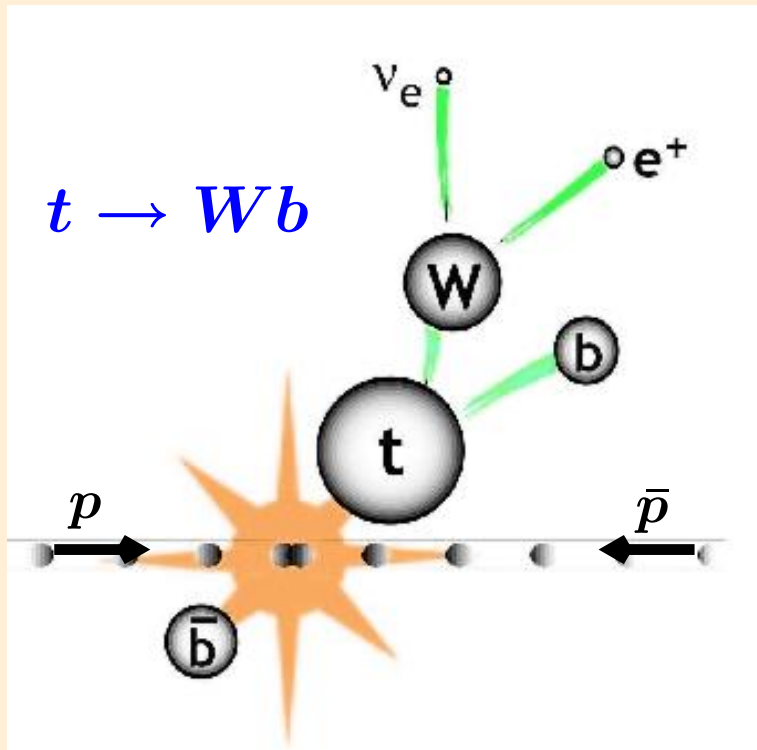


CDF Collaboration Meeting
Barcelona, 6/1/2005



- B-Tagging with NN
- Plug electrons with NN
- Check of Production Model

Motivation for Improvements



Single top publication:

Phys. Rev. D71, 012005 (2005)

◇ **b -tag using SecVtx:** $\approx 50\%$ of non-top BG from $W + c/uds$

⇒ **Increase purity** with improved b -tagging

◇ **Central e :** $|\eta(e)| < 1.1 \approx 70\%$

⇒ **Increase acceptance** including plug electrons

◇ **Signal modeling:**

⇒ **Comparison** between NLO and standard MC

Single top signature:

- ◇ $W + \text{Jets}$
- ◇ 1 high p_T lepton, high missing E_T
- ◇ ≥ 1 b -jet

B-Tagging With a Neural Net

Svenja Richter, Wolfgang Wagner

non-top BG (After SecVtx-Tag)	fraction [%]
$Wb\bar{b}$	33
$Wc\bar{c}, Wc$	24
$Wuds$	26
non-W	14
Di-boson	3

⇒ 50% of non-top BG from charm or light quarks

New B-Tagging exploits:

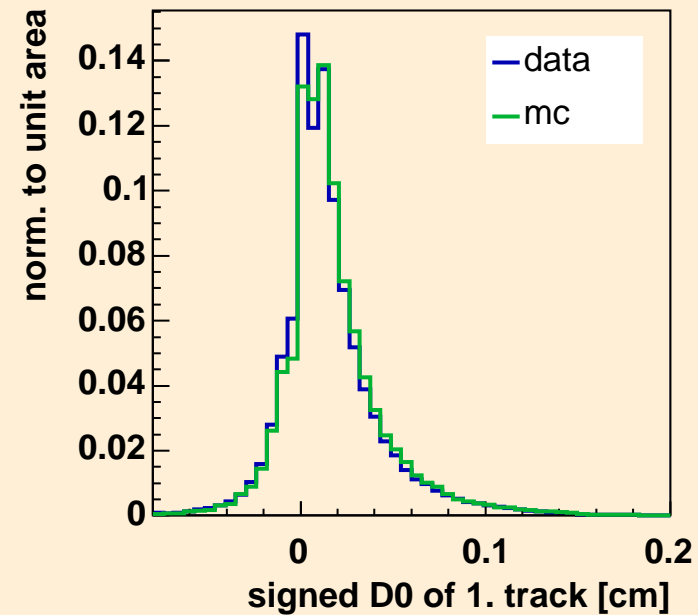
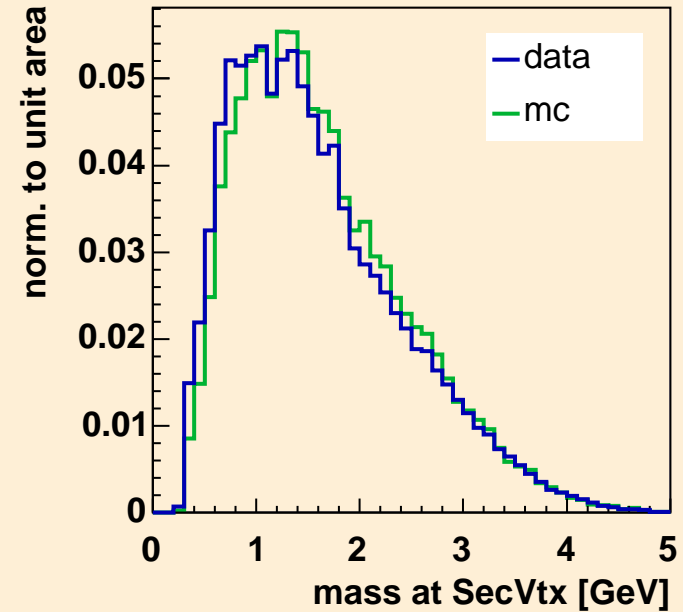
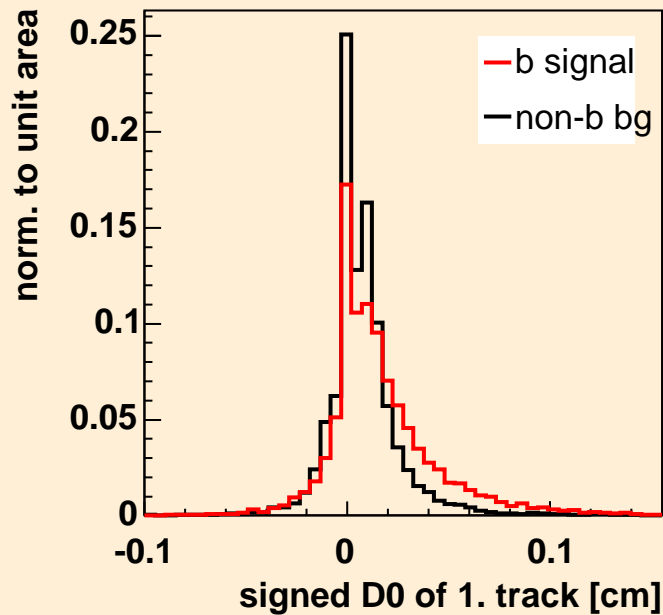
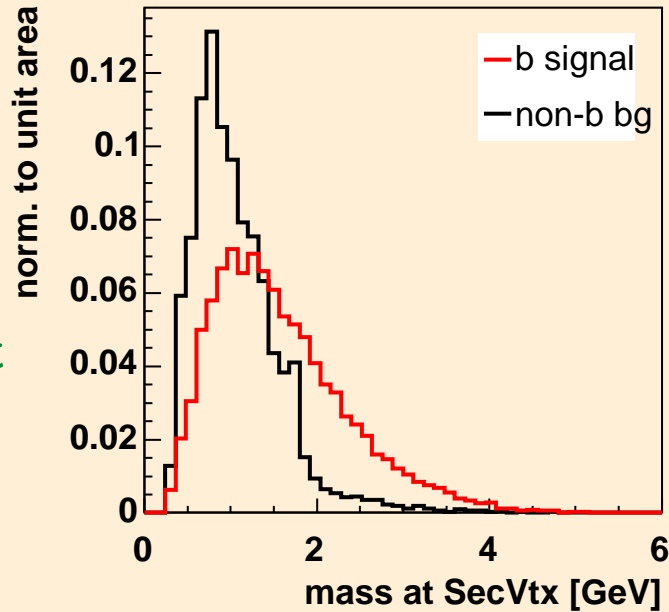
- ◇ Large lifetime (also used by SecVtx)
- ◇ High mass of b -hadrons
- ◇ High decay probability into leptons
- ◇ High track multiplicity

Combination of 23 quantities (relevance $> 4.5\sigma$) in a NN (NeuroBayes)

⇒ Correlations between quantities are exploited

Example of Used Quantities

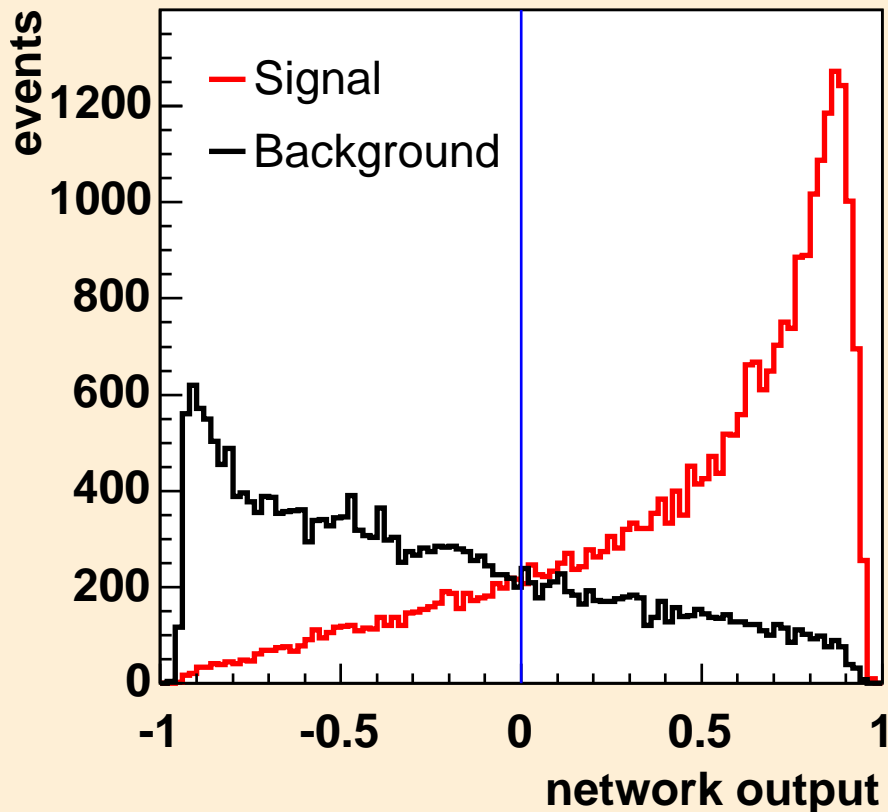
Different shapes for b -signal and BG (Version 5.3.3)



Data are described by the MC (incl. e sample used)

Performance of the Neural Net

Use sample composition according to BG estimation



Optimization on S/\sqrt{BG}

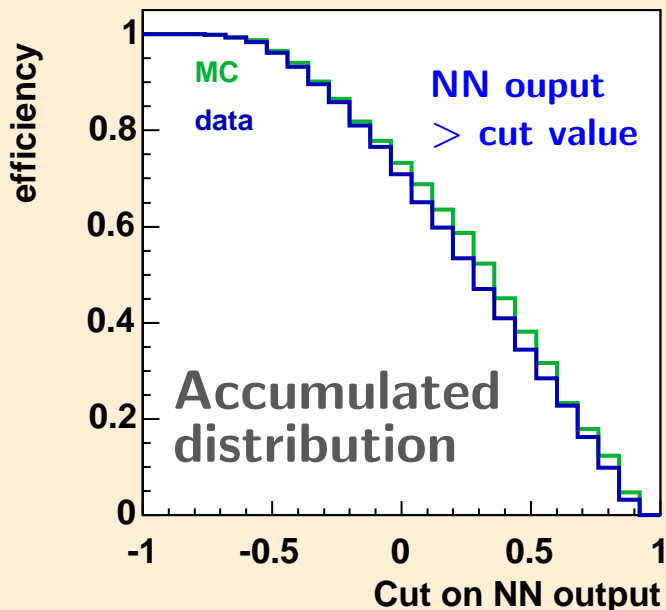
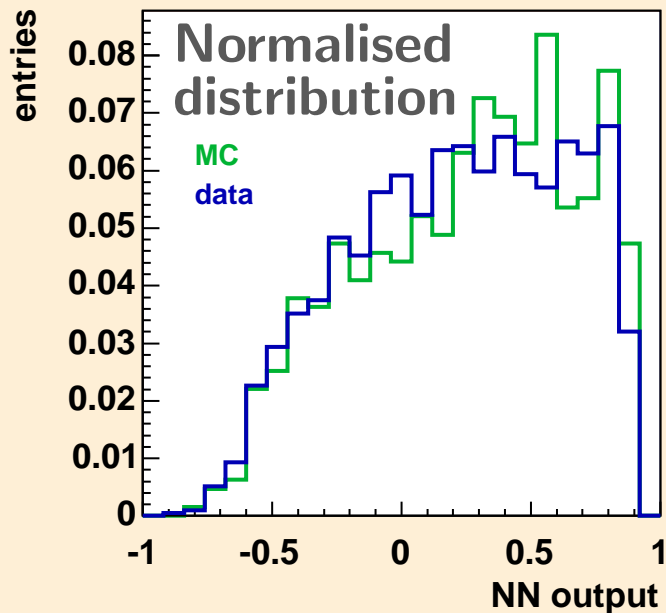
\Rightarrow cut on NN output of > -0.2

NN output > -0.2	cut efficiency [%]	
single top	90	signal
$t\bar{t}, Wb\bar{b}$	88	b-like BG
Wc/uds	40	non-b BG
Σ BG	67	

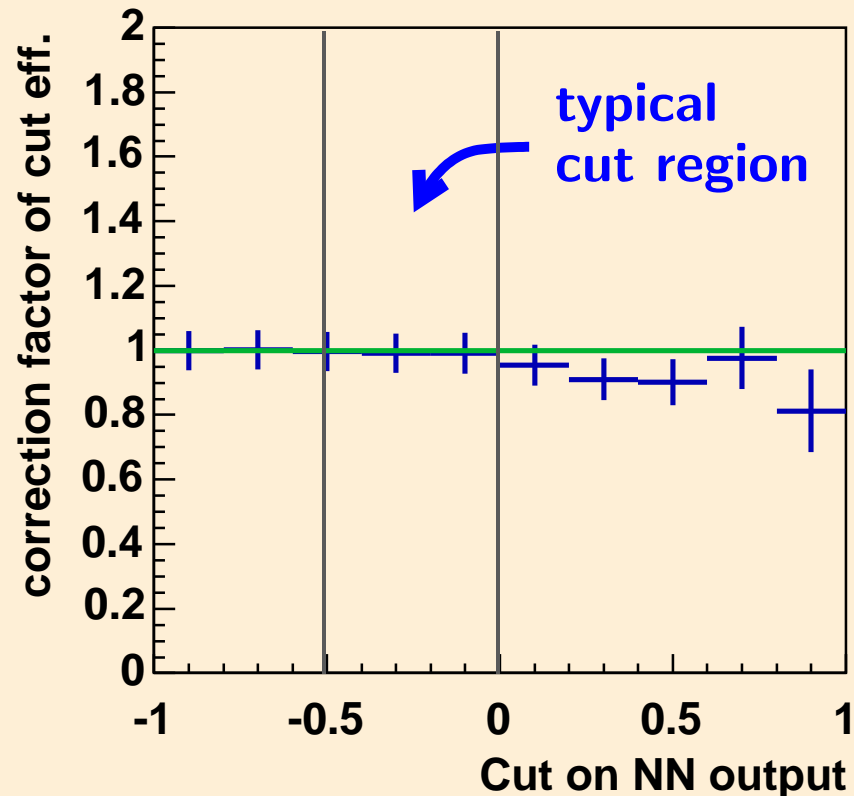
\Rightarrow **Expected purity increase for single top $\approx 35\%$**

◇ Good Separation

Scale Factor for Neural Net Efficiencies



- ◇ Select $b\bar{b}$ sample: (incl. 8 GeV e sample)
1 high p_T e near jet (SecVtx-Tag)
Use jet (SecVtx-Tag) opposite in ϕ for NN



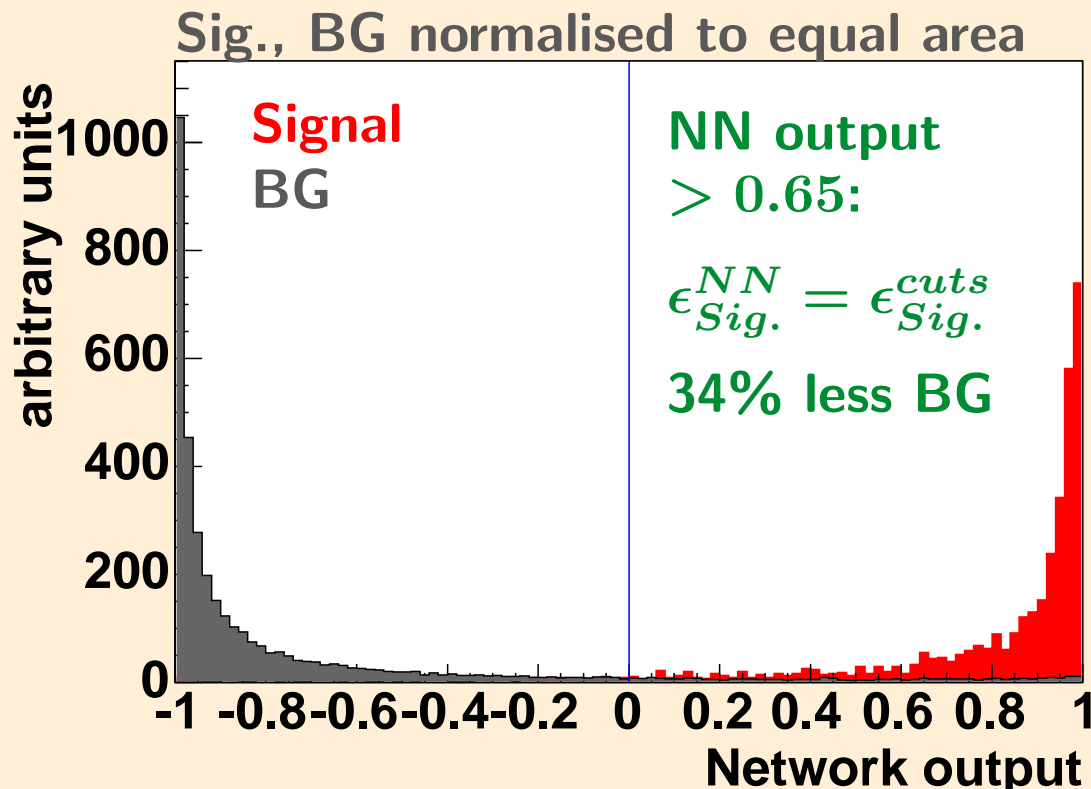
⇒ Scale factor: 1 ± 0.05

Plug Electrons Using a Neural Net

Yves Kemp, Wolfgang Wagner

- ◇ Use same quantities as in cut based selection
- ◇ Combine quantities in NN
- ⇒ Exploit correlations between quantities
- ◇ e -Signal: Z events
- ◇ BG: 2 jet events
- ◇ 1 very well measured central e /jet; e cand. in Plug

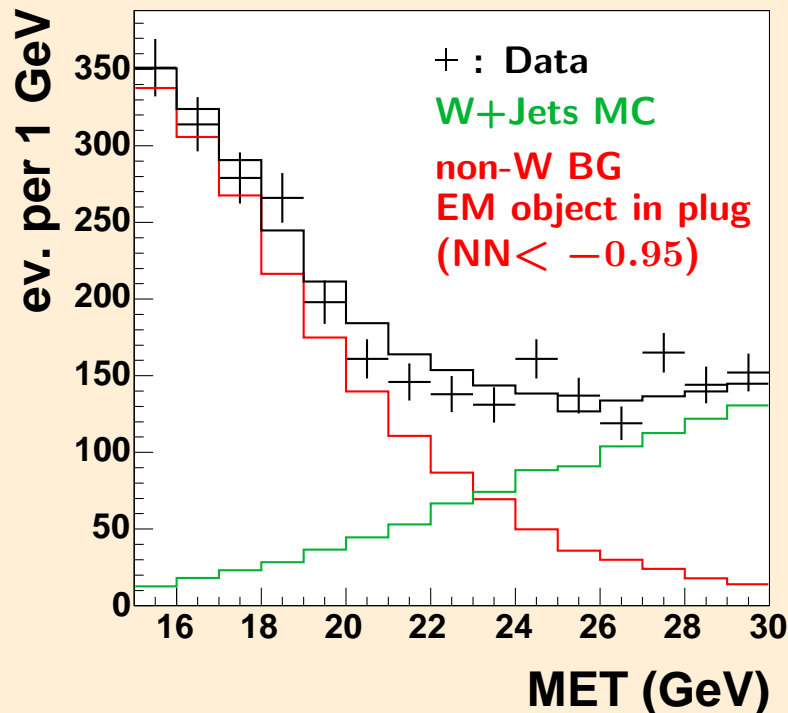
Good separation
(Version 4.11 used)



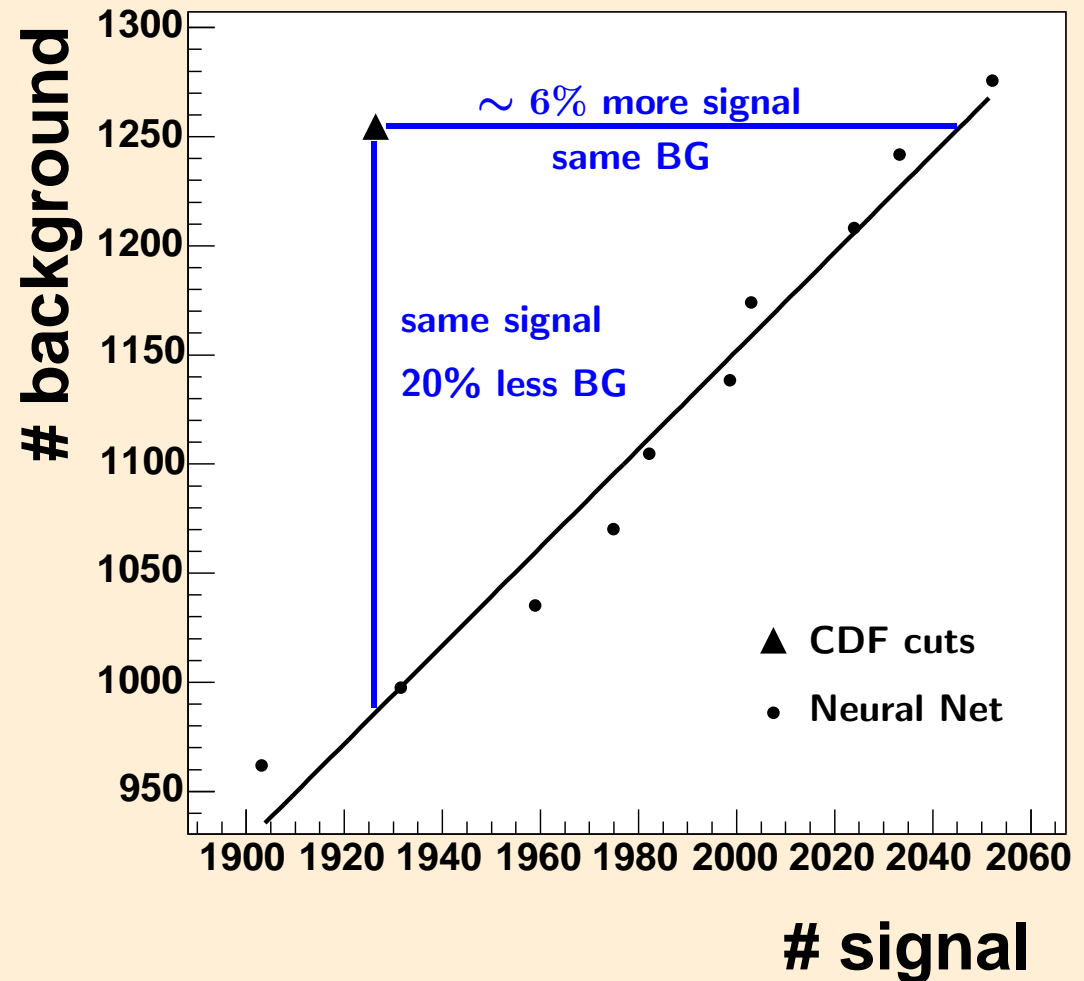
$\epsilon_{Sig.}^{NN}$, ϵ_{BG}^{NN} can
be optimized,
eg. S/\sqrt{BG}

Performance of NN for $W+Jets$ Events

- ◇ Determine signal fraction from fit to MET for different NN outputs



W+2jets (used for single top)

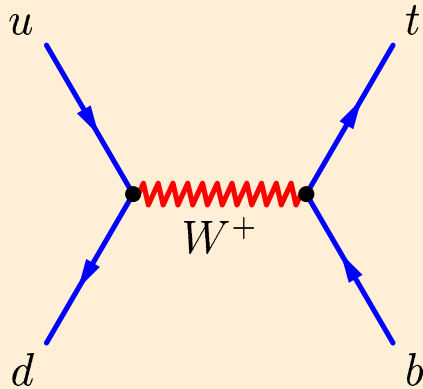


Optimisation e.g. on S/\sqrt{BG} possible

Check of Single Top Production Model

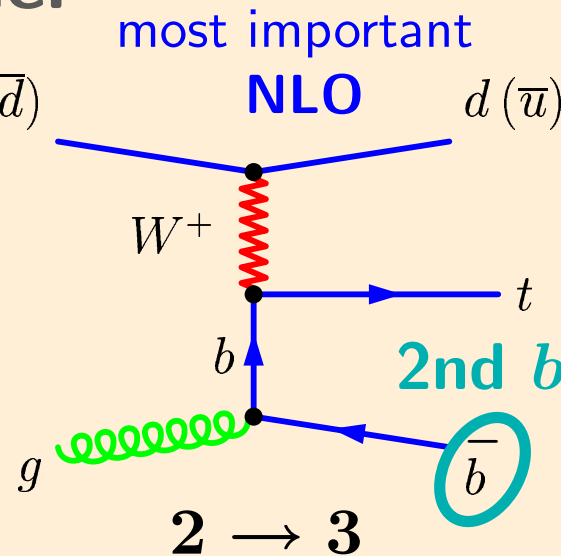
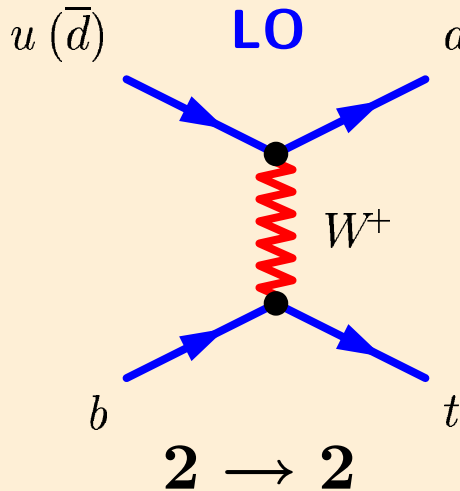
Jan Lück, Wolfgang Wagner

Single top: $t \rightarrow bW$



s-channel
(no problem)

t-channel



Pythia:

$2 \rightarrow 3$ process not simulated (t-channel)

\Rightarrow Modeling of 2nd b wrong



MadEvent:

$p_T^{2nd b} \leq 10$ GeV: $2 \rightarrow 2$

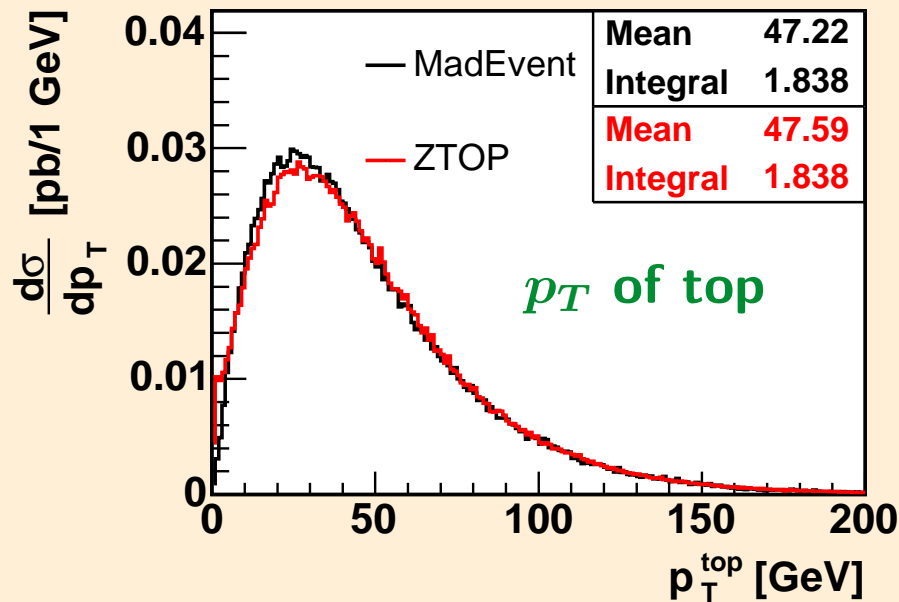
$p_T^{2nd b} > 10$ GeV: $2 \rightarrow 3$

(current 5.3.3 official samples)

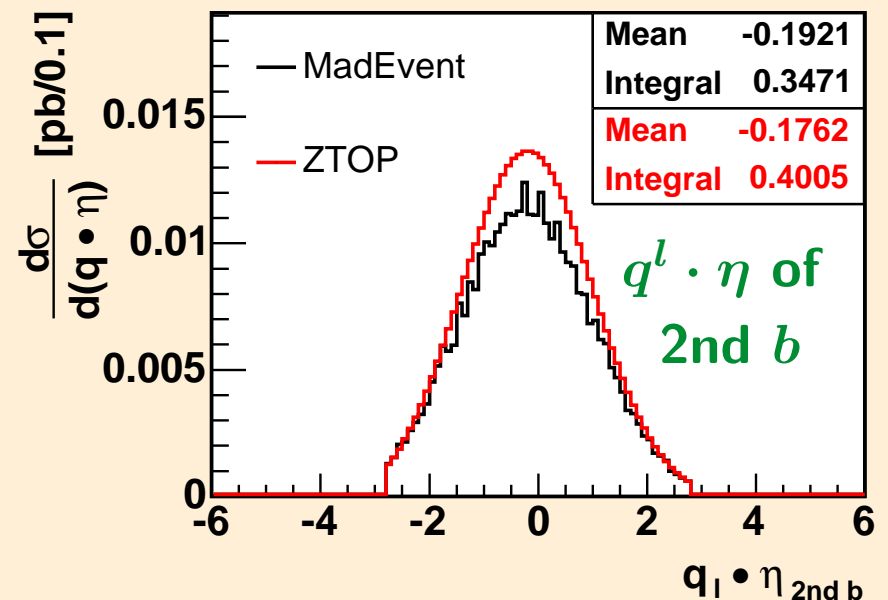
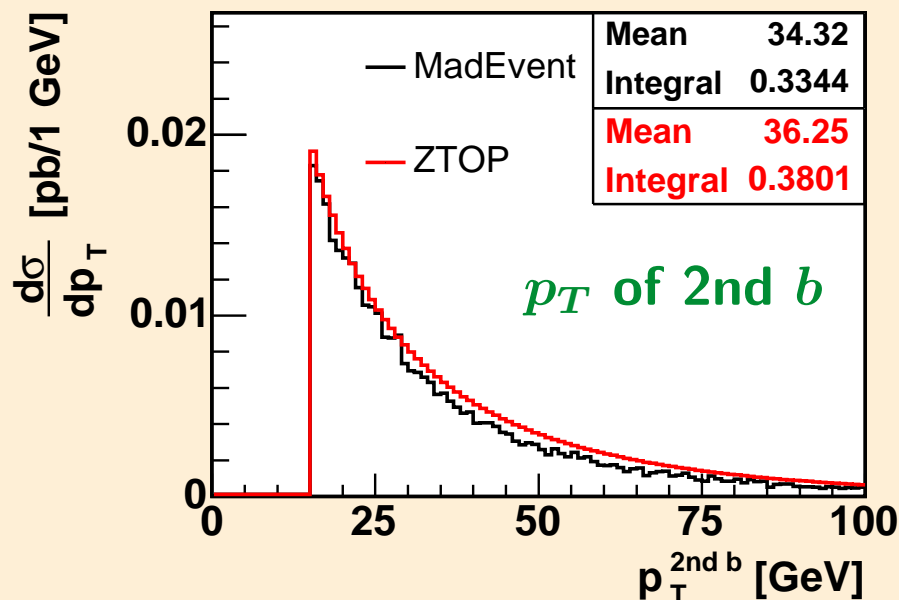


Comparison with
NLO calculation?

Matched MadEvent versus NLO (ZTOP)



- ◇ Good Qualitative agreement between MadEvent and NLO
 ⇒ Matching works ✓
- ◇ Will use comparison to derive syst. error on model uncertainty (so far obtained from dev. between TopRex and MadEvent)



Summary and Outlook

Working on several improvements for single top analysis:

- ◇ NN for b -tagging (based on SecVtx-Tag):
 - ▷ Estimated purity increase for single top $\approx 35\%$
 - ▷ Scale factor for NN output cut efficiency: 1 ± 0.05
 - ▷ **Outlook:** Development of a NN without SecVtx-Tag req. (e.g. useful for events with ≥ 2 b-jets)
- ◇ Acceptance increase using Plug e ($|\eta(e)| > 1.1 \approx 30\%$):
 - ▷ NN: 20% less QCD BG for same signal ($W+2$ jets)
- ◇ Check of single top production model:
 - ▷ Good agreement between matched MadEvent and NLO
 - ▷ **Outlook:** Use deviations between MadEvent and NLO to derive syst. error on model uncertainty