

Single top production at hadron colliders

Francesco Tramontano

In collaboration with J. Campbell, R. Frederix and F. Maltoni

Single top production has been observed this year:

$$\sigma_{NLO} @ Tevatron \approx 3 \text{ pb}$$

5σ Statistical significance

arXiv:0903.0885

CDF Collaboration 3.2 fb^{-1}

$2.3_{-0.5}^{+0.6} (\text{stat} + \text{sys}) \text{ pb}$ $|V_{tb}| > 0.71$ at the 95% C.L.

$|V_{tb}| = 0.91_{-0.11}^{+0.11} (\text{stat} + \text{sys}) \pm 0.07(\text{theory})$

arXiv:0903.0850

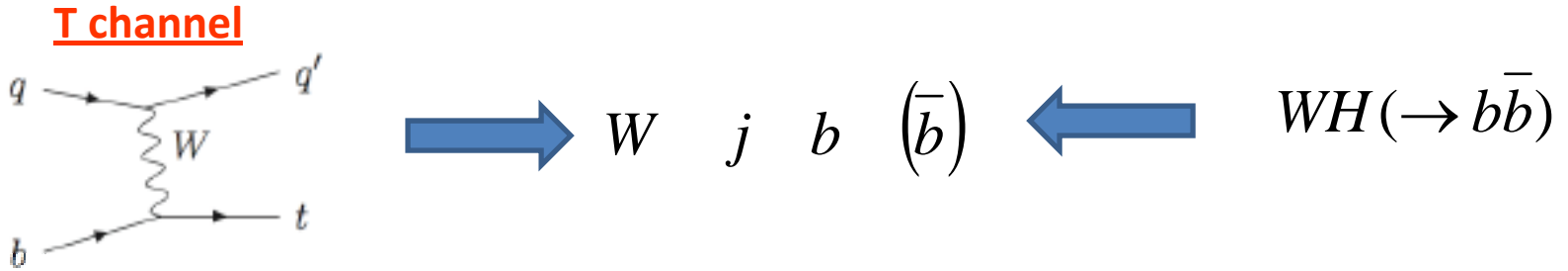
$D\bar{\theta}$ Collaboration 2.3 fb^{-1}

$\sigma(p\bar{p} \rightarrow tb + X, tqb + X) = 3.94 \pm 0.88 \text{ pb}$

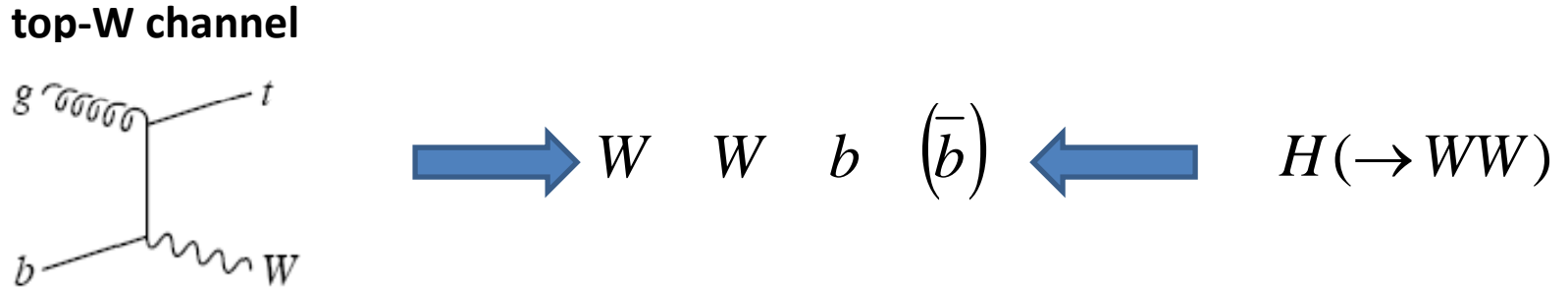
Leading Order processes to produce a single top

$$\sigma_{NLO} @ LHC \approx 316 pb \sim \frac{1}{3} \sigma(t\bar{t})$$

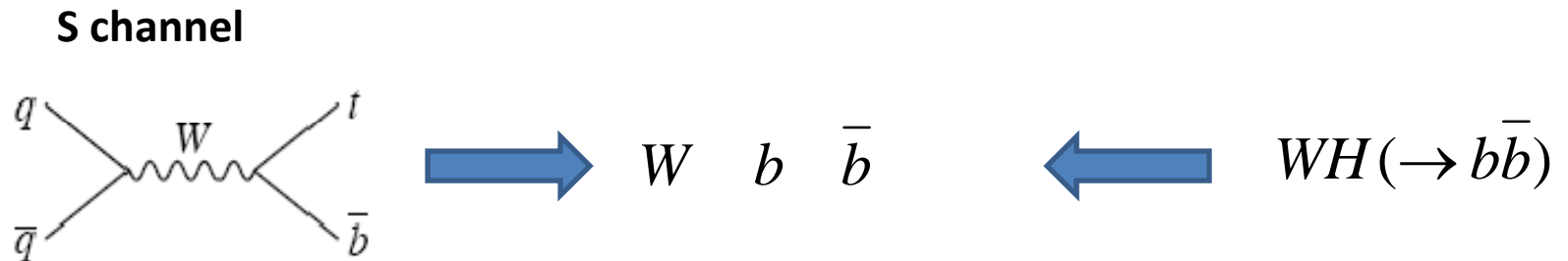
240 pb



66 pb

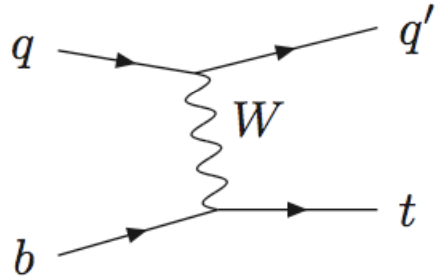


10 pb



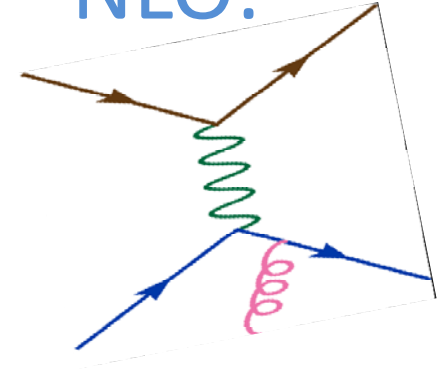
At NLO there are two ways to start: 1. with HQpdf

LO: $2 \rightarrow 2$



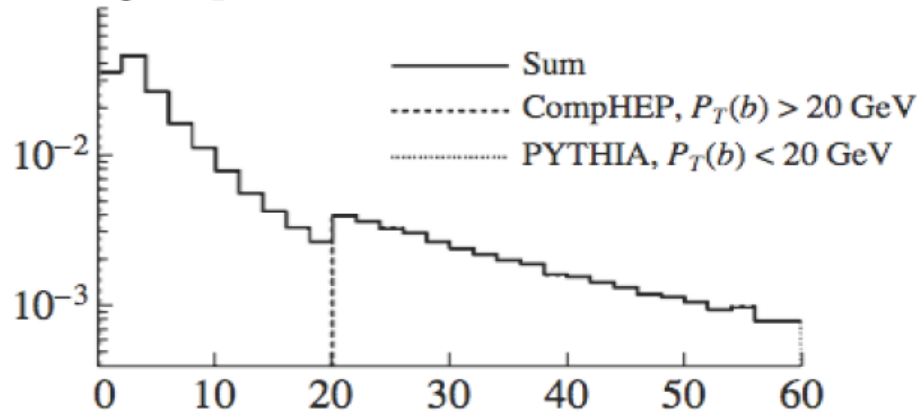
Resummation
of collinear log
b-pdf

NLO:



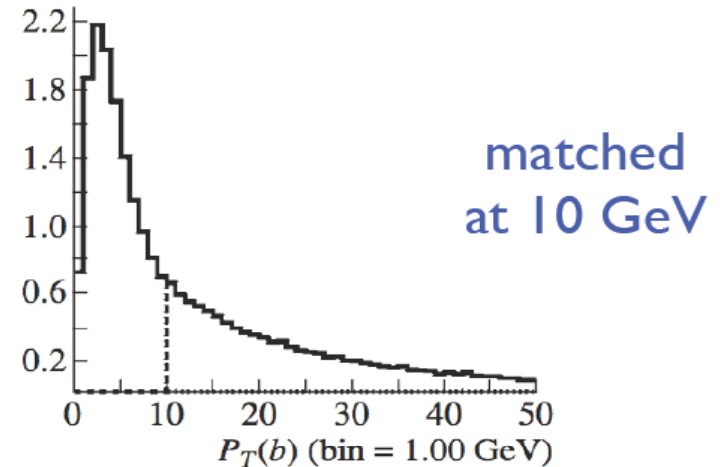
The extra b enters in the NLO corrections

$d\sigma/dP_T(b)$, pb/GeV



Boos et al
Phys At Nucl
(2006)

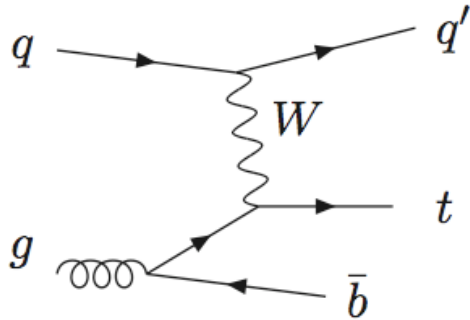
$dN_{\text{event}}/dP_T(b)$, GeV^{-1}



At NLO the extra b distributions are predicted with an accuracy comparable to the one obtained with the lowest order of the 2 \rightarrow 3 computation

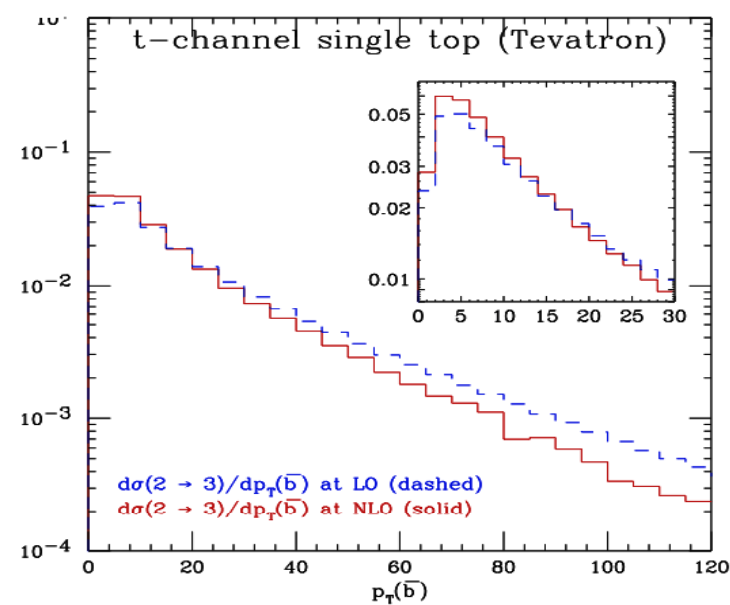
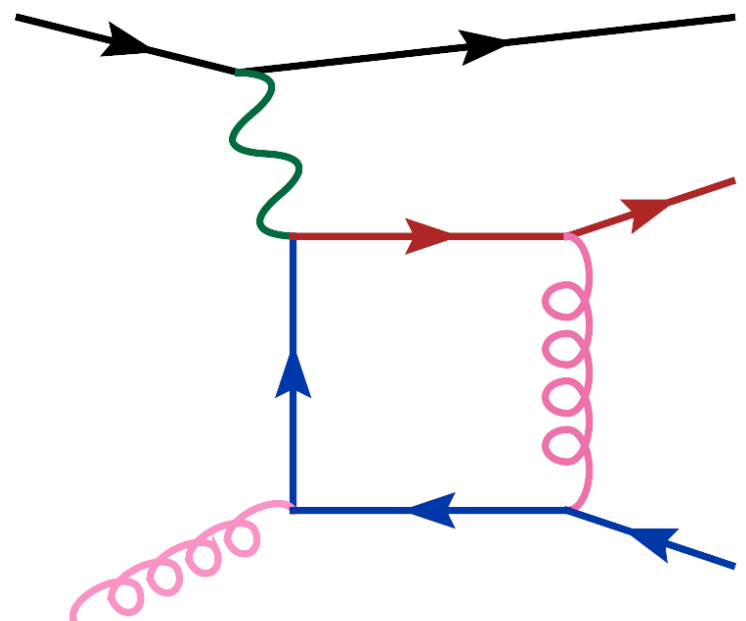
2. without HQpdf

LO: $2 \rightarrow 3$



The extra b enters at the LO

NLO: $2 \rightarrow 3$



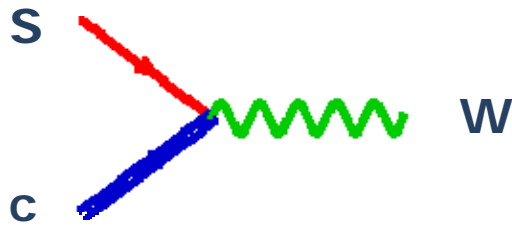
Campbell et al
PRL (2009)

At NLO the extra b distributions are predicted with truly with NLO accuracy

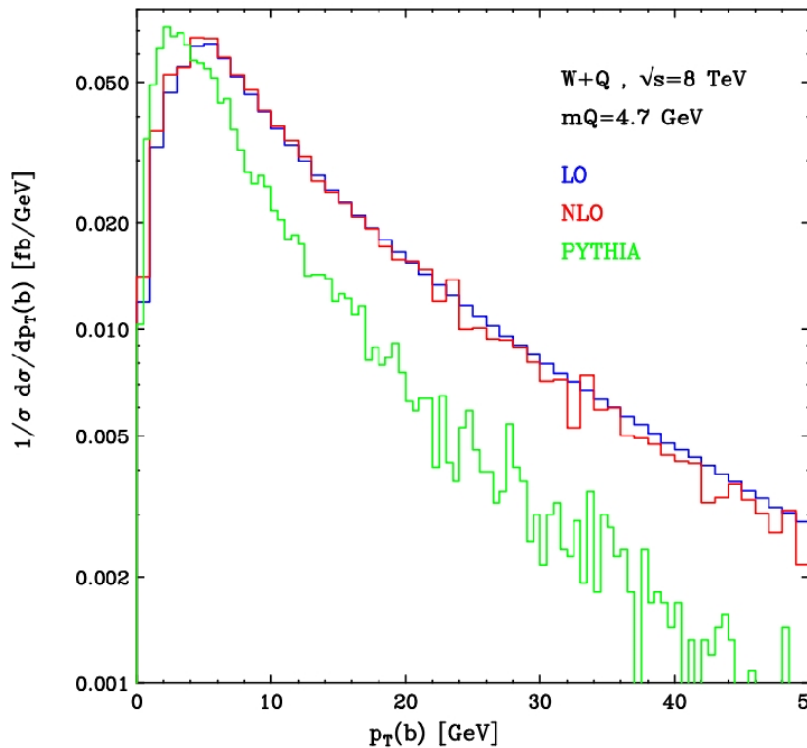
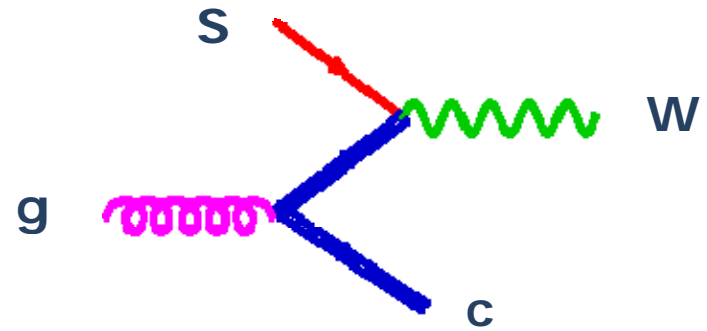
Similar behaviour in $gs \rightarrow cW$

Campbell, Maltoni, Mangano, Tramontano, in progress

LO: $2 \rightarrow 1$



LO: $2 \rightarrow 2$



- Pt spectrum of the spectator HQ unchanged
- No call for resummation
- 2 to 2 prediction for the spectator theoretically solid

Results: T channel total cross-section

Campbell et al
JHEP (2009)

$$\sigma = \sigma_{central} \begin{matrix} +\Delta_{\mu}^{+} & +\Delta_{pdf}^{+} & +\Delta_{m_t}^{+} & +\Delta_{m_b}^{+} \\ -\Delta_{\mu}^{-} & -\Delta_{pdf}^{-} & -\Delta_{m_t}^{-} & -\Delta_{m_b}^{-} \end{matrix}$$

$\sigma_{t\text{-ch}}^{\text{NLO}}(t + \bar{t})$	$2 \rightarrow 2$ (pb)					$2 \rightarrow 3$ (pb)				
Tevatron Run II	1.96	+0.05 -0.01	+0.20 -0.16	+0.06 -0.06	+0.05 -0.05	1.87	+0.16 -0.21	+0.18 -0.15	+0.06 -0.06	+0.04 -0.04
LHC (10 TeV)	130	+2 -2	+3 -3	+2 -2	+2 -2	124	+4 -5	+2 -3	+2 -2	+2 -2
LHC (14 TeV)	244	+5 -4	+5 -6	+3 -3	+4 -4	234	+7 -9	+5 -5	+3 -3	+4 -4

Resummation does not seem to play an important role

To do list:

- ❑ Detailed assesment of impact on current single top searches
- ❑ Inclusion of top decay (we worked with helicity amplitudes)
- ❑ Inclusion in a full shower Monte Carlo program (a la MC@NLO)