Large-Q_T W-boson production at the Tevatron

Nikolaos Kidonakis

(Univ. of Cambridge and Kennesaw State Univ.)

- W production at large Q_T
- NNLO threshold corrections
- W production at the Tevatron

N. Kidonakis and A. Sabio Vera, JHEP 02, 027 (2004)

W production at large Q_T

W hadroproduction useful in estimates of backgrounds to new physics (Higgs)

Q_T distribution falls rapidly as Q_T increases

Full NLO results available

Arnold, Reno (1989); Gonsalves, Pawlowski, Wai (1989)

Partonic channels

$$q(p_a) + g(p_b) \longrightarrow W(Q) + q(p_c)$$

$$q(p_a) + \bar{q}(p_b) \longrightarrow W(Q) + g(p_c)$$

Define $s = (p_a + p_b)^2$, $t = (p_a - Q)^2$, $u = (p_b - Q)^2$

and $s_2 = s + t + u - Q^2$

At threshold $s_2 \to 0$

Soft corrections $\left[\frac{\ln^l(s_2/Q_T^2)}{s_2}\right]_+$

Virtual corrections $\delta(s_2)$

Soft-gluon corrections

$$\mathcal{D}_l(s_2) \equiv \left[\frac{\ln^l(s_2/Q_T^2)}{s_2}\right]_+$$

For the order α_s^n corrections $l \leq 2n-1$

At NLO, $\mathcal{D}_1(s_2)$, $\mathcal{D}_0(s_2)$, and $\delta(s_2)$ terms

At NNLO, $\mathcal{D}_3(s_2)$, $\mathcal{D}_2(s_2)$, $\mathcal{D}_1(s_2)$, $\mathcal{D}_0(s_2)$, and $\delta(s_2)$ terms LL, NLL, NNLL, NNNLL

We can formally resum these logarithms to all orders in α_s N. Kidonakis and V. Del Duca, Phys. Lett. B 480, 87 (2000)

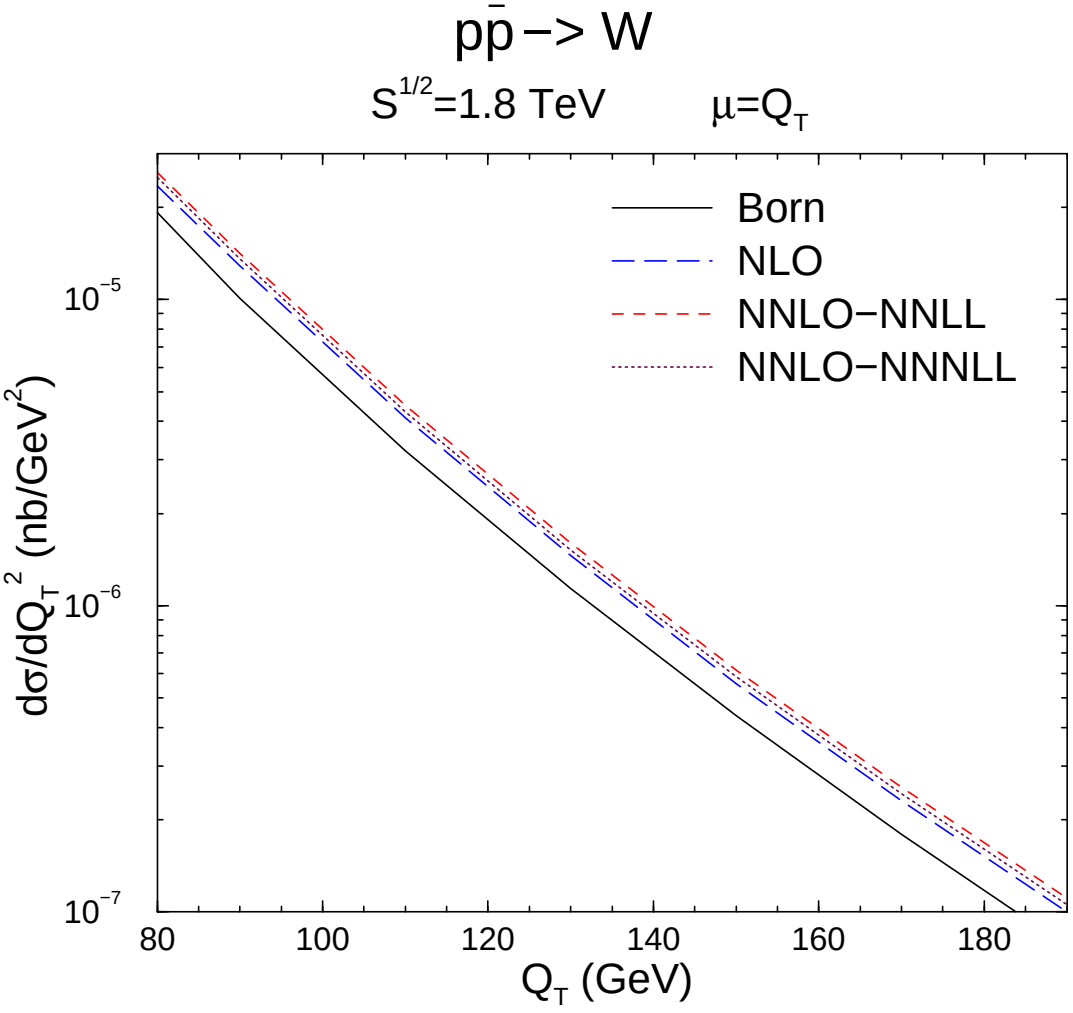
A unified approach and a master formula for calculating these distributions at NNLO for any process

N. Kidonakis, Int. J. Mod. Phys. A 19, 1793 (2004)

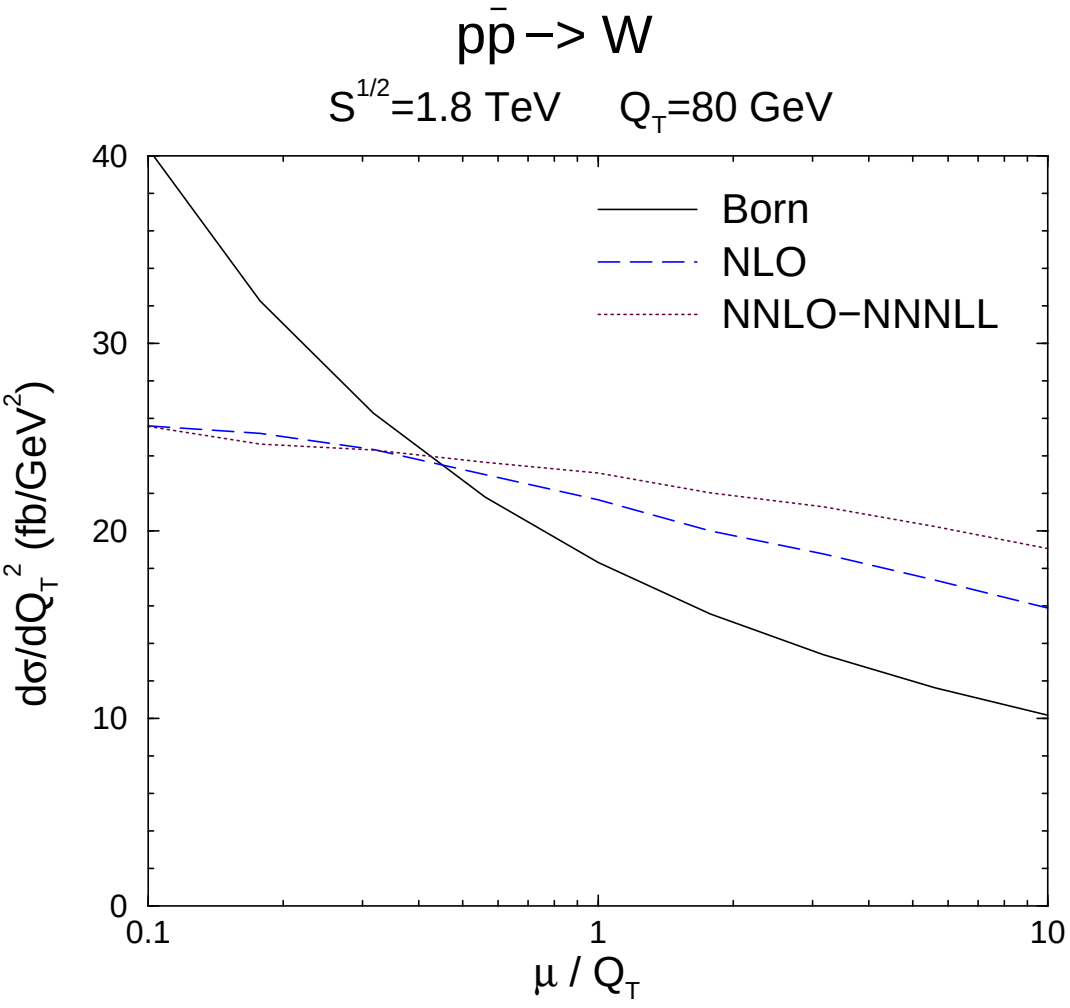
Applied to W production in

N. Kidonakis and A. Sabio Vera, JHEP 02, 027 (2004)

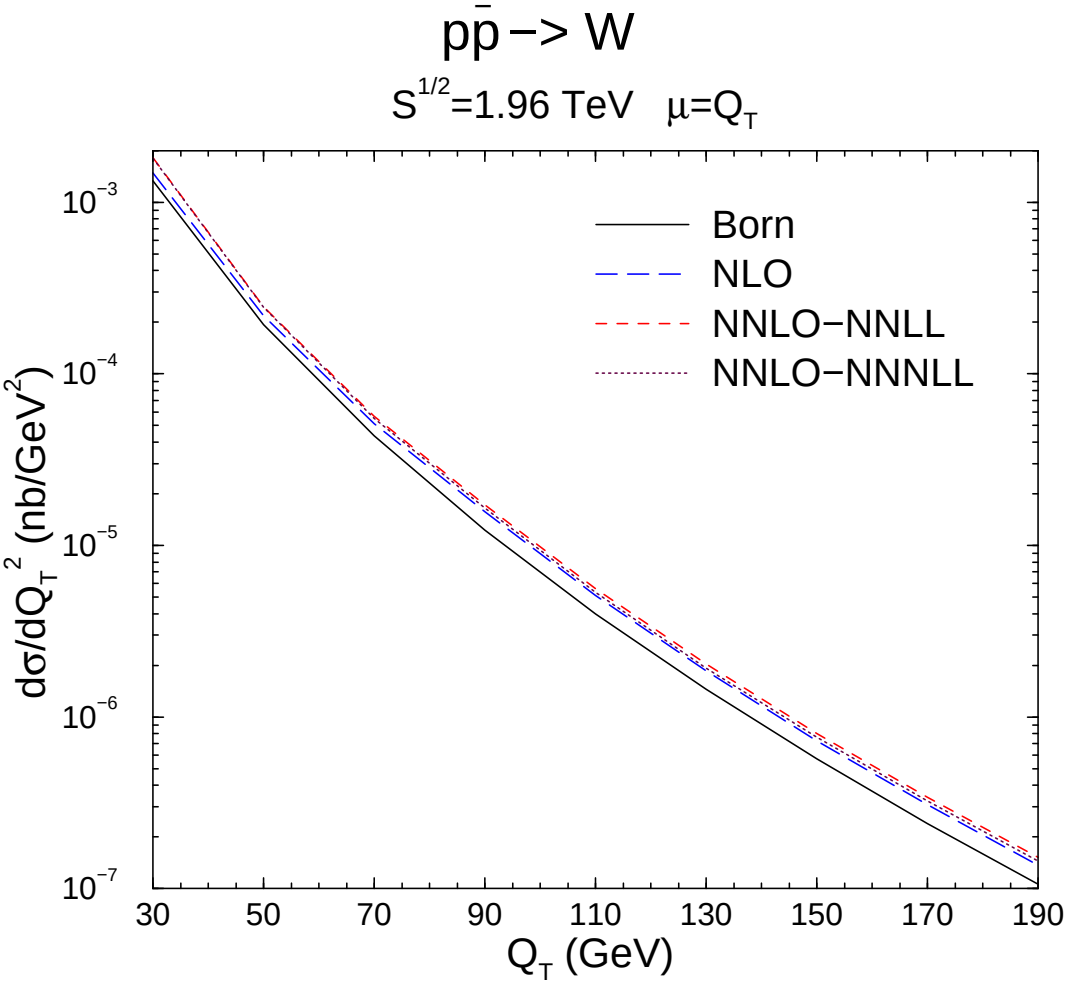
Q_T distribution



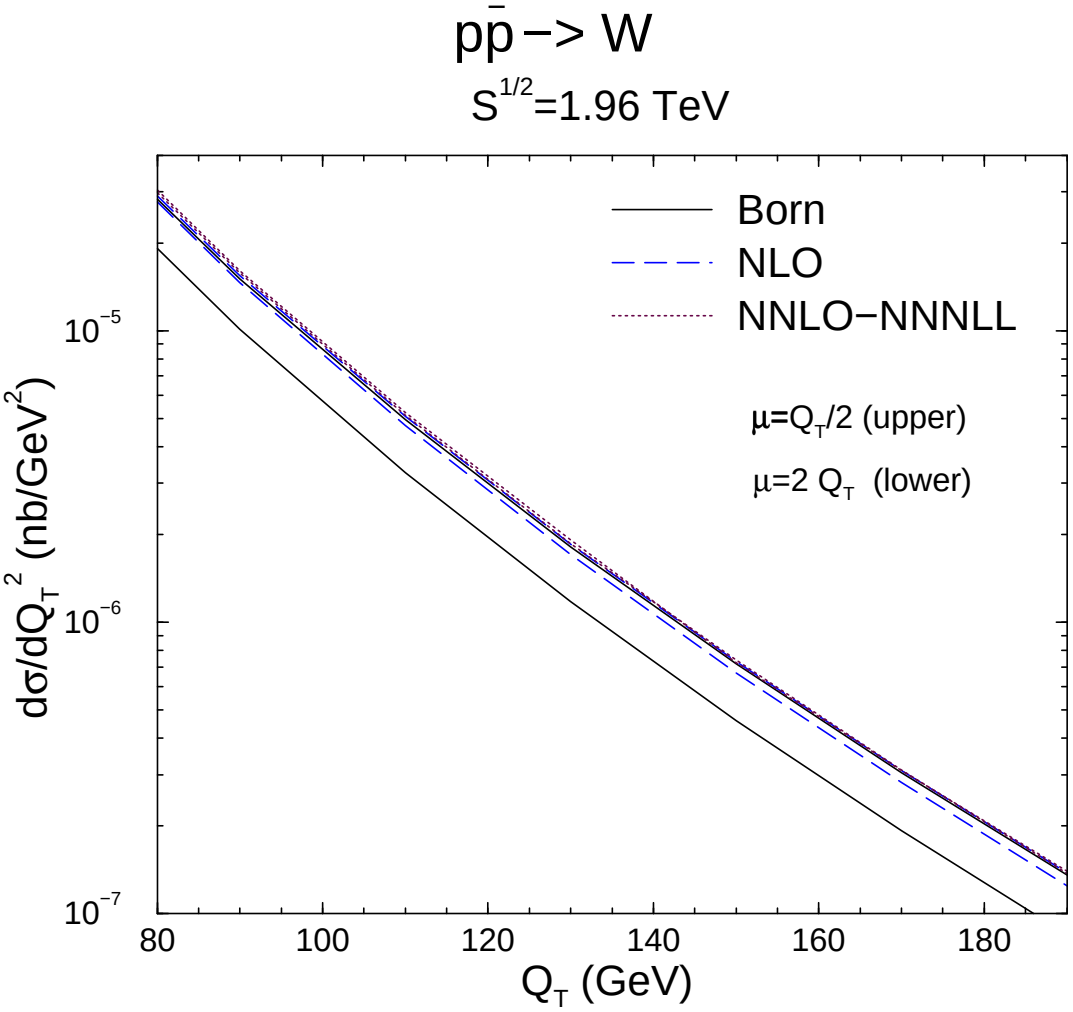
Scale dependence



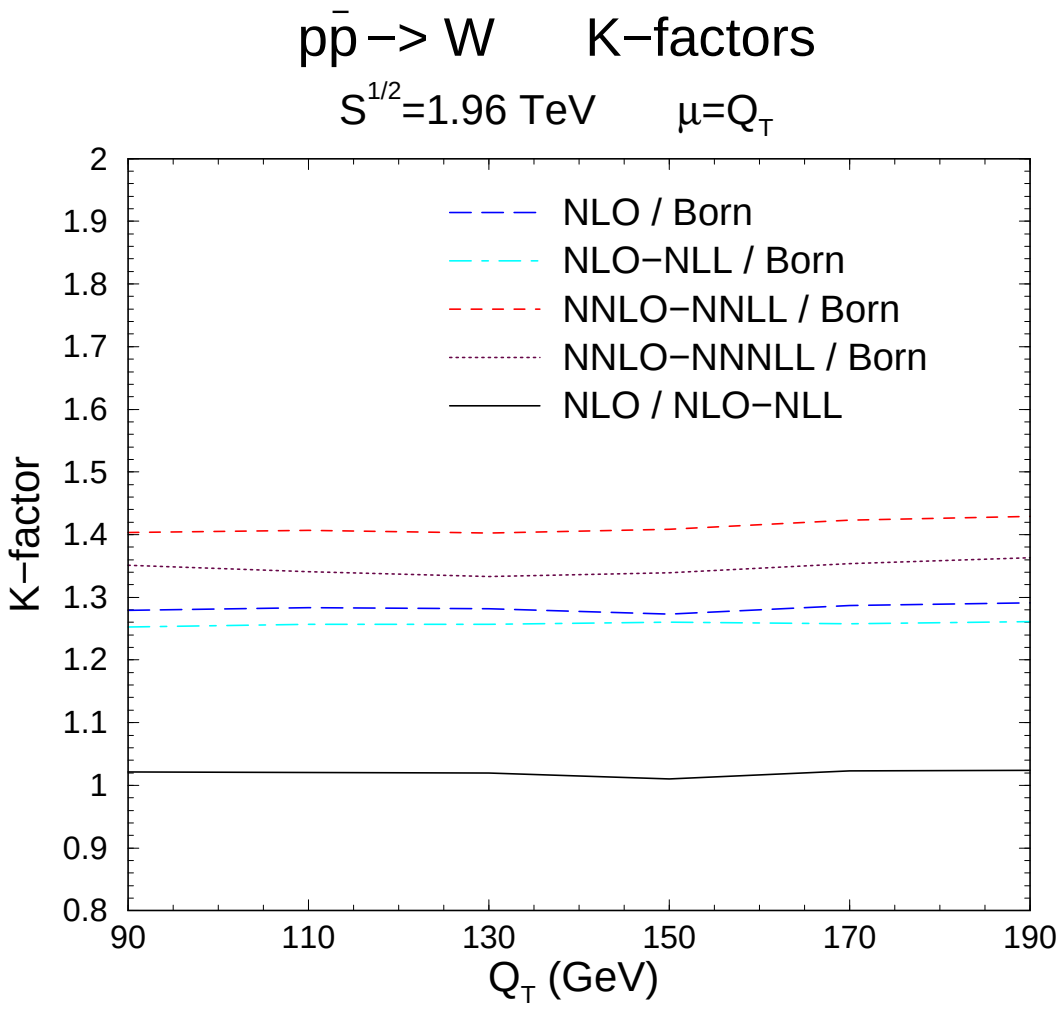
Q_T distribution



Scale dependence



K-factors


pp̄ -> W K−factors
S^1/2=1.96 TeV μ=Q_T
NLO / Born
NLO−NLL / Born
NNLO−NNLL / Born
NNLO−NNNLL / Born
NLO / NLO−NLL
K−factor
Q_T (GeV)
2
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
90
110
130
150
170
190

Summary

- W production at large-Q_T in $p\bar{p}$ interactions
- Soft-gluon threshold corrections dominant at NLO
- NNLO threshold corrections have been calculated
- Reduced scale dependence
- Sizable K-factors