$p_{\mathrm{T}}^{W}/p_{\mathrm{T}}^{Z}$ studies

Effect of heavy-flavour initiated processes

Check $p_{\mathrm{T}}^{W}/p_{\mathrm{T}}^{Z}$ for different allowed initial state flavours:

- 2 flavours → keep only $uu \to Z$, $dd \to Z$ and $ud \to W$ couplings;
- 3 flavours → add $ss \to Z$ and $us \to W$;
- 4 flavour → add $cc \to Z$ and $cs \to W$, $cd \to W$;
- 5 flavour → add $bb \to Z$ and $ub \to W$, $cb \to W$;

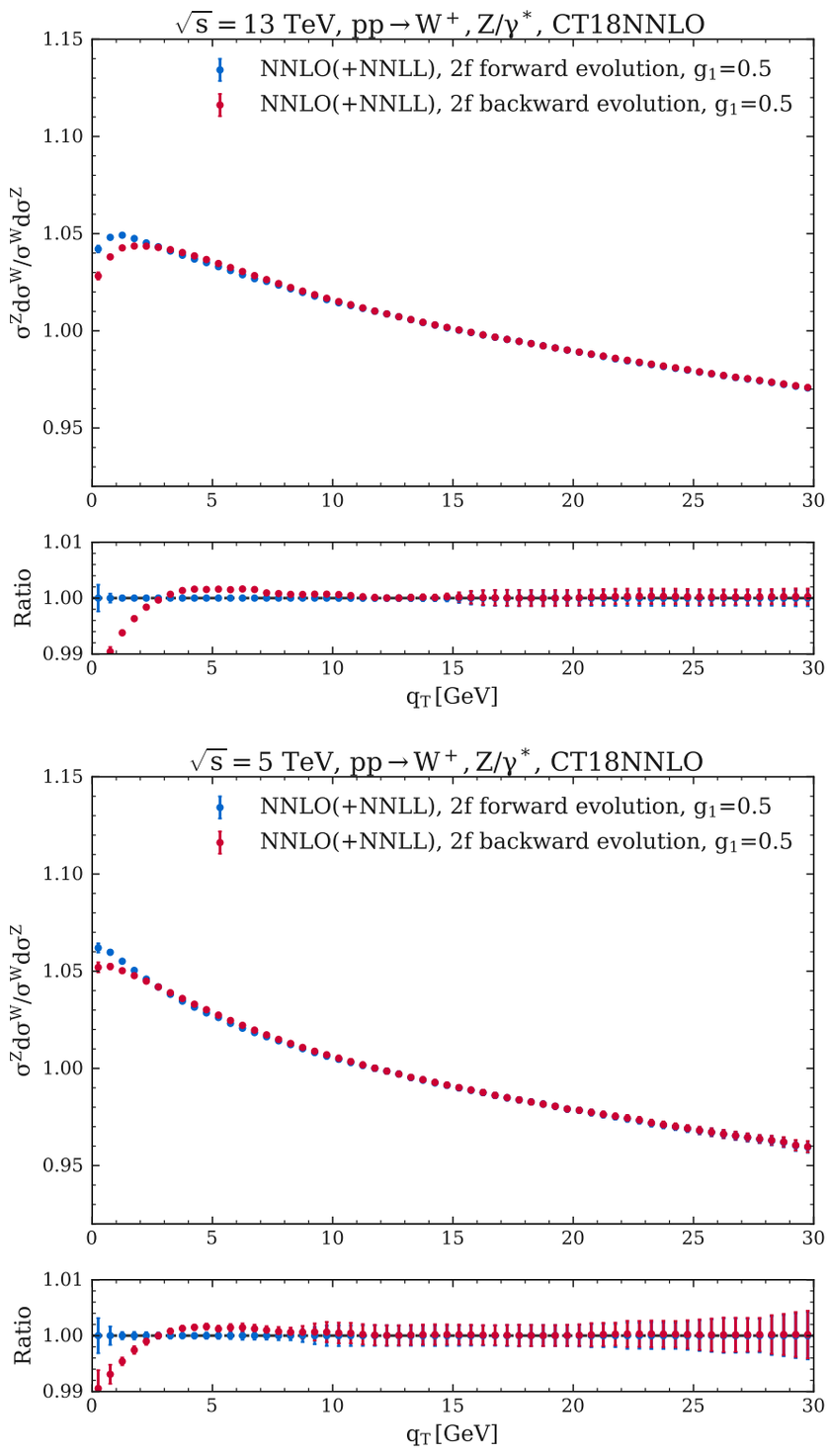
comparing

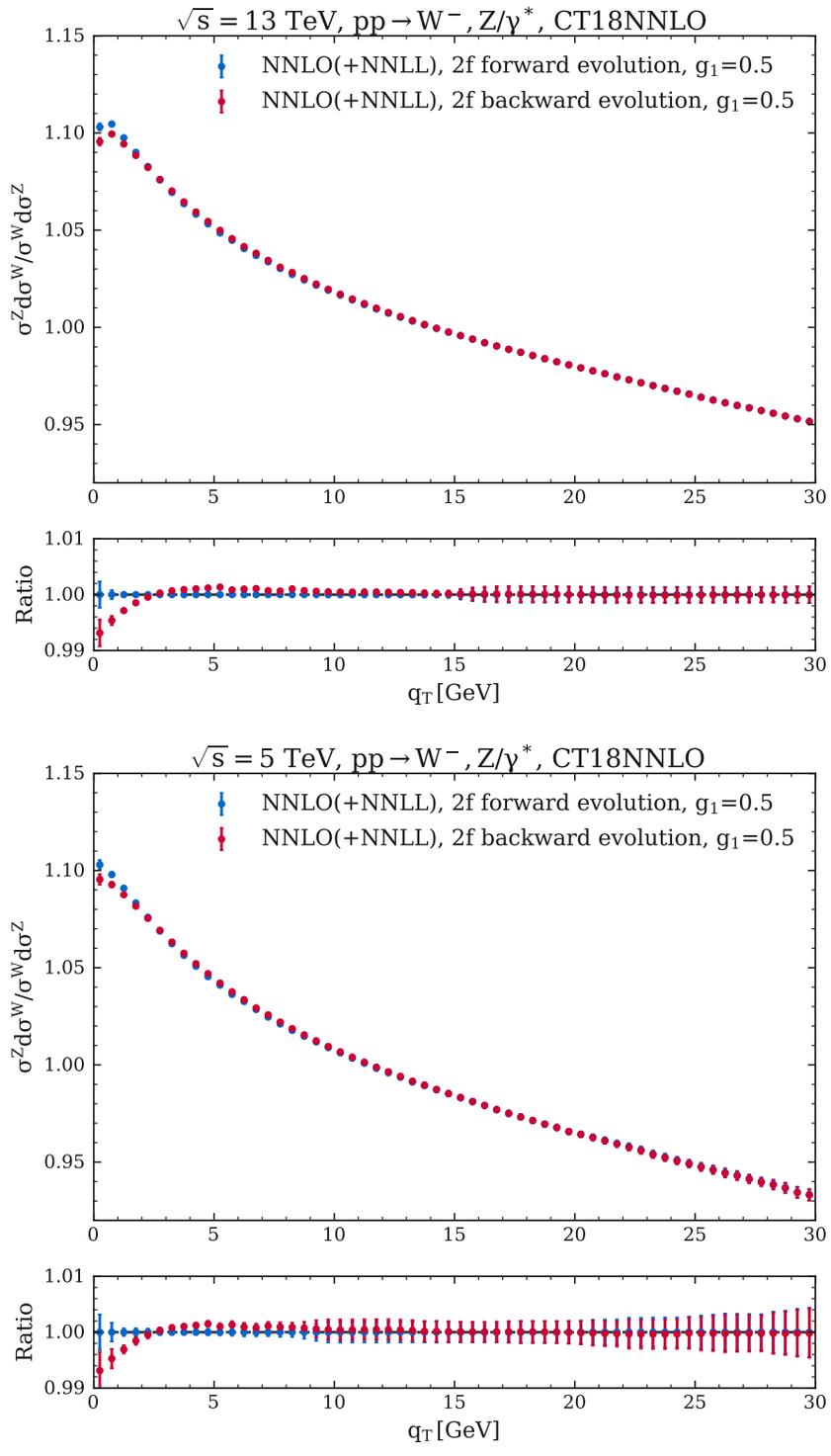
- VFN forward evolution of the PDFs from $Q_0 \to b_0/b \sim p_{\mathrm{T}}$ with LHAPDF;
- FFN iterative backward evolution of the PDFs from $\mu_F \to b_0/b \sim p_{\mathrm{T}}$.

(Always hfmode = 2 → switch off b and c PDFs below the corresponding thresholds.)

$p_{\mathrm{T}}^{W}/p_{\mathrm{T}}^{Z}$ studies

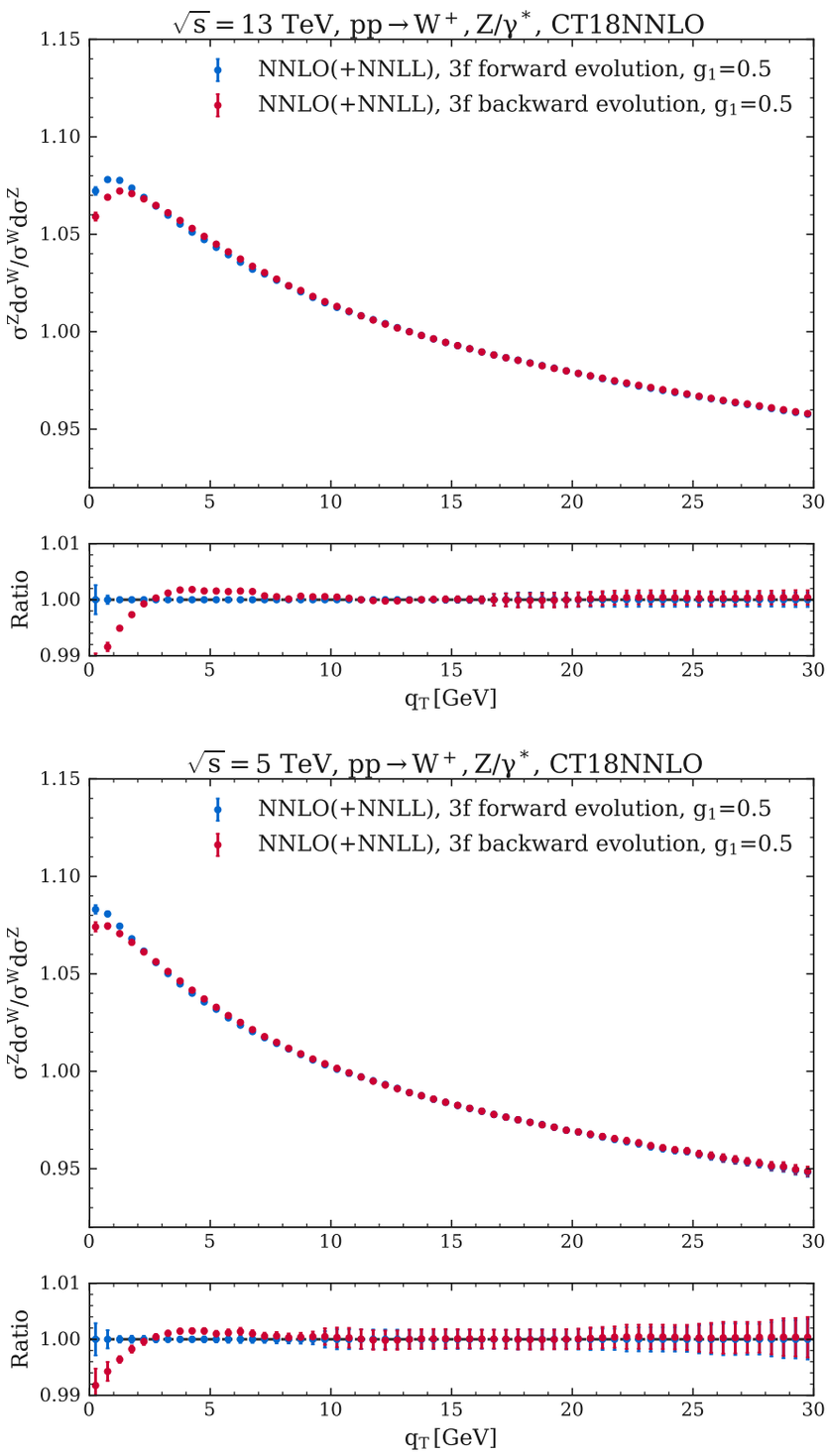
2 flavours: forward vs backward

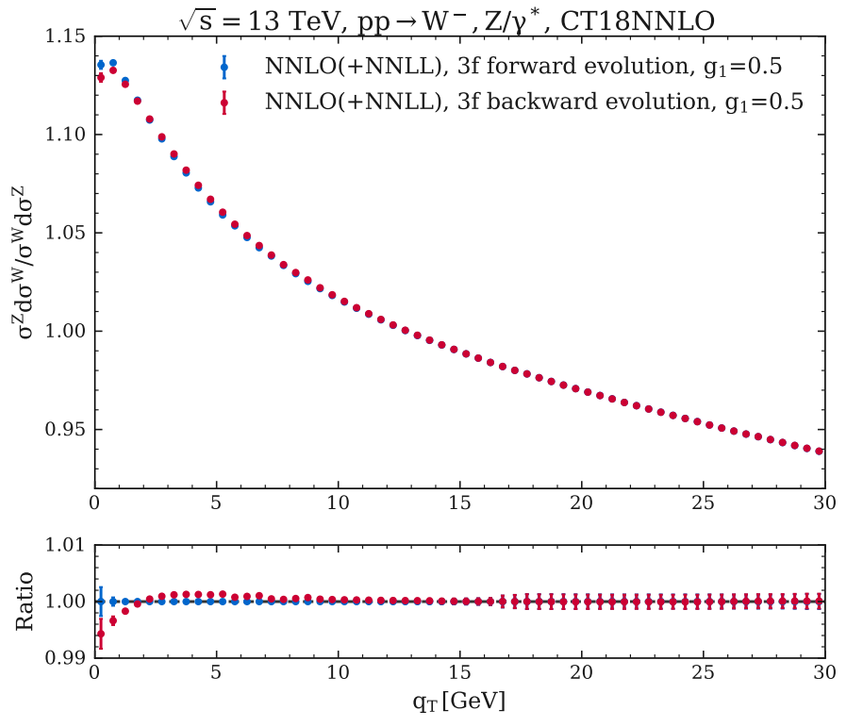


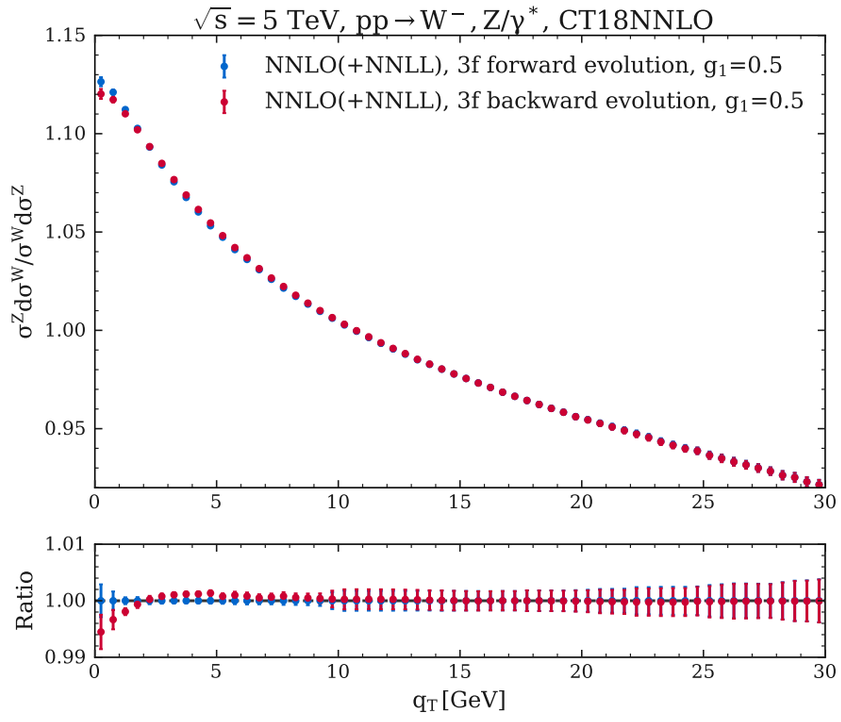


$p_{\mathrm{T}}^{W}/p_{\mathrm{T}}^{Z}$ studies

3 flavours: forward vs backward

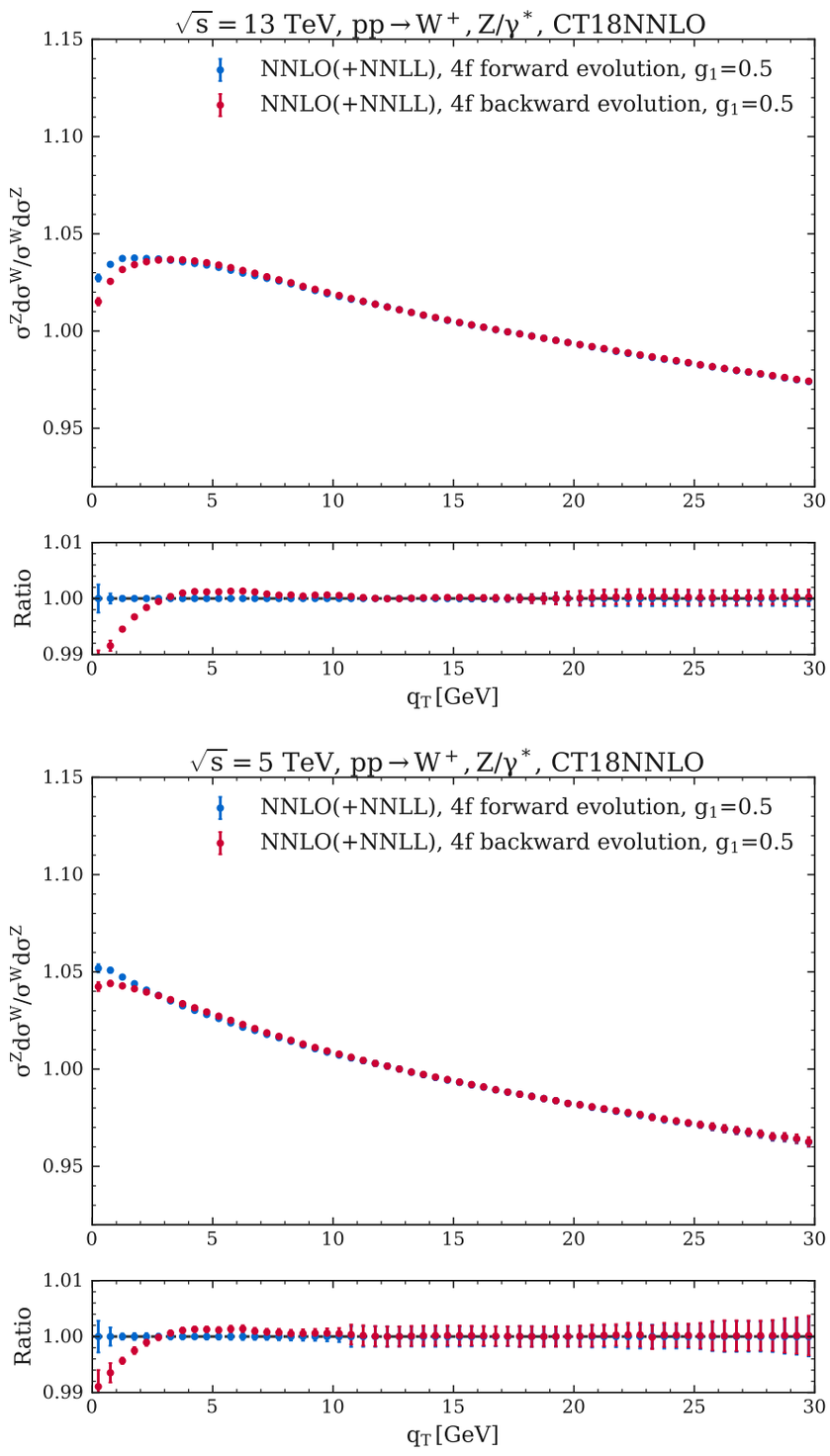


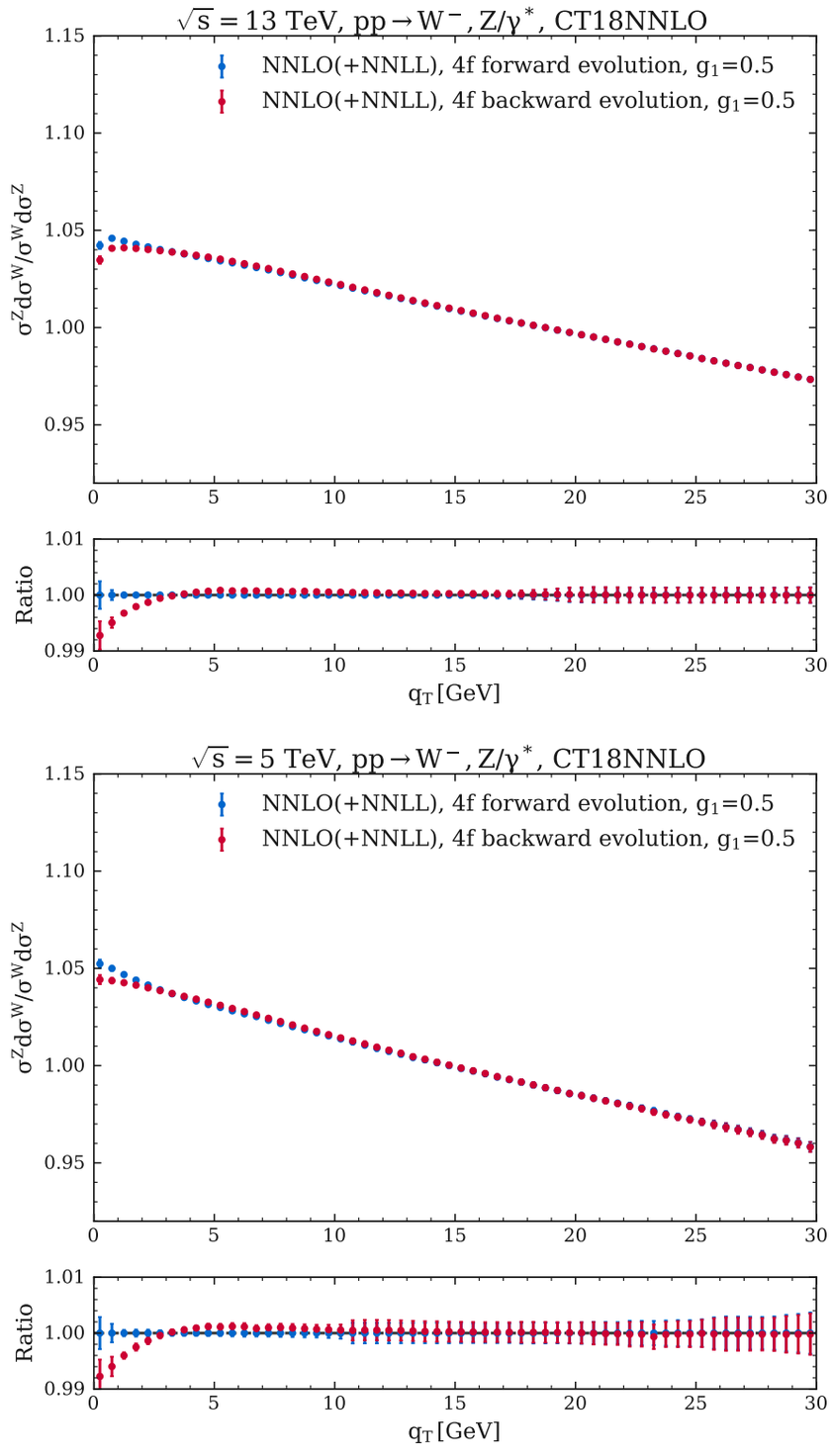




$p_{\mathrm{T}}^{W}/p_{\mathrm{T}}^{Z}$ studies

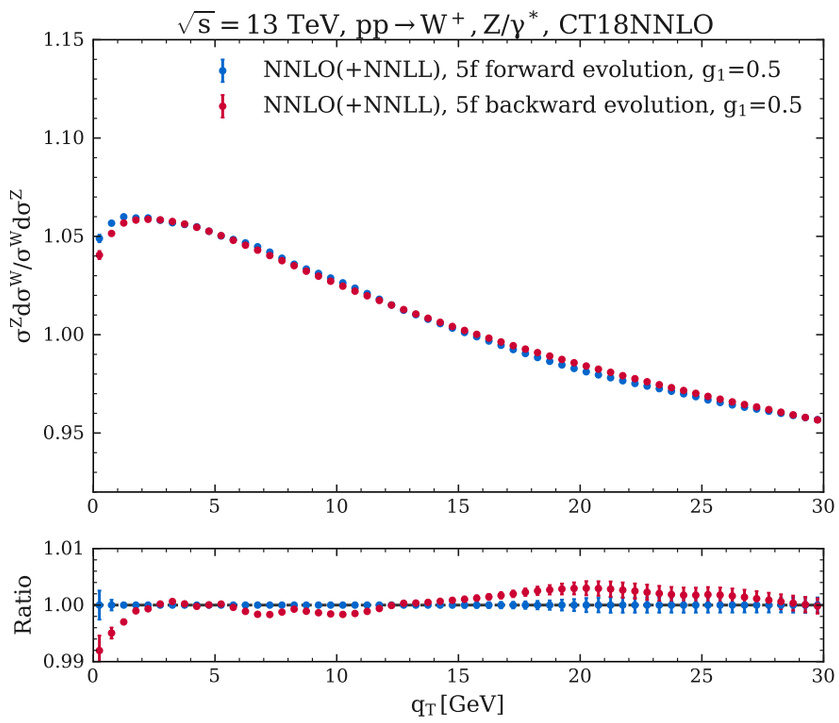
4 flavours: forward vs backward

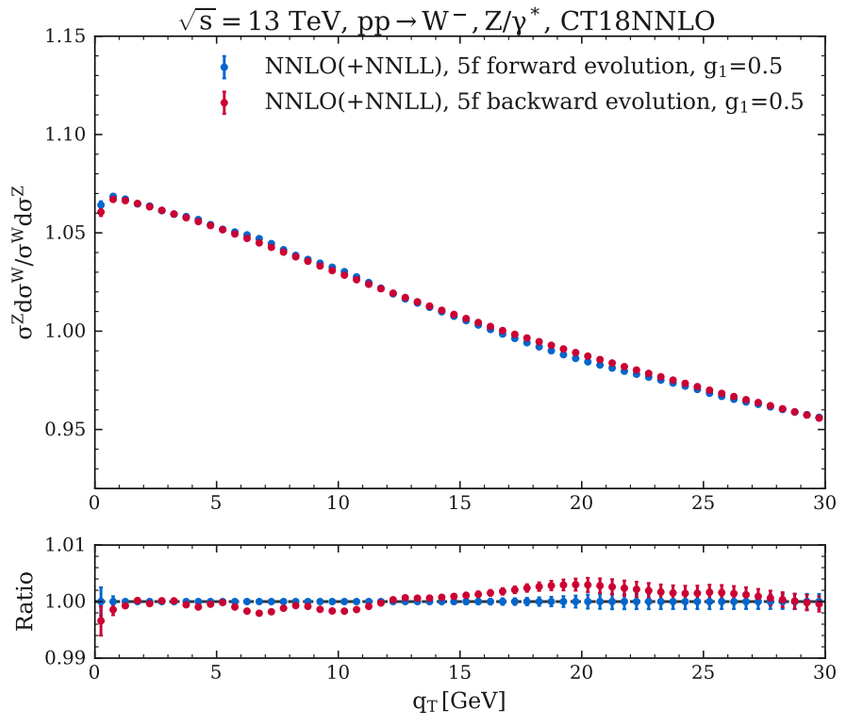


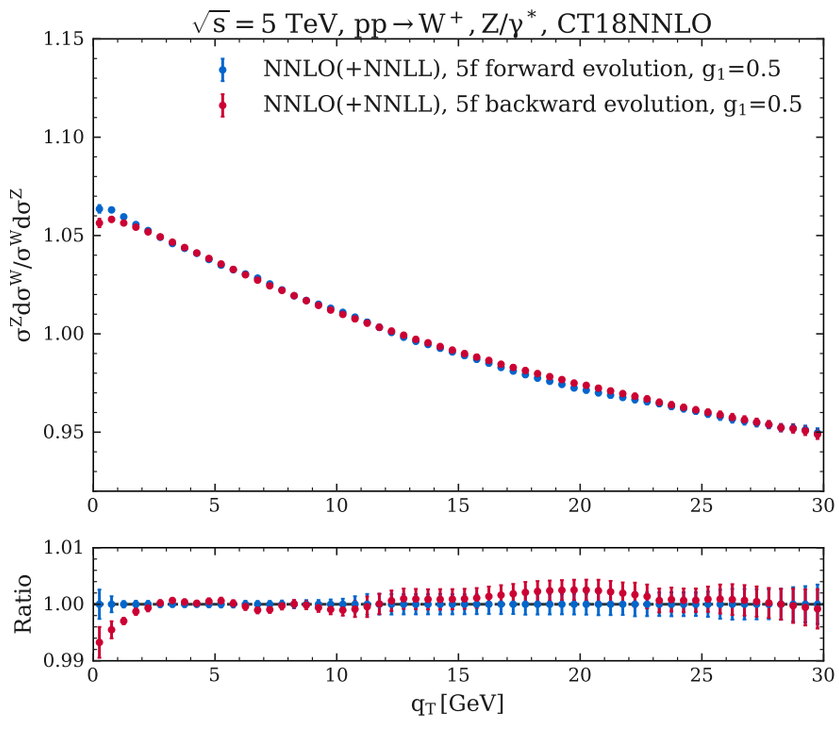


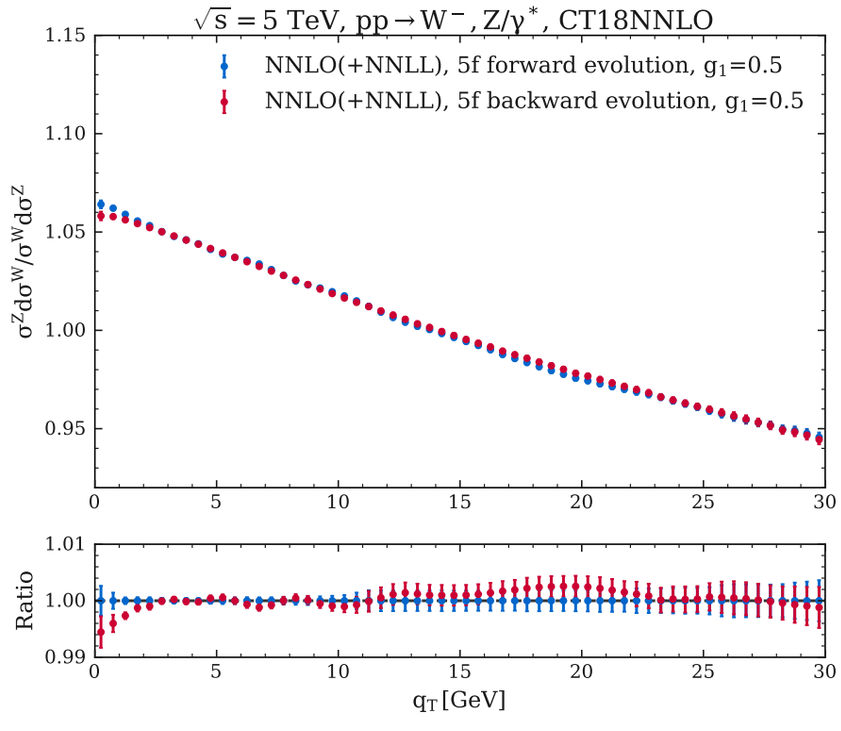
$p_{\mathrm{T}}^{W}/p_{\mathrm{T}}^{Z}$ studies

5 flavours: forward vs backward









$p_{\mathrm{T}}^{W}/p_{\mathrm{T}}^{Z}$ studies

Effect of non-perturbative FF

Check $p_{\mathrm{T}}^{W}/p_{\mathrm{T}}^{Z}$ with 5 flavour couplings for different values of g_1 in the non-perturbative FF:

- $g_1 = 0, 0.5, 1, 1.5\ \mathrm{GeV}^2$;

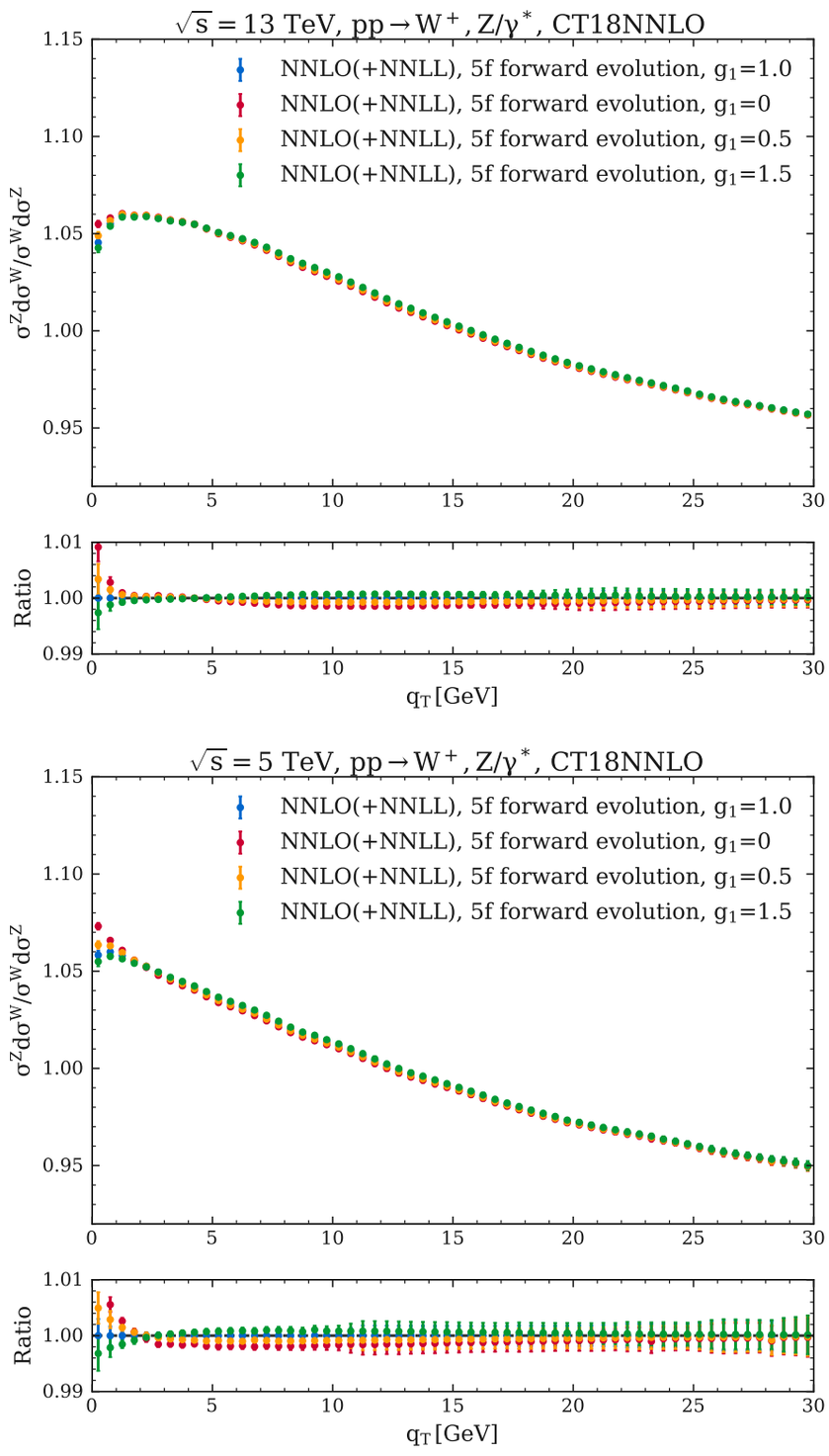
comparing

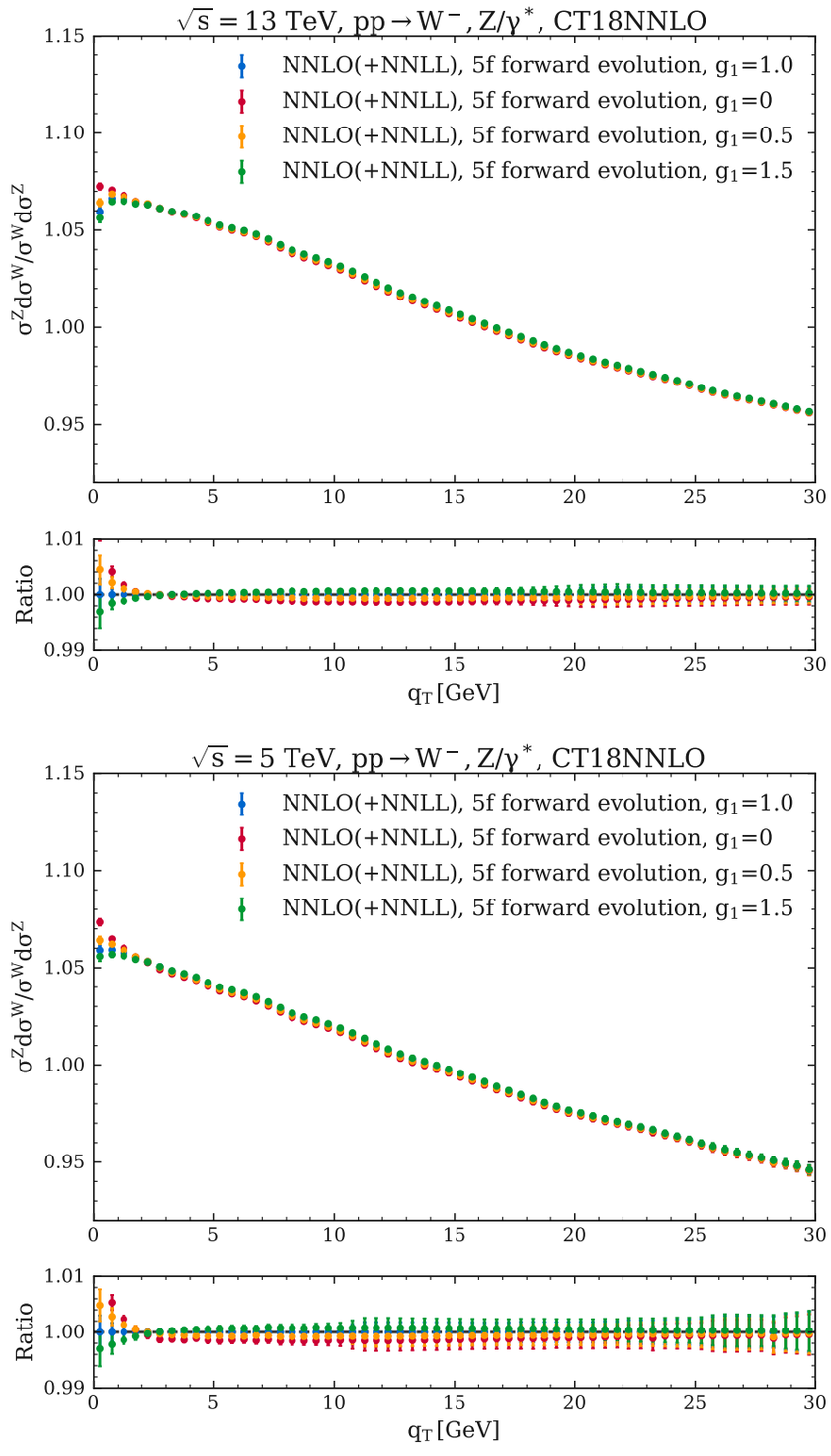
- VFN forward evolution vs FFN iterative backward evolution of the PDFs.

(Always hfmode = 2 → switch off b and c PDFs below the corresponding thresholds.)

$p_{\mathrm{T}}^{W}/p_{\mathrm{T}}^{Z}$ studies

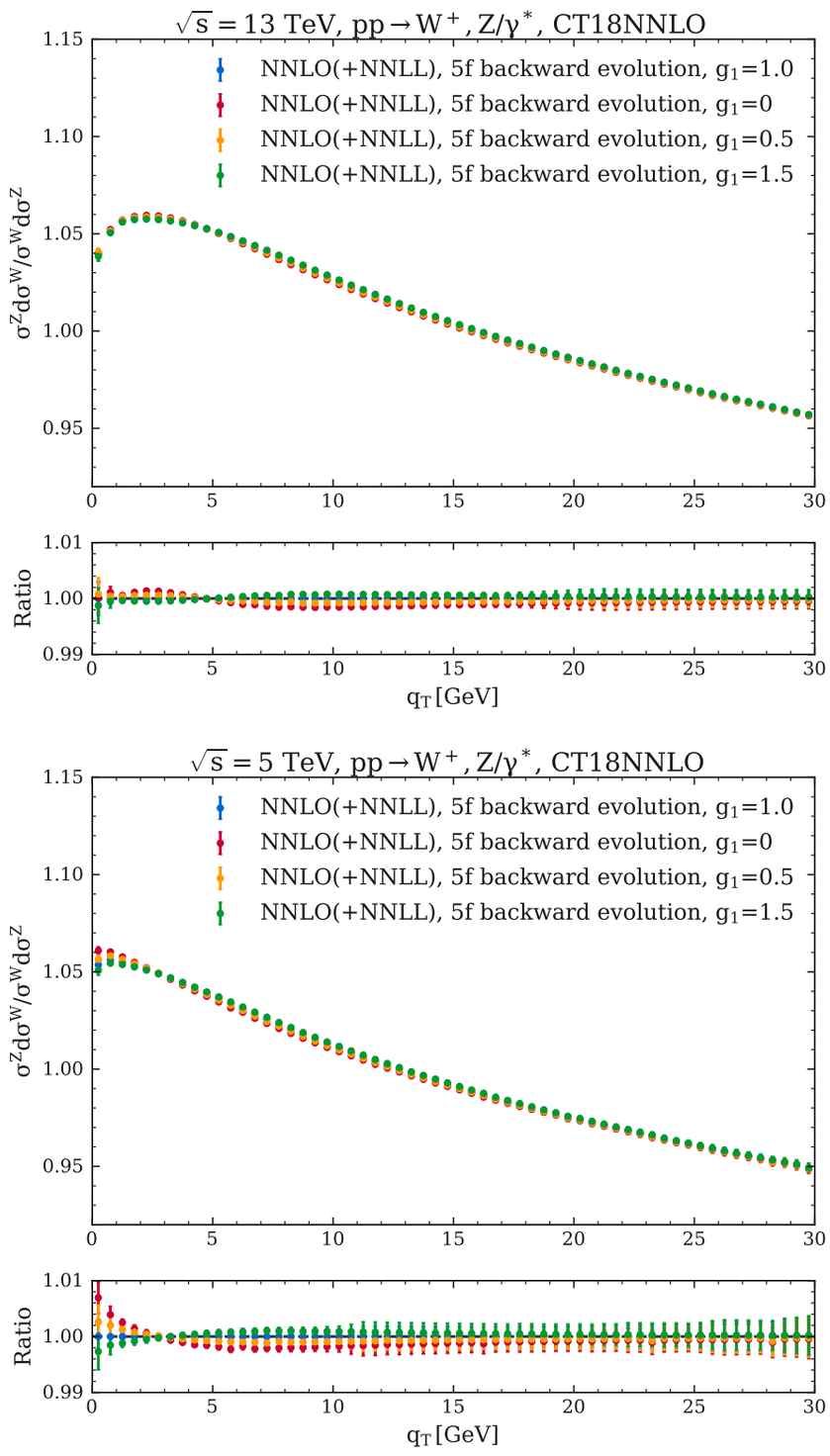
5 flavours, forward evolution: $g_1 = 0, 0.5, 1, 1.5\ \mathrm{GeV}^2$

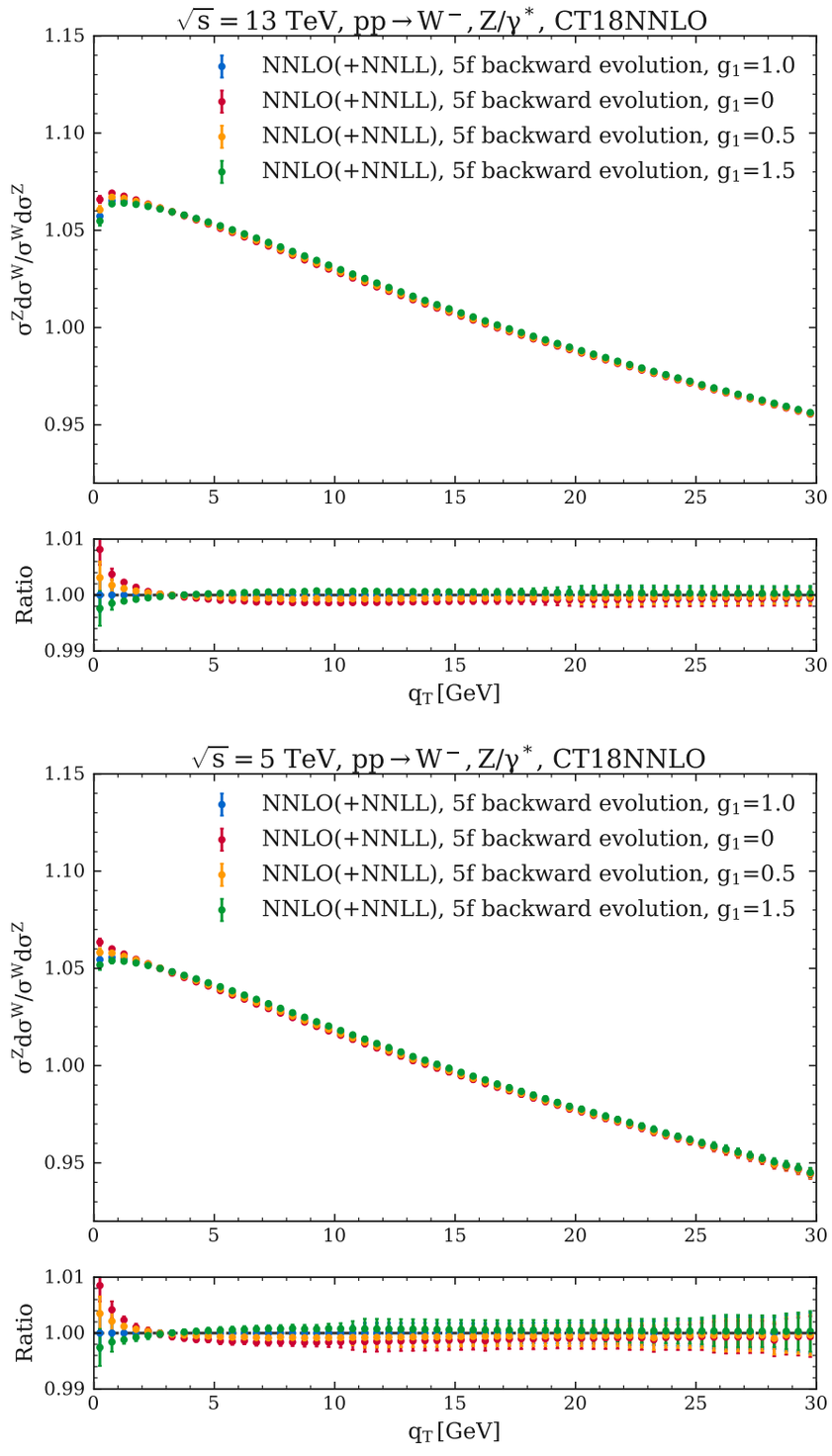




$p_{\mathrm{T}}^{W}/p_{\mathrm{T}}^{Z}$ studies

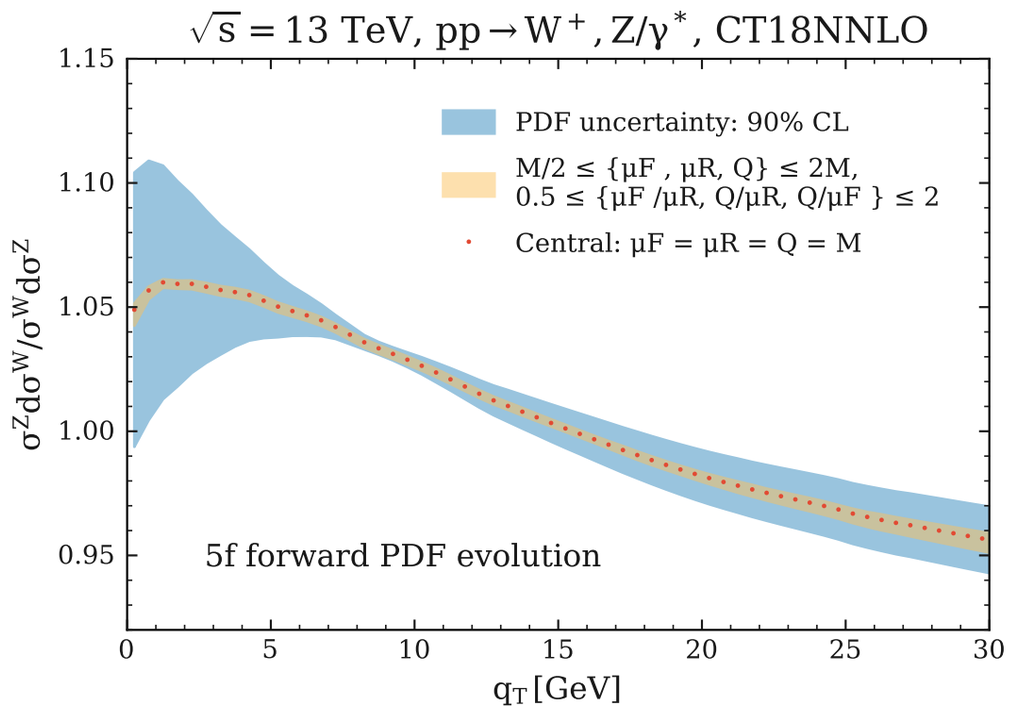
5 flavours, backward evolution: $g_1 = 0, 0.5, 1, 1.5\ \mathrm{GeV}^2$

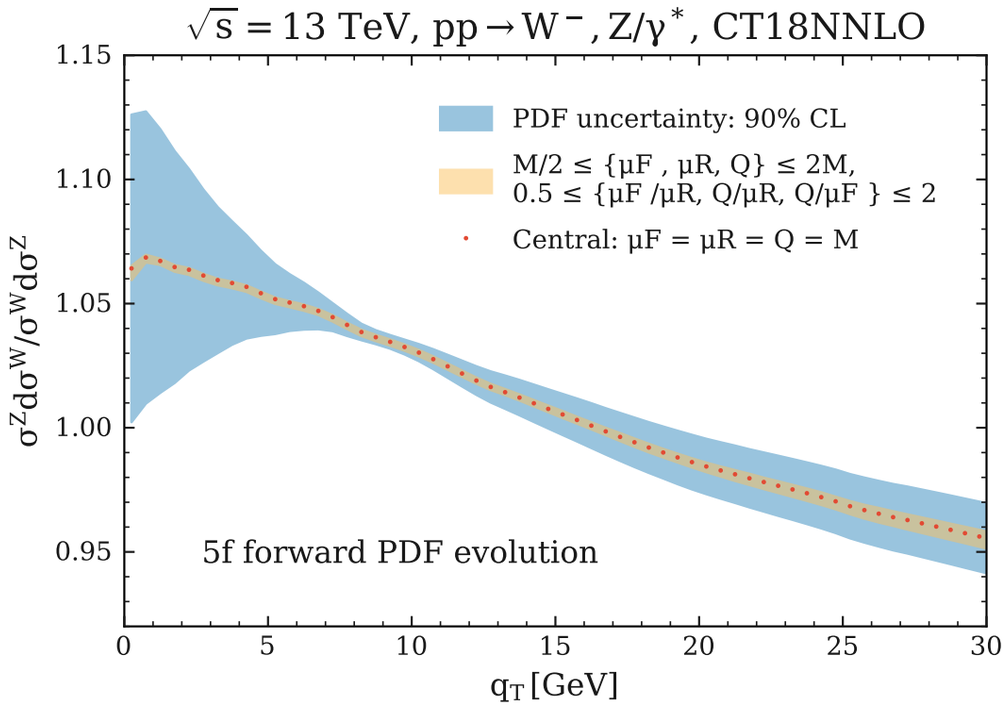


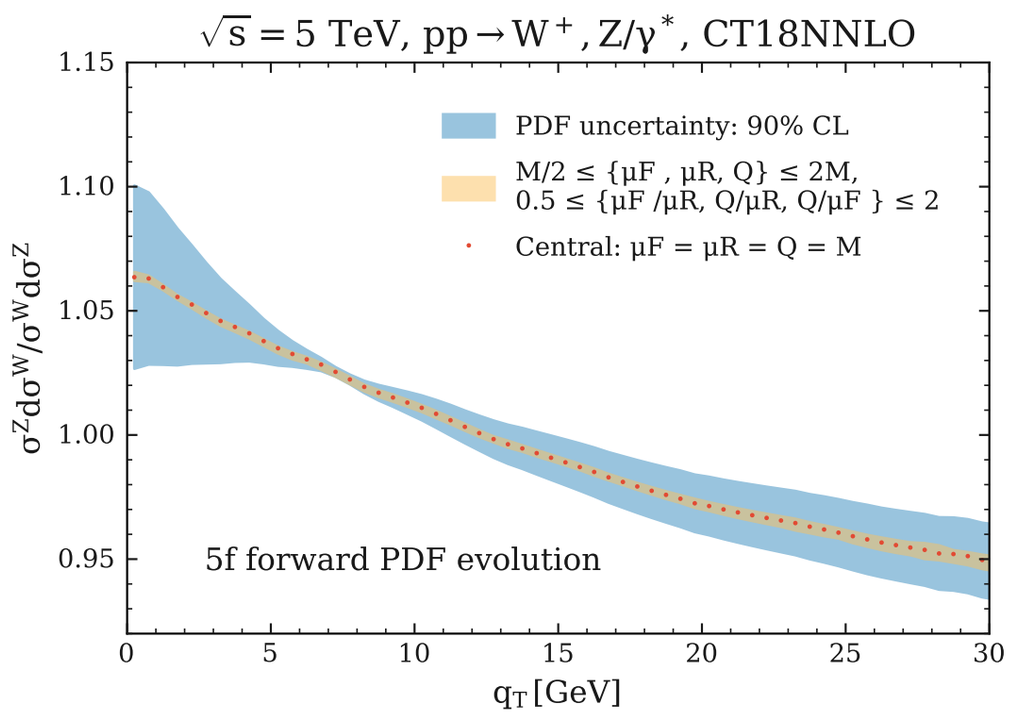


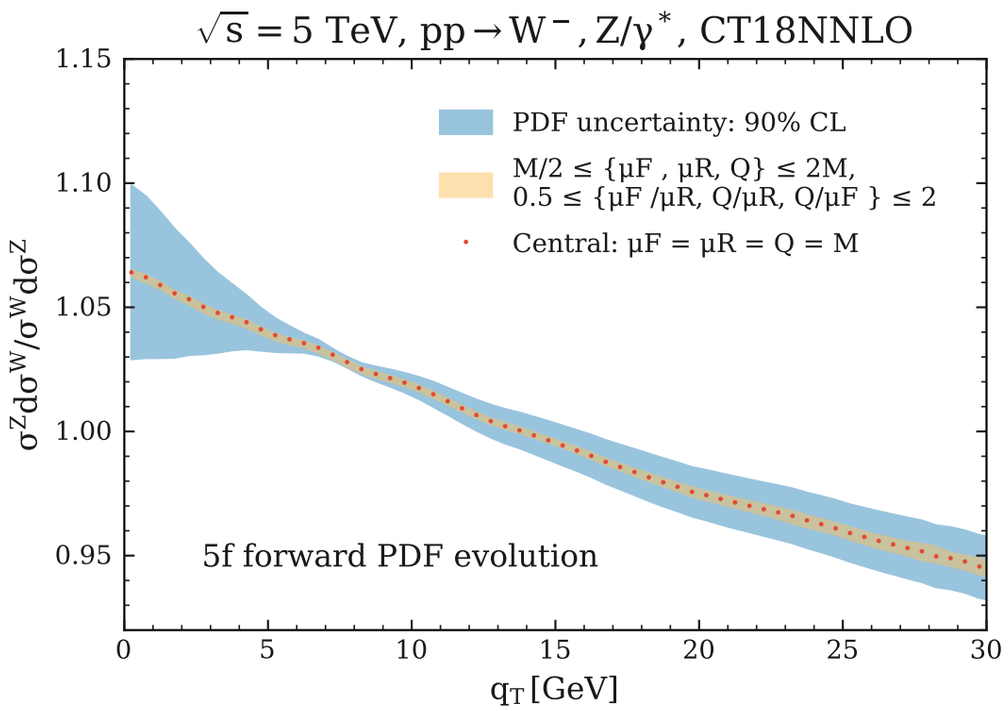
$p_{\mathrm{T}}^{W}/p_{\mathrm{T}}^{Z}$ studies

5 flavours, forward evolution: PDF + scale uncertainties



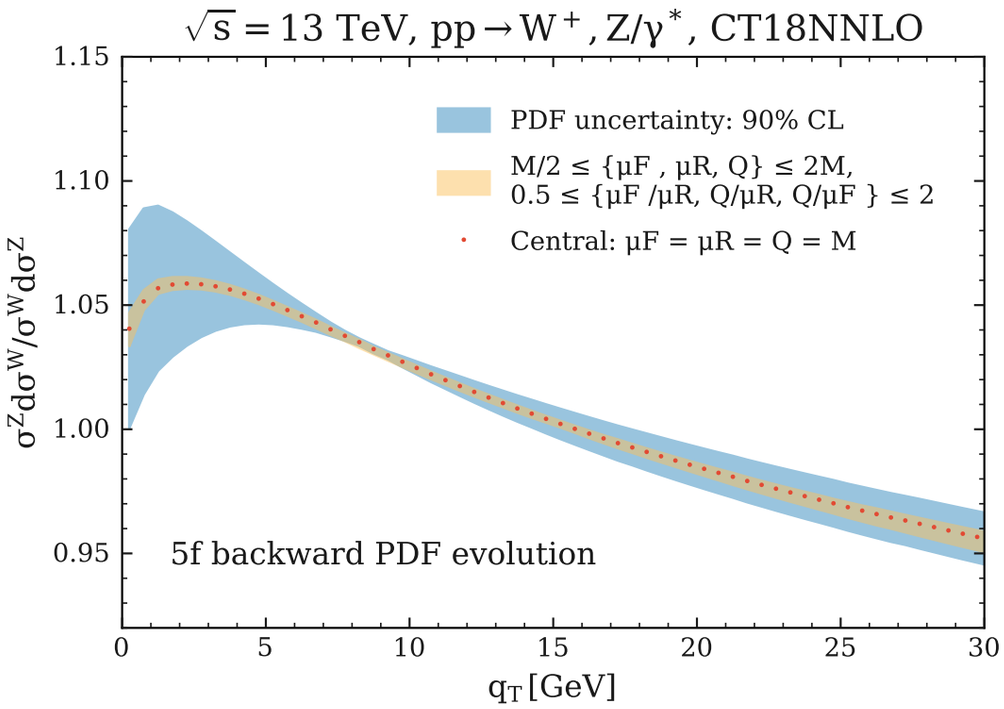


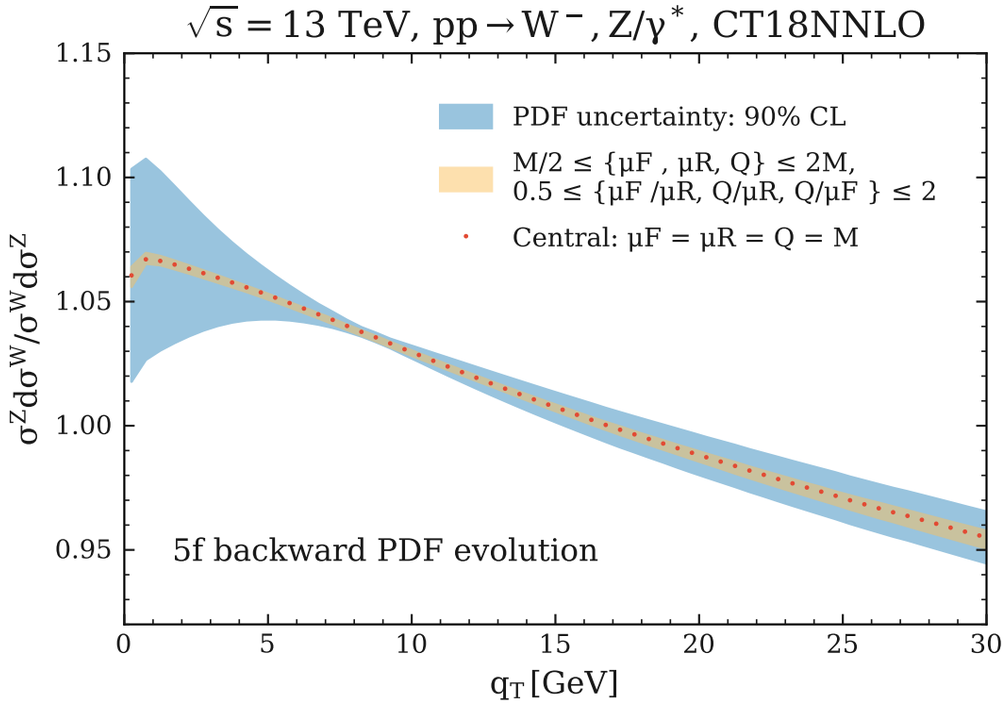


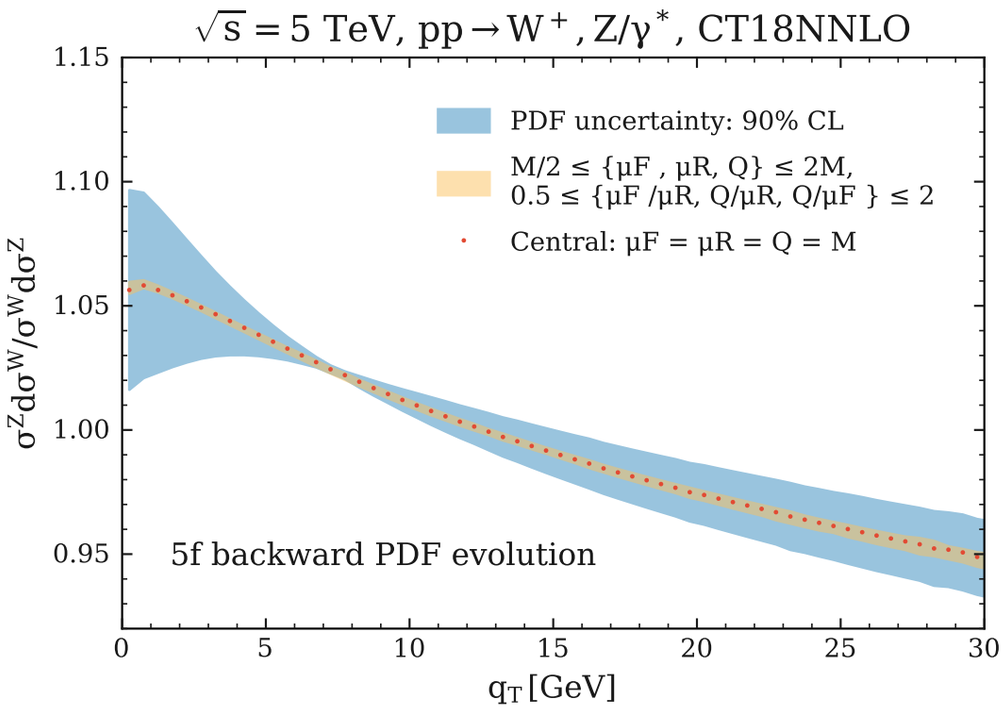


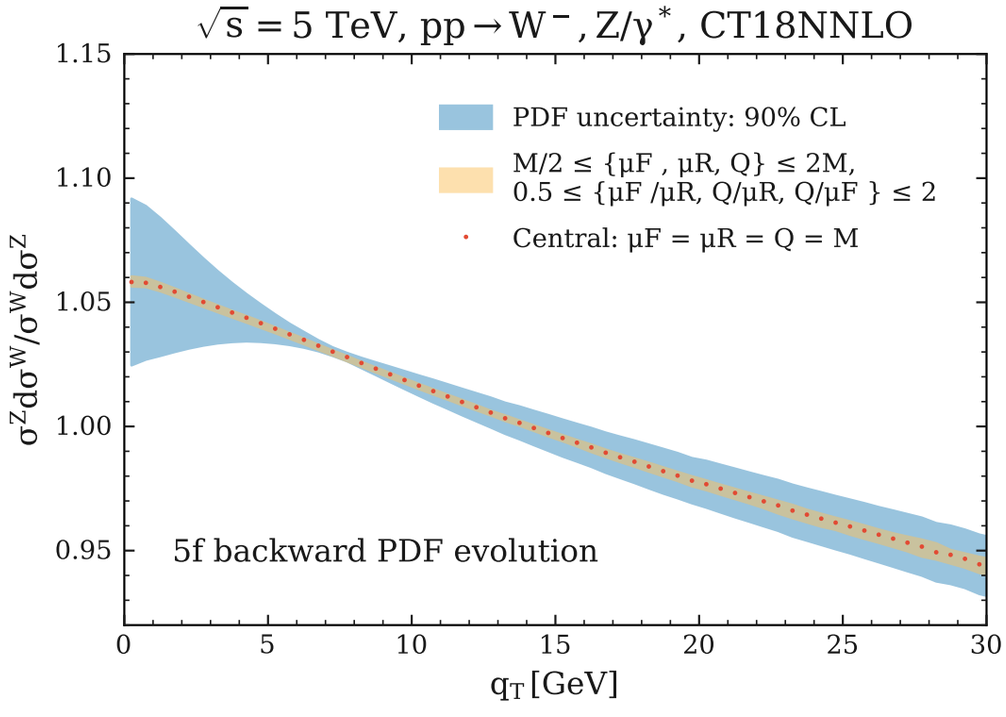
$p_{\mathrm{T}}^{W}/p_{\mathrm{T}}^{Z}$ studies

5 flavours, backward evolution: PDF + scale uncertainties









Fits to low-mass DY

Setup

- QCD order: NNLO(+N3LL);
- $\mu_{\mathrm{R}} = \mu_{\mathrm{F}} = \mu_{\mathrm{RES}} = 0.5$
- $b_{lim} = 1.5$
- Non-perturbative parameters included in the profiling: g_1 and q
  - Pre-fit values of non-perturbative parameters: $g1 = 0.5 \pm 0.1$, $q = 0 \pm 0.1$
- Latest EW k-factors included
- ~improved model with de-correlated isolation stat uncertainty: 1 NP → 9 NP

(xFitter datafiles and applgrids stored on QCD fits repository)

Fits to low-mass DY

Fits with different PDF sets

PDF set	X2/dof	g1	q
MSHT20an3lo	77/28	0.62 ± 0.12	-0.01 ± 0.04
CT18NNLO	68/28	0.92 ± 0.17	0 ± 0.03
CT18ANNLO	69/28	0.90 ± 0.18	0 ± 0.03
HERAPDF20_NNLO	93/28	0.27 ± 0.11	0.01 ± 0.04
NNPDF40_nnlo	117/28	no sens.	no sens.

(Tried also NNPDF40_an3lo from their web page, but code breaks... investigating)

Fits to low-mass DY

MSHT20an3lo vs CT18NNLO

Invariant mass bin	MSHT20an3lo	CT18NNLO
ATLAS lmDY pT 13 TeV 28.0-36.0 GeV	4.5 / 4	3.8 / 4
ATLAS lmDY pT 13 TeV 14.0-17.0 GeV	12 / 4	11 / 4
ATLAS lmDY pT 13 TeV 46.0-56.0 GeV	0.97 / 4	0.74 / 4
ATLAS lmDY pT 13 TeV 22.0-28.0 GeV	3.6 / 4	4.3 / 4
ATLAS lmDY pT 13 TeV 12.0-14.0 GeV	16 / 4	11 / 4
ATLAS lmDY pT 13 TeV 36.0-46.0 GeV	6.7 / 4	6.6 / 4
ATLAS lmDY pT 13 TeV 17.0-22.0 GeV	14 / 4	13 / 4
Correlated χ^2	21	19
Log penalty χ^2	-2.38	-2.22
Total χ^2 / dof	77 / 28	68 / 28

Fits to low-mass DY

MSHT20an3lo vs CT18NNLO