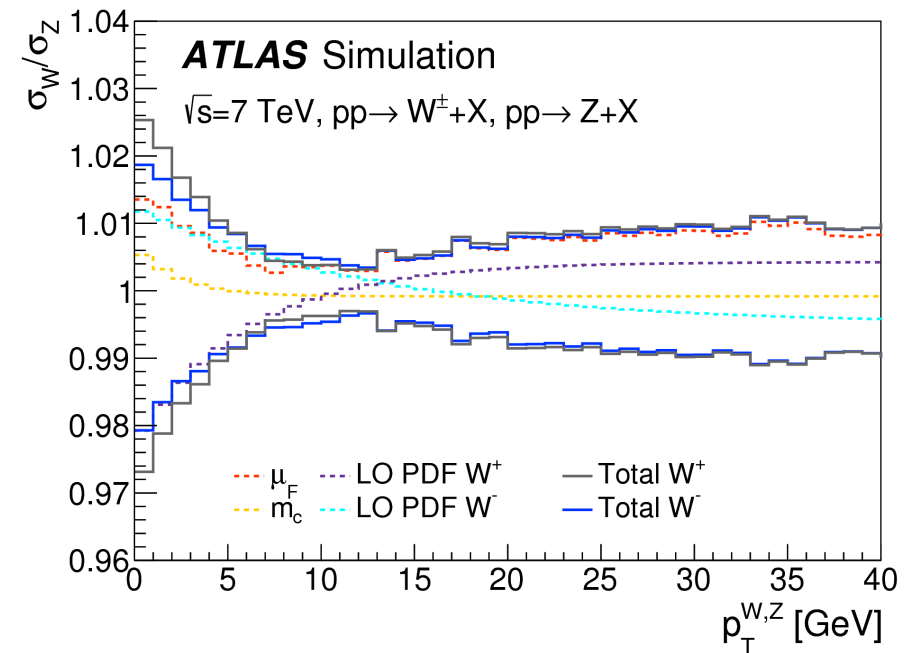# p_T^W uncertainties

Heavy flavour initiated production (HFI) introduces differences between Z and W and determines a harder pT spectrum, expect certain degree of decorrelation.

However higher-order QCD expected to be largely correlated between W and Z produced by light quarks

Uncertainty: heavy quark mass variations *(varying m_c by ±0.5 GeV)*, factorisation scale variations in the QCD ISR *(separately for light and heavy-quark induced production)*

Largest deviation of $p_T(W)/p_T(Z)$ for the parton shower PDF variation: CTEQ6L1 LO (nominal) to CT14lo, MMHT2014lo and NNPDF2.3lo

W-boson charge	W^+		W^-		Combined	
Kinematic distribution	p_T^ℓ	m_T	p_T^ℓ	m_T	p_T^ℓ	m_T
Charm-quark mass	1.2	1.5	1.2	1.5	1.2	1.5
Parton shower μ_F with heavy-flavour decorrelation	5.0	6.9	5.0	6.9	5.0	6.9
Parton shower PDF uncertainty	3.6	4.0	2.6	2.4	1.0	1.6