

# Mass-shift dependence on $W$ and $Z$ $p_T$ distributions

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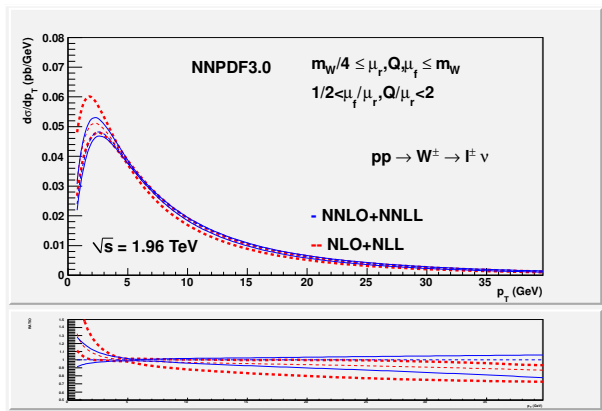


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- Introduction on the scale variation applied;
- Impact on single Z and W production;
- Impact of mass parameters shift  
( $M_Z = M_Z, \Gamma_W = \Gamma_Z$ ) on  $p_T$  and ratio distributions;
- Conclusions and further comments;

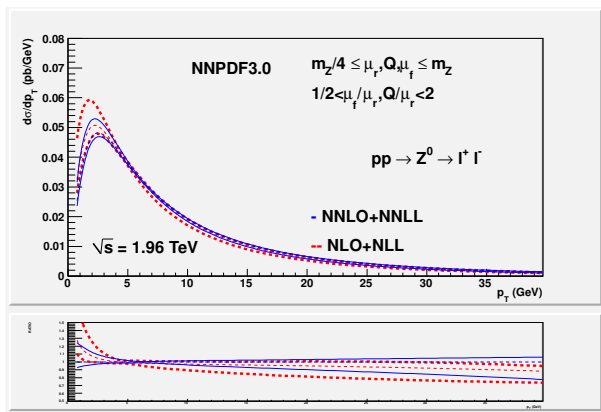
- We use the following scaling of  $\mu_R, \mu_F, Q$ :  
 $1/4 \leq Q/m, \mu_R/m, \mu_F/m \leq 1$ ;
- Constraints  $1/2 < \mu_R/Q, \mu_R/\mu_F < 2 \longrightarrow$  avoid logarithms  $\ln(Q/m) = \ln(2), \ln(1/2)$ ;

- $p_T^W$  distributions



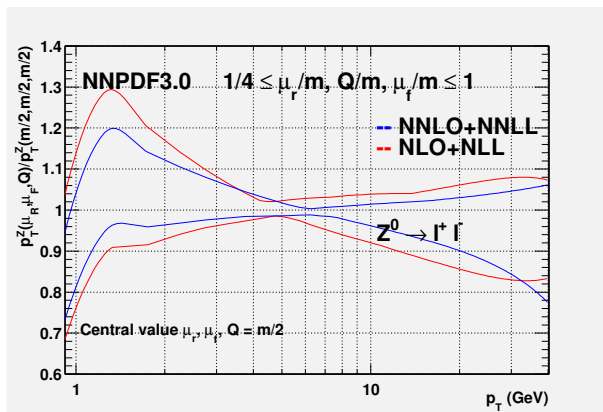
- NLO+NLL 20% spread in peaks, NNLO+NNLL reduces to about 15%;
- NLO+NLL: good prescription for higher order.

- $p_T^Z$  distributions



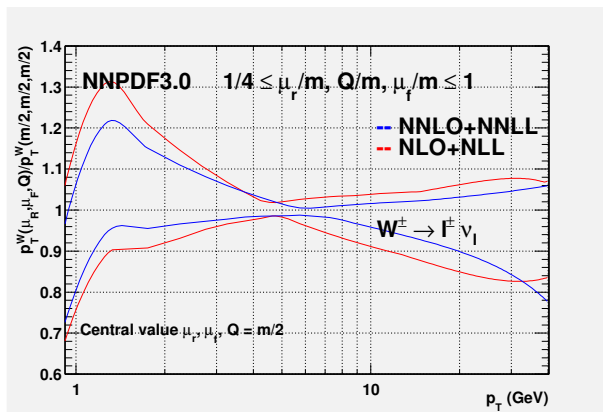
- NLO+NLL 20% spread in peaks, NNLO+NNLL reduces to 15%;

- $p_T^W/p_T^W$  and  $p_T^Z/p_T^Z$  ratio to the central value



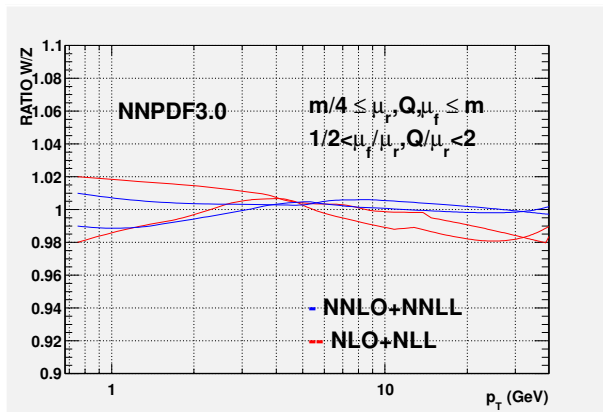
- Ratio  $p_T^{Boson}(\mu_R, \mu_F, Q)/p_T^{Boson}(m/2, m/2, m/2)$ ;

- $p_T^W/p_T^W$  and  $p_T^Z/p_T^Z$  ratio to the central value



- Ratio  $p_T^{Boson}(\mu_R, \mu_F, Q)/p_T^{Boson}(m/2, m/2, m/2)$ ;

- $p_T^W(\mu_R, \mu_F, Q)/p_T^Z(\mu_R, \mu_F, Q)$  ratio distributions



- Left panel: ratio  $(\mu_R, \mu_F, Q)/(\mu_R, \mu_F, Q)$ . Right panel: ratio  $(\mu_R, \mu_F, Q)/(m/2, m/2, m/2)$ .



- NNLO+NNLL bands are included in NLO+NLL in each case;
- W and Z distributions look similar at the same order;
- Flatness of ratio  $p_T^W / p_T^Z$ .