

Transverse momentum resummation on the azimuthal spectra of the final leptons in the Drell-Yan processes

To propose an alternative portal to the W^\pm/Z correlations, the azimuthal opening angle ϕ_L between the final leptons is investigated in the DY processes. In the fixed-order context, the calculation on the ϕ_L distribution is not straightforward, as the soft and collimated beam radiations in the regime of $\phi_L \rightarrow \pi$ or $q_T \rightarrow 0$ GeV give rise to large logarithms bringing down the perturbativity. Hence, it is essential to carry out the all-perturbative order resummation over those singular behaviors, more specifically, the $\ln^m[q_T^2/M_V^2]/q_T^2$ terms. To accomplish this goal, the soft-collinear effective theory is utilized in this work for the factorization and exponentiation. Thanks to the rapid developments of the fixed-order studies, the beam and soft ingredients for this method have been computed up to the three-loop level, which permits us to access the N^3LL' evaluations. In tackling the hard sectors, not only are the non-singlet amplitudes comprised in the calculation, the singlet influences are also addressed for the neutral DY process particularly. To this end, we make use of the axial-vector effective field theory to integrate out the top-quark influences and then recast the hard functions in terms of the Wilson coefficients and 5-flavour amplitudes. Their anomalous dimensions and perturbative expressions are extracted from the anomaly-dependent quark form factors.

For the numerical outputs, the comparisons between the singular and QCD contributions are presented first of all to demonstrate the validation of the asymptotic expansion. Their manifest agreements are observed in the vicinity of $q_T = 0$ GeV. Furthermore, the resummation-improved results from NLL' to N^3LL' are exhibited in the q_T and ϕ_L spectra. It is seen that within the asymptotic domains ($\phi_L \rightarrow \pi$ or $q_T \rightarrow 0$ GeV), the $N^{3(2)}LL'$ results are well situated in the $N^{2(1)}LL'$ error bands, and with the increase in accuracy, the theoretical uncertainties are diminished substantially.

Authors: SCHOENHERR, Marek (University of Durham); JU, Wanli (Durham University)

Presenter: JU, Wanli (Durham University)

Session Classification: Talks