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Parton distributions in the SMEFT from high-energy Drell-Yan tails

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The high-energy tails of charged and neutral-current Drell-Yan (DY) processes provide important constraints on the light quark and antiquark parton distribution functions (PDFs) in the large-x region. On the other hand, a hypothetical short-distance new physics would smoothly distort the high-energy tails as described by the Standard Model Effective Field Theory (SMEFT). In this work, we assess for the first time the interplay between PDF and EFT effects in high-mass DY at the LHC. We determine the extent to which EFT signals that would manifest themselves in the tails of the DY distributions could be reabsorbed into the large-x (anti)quark PDFs, and present a strategy aimed at disentangling possible new physics effects from proton structure modifications. We quantify the impact that a consistent joint determination of the PDFs and Wilson Coefficients has in two motivated short-distance new physics scenarios: 1) electroweak oblique corrections ($\hat{W}$, $\hat{Y}$) and 2) four-fermion interactions possibly behind the LHCb anomalies in $R(K^{(*)})$. Finally, we present dedicated projections for the High-Luminosity LHC and evaluate its ultimate potential to constrain the EFT parameters, while taking into account potential modifications of the proton structure.

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