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NNLO mixed QCD-EW corrections to W-pair production at electron-positron colliders

The discrepancy between the CDF measurement and the Standard Model theoretical prediction for the W-boson mass underscores the importance of conducting high-precision studies on the W boson, which is one of the predominant objectives of proposed future e+e− colliders. We investigate in detail the production of W-boson pairs at e+e− colliders, and compute the next-to-next-to-leading order mixed QCD-EW corrections to both the integrated cross section and various kinematic distributions. By employing the method of canonical differential equations, we analytically calculate the two-loop master integrals for the mixed QCD-EW virtual corrections. After rationalization of square roots, we express these master integrals in terms of Goncharov polylogarithms. However, six of the master integrals at weight 4 involve square roots that cannot be rationalized. They are ultimately expressed in terms of elliptic multiple polylogarithms. Upon applying our analytic expressions of these master integrals to the phenomenological analysis of W-pair production, we observe that the O(ααs) corrections are significantly impactful in the α(0) scheme, which can reach up to 1%.

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