Contribution ID: **63** Type: **not specified**

Two-loop master integrals for W-pair production at CEPC and LHC

Wednesday, 9 July 2025 10:30 (15 minutes)

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. This presentation focuses on the analytic calculation of the two-loop master integrals of the W-pair production at CECP and LHC. We derive a set of canonical master integrals for the integral families in the W-pair production at CEPC. We express all these canonical master integrals as Taylor series in ε up to ε4, with coefficients articulated in terms of Goncharov polylogarithms up to weight four after the rationalization of all square roots for the on-shell W-pair production cases. While, for the off-shell W-pair production, six of the master integrals at weight 4 still involve square roots that cannot be rationalized. They are ultimately expressed in terms of elliptic multiple polylogarithms. As a byproduct, we apply these analytic results to calculate the NNLO mixed QCD-EW correction to the W -pair production at electron-positron colliders. Our numerical results reveal that the mixed QCD-EW corrections can reach up to 1%, underscoring their potential phenomenological significance. In the study of two-loop MIs for NNLO QCD corrections to -pair production at the LHC, we investigate the contribution of MIs with a closed top-quark loop, and encounter elliptic Feynman integrals within a specific sector. By analyzing the maximal cut of integrals within this elliptic sector, we obtain the elliptic curves related to the elliptic sector. Utilizing the periods of elliptic curves, we construct a linear basis satisfying differential equations in a linear form with respect to , and successfully represent these MIs in as iterated integrals.

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