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Reconciling the FOPT and CIPT predictions for the hadronic tau decay rate

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The discrepancy between the FOPT and CIPT predictions for the hadronic tau decay rate (and other spectral function moments) has been a subject of intense investigations for many years and constitutes a major theoretical uncertainty for strong coupling determinations from hadronic tau decay spectral data. We demonstrate that the discrepancy may be understood since the Borel representations (which have been assumed to be identical for both approaches until now) are not equivalent in the presence of infrared renormalons. The difference, called asymptotic separation, can be calculated analytically for any concrete model of the Borel transform of the euclidean Adler function. Theoretically this implies that the OPE condensate corrections are, as a matter of principle, different for the FOPT and CIPT approach, and one can show that only the OPE corrections within FOPT have the standard form assumed in previous phenomenological analyses. This opens up the possibility that OPE predictions based on FOPT and CIPT perturbation theory can be reconciled reducing the theoretical uncertainty in future strong coupling determinations. In practice, the asymptotic separation is only sizeable (and thus phenomenologically relevant) if the known perturbative coefficients of the Adler function are dominated by the gluon condensate renormalon. The analytic knowledge of the asymptotic separation allows the dedicated construction of spectral function moments, where the discrepancy between the FOPT and CIPT predictions is suppressed, and it predicts that FOPT and CIPT lead to compatible predictions for any moment in the presence of infrared subtractions in the loop computations. In this talk we present why the Borel representations of the FOPT and CIPT series in general differ, we discuss the conceptual aspects of the asymptotic separation, and we demonstrate that the asymptotic separation correctly describes the different large-order asymptotic behaviour of the FOPT and CIPT spectral function moments for concrete Borel models. We also show first results for FOPT and CIPT spectral function moment predictions based on infrared-subtracted perturbation theory.

What is your topic?

Hadronic decays

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