Description of master thesis project
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Renormalons in Hadronic τ-Decays

In my master thesis project I am investigating a particular source of divergence of perturbative expansions related to the theoretical treatment of hadronic tau decays.
Given a perturbative series, say of a physical matrix element, one can in general assume that the considered series is of an asymptotic nature. There exists however a well-known technique for improving the convergence of a power series, the so-called Borel transformation. Performing such a transformation is nevertheless accompanied by the occurrence of renormalons, which are poles of the Borel transform located on the real axis in the Borel plane.
In particular, those renormalon poles occur in the perturbative contribution to the Operator Product Expansion (OPE) of the Adler function, which is a quantity appearing in the description of the tau hadronic width.
When it comes to performing renormalisaton group improvements of the perturbative contribution to the OPE, there exist different possibilities. The two most widely used techniques are known as Fixed-Order (FOPT) and Contour-Improved (CIPT) perturbation theory.
In the study of FOPT and CIPT one encounters the problem that the different approaches lead to different values for the perturbative contribution. This leads to a theoretical uncertainty in the prediction of the hadronic tau decay rate. The discrepancy between the two approaches can be traced back to the presence of renormalons in the Borel transform of the perturbative series. Getting predictable control over this discrepancy is the main goal of my thesis.