Description of master's thesis
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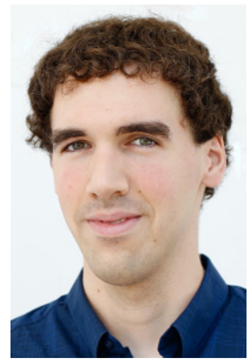
Renormalons and R-evolution for hadronic τ decays



In my master's thesis, I addressed the well-known issue that perturbative series in Quantum Chromodynamics (QCD) are in general divergent and can at best be considered asymptotic. An important source of divergence, directly related to contributions from small and large loop momenta in perturbative calculations, is referred to as renormalons. Depending on their physical origin one can distinguish between infrared (IR) and ultraviolet (UV) renormalons.
Studies of renormalon divergences have become increasingly important in high-energy physics to achieve ever higher precision in theoretical predictions of fundamental parameters. In this context, I reviewed the QCD description of hadronic τ decays, which provide an ideal tool for the low-energy extraction of the strong coupling constant α_s. In particular, I summarised what is known about IR and UV renormalons and studied the close connection between IR renormalons and non-perturbative power corrections in QCD.
Furthermore, I presented a particular approach to deal with renormalon divergences in my thesis and showed how the introduction of an additional cut-off scale R can be used to improve the poor convergence behaviour of perturbative series suffering from renormalons. From the solution of a renormalisation group equation (RGE) with respect to the scale R, the R-evolution equation, I deduced an analytic all-order expression for the so-called Borel transform of perturbative series that can be used as a test for renormalon divergences. As a practical application, I studied the Borel transform of the Adler function, which represents the central quantity in the perturbative description of hadronic τ decays, in the context of a simplifying limit of QCD known as the large-β_0 approximation.