Description of doctoral project
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Differential treatment of boosted top quark decays

In my doctoral project, under supervision of Univ.-Prof. Dr. André Hoang and Dr. Simon Plätzer, we focus on a differential treatment of the decay of highly boosted top quarks within an effective field theory (EFT) framework.
In particular, my current goal is the determination of the differential jet function in soft-collinear effective theory (SCET) at next-to-leading (NLO) order, taking into account strong and electro-weak effects. The jet function arises in the context of factorisation theorems, which are used to resum large logarithms to all orders in perturbation theory. Resummation is an essential tool to make precise predictions for any kind of observable involving physics at several disparate scales. Traditionally, this has been achieved with full analytic control for more inclusive observables.
However, the study of boosted top quark decays requires a partially numerical approach to the differential jet function, since a fully analytic treatment becomes intractable. For a numerical implementation it will be necessary to understand in detail the complex divergence structure of the effective field theory operators relevant to the process. This is important since an analytic cancellation of divergences has to be ensured before numerical calculations can be carried out. In the context of fixed order QCD calculations this task is routinely accomplished by so-called subtraction methods.
A key component of my thesis will therefore be to extend the applicability of these techniques to more intricate divergence structures appearing in SCET. A distinct advantage of the semi-analytic approach we are pursuing is that effects related to the top quark decay can be treated numerically while the resummation can still be performed in an analytic setting. This way of organising the calculation of observables promises a higher degree of theoretical control compared to fully numerical procedures.