

Description of doctoral project
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Infrared parton shower dynamics and the top quark mass

In my doctoral project, I am working on top quark physics and focus in particular on theoretical uncertainties concerning the determination of the top quark mass.

The top quark mass is a fundamental parameter relevant for the stability of the Standard Model vacuum and an accurate determination of this quantity is therefore of utmost importance. Upon the most precise top mass measurements are so-called direct methods, which are based on the reconstruction of the top quark decay products. Since the observables employed for the reconstruction analyses are often too complicated for systematic calculations, the theoretical predictions for the top mass measurements rely heavily on multipurpose Monte Carlo (MC) event generators. Consequently, it is in fact the MC top mass parameter that is determined in the measurements.

Even though major efforts have been made to reduce the theoretical uncertainties of the MC generators, which are often related to the parton shower component of the generators, the field theoretic meaning of the MC top mass has not yet been fully understood. The main tasks of my thesis will therefore be to gain more insight into the field theoretic interpretation of the MC top mass parameter and to work out the relation between the MC top mass and other renormalised top mass schemes.

Starting from QCD factorization theorems for top quark production and decay in the framework of effective field theories (EFT) a crucial part of my project entails the investigation of observables differential in the top decay at kinematic endpoints and resonances, where the direct top mass measurements are obtained from. Another important aspect of my thesis concerns the treatment of top quark finite lifetime effects in these observables.

