Abstract

In this work we perform a quantum chromodynamics (QCD) analysis on hadronic tau decays. QCD is describing the strong force, which dictates the interactions of quarks. Quarks are elementary particles. E.g. a proton is build of three quarks. The strength of the interactions is given by the strong coupling constant, which in contrary to its name is dependent on energy. In this thesis we will measure the strong coupling from hadronic tau decays. The tau is the only known lepton which is heavy enough to decay into hadrons. Nevertheless it lets us probe the strong coupling for low energies. As the strong coupling decreases for higher energies, so do the errors. The framework of extracting the strong coupling is referred to as qcd sum rules. Within the sum rules we have to choose between fixed-order perturbation theory (FOPT) or contour-improved perturbation theory (CIPT). Both methods are equally valid, but lead to different values. To test the validity of FOPT we make use of the Borel Summation (BS). The BS can be used to give the best possible sum of divergent asymptotic series as the one we are dealing with in by extracting the strong coupling. For low energies the coupling is large and for high energies the coupling is small. This leads to confinement. Quarks always appear as composite particles, the so-called Hadrons. Until today we have never measured an isolated quark. This is problematic as QCD is a theory describing quarks, but experiments are measuring hadrons. Consequently quark-hadron duality has been introduced, which states that we can describe physical quantities either in the quark-gluon picture or the hadronic picture, and that both description are equally valid. Unfortunately the assumption of duality is often violated. In theory we can suppress these duality violations (DV) by applying so called pinched weights. The higher the pinching the more suppressed are DV. We will perform fits for different weights to state, that even for low pinching, DV are sufficiently suppressed to extract the strong coupling.