

Effects of additional scalar decaplet in the RG evolution of the running gauge couplings in the minimal $SO(10)$ grand unified theory

Pavel Press

Abstract

We begin the thesis with the fundamentals of Lie groups and algebras. Then we introduce basic concepts regarding classical field theory and gauge theory. We formulate the Goldstone theorem and with it we describe the Higgs mechanism. We quantize the classical fields and outline the calculations within the quantum field theory. Using the renormalization procedure we derive the equations for the running coupling of a general gauge theory. We calculate the running gauge couplings in the Standard model and motivate theories beyond it. In particular, we will study the Grand Unified Theories. We discuss a specific Higgs sector with a $45 \oplus 126$ Higgs field. In order to have a more realistic theory we add a scalar Higgs decaplet and study its effects on the running couplings. Finally we discuss the implications of the decaplet for the proton decay.

Keywords

Quantum field theory, gauge field theory, running couplings, grand unification, proton decay