Bachelorprojekt
Ikkekummutativ geometri og Standard Modellen

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Abstract

I den foreliggende rapport skal vi undersÃÿge hvilken effekt ikkekummunikativ rumtids geometri vil have pÃě Z^0 henfald.

Contents

Citation example.[1]

1 Introduction

In describing fundamental physical phenomena, physicists make use of the concept of a particle representing a certain small-scale state (of the order $10^{-}15$ m) of the universe. Particles can interact with each other to annihilate or create new particles (or states). To account for this we use the concept of interactions. With these two concepts in hand we can go on and build mathematical frameworks based on experimental results and/or purely mathematical ideas, with the intend to extend our knowledge of the Universe and increase the predictive power and accuracy of the theories involved. Using this method physicists have been able to create an extensive theoretical framework with amazing predictive accuracy. This framework is commonly know as the Standard Model of particle physics, abbreviated SM.

Another accurate framework was developed in the beginning of the last century by german physicist Albert Einstein. This framework, describing gravity on large scales, is know as the General Theory of Relativity (GR). Together with the SM these two theories represent our best current knowledge[1] of the physical Universe at the very large and very small scales.

A lot of effort as been put in to unifying the encompassing physical theory of the large GR, with the theory of the s and the SM

[1] Henceforth when we write knowledge the reader may assume this is equivalent to the information available from being able to predict the time evolution of physical systems or states.

2 Theory

The particles and interactions of the SM are described in the language of quantum mechanics and quantum field theory, which have a natural way of unifying the mathematical concepts in a concise way.

The particles are divided into two main groups; fermions and bosons. Where fermions are defined as having half-integral spin and are described by Fermi-Dirac statistics, these include the leptons and quarks. Fermions constitutes all known matter and as such they are sometimes described as matter particles. Bosons on the other hand have zero or integral spin and are described by Bose-Einstein statistics. Some of these, namely the gauge bosons, are responsible for the weak, strong and electromagnetic interactions. Therefore the gauge bosons are often called the force-carriers of their respective interactions. It may be appropriate to note that the formalism of quantum mechanics makes no clear distinction between the concepts of matter and force -particles.

[FIGUR MED PARTIKLER, den fra wiki]

2.1 Gauge transformations

2.2 Gauge groups

The gauge boson mediating the electromagnetic force is the photon (γ). The theory is derived from the U(1) gauge group, which is just the group of phase rotations.

$$\psi \rightarrow e^{i\alpha}\psi \tag{2.1}$$

The weak interaction is derived from the SU(2) group of unitary matrices with determinant 1. The gauge boson associated with this group are the W^+, W^- and the Z^0 bosons.

Combining these two theories Weinberg and Salam [CITATION] arrived at what is called Quantum Electrodynamics (QED) which is described by the gauge group U(1) $\times$ SU(2).

The gauge bosons mediating the strong interaction are characterized by the SU(3) gauge group. The generators of which are the 8 Gell-Mann matrices giving rise to 8 gauge bosons of the strong interaction know as gluons, each having a property called color. Because of this color feature the gauge theory of the strong interaction is called Quantum Chromodynamics (QCD).

Combining QED and QCD into U(1) $\times$ SU(2) $\times$ SU(3) we arrive at what is know as the Standard Model (SM) of particle physics.

But one important feature is still missing.

2.3 Gravity

General Relativity (GR) is the theory describing

So far there have been no successful unification of the SM and General Relativity (GR), which is the theory describing all know macroscopic

References

[1] B. Melić, K. Passek-Kumerički, J. Trampetić, P. Schupp, and M. Wohlgenannt. The standard model on non-commutative space-time: strong interactions included. *The European Physical Journal C-Particles and Fields*, 42(4):499–504, 2005.

3 Appendix A

4 Appendix B

5 Appendix C

6 Appendix D