Contents

CHAPTER 1

Introduction

The introduction usually gives a few pages of introduction to the whole subject, maybe even starting with the Greeks.

For more information on LaTeX and the packages that are available see for example the books of Kopka [**kopka04**] and Goossens et al [**goossens04**].

A lot of useful information on particle physics can be found in the "Particle Data Book" [**pdg2010**].

I have resisted the temptation to put a lot of definitions into the file `thesis_defs.sty`, as everyone has their own taste as to what scheme they want to use for names. However, a few examples are included to help you get started:

- cross-sections are measured in pb and integrated luminosity in pb^{-1};
- the K_S^0 is an interesting particle;
- the missing transverse momentum, $p_{\text{T}}^{\text{miss}}$, is often called missing transverse energy, even though it is calculated using a vector sum.

Note that the examples of units assume that you are using the siunitx package.

It also is probably a good idea to include a few well formatted references in the thesis skeleton. More detailed suggestions on what citation types to use can be found in the thesis guide [**thesis-guide**]:

- articles in refereed journals[**pdg2010**, **Aad:2010ey**];
- a book [**Halzen:1984mc**];
- a PhD thesis [**tlodd:2012**] and a Diplom thesis [**mergelmeyer:2011**];
- a collection of articles [**lhc:vol1**];
- a conference note [**ATLAS-CONF-2011-008**];
- a preprint [**atlas:perf:2009**] (you can also use `@online` or `@booklet`for such things;
- something that is only available online [**thesis-guide**].

At the end of the introduction it is normal to say briefly what comes in the following chapters.

The lines at the end of this file are used by AUCTeX to specify which is the master LaTeX file, so that you can compile your thesis directly within `emacs`.

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CHAPTER 2

The Standard Model of Partical Physics

The basic principal behinde the interactions, which are mediated by gauge Bosons, is that the Lagrange density is invariant under local gauge transformation. More Precisse, the particals are discribed as Fields. The Time and Space evolution of those fields follows the Euler-Lagrange equation which can be determinde using Hamiltions variation Pricipall of minmal Action. Loclal gauge trenasoformation The basic principal behinde the interactions, which are mediated by gauge Bosons, is that the Lagrange density is invariant under local gauge transformation. More Precisse, the particals are discribed as Fields. The Time and Space evolution of those fields follows the Euler-Lagrange equation which can be determinde using Hamiltions variation Pricipall of minmal Action. Loclal gauge trenasoformation

2.1 Particals, Forces and Fields

The Standard Model of Particle Physics [1–7] is a relativistic Quantum Field Theory (QFT), which describes all known elementary particles and fundamental forces, gravity excluded. It's basic framework, consists of a small number of particles, described as fields Ψ [1], and symmetry principles. As displayed in fig. 2.1, there are currently three generations of fermions (spin 1/2), distinguishable into quarks and leptons. Each generation consist of a up- and a down-type quark, a charged lepton and the corresponding light neutrino. Measurements of the Z-boson decay width could only confirm the existence of three light neutrino species [**schael2006aleph**].

Despite there are more than one generation of fundamental Fermions, all known observable matter is just mad from the first one, concluding that members of the higher fermion generations are unstable.

The Standard Modell of Partical Physics , is a re-normalizable and relativistic Quantum Field Theory (QFT) of the fundamental fermions (spin $s = 1/2$) and their interactions mediated by gauge bosons (spin $s = 1$). It is based on a small number of particles and symmetry principles. Basically, as shown in fig. 2.1, there are three fermion generations. Each of them consists of a up- and a down type quark, a charged lepton and a corresponding light neutrino.

It's basic structure is depicted in , with three generations of fermions (quarks and leptons), of which each conists of a up- and a down type quark, a charged lepton and a corresponding neutrino. The existence of further heavy generation of up- and down-type has been exluded as for Mt and Mb wit 95 CL. Additionally the mass of a possible 4th lepton generation is limmited by the mass of the Z boson,

[1] In this context, the term particle refers to the excitation of a fieldoperator.

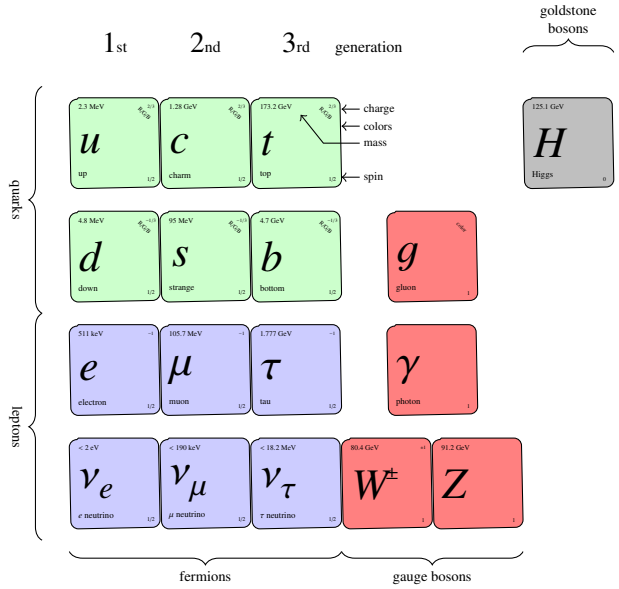

Figure 2.1: Graphical

and its lifetime Measuremntes confirms only three light neutrion generatis.

In the theory the particles are described as fields ψ, which follow
The basic principal behinde the interactions, which are mediated by gauge Bosons, is that the Lagrange density is invariant under local gauge transformation. More Precisse, the particals are discribed as Fields. The Time and Space evolution of those fields follows the Euler-Lagrange equation which can be determinde using Hamiltions variation Pricipall of minmal Action. Loclal gauge trenasoformation

Local gauge invariance requires the Standard Model Lagrangian to remain invariant when transforming the fermion fields in the following manner: → exp(i j(x) f j). (2.1) This principle is only valid in the presence of (massless) fields which transform in the same manner as the fermion fields thus compensating the fermion field transformations in each point of space and time. Based on the choice of the local gauge symmetry group the strong and electroweak interaction theories emerge - introducing a set of bosonic particles intermediating the corresponding forces. Following Noether's theorem, each symmetry group introduces field-charges which are conserved under local gauge transfromation.

Figure 2.2

Figure 2.3

2.2 QCD

Figure 2.4

2.3 Elektroweak inteaction theory and Higgs Mechanism

Bibliography

[1] S. L. Glashow, *Partial-symmetries of weak interactions*, Nuclear Physics **22** (1961) 579 (cit. on p. 3).

[2] S. L. Glashow, J. Iliopoulos and L. Maiani, *Weak interactions with lepton-hadron symmetry*, Physical Review D **2** (1970) 1285 (cit. on p. 3).

[3] D. J. Gross and F. Wilczek, *Asymptotically free gauge theories. I*, Physical Review D **8** (1973) 3633 (cit. on p. 3).

[4] H. D. Politzer, *Reliable perturbative results for strong interactions?*, Physical Review Letters **30** (1973) 1346 (cit. on p. 3).

[5] H. D. Politzer, *Asymptotic freedom: An approach to strong interactions*, Physics Reports **14** (1974) 129 (cit. on p. 3).

[6] A. Salam and J. C. Ward, *Electromagnetic and weak interactions*, Physics Letters **13** (1964) 168 (cit. on p. 3).

[7] S. Weinberg, *A model of leptons*, Physical review letters **19** (1967) 1264 (cit. on p. 3).

APPENDIX A

Useful information

In the appendix you usually include extra information that should be documented in your thesis, but not interrupt the flow.

List of Figures

List of Tables

Acknowledgements

I would like to thank ...

You should probably use `\chapter*` for acknowledgements at the beginning of a thesis and `\chapter` for the end.