WIP: Work in Progress Title

Ludwig-Maximilians-University Munich
Faculty of Physics

Dissertation

Eric Schanet

December 2020

WIP: Work in Progress Title

Ludwig-Maximilians-Universität München
Fakultät für Physik

Dissertation

Eric Schanet

December 2020

Supervisor: Prof. Dr. Dorothee Schaile

Abstract

My abstract

Zusammenfassung

Meine Zusammenfassung

Contents

Todo list

Introduction

Here is my introduction

Chapter 1

Theory

This chapter outlines the basic principles

1.1 The Standard Model of Particle Physics

By the end of the 1920s, quantum mechanics and general relativity had been relatively well established and the consensus among physicists was that matter was made of nuclear atoms consisting of electrons and protons. During the 1930s, a multitude of new experimental discoveries and theoretical puzzles excited physicists in three main fields of research: nuclear physics, cosmic rays and relativistic quantum mechanics. The following years and decades saw particle physics emerge as a result of these currents ultimately flowing together.

Since these early times of particle physics research, physicists have made extraordinary progress in describing nature at the subatomic scale. Today, a century later, the resulting theoretical framework, the Standard Model of Particle Physics (SM), is the most fundamental theory of nature to date. It provides an extremely precise description of the interactions of elementary particles and—using the Large Electron Positron collider (LEP)—has been tested and verified to an unprecedented level of accuracy up to the electroweak (EWK) scale. Given the unprecedented success of SM, it is not surprising that its history is paved with numerous awards for both experimental and theoretical work. In 1964, the Nobel prize was awarded to Feynman, Schwinger and Tomonoga for their fundamental work in quantum electrodynamics (QED). This quantum field theory allows to precisely calculate fundamental processes as e.g. the anomalous magnetic moment of the electron to a relative experimental uncertainty of 2.3×10^{-10} [1]. In 1979, Glashow, Weinberg and Salam were awarded with the Nobel prize for their work towards electroweak unification. The most prominent recent progress is undoubtedly the discovery of the Higgs boson, not only resulting in the Nobel prize being awarded to Englert and Higgs, but also completing the SM, roughly 50 years after the existence of the Higgs boson had been theorised.

Couplings and masses are measured from experiment

The following theoretical descriptions and notations largely follow [2].

1.1.1 Quantum field theories

Formally, the SM is a collection of quantum field theories. Quantum field theory (QFT) is similar to quantum mechanics in the sense that is is the application of

1.1.2 Renormalisation

1.1.3 Particle content

1.2 Supersymmetry

Chapter 2

The LHC and ATLAS

Chapter 3

Data and Monte Carlo Simulation

3.1 Data

Chapter 4

Statistical data analysis

Chapter 5

Analysis

Chapter 6

Summary

Here be dragons/

Bibliography

[1] P. J. Mohr, D. B. Newell, and B. N. Taylor, "CODATA Recommended Values of the Fundamental Physical Constants: 2014," *Rev. Mod. Phys.* **88** no. 3, (2016) 035009, arXiv:1507.07956 [physics.atom-ph].

[2] M. E. Peskin and D. V. Schroeder, *An Introduction to quantum field theory.* Addison-Wesley, Reading, USA, 1995. http://www.slac.stanford.edu/~mpeskin/QFT.html.

Symbols

Roman Symbols

LEP	Large Electron Positron Collider, page 5
QED	Quantum Electrodynamics, page 5
QFT	Quantum Field Theory, page 6
SM	Standard Model of Particle Physics, page 5

Appendix A

A.1 N-1 plots for cut-scan results

Appendix B

B.1 Scatter plots comparing truth and reco yields in the SRs

Acknowledgements

An dieser Stelle möchte ich mich herzlich bei allen bedanken, die mich bei der Anfertigung dieser Arbeit unterstützt haben. Insbesondere danke ich herzlich

- Prof. Dr. Dorothee Schaile für die Möglichkeit, diese Arbeit an ihrem Lehrstuhl durchzuführen sowie das Korrekturlesen der Arbeit.
- Dr. Jeanette Lorenz für die ausgezeichnete Betreuung, die vielen Anregungen, sowie die ehrliche und konstruktive Kritik beim Korrekturlesen dieser Arbeit. Sie hat es mir ermöglicht aktiv im 1-Lepton Analyseteam an der Suche nach Supersymmetrie mitwirken zu können.
- Dr. Nikolai Hartmann für die unzähligen Diskussionen über den Sinn und Unsinn der Datenanalyse mit und ohne ATLAS Software. Vielen Dank für die stets geduldige und ausführliche Beantwortung meiner Fragen, sowie das Bereitstellen unzähliger Zeilen Code, ohne die vieles schwieriger gewesen wäre.
- Allen Mitgliedern des Lehrstuhls Schaile für die angenehme und freundliche Arbeitsatmosphäre.
- Allen Freunden, die stets da waren, wenn ich sie gebraucht habe.

I also want to thank the entire 1-lepton analysis team, especially the coordinators Jeanette Lorenz, Da Xu and Alberto Cervelli. Thank you for the always supportive and enjoyable work environment. Many thanks also to Valentina Tudorache for patiently answering all my questions as well as all the entertaining conversations.

I would further like to thank Dr. Brian Petersen without whom the presented pMSSM studies would not have been possible.

En léiwen Merci och dem Yannick Erpelding fir d'Korrekturliesen—och wann en net alles verstanen huet—an dem Nick Beffort, fir all déi domm Reddit Posts, d'Korrekturliesen, an dei onzähleg Stonnen zesummen mat enger Spezi an der Hand.

Zu gudder Läscht, wëll ech op dëser Platz menger ganzer Famill merci soen, virun allem mengen léiwen Elteren an menger wonnerbarer Schwëster. Merci dass dir mëch bei allem waat ech maachen ënnerstëtzt an dass ech ëmmer op iech zielen kann, och wann ech weit fort sin. Ouni iech wier daat heiten net méiglech gewiescht. Besonneschen Merci och dem Nathalie Münster, dofir dass et mech seit Joren ëmmer ënnerstëtzt an ëmmer fir mech do as, och wann ech heiansdo depriméiert oder duercherneen sin.

Selbstständigkeitserklärung

Hiermit erkläre ich, die vorliegende Arbeit mit dem Titel

WIP: Work in Progress Title

WIP: Work in Progress Title

selbständig verfasst zu haben und keine anderen als die in der Arbeit angegebenen Quellen und Hilfsmittel benutzt zu haben.

Eric Schanet

München, den 01. Mai 2021