



A thesis presented to the Faculty of Science
Master of Science in physics at the Niels Bohr Institute

TITLE

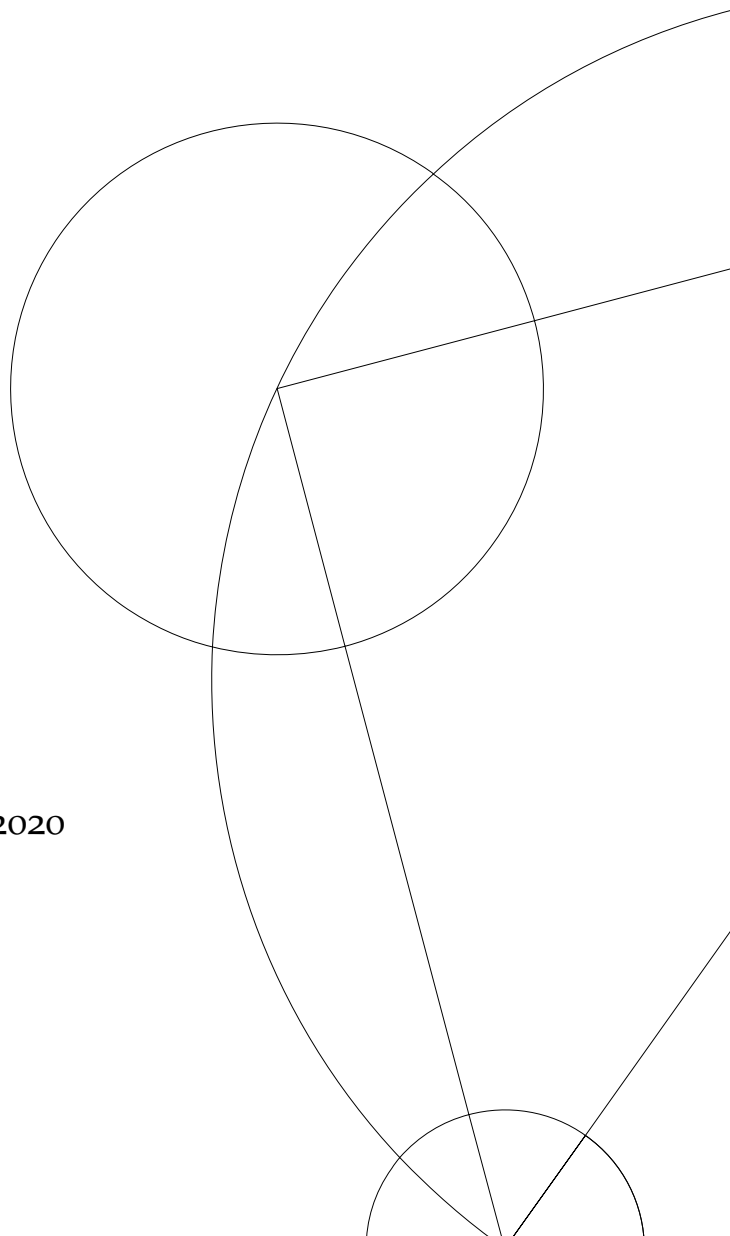
Your name

Your mail

Supervisor name

Supervisor mail

7th of Spooktober, 2020



ABSTRACT

THE ABSTRACT

ACKNOWLEDGEMENTS

I Acknowledge myself.
Good job me.

INTRODUCTION

Intro

CONTENTS

I	THE LORD OF THE RINGS	1
1	THE FELLOWSHIP OF THE RING	3
1.1	The Shire	3
1.1.1	Frodo be chillin	3
1.1.2	Gandalf Commth	3
2	THE TWO TOWERS	5
2.0.1	Feynman diagrams	5
3	THE RETURN OF THE KING	7
II	THE HOBBIT	9
4	LET'S WASTE 10 HOURS IN THE SHIRE - THE MOVIE	11
5	SOME SHIT OR SOMETHING IDK DON'T REMBER	13
5.1	blop	13
5.2	Same blop	13
6	WAIT THERE'S THREE?	15
III	APPENDICES	17
A	APPENDIX A: THEORY AND PRODUCTION	19
B	APPENDIX B: PRODUCTION AND DATA	21
C	APPENDICES	23
	Acronyms	24
	List of Figures	28
	List of Tables	30
	BIBLIOGRAPHY	32

Part I

THE LORD OF THE RINGS

THE FELLOWSHIP OF THE RING

I am a pretext!

1.1 THE SHIRE

I will cite a book! *Quantum Field Theory* by Srednicki [4].

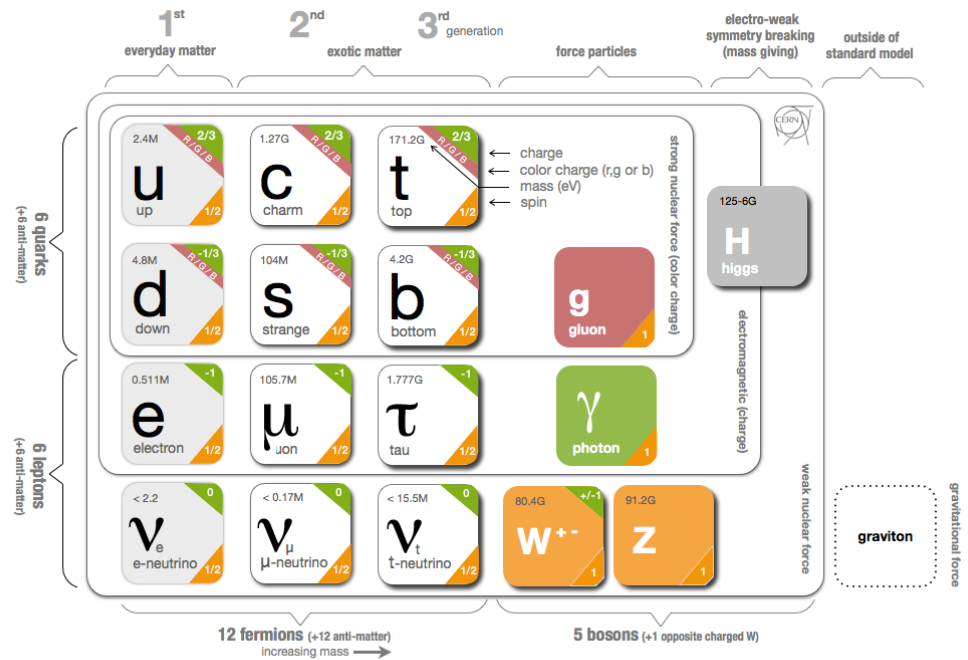
1.1.1 *Frodo be chillin*

Not a lot happens

1.1.2 *Gandalf Commeth*

Some weird shit happens Here's a figure on the side! Use Hspace and Vspace to fineadjust.

Figure 1: Simple overview of the elementary particles of the Standard Model. Schematic from Purcell [2]



THE TWO TOWERS

In [Chapter 1](#) we see that pippin is pimpin. The first chapter has the label 'ch:fellowship'. Using ref gives: [1](#). Using autoref gives: [Chapter 1](#).

2.0.1 Feynman diagrams

We are not only interested in the probability of collision, but also how particles in that collision decay and what they decay to after an interaction. This requires some theoretical calculation. Fermi's Golden rule describes the probability of some initial particle (i) decaying into a specific final mode f and is given by [\[3\]](#):

$$\Gamma_{i \rightarrow f} \sim |M_{i \rightarrow f}|^2 \delta(E_f - E_i) \quad (1)$$

[Equation 1](#) is an equation.

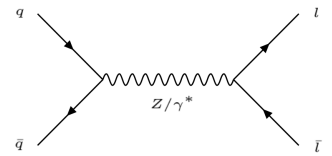


Figure 2: Feynman diagram for the $q\bar{q} \rightarrow Z/\gamma^* \rightarrow l\bar{l}$ decay where γ^* is a virtual photon

THE RETURN OF THE KING

The best one

An acronym the first time it is used: Conseil européen pour la recherche nucléaire [English: European Organization for Nuclear Research] ([CERN](#)).

An acronym the post-first time: [CERN](#)

Part II

THE HOBBIT

4

LET'S WASTE 10 HOURS IN THE SHIRE - THE MOVIE

AA



Figure 3: A very cute cat

5

SOME SHIT OR SOMETHING IDK DON'T REMBER

5.1 BLOP

5.2 SAME BLOP

6

WAIT THERE'S THREE?

Part III

APPENDICES

APPENDIX A: THEORY AND PRODUCTION

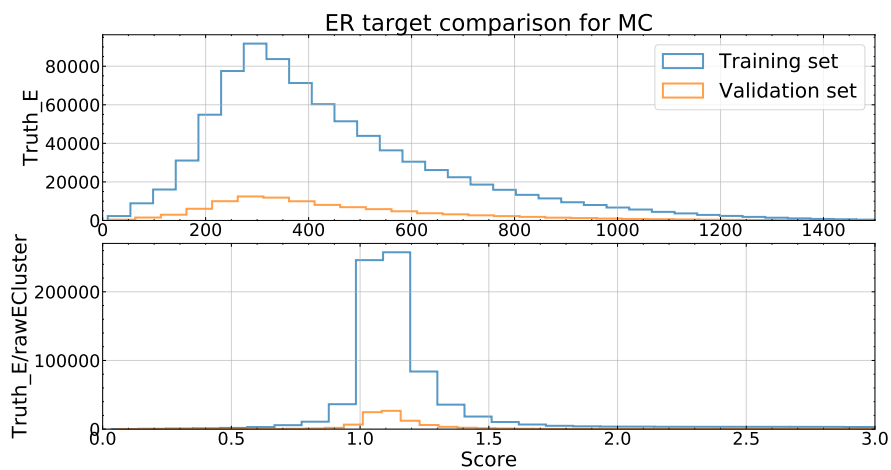


Figure 4: A comparison of two different targets when training a regression model. Top graph showing the true energy as target. Bottom graph showing the true energy divided by the raw E Cluster energy measured by the detector

B

APPENDIX B: PRODUCTION AND DATA

Table 1: Overview of egamma xAOD derivations types. For more information see *Twiki: egamma xAOD derivations*[\[1\]](#)

EGAM1	$J \rightarrow ee$ (central)
EGAM2	$J/\psi \rightarrow ee$
EGAM3	$Z \rightarrow ee\gamma, Z \rightarrow eee$
EGAM4	$Z \rightarrow \mu\mu\gamma, Z \rightarrow \mu\mu e$
EGAM5	$W \rightarrow e\nu$
EGAM6	$Z \rightarrow ee$ (looser than EGAM1)
EGAM7	Inclusive electrons
EGAM8	$Z \rightarrow ee$ (At least 1 fwd e)
EGAM9	Bootstrap for γ trigger

C

APPENDICES

Stuff

ACRONYMS

AKA	Also Known As
ALICE	A Large Ion Collider Experiment
ATLAS	A Toroidal LHC ApparatuS
AUC	Area Under the Curve
BDT	Boosted Decition Tree
CERN	Conseil européen pour la recherche nucléaire [English: European Organization for Nuclear Research]
cms	center-of-mass
CMS	Compact Muon Solenoid
CSC	Cathode Strip Chambers
ECAL	Electromagnetic CALorimeter
EF	Event Fitler
EMEC	ElectroMagnetic Endcap Calorimeter
ER	Energy Regression
FCAL	Forward CALorimeter
FPR	False Positive Rate
GBReweighter	Gradient Boosted Reweighter
IBL	Insertable B-layer
IQR	InterQuartile Range
HCAL	Hadronic CALorimeter
HEC	Hadronic Endcap Calorimeter
HLT	High Level Trigger
L ₁	Level-1 trigger
L ₂	Level-2 trigger
LAr	Liquid Argon
LDA	Linear Discriminant Analysis

LH	Likelihood
HL-LHC	High-Luminosity Large Hadron Collider
HP	Hyper Parameters
ID	Inner Detector
LHC	Large Hadron Collider
LHCb	Large Hadron Collider beauty
MAE	Mean Absolute Error
MC	Monte Carlo
MDT	Monitored Drift Tubes
MET	Missing E_T
ML	Machine Learning
MS	Muon Spectrometer
MSE	Mean Squared Error
NN	Neural Network
p	Proton
PDF	Probability Density Function
PI	Permutation Importance
PID	Particle IDentification
PP	Particle Physics
QCD	Quantum ChromoDynamics
QFT	Quantum Field Theory
RE	Relative Error
RF	Random Forest
rIQR	relative InterQuartile Range
ROC	Receiver Operating Characteristics
RPC	Resistive Plate Chambers
SHAP	SHapeley Additive exPlanations
SCT	SemiConductor Tracker
SM	Standard Model

TGC	Thin Gap Chambers
TPR	True Positive Rate
TRT	Transition Radiation Tracker
VBF	Vector-Boson Fusion
VBS	Vector-Boson Scattering

LIST OF FIGURES

Figure 1	Simple overview of the elementary particles of the Standard Model. Schematic from Purcell [2]	4
Figure 2	Feynman diagram for the $q\bar{q} \rightarrow Z/\gamma^* \rightarrow l\bar{l}$ decay where γ^* is a virtual photon	5
Figure 3	A very cute cat	11
Figure 4	A comparison of two different targets when training a regression model. Top graph showing the true energy as target. Bottom graph showing the true energy divided by the raw E Cluster energy measured by the detector . .	19

LIST OF TABLES

Table 1	Overview of egamma xAOD derivations types. For more information see <i>Twiki: egamma xAOD derivations</i> [1]	22
---------	--	--------------------

BIBLIOGRAPHY

- [1] The ATLAS Collaboration. *Twiki: egamma xAOD derivations*. Requires ATLAS login. URL: <https://twiki.cern.ch/twiki/bin/viewauth/AtlasProtected/EGammaxAODDerivations>.
- [2] Andrew Purcell. "Go On a Particle Quest at the First CERN Webfest." In: (2012). URL: <https://cds.cern.ch/record/1473657>.
- [3] Matthew D. Schwartz. *Quantum Field Theory and the Standard Model*. 1st Edition. Cambridge University Press, 2013. ISBN: 978-1-107-03473-0.
- [4] Mark Srednicki. *Quantum Field Theory*. 1st Edition. Cambridge University Press, 2006. ISBN: 978-0-521-86449-7.

