UNIVERSITY NAME (IN BLOCK CAPITALS)

Thesis Title

by

Author Name

A thesis submitted in partial fulfillment for the
degree of Doctor of Philosophy

in the
Faculty Name
Department or School Name

January 2016

Declaration of Authorship

I, AUTHOR NAME, declare that this thesis titled, 'THESIS TITLE' and the work presented in it are my own. I confirm that:

- This work was done wholly or mainly while in candidature for a research degree at this University.
- Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.
- Where I have consulted the published work of others, this is always clearly attributed.
- Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work.
- I have acknowledged all main sources of help.
- Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself.

Signed: ____

Date: ____

"The roots of eduation are bitter but the fruit is sweet"

Aristotle

UNIVERSITY NAME (IN BLOCK CAPITALS)

Abstract

Faculty Name
Department or School Name

Doctor of Philosophy

by Author Name

The Thesis Abstract is written here (and usually kept to just this page). The page is kept centered vertically so can expand into the blank space above the title too…

Acknowledgements

The acknowledgements and the people to thank go here, don't forget to include your project advisor…

Contents

List of Figures

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Abbreviations

LAH	**L**ist **A**bbreviations **H**ere

Physical Constants

Speed of Light	c	$=$	$2.997\ 924\ 58 \times 10^{8}$ ms$^{-\mathrm{S}}$ (exact)

Symbols

a	distance	m
P	power	W (Js^{-1})
ω	angular frequency	$rads^{-1}$

For/Dedicated to/To my…

Chapter 1

Introduction

Here we introduce the importance of particle detectors in particular solid state detectors. We will then explain briefly why a good simulator is not only helpful but also needed. This all should be written in such a way that serves as a project overview and summary.

1.1 Solid State Detectors in High Energy Physics

In this section we shall clarify how and why particles are detected using solid state detectors in particular Si.

1.1.1 Principles of particle detection

It should be clear how particles are detected in almost every single detector existing today: Have detector with Electric field inside; particle goes boom; boom creates charges; charges drift in electric field; drift generates signal; signal tells how is the particle that went boom. This could be a good place to introduce concepts such as

1.1.2 Specific charateristics of a *Si*-based particle detector

In this subsection we should tackle everything specific to *Si* detectors, from te advantages over gas detectors to the technical details of their design and operation. Typical numbers can be helpful. The Diode should be explained in detail and its importance in research and understanding should be clear in a context where nobody actually detects particles with them anymore. Should we explain detailed the semiconductors and p-n junction?

1.2 Radiation damage in *Si* detectors

We should clearly explain the effects of radiation in *Si* without going too deep in the differences between proton-like and neutron-like. We can only afford to go deep into traps and trapping as well as space charge modification inside the detector. Leakage current, higher vdep, etc. should be mentioned as wel.

Chapter 2

Simulator development and results

By now it should be clear why we need a simulator so we will briefly introduce the work. Information on where and how the simulator was made could fit very well as introduction to the actual work.

2.1 The simulator, a radiation upgrade to TRACS

The initial idea, main goal of the project clearly stated and a route-map to achieve it.

2.1.0.1 Starting Point (TRACS)

We should explain here why we chose to use TRACS as a starting point and what it could do before radiation upgrade. Initial approximations can be named and The usage of FENICS should be the main topic of this small subsection (should be brief)

2.1.0.2 Theoretical background and approximaitons

We should explain and justify the different approximations that we made for the software to be easier to develop and faster to run. The actual development should be explained here as well including, maybe, stating the attempt to parallelize the operation.

2.1.0.3 Goodness of the results

Here we should present the results obtained and comment qualitatively on their accuracy. The need for a comparison against real measured data show be risen here as a connector-bridge to the next chaptr in which the experimental measurements are to be explained and analyzed.

Chapter 3

Experimental measurements

Rationale behind the measurements

3.1 Experimental method

Where how and what we measured. These are not real world measurements but testing/calibrating measurements that can tell us how good the simulation is.

3.2 Fitting method

Here is where we show the pivoting capabilities of the project where it can be used as a simulator to predict the signal from a very well known detector as well as to "measure"/know the field and space charge distribution inside an irradiated sample of which we only know their transients.

3.3 Results and comparison with TRACS-rad

Comparison of the results obtained from the actual measurements and the fitted space charge distribution. These are THE results of the bachelor's thesis. Most important part of the whole project. We shall be objective and very critic with optimism and without forgetting about the grand scheme of thing.

Chapter 4

Conclusions

With all the data taken and already compared it's time to look at the grand scheme of things and conclude how good this project is, how good things developed and how good we developed things.

4.1 Results and achievements

here we shall talk about the initial goals and how well we accomplished them. Having experimental and simulated measurements is great (+1pt for the project) but we need to analyse how good the simulator is (+-1pt depending on the outcome).

The project deserves between A+ and B+ =¿ This should be the take away of the conclusion

4.2 Let's put the project in perspective

It's time to sell the product! It has been presented in RD50 (Hamburg) and validated by the collaboration (at least PdC part). The tool is unique in many ways. From its never-seen-before ability to manipulate and fit the space charge distribution inside a detector to the more common but still in development capacity to simulate and predict transients on radiated silicon detectors.

It's a tool for the future, working in the limits of knowledge and (maybe) pushing them forwards. (toma sobrada!)

Chapter 5

Future Proyection and extensibility

Let's take a look at the future posibilities and possible improvements of the software.

5.1 Future Improvements

Make trapping random and/or position dependent. Implement diffusion. Parallelization. Multiplication layers (LGAD). 3D detectors...

5.2 Future proyection

It has already been used for simulations of the still-in-development TPA characterization. It's used regularly in IFCA by Ivan's group. Coupled with the laser simulator it can help understad detectors and how radiation damages them.

Appendix A

An Appendix

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Bibliography