Abstract of thesis entitled

This is the title of my thesis

Submitted by

Cheuk Yee LO

for the degree of Doctor of Philosophy

at The University of Hong Kong

in August 2018

These are the motivations. These are the methods. These are the results. These are the discussions. These are the significance.

An abstract of exactly 499 words

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by

Cheuk Yee LO

A thesis submitted in partial fulfilment of the requirements for
the Degree of Doctor of Philosophy
at The University of Hong Kong.

August 2018

Declarations

I declare that this thesis represents my own work, except where due acknowledgement is made, and that it has not been previously included in a thesis, dissertation or report submitted to this University or to any other institution for a degree, diploma or other qualifications.

Signed ....

Cheuk Yee LO

Acknowledgments

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LHC	Large Hadron Collider
SUSY	Supersymmetry

Chapter 1

Experimental Setup

1.1 Introduction

Our experimental data was collected from the ATLAS particle detector in the Large Hadron Collider (LHC). The following section will introduce LHC and the ATLAS particle detector.

1.2 The Large Hadron Collider

The Large Hadron Collider (LHC) was built in the border between France and Switzerland by the European Organization for Nuclear Research (CERN). It is a circular particle collider under the ground with circumference 27 km. Two beams of protons will be accelerated in opposite directions, and then these two beams will collide with each other at the collision point. The energy of each beam is 6.5 TeV, and hence the center-of-mass energy of the two beams $\sqrt{s}$ is 13 TeV, which is the energy used in this experiment. This energy is equivalent to the speed that the beam will circulate the ring 11,245 times per second. Figure 1.1 shows the schematic diagram of the CERN accelerator complex, which contains a series of accelerators, from low energy to high energy. The dark blue big circle in figure 1.1 represents the LHC, on which there are 4 particle detectors at 4 different yellow points: ATLAS, CMS, LHCb and ALICE.

Before the beam is injected into LHC, the protons need to be accelerated by a series of accelerators. The journey of the protons starts from a tank of hydrogen gas. The proton and the electron are separated by a electric field. The protons are then accelerated to 50 MeV by Linac2, which is a linear accelerator. The beam is then injected to the second accelerator called the Proton Synchrotron Booster (PSB), which accelerates the beam to 1.4 GeV. The beam is then injected to the third accelerator called the Proton Synchrotron (PS), which pushes the beam to 25 GeV. The beam is then injected to the fourth accelerator called the Super Proton Synchrotron (SPS), which further pushes the beam to 450 GeV. Finally, the beam is injected to the two beam pipes of the LHC. One of the beam moves in clockwise direction, while another beam moves in anti-clockwise direction. Two beams will be collided at the collision point inside the ATLAS detector. [2]

The circular path of the proton beam is maintained by many superconducting electromagnets along the LHC tunnel. There are 1232 main magnetic dipoles, and

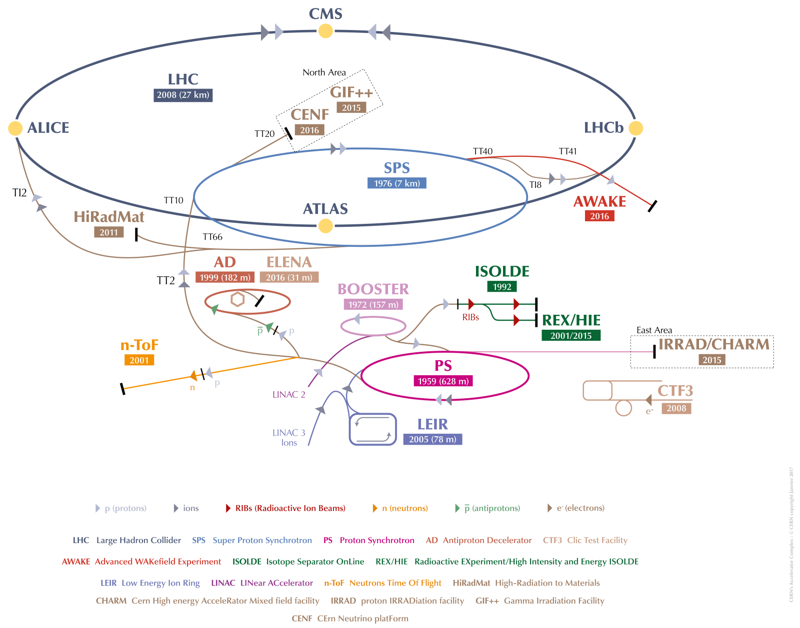

Figure 1.1: The schematic diagram of the CERN accelerator complex, which shows a series of accelerators and facilities. [1]

each of them generates a large magnetic field of 8.3 T. In order to generate such a high magnetic field, the coils need to have very high currect of 11,080 A, and hence supercoducting coil need to be used, to reduce the heat loss due to the electrical resistance. The material of supercoducting coil is niobium-titanium (NbTi). To reach the condition for supercoductivity, the electromagnets operate at a very low temperature of 1.9 K. There are also 392 magnetic quadrupole to make the beam narrower, and the chance of proton-proton collision will be higher. [3, 4]

The protons in the beam are grouped into different bunches, and there are about 10^{11} protons in each bunch. The time-spacing between two adjacent bunches is 25ns. This means that in each 25 ns, two bunches are collided at the collision point. For each bunch collision, there are about 10 to 50 collisions happened.

The interacting rate for a physics proccess $\frac{dN}{dt}$ is the product of the cross section of that physics proccess σ and the instantaneous luminosity $\mathcal{L}$.

$$\frac{dN}{dt} = \sigma \mathcal{L} \tag{1.1}$$

The instantaneous luminosity $\mathcal{L}$ is a measure of the interacting rate of two protons at the collision point, which is related to the density of the protons and the speed of the protons. The instantaneous luminosity in this experiment is about 10 $(\text{nb})^{-1}$ s^{-1}.

References

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