SAMPLE FILE FOR A THESIS WITH THE 'PITTETD' CLASS

by

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TABLE OF CONTENTS

1.0 INTRODUCTION

We begin by saying that we do not really have much to say, but for the sake of clarity we divide our topic in chapters.

2.0 LHC

The topics treated in this chapter can be somewhat obscure. For humanitarian considerations, the chapter will be subdivided.

2.1 ATLAS

2.1.1 Coordinate System Used in ATLAS

ATLAS adopted a common coordinates system based on the geometry of LHC, with certain modifications due to convenience. The origin of the coordinate system is defined as the interaction point, which is located in the center of the detector. The z-axis is oriented to be along the beam line, and perpendicular to that an x-y plane, also conventionally called the transverse plane, is defined. The positive Cartesian x-axis points towards the center of the LHC, and the y-axis points upwards just as the right-hand convention. We define the half of the detector that is located on the positive z-axis the "A-side", where the other half is called the "C-side". On the transverse plane, we commonly apply the standard polar coordinates, where r and ϕ represent the radius and the azimuthal angle. The polar angle θ however, is usually reported in terms of "pseudorapidity" η, where

$$\eta \equiv -\ln[\tan(\frac{\theta}{2})] \tag{2.1}$$

The origin of this quantity comes from the "real" rapidity, y, which was defined as

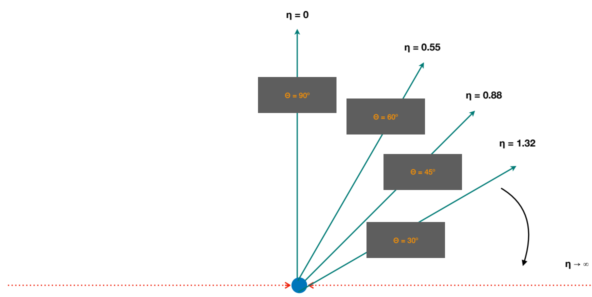

Figure 1: An illustration of the connections between pseudorapidity η and the polar angle θ in three-dimensional space.

following:

$$y \equiv \frac{1}{2} \ln(\frac{E + p_z}{E - p_z}) \tag{2.2}$$

The motivation for defining such quantity is very practical, which is that in fact, the difference of two particles' rapidities Δy is Lorentz invariant, making it one of the most crucial quantities in accelerator physics. However, to precisely measure rapidity requires both the total energies and beam-line momentums of the protons, which is a nontrivial task. Hence, with the approximation from highly relativistic particles ($E \approx P$, etc), we could reduce y into:

$$y \approx \frac{1}{2} \ln(\frac{1 + p_z/p}{1 - p_z/p}) \tag{2.3}$$

Since the polar angle $\theta = p_z/p$, we get to our final form:

$$y \approx \frac{1}{2} \ln(\frac{\cos^2(\theta/2)}{\sin^2(\theta/2)}) = -\ln[\tan(\frac{\theta}{2})] = \eta \tag{2.4}$$

Based on pseudorapidity, we could also define the distance ΔR to be equal to:

$$\Delta R = \sqrt{\Delta\eta^2 + \Delta\phi^2} \tag{2.5}$$

2.1.2 Tracking

This is well-known topic, and we shall discuss it no more.

2.1.3 Calorimetry

This is a very complicated topic and we shall discuss it in our next paper.

3.0 CONCLUSIONS

This is the second chapter of the present dissertation. It is more interesting than the first one, for it is the last one.