Measurement of jets produced in top quark events using the $e\mu$ final state with 2 b-tagged jets in pp collisions at $\sqrt{s} = 8$ TeV with the ATLAS detector

by

Jacquelyn Kay Brosamer

A dissertation submitted in partial satisfaction of the
requirements for the degree of
Doctor of Philosophy

in

Physics

in the

GRADUATE DIVISION
of the
UNIVERSITY OF CALIFORNIA, BERKELEY

Committee in charge:
Professor Marjorie Shapiro, Chair
Professor Joshua Bloom
Professor Barbara Jacak
Professor Lawrence Hall

Fall 2015

The dissertation of Jacquelyn Kay Brosamer is approved:

Chair Date

Date

Date

Date

University of California, Berkeley

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Abstract

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The transverse momentum (p_{T}) and multiplicity of jets produced in top quark events are measured using 20.3 fb^{-1}of pp collision data at a center-of-mass energy of $\sqrt{s}$ =8 TeV. Jets are selected from top events requiring an opposite-charge $e\mu$ pair and two b-tagged jets in the final state. The data are corrected to obtain the particle-level fiducial cross section $\frac{1}{\sigma_{e\mu+2\ b\text{-jets}}}\frac{d\sigma_{\mathrm{jet}}}{dp_T}$for additional jets with rank 1-4, where rank=1 is the leading additional jet. These distributions are used to obtain the extra jet multiplicity as a function of minimum jet p_{T} threshold.

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To do

Chapter 1

Introduction

Chapter 2

Theory

This chapter reviews some of the theoretical concepts relevant to the subsequent physics analysis. The the importance of the top quark within the Standard Model is first discussed. The modeling of physics at hadron colliders is also reviewed.

2.1 The top quark

The top quark was first discovered at Fermilab in 1995 [2][1]. As the heaviest known fundamental particle, the top quark is an important probe of the Standard Model (SM). Before the Large Hadron Collider (LHC), the Tevatron provided the only experimental observation of the top. The LHC produces a top quark every few seconds, about a hundred times more frequently than the Tevatron. This signifigant increase in statistics allows precision measurements of the top at the LHC, which is sometimes called a "Top Factory."

2.1.1 Importance of the top quark in the SM

Table **??** summarizes the properties of the fundamental particles of the SM: three generations of quarks, three generations of leptons, gauge bosons, and the recently discovered Higgs boson. The interactions of these particles at the LHC are described by the mathematical framework of Quantum Field Theory (QFT) [3].

Because of its large mass, the top quark plays a special role in the SM. The top mass is about 172 GeV, about the same as a gold atom nucleus, 40 times larger than the next heaviest quark and 10^5 times heavier than the lightest quark.

The heavy top has a very short lifetime ($\sim 5\times10^{-25}$ s), so it is the only quark that decays before it can form a hadron with other quarks. This unique property means that the top is the only "bare" quark that can be accessed at the LHC. Measuring the properties of the top thus provides an important test of Quantum Chromodynamics (QCD), the SM description of interactions between quarks via the strong force.

	particles			spin	electric charge
Quarks	$(u,d)_L$	$(c,s)_L$	$(t,b)_L$	$(\frac{1}{2},\frac{1}{2})$	$(+\frac{2}{3},-\frac{1}{3})$
	u_R	c_R	t_R	$\frac{1}{2}$	$+\frac{2}{3}$
	d_R	s_R	b_R	$\frac{1}{2}$	$-\frac{1}{3}$
Leptons	$(\nu_e,e^-)_L$	$(\nu_\mu,\mu^-)_L$	$(\nu_\tau,\tau^-)_L$	$(\frac{1}{2},\frac{1}{2})$	(0,-1)
	e_R^-	μ_R^-	τ_R^-	$\frac{1}{2}$	-1
Gauge bosons	g			1	0
	$W^\pm$ and Z			1	± 1 and 0
	γ			1	0
Scalar boson	H			0	0

Table 2.1: Spin and charge of particles in the SM.

	Particle	Mass
Leptons	e	0.511 MeV
	μ	105 MeV
	τ	1777 MeV
Gauge bosons	$W^\pm$	80.2 GeV
	Z	91.19 GeV
	H	126 GeV
Hadrons	p	938 MeV
	n	939 MeV
	$\pi^\pm$	139.6 MeV
	π^0	135.0 MeV

Table 2.2: Mass, lifetime, and decay mode of particles in the SM.

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Appendix 1

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