Master Thesis

Signal and background studies for scalar leptoquark pair production in the $t\bar{t} + 2\tau$ channel at the ATLAS experiment

Daniel Adlkofer

Supervisor
Prof. Dr. Raimund Ströhmer

Advisor
Dr. Mahsana Haleem

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Physikalisches Institut
Lehrstuhl für Physik und ihre Didaktik
Julius-Maximilians-Universität Würzburg

Contents

1 XyZ

$2\,\mathrm{eV\,m^{-1}}$

sample	t$\bar{\text{t}}$		t$\bar{\text{t}}$H	
selection	reconstruction event yield	truth event yield	reconstruction event yield	truth event yield
≥ 2 b-jets	66878	252200	73	200
≥ 2 b-jets $+1\,\tau$	188	5923	2.5	28
≥ 2 b-jets $+2\,\tau$	0.7	49	0.2	8.2

Table 1.1: Event yield for different selections with tau leptons for the t$\bar{\text{t}}$ and the t$\bar{\text{t}}$H Monte Carlo sample. The luminosity account for $36.1\,\mathrm{fb^{-1}}$.

sample	t$\bar{\text{t}}$	t$\bar{\text{t}}$H
selection	efficiency $\frac{\epsilon}{\%}$	efficiency $\frac{\epsilon}{\%}$
≥ 2 b-jets	26.52	36.72
≥ 2 b-jets $+1\,\tau$	3.18	8.83
≥ 2 b-jets $+2\,\tau$	1.41	2.13

Table 1.2: Efficiencies for different selections with tau leptons for the t$\bar{\text{t}}$ and the t$\bar{\text{t}}$H Monte Carlo sample.

sample		$t\bar{t}$		$t\bar{t}H$	
selection	reference selection	reconstruction ratio $\frac{r}{\%}$	truth ratio $\frac{r}{\%}$	reconstruction ratio $\frac{r}{\%}$	truth ratio $\frac{r}{\%}$
≥ 2 b-jets $+1\,\tau$	≥ 2 b-jets	0.28	2.35	3.43	14.26
≥ 2 b-jets $+2\,\tau$	≥ 2 b-jets	0.0011	0.020	0.24	4.11

Table 1.3: Ratios for different selections with tau leptons for the $t\bar{t}$ and the $t\bar{t}H$ Monte Carlo sample.

sample	$t\bar{t}$		$t\bar{t}H$	
selection	numerator event yield	denominator event yield	numerator event yield	denominator event yield
truth matching for tau	63	13723	5590	21610
efficiency	0.46%		25.9%	
tau from H^0, $W^\pm$, Z^0	0	0	4859	11988
efficiency	-		40.5%	
tau from B-mesons	63	13722	20	7416
efficiency	0.46%		0.27%	
tau within a jet	8440	3776952	18511	20327225
efficiency	0.22%		0.091%	
tau within a b-jet	6098	2658379	2317	1208924
efficiency	0.23%		0.19%	

Table 1.4: Event yield for different selections with tau leptons for the $t\bar{t}$ and the $t\bar{t}H$ Monte Carlo sample. The luminosity account for $36.1\,\text{fb}^{-1}$.

sample	LQ$_{500\,\mathrm{GeV}}$		LQ$_{1\,\mathrm{TeV}}$	
selection	numerator event yield	denominator event yield	numerator event yield	denominator event yield
truth matching for tau	2604	5362	2263	5055
efficiency	48.6%		44.8%	
tau from H^0, W$^\pm$, Z^0	95	340	82	461
efficiency	27.9%		17.8%	
tau from B-mesons	0	183	0	200
efficiency	0.0%		0.0%	
tau from LQ	1744	3286	1057	2022
efficiency	53.1%		52.3%	
tau within a jet	7232	55208	7011	63671
efficiency	13.1%		11.0%	
tau within a b-jet	2317	1208924	6098	2658379
efficiency	0.45%		0.23%	

Table 1.5

2 Experimental setup for the search of scalar leptoquarks

2.1 The ATLAS detector at the LHC

[20],[21],[22] in Bachelorarbeit

Bibliography