論文 / 著書情報
Article / Book Information

題目(和文)	
Title(English)	Search for new phenomena in top-antitop quarks final states with additional heavy-flavour jets in proton-proton collisions with the ATLAS detector
著者(和文)	山口大貴
Author(English)	Daiki Yamaguchi
出典(和文)	学位:博士(理学), 学位授与機関:東京工業大学, 報告番号:甲第10717号, 授与年月日:2018年3月26日, 学位の種別:課程博士, 審査員:陣内 修,久世 正弘,柴田 利明,河合 誠之,中村 隆司
Citation(English)	Degree:Doctor (Science), Conferring organization: Tokyo Institute of Technology, Report number:甲第10717号, Conferred date:2018/3/26, Degree Type:Course doctor, Examiner:,,,,
学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

専攻： Department of	基礎物理学　専攻	申請学位（専攻分野）： Academic Degree Requested	博士　（　理学　） Doctor of
学生氏名： Student's Name	山口大貴	指導教員（主）： Academic Supervisor(main)	陣内修
		指導教員（副）： Academic Supervisor(sub)	久世正弘

要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

In the particle physics, in order to explain the shortcomings in the Standard Model (SM), physics models beyond the Standard Model (BSM) have been proposed. Some of them predict the existence of new particles such as vector-like quarks (VLQ) or enhancement of four-top-production. A search for new phenomena in top-antitop quarks final states with additional heavy-flavour jets has been carried out in this thesis. The analysis was executed for 36.1 fb^{-1} of $\sqrt{s}$ = 13 TeV proton-proton collisions data taken with the ATLAS detector at the Large Hadron Collider (LHC). The main target of this search is one of the VLQ, referred to as the vector-like top partner (VLT).
In the BSM search, high-quality data taking is one of the most important works. The monitoring tools for the Pixel detector are developed in this dissertation, which enable to properly understand the detector condition. By using the tools, the potential issue on the B-Layer about the hit occupancy in 2015 was identified. The prompt feedbacks contribute to the smooth data acquisition in 2016 and later.
Reconstructed tracks, which are trajectories of the charged particles in the Inner Detector, are one of the most basic physics objects. The distance between tracks and collision points, which is so-called impact parameter, is a characteristic parameter to distinguish the tracks associated with secondary vertices from those associated with the primary vertex. Measurements of the impact parameter resolutions with the data taken in early 2015 are presented in this dissertation. The results show that the observed resolutions are improved compared with those in Run1 as expected from the installation of the new innermost Pixel layer (IBL). The resolutions and their uncertainties are propagated into the other performance measurements for the other physics objects. This study widely contributed to the event reconstruction and data analyses in the ATLAS experiment.
The signal events of VLQ and BSM four-top-production include boosted heavy particles such as Higgs bosons and top quarks. Introduction and optimisation of Higgs boson and top quarks identifiers with the re-clustering technique are developed in this dissertation. They improve the discrimination of signals from the SM backgrounds. Events are classified with jet, b-jet, Higgs-jet, and top-jet multiplicities and compared on the total energy in the transverse plane between the data and SM prediction. To improve the accuracy of the background estimation, a likelihood fit of the predicted backgrounds to the observed data is performed. Before searching any excess of the data in the signal region, the background prediction is needed to be consistent with the data in the validation regions. After the fit, the background predictions are confirmed to be consistent with the data within their uncertainty in the validation region. Therefore, any excess is searched for in the signal region.
As a result, no significant excess of events from the SM expectation is observed, hence the exclusion limits on the cross section for various BSM models are set. For the VLT signals, the cross section limits are interpreted as the lower VLT mass limits by comparing with the theoretical cross section. In the case of the fixed branching ratio of the VLT decaying into the Higgs boson and top quark, BR(T→Ht)=1, the observed (expected) mass limit on the mass is set to be $m_{VLT} > 1.43$ (1.34) TeV. The observed (expected) limits for a weak-isospin doublet and singlet are set to be $m_{VLT} > 1.31$ (1.26) TeV and $m_{VLT} > 1.19$ (1.11) TeV, respectively. For the other branching ratios, the observed and expected limits are set, assuming BR(T→Ht) + BR(T→Zt) + BR(T→Wb) = 1. As for the four-top-quark production, the observed (expected) cross section limit for a contact interaction in an effective field theory model is set to be 16.4 (30.9) fb. For two universal extra dimensions with the real projective plane, the Kaluza-Klein mass limits with the symmetric geometry case are set to be $m_{KK} > 1.80$ (1.73) TeV.
A small deficit against the SM background is seen in 1-lepton channel. Since it could have been due to potential issues in this analysis, all the possibilities are discussed. The test results show that no evidence of issues is observed. Therefore, the deficits on the observed events can be concluded to be originated from the statistical fluctuation.
This analysis does not discover new phenomena. However, improvements of sensitivities by an increase of the integrated luminosity and development of the taggers significantly extended the mass coverage of the VLT signal from the previous analysis in the ATLAS experiment. The limits set in this analysis constraint in the parameter space in signal models.
At last, the prospects for future experiments are shown. In the future, the LHC will be upgraded to increase the instantaneous and integrated luminosities with the centre-of-mass energy of 14 TeV. This analysis has good potentials for a further VLT search.

備考 ： 論文要旨は、和文 2000 字と英文 300 語を 1 部ずつ提出するか、もしくは英文 800 語を 1 部提出してください。
Note : Thesis Summary should be submitted in either a copy of 2000 Japanese Characters and 300 Words (English) or 1copy of 800 Words (English).

注意：論文要旨は、東工大リサーチリポジトリ(T2R2)にてインターネット公表されますので、公表可能な範囲の内容で作成してください。