

國立中央大學

物理學系

碩士論文

**Search for heavy resonances decaying into a Z
boson and a Higgs boson in the 2l2b final state
in pp collisions at $\sqrt{s} = 13$ TeV**

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**Search for heavy resonances decaying into a Z boson
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by

Yee Shian Henry Tong

Submitted to the Department of Physics
in partial fulfillment of the requirements for the degree of

Master of Physics

at the

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Abstract

A search for heavy resonances decaying to a Higgs boson and a Z boson is presented. The analysis is based on the data collected in 2015 with the CMS detector at a center-of-mass energy $\sqrt{s} = 13$ TeV, corresponding to an integrated luminosity of 2.51 fb^{-1} . The Higgs bosons are reconstructed from high momentum $b\bar{b}$ quark pairs that are detected as a single massive jet, while the Z bosons are reconstructed from electron pairs and muon pairs. The analysis is separated in electron and muon channels, with single and double b-tag categories. A 95% upper limit on the production cross section of $\sigma_X \times \mathcal{B}(X \rightarrow ZH)$ is derived from the combination of four categories with a limit of 0.063 pb to 0.265 pb for m_X from 800 to 4000 GeV.

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摘要

本篇論文呈現了由新理論模型預測之粒子衰變到一個希格斯粒子和一個 Z 玻色子的分析。本分析使用了於 2015 年由大強子對撞機中的緊湊渺子線圈偵測器所記錄之質子-質子對撞總能量為 13 TeV，總亮度為 2.5 fb^{-1} 的數據。高動量的希格斯粒子衰變到一個底夸克和一個反底夸克，在偵測器裡被偵測為一個大質量的噴流。 Z 玻色子有兩個衰變通道，分別為正反電子通道以及正反渺子通道。本分析將分別探討電子通道和渺子通道，各通道將再細分為單底夸克標記和雙底夸克標記此二類別。通過合併電子通道和渺子通道，以及它們所有的底夸克標記類別，結果顯示質量由 800 GeV 至 4000 GeV 的新粒子於 95% 信置區間的生產截面上限為 0.063 pb 至 0.265 pb 。

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Chapter 1

Analysis Strategy

The target of the analysis is to search for the heavy resonances decaying to di-Higgs whose mass is above 800 GeV. Each Higgs boson is assumed to further decay to $b\bar{b}$ and is reconstructed in a larger boosted jet including two b-flavored-like merged sub-jets by anti-kT08 algorithm. Higgs identification is done by selection on soft-drop PUPPI mass, n-subjetness, and double b-tagger.

In this Chapter,

1.1 Data and simulated samples

The analysis is performed based on the data collected in pp collision with the CMS detector at $\sqrt{s} = 13$ TeV. The integrated luminosity is $35.9 fb^{-1}$. Runs in which the detector normally operates is chosen according to the golden JSON file: *Cert_271036 – 284044_13TeV_23Sep2016ReReco_Collisions16_JSON.txt*. The samples of data is listed in Table 1.

Dataset	Processing	Int. lumi. (fb^{-1})
JetHT/Run2016B	23Sep2016	5.9
JetHT/Run2016C	23Sep2016	2.6
JetHT/Run2016D	23Sep2016	4.4
JetHT/Run2016E	23Sep2016	4.1
JetHT/Run2016F	23Sep2016	3.2
JetHT/Run2016G	23Sep2016	7.7
JetHT/Run2016H	PromptReco	8.9
Total		35.9

TABLE 1.1: A simple table