論文 / 著書情報
Article / Book Information

題目(和文)	ATLAS検出器を用いたヒッグスを介し崩壊するチャージーノ・ニュートラリーノ対の直接生成事象探索
Title(English)	Search for direct production of charginos and neutralinos decaying via Higgs boson with the ATLAS detector
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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	留目和輝	指導教員（主）： Academic Supervisor(main)	陣内修
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

The basic model for particle physics, the Standard Model (SM) precisely describes the particles phenomena, and most of observations and measurements from experiments agree with the prediction by the SM so far. However, there are some issues that cannot be explained by the SM, such as the hierarchy problem and dark matter. In order to explain those, many beyond the Standard Models (BSM) have been constructed. One of the BSM is the supersymmetry (SUSY), which can explain both hierarchy and dark matter problems. In this thesis, pair production of electroweak gauginos predicted by the SUSY model is searched.

The target of this thesis is pair production of charged electroweak gaugino (chargino) and neutral electroweak gaugino (neutralino). The event where charginos decay via W boson and neutralinos decay via Higgs, then Higgs decay to diphoton and W decay to $\ell\nu$ is chosen as the target process. In this channel, some of background processes are strongly suppressed by using a mass reconstructed by diphoton. Therefore, although expected signal yields are relatively lower than other channels, high significance is expected due to the scarce backgrounds.

The analysis is performed with 36.1 fb^{-1} of $\sqrt{s}$ = 13 TeV proton-proton collision data collected by the ATLAS detector at LHC in 2015 and 2016. The background sources are classified into two types; ones including a Higgs in their processes are classified as peaking backgrounds, and the others are classified as non-peaking backgrounds. The contributions of the peaking backgrounds are evaluated using MC samples, and the contributions of the non-peaking backgrounds are evaluated using a data-driven method.

For the event selection, exact numbers of the expected objects are required, such as exactly two photons, exactly one lepton and large missing transverse energy. Selection criteria related to missing transverse energy, which are for E_T^{miss}, $M_T^{W\gamma 1}$ and $M_T^{W\gamma 2}$, are useful to suppress backgrounds since only signal event is expected to have large missing transverse energy because of LSPs. In order to suppress non-peaking backgrounds, $m_{\gamma\gamma}$ cut and $\Delta\Phi$(W,h) cut are applied. A new selection criterion, b-jet veto is introduced to suppress one major background, tth process. This new selection improves sensitivity by ～10%.

In order to improve significance while keeping signal acceptance, the signal region is optimized by dividing the region. The threshold dividing region is optimized by maximizing expected discovery significance. As a result of the optimization, the significance is improved by 300%. Based on the optimized signal regions, which are denoted as SRa and SRd, expected limit on excluded model parameter is evaluated. The limit is distributed around NLSP mass = 180 GeV, which is improved from NLSP mass = 160 GeV of the limit evaluated in the 8 TeV analysis.

In the unblinded data, 2 events in SRa and 9 events in SRd are observed. Since the backgrounds are 0.36 ± 0.22 events and 5.35 ± 0.95 events are expected in SRa and SRd respectively, both observed results have mild excesses. Those are evaluated as 1.93σ deviation and 1.36σ deviation in SRa and SRd respectively. From those evaluations, it is concluded that the mild excesses are not statistically significant. This is expected to be due to the large statistical uncertainty on the non-peaking backgrounds. Therefore, these results suggest importance of further study with more data statistics expected in the on-going and future experiments.

Model dependent upper limits on the signal cross section are evaluated for all models assumed in the analysis. All the evaluated upper limits on the cross section are larger than the assumed models. Therefore, no model assumed in the analysis were excluded. Model independent upper limits on the signal yields are evaluated as 5.7 fb in SRa and 10.4 fb in SRd.

As discussions, preferred signal models and expected observations in other channels are described. Preferred signal models have been evaluated using best fit μ, which is the fitting results of the signal strength in the likelihood. However, since the best fit μ have large fitting error due to large statistical uncertainty, preferred signal models are distributed in wide range, which is from NLSP mass = 150 GeV to NLSP mass = 350 GeV. Expected observations are evaluated regarding 3ℓ channel, which is the channel for the events Higgs decay to pair leptons and W decay to $\ell\nu$, assuming observed mild excesses are sign of new physics. Although 3ℓ channel provided the second largest limit in 8 TeV analysis, expected excesses in 3ℓ channel in 13 TeV analysis is equivalent to 0.99σ mainly because of large background.

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).

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