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論 文 要 旨

THESIS SUMMARY

専攻： Department of	基礎物理学	専攻	
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申請学位（専攻分野）： Academic Degree Requested	博士（理学） Doctor of
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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

Many extensions of the Standard Model of particle physics predict the existence of heavy and long-lived particles. A Split-SUSY model often predicts long-lived supersymmetry (SUSY) particles which decay inside the inner tracking volume of the ATLAS detector and they can be reconstructed as displaced vertices (DVs). A Split-SUSY model is one of phenomenologically motivated SUSY models that is consistent with the squark mass of O(10-1000) TeV implied by the observed Higgs mass of 125 GeV. It would also explain the relic density of dark matter when gaugino co-annihilation mechanism is realised. The decay point of the long-lived particle is reconstructed by finding the crossing point of the tracks of the charged particles. The charged particles with large impact parameter cannot be reconstructed efficiently with the ATLAS standard tracking strategy, therefore a special "large radius tracking" criteria was performed after the chain of standard tracking. The large radius tracking criteria uses detector hits which were not used in the standard tracking and the requirements on impact parameters and the number of hits are relaxed.

A search for direct production of long-lived gluino pairs which transform into R-hadrons in final states with massive DVs with high track-multiplicity and missing transverse momentum has been performed using proton-proton collision data from the 2016 data taking period corresponding to an integrated luminosity of 32.7 fb^{-1} recorded at $\sqrt{s}$ = 13 TeV by the ATLAS detector at the LHC. In order to cover a wide range of parameter space of a Split-SUSY model, a generic DV+Missing Transverse Energy (missing E_T) channel is investigated in this dissertation. One of the powerful features of the search for new physics via massive and high track-multiplicity DVs is the extremely low level of background. No SM particles result in the signature and only experimentally induced backgrounds become important. DVs arising from hadronic interaction with detector materials are significantly reduced using a three-dimensional detector material map created with a data-driven method. The number of DVs which were accidentally merged with a neighbour DV and fall into the signal region was found to be negligible. The number of DVs crossed by track randomly is estimated using templates of DV mass distributions constructed by adding a track to a seed vertex and re-calculating its invariant mass.

Not only explicit improvements such as the increase of the LHC beam energy and installation of new layer of pixel detector into the ATLAS detector but also several improvements and re-optimisations have been made from the previous analysis. A newly developed event filter purely based on missing E_T significantly improved the signal acceptances for scenarios with small mass difference between gluino and neutralino. The filter requirement to find jets which are not associated with tracks from the primary vertex was replaced with the simple calorimeter-based missing E_T cut. In addition, a method to estimate remaining DVs which were not vetoed by the material map has been developed and criteria for validation of the background estimation methods have been revised to accommodate to R-hadron specific signatures. Two different validation regions were constructed by inverting the material veto requirement, or setting an upper limit on the missing E_T and the smallest difference of azimuthal angle between selected jets and missing E_T.

No vertices are observed in the signal region, and exclusion limits at 95% confidence level are set for a range of production cross-sections and long-lived-particle lifetimes in a Split-SUSY model, where gluino decays to a pair of quarks and the lightest neutralino. The excluded limits are set for an interval of proper decay length $c\tau$ =1-10000 mm. The exclusion limit on gluino mass was set up to ~2400 GeV. There is a significant gain compared to the limit in the previous analysis up to ~1600 GeV. In addition, a wide range of parameter space with small mass difference between gluino and neutralino has been excluded up to ~1600 GeV. It is the first time for the ATLAS to set a limit on this small mass-splitting scenario.

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。
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