論文の内容の要旨

Search for supersymmetry in the final state with multiple jets, missing transverse momentum and one isolated lepton, using $20.3\,\mathrm{fb}^{-1}$ of data recorded by the ATLAS detector at $\sqrt{s} = 8\,\mathrm{TeV}$

(ATLAS 検出器を用いた重心系エネルギー 8TeV における 1 本のレプトンを終状態に持つ超対称性事象の探索)

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Supersymmetry is one of the most attracting theories beyond the Standard Model. In the context of R-parity conserving supersymmetry model, the supersymmetric particles are produced in pairs and the lightest supersymmetric particle (LSP) is stable. Large gluino and squark production cross-sections are expected at the proton-proton collisions. Once gluinos and squarks are produced, they decay through a cascade of multiple stages to the final states with the LSP. The LSP is only weakly interacting and escapes detection, resulting in large missing transverse momentum E_T^{miss}. The decay also accompanies many hadronic jets and several leptons, which often give a distinct signature from the Standard Model processes.

This thesis presents a general search for supersymmetry in final states with jets, missing transverse momentum and one isolated electron or muon, using $20.3\,\mathrm{fb}^{-1}$ of proton-proton collision data at $\sqrt{s} = 8\,\mathrm{TeV}$ recorded by the ATLAS detector at the LHC in 2012.

One of the notorious backgrounds in proton-proton colliders is QCD multi-jet, which has an overwhelming cross-section, can be suppressed by requiring an isolated electron or muon. Therefore, leptonic analysis is an ideal way to search for new physics with small cross-sections at the LHC. Based on a topology selection of one lepton, large E_T^{miss} and multiple jets, three signal regions are introduced to cover a wide range of signal event topologies.

Since no excess over the Standard Model expectation is found in the Signal Regions, the results are interpreted as mass limits in several models. In a minimal supergravity model, a gluino mass up to 1200 GeV is excluded, and a squark mass is excluded up to 1500 GeV. The results is also interpreted in a simplified model and an upper limit on the cross-section times branching fraction is set on the gluino pair-production cross-section $\sigma\,(\tilde{g}\text{-}\tilde{g})$ and branching fraction $\mathrm{Br}\,(\tilde{g} \to qqW^{(*)}\tilde{\chi}_1^0)$, which is

$$\sigma\,(\tilde{g}\text{-}\tilde{g}) \times \mathrm{Br}\,(\tilde{g} \to qqW^{(*)}\tilde{\chi}_1^0)^2 < 20\,\mathrm{fb}.$$

This limit is a good approximation independent of the gluino decay pattern except for some extreme mass spectra.