Search for squarks and gluinos with the ATLAS detector in final states with jets and missing transverse momentum in Run2

Yuta Sano, D1, N-lab, Nagoya University

1. Introduction

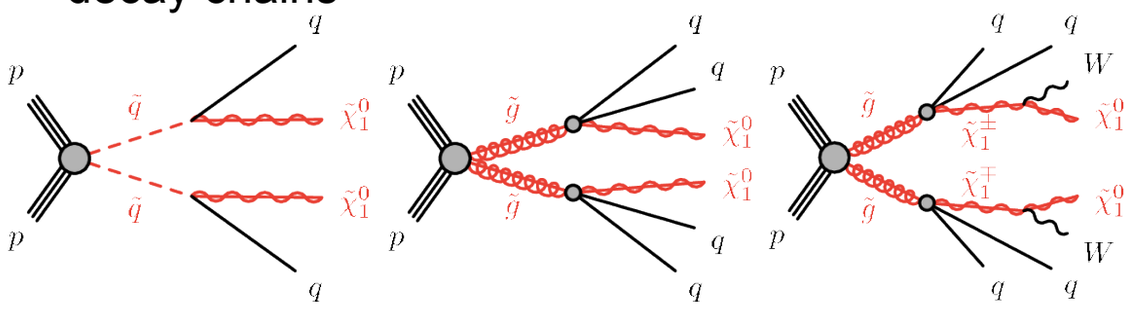
The recent increase in the center of mass energy of the proton-proton collisions gives a unique opportunity to extend the sensitivity to production of supersymmetric particles at the Large Hadron Collider. The production cross section of 1.5 TeV gluinos for $\sqrt{s}$ = 13 TeV is 50 times larger than that for $\sqrt{s}$ = 8 TeV. Our focus is on gluinos and squarks.

Final state:

- 0 lepton + 2 – 6 jets + missing transverse energy
- This 0-lepton channel is one of the promising analyses for SUSY discovery exceeding the Run-1 exclusion just with the early Run-2 dataset.

Covered signatures:

- 2j for squark pairs, 4j for gluino pairs, ≥ 5j for long decay chains



2. Analysis strategy

The analysis is based on 13.3 fb^{-1} of ATLAS data at $\sqrt{s}$ = 13 TeV. Signal Regions (SRs) to enhance each targeted signal are defined.

Main discriminating variables:

- Number of jets, Effective mass (m_{eff}, the scalar sum of transverse momenta of the jets and missing transverse energy)

The other variables:

- E_T^{miss}/m_{eff} (E_T^{miss}: missing transverse energy), $\Delta\Phi(j_i, E_T^{miss})$ (Angular between jets and E_T^{miss}) to reduce QCD backgrounds
- Aplanarity to distinguish spherical events from planar or linear events.

Definition of one of the SRs, SR4j-2200:

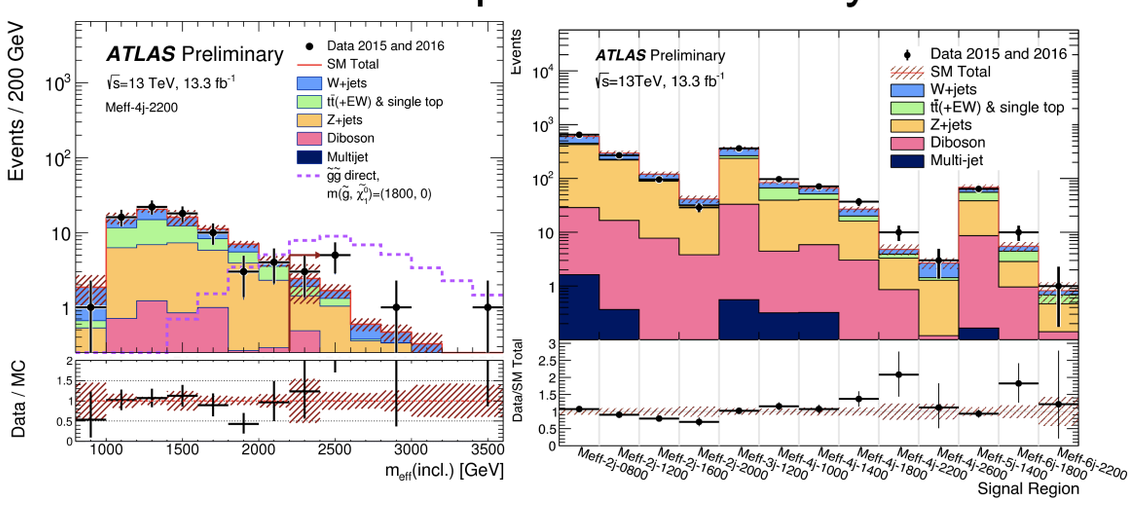
- Number of jets ≥ 4, m_{eff} > 2200 GeV
- Aplanarity > 0.04, E_T^{miss}/m_{eff} > 0.2, $\Delta\Phi(j_i, E_T^{miss})$ > 0.4

Background estimation:

- W+jets, ttbar, Z+jets, QCD: normalization fitted simultaneously to data in specific CR
- Diboson: estimated entirely using MC simulation

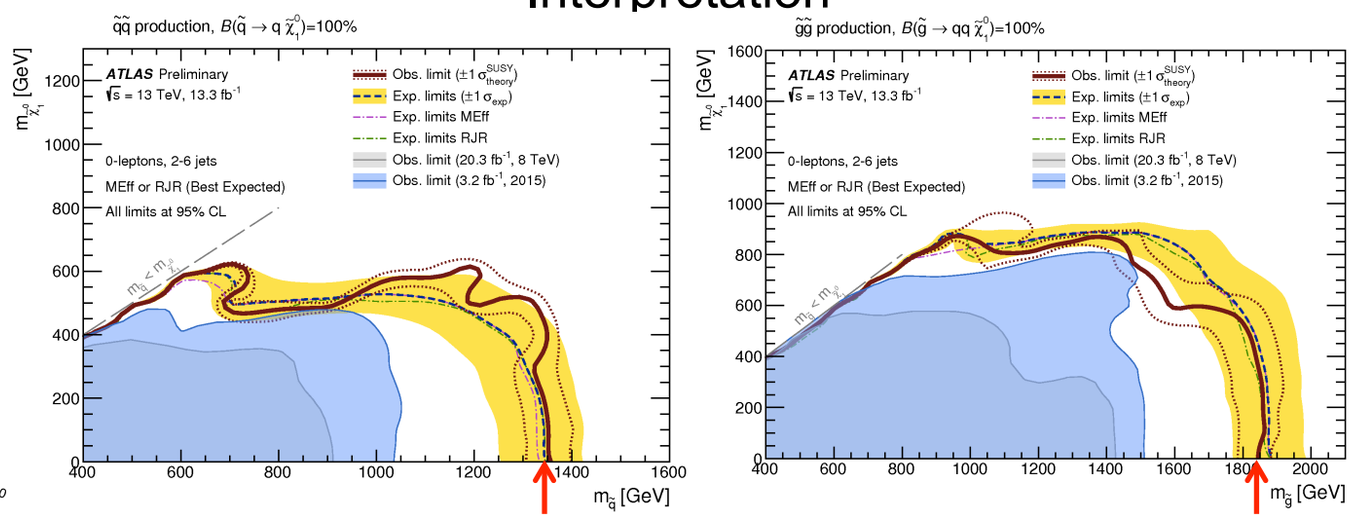
3. Results using 13.3 fb^{-1} data (ATLAS-CONF-2016-078, http://cds.cern.ch/record/2206252)

Observed vs predicted event yields



No excess above the Standard Model background expectation was observed in any of the SRs

Interpretation



Squark masses below 1.35 TeV and gluino masses below 1.86 TeV are excluded at the 95% confidence level

4. Outlook for the analysis with more data

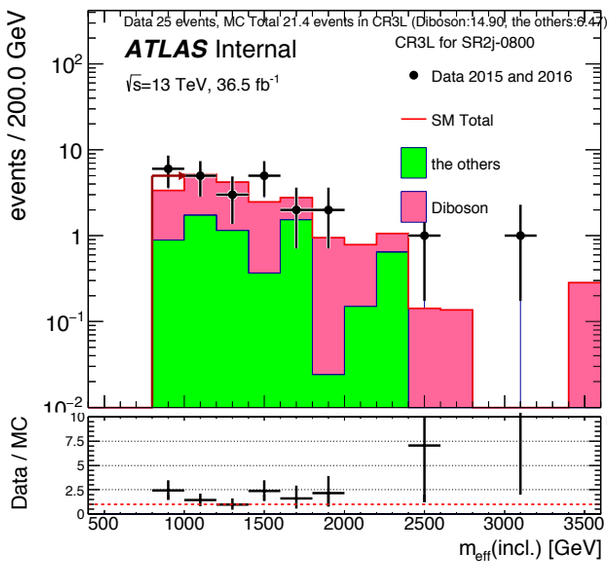
We are currently updating the results with 2015+2016 dataset (40 fb^{-1}) for this spring.

As one of the improvements, we developed new control region for diboson background, which was predicted only with MC simulation and uncertainties are very large (50%) due to PDF, renormalization, factorization and resummation scale uncertainties. The uncertainty may be reduced using final state with three leptons (WZ → lvll) considered as CR for diboson background.

For next update with Run2 full dataset, we are investigating new b-veto/b-tag SRs in order to cover various models more widely e.g. pMSSM.

Channel	Meff-2j-0800
Total bkg	610
Total bkg unc.	±50 [8%]
MC statistics	–
$\Delta\mu_{Z+jets}$	±12 [2%]
$\Delta\mu_{W+jets}$	±9 [1%]
$\Delta\mu_{Top}$	±5 [1%]
$\Delta\mu_{Multi-jet}$	±0.04 [0%]
CRγ corr. factor	±22 [4%]
Theory Z	±40 [7%]
Theory W	±0.32 [0%]
Theory Top	±3.4 [1%]
Theory Diboson	±14 [2%]
Jet/MET	±5 [1%]
Multi-jet method	±1.6 [0%]

The uncertainty on the background estimate for SR2j-0800. Diboson events has one of largest uncertainty.



Region of SR2j-0800 with three leptons w/o cuts on variables to reduce QCD events. 40 fb^{-1} is used.

Reference : ATLAS-CONF-2016-078