



ATLAS SUSY

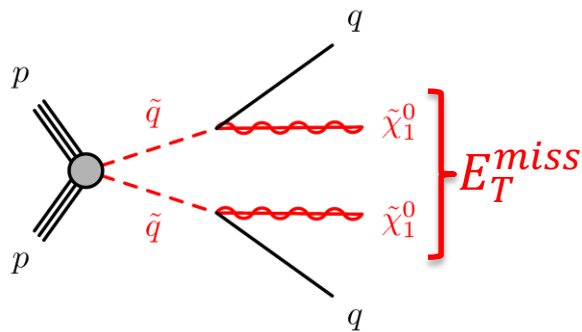


Search for **squarks** and **gluinos**
with the ATLAS detector in final
states with jets and transverse
missing momentum using 2015 data

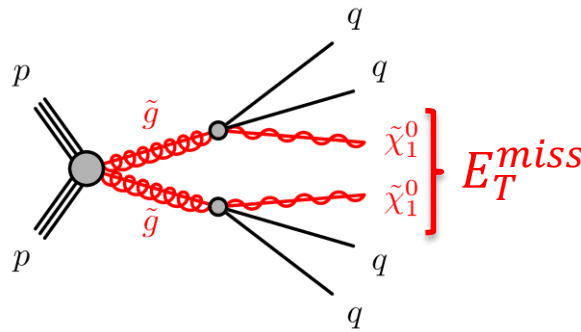
Shunsuke Adachi (The University of Tokyo)
for the ATLAS collaboration

Introduction

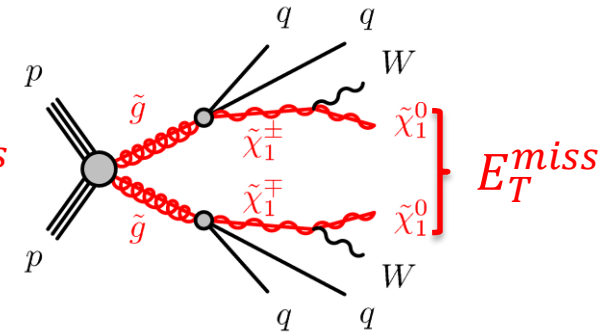
- Target signal has a few assumptions :
 - R-parity conservation
 - The lightest neutralino ($\tilde{\chi}_1^0$) is the lightest supersymmetric particle (LSP) .



Squark-pair production
direct decay



Gluino-pair production
direct decay



Gluino-pair production
one-step decay

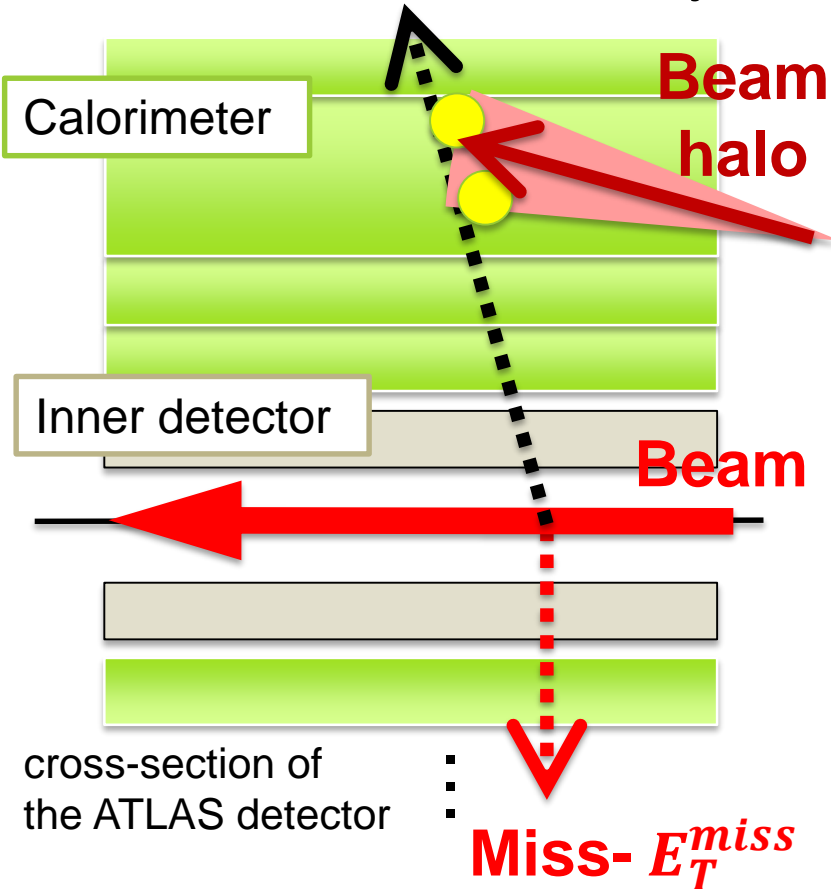
The final state with (2—6) **jets** and **transverse missing momentum** (E_T^{miss})

*All hadronic decay. No lepton (μ or e).

This poster shows a important result for SUSY search, using **3.2 fb⁻¹** full p-p collision data recorded with the ATLAS detector in 2015.

Non-collision background

Miss-reconstructed jet



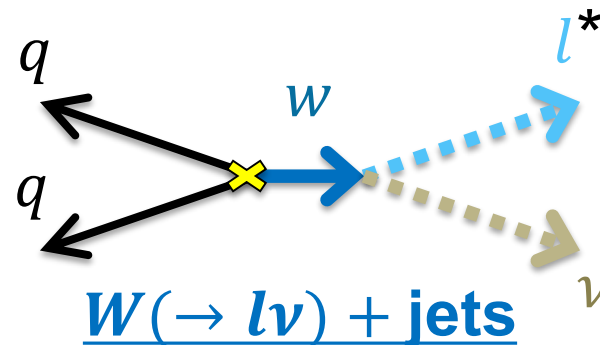
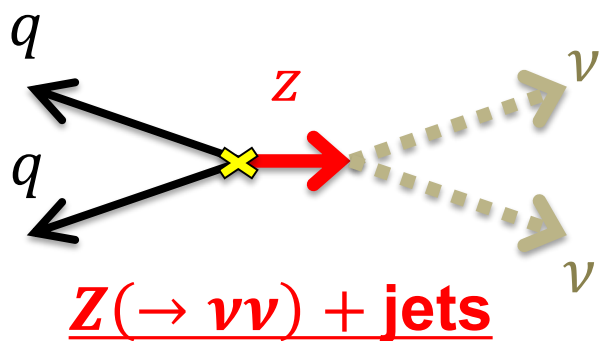
Non-collision background is a potentially dangerous background for this analysis :

- Miss-reconstructed jet makes also **miss- E_T^{miss}** on the opposite direction.
⇒ **Similar to signal characteristics**
(jet + E_T^{miss})
- It cannot be reproduced by Monte-Carlo.

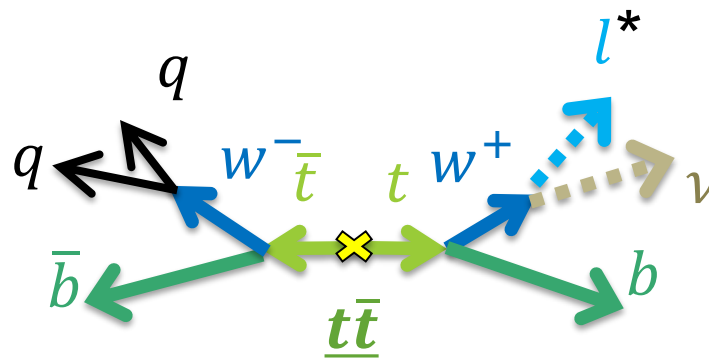
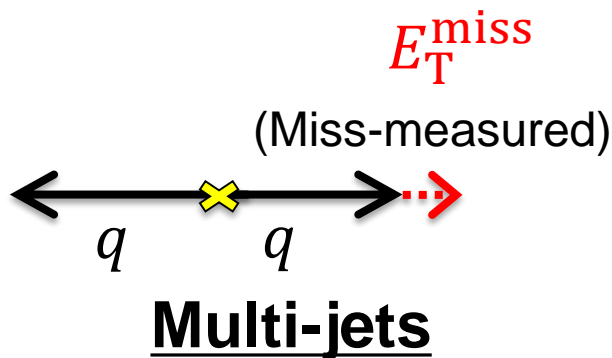
At first, we need to reject the **non-collision background to the negligible level.**

Standard model background

There are 4 kinds of **standard model background**.

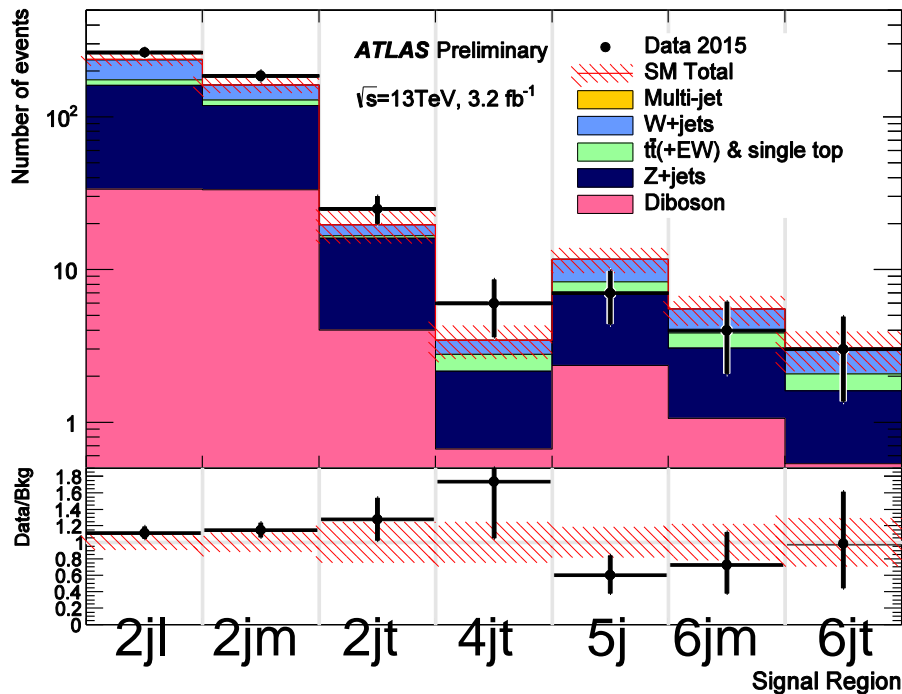


* Lepton is missed, or it's a hadronically decaying tau



- Background is estimated by Monte-Carlo.
- The normalisation of the MC is estimated in 4 dedicated **control regions**, each dominated by a specific SM process.

Result



- 2/4/5/6 is the minimum number of jets
- l/m/t : Loose/Medium/Tight selection

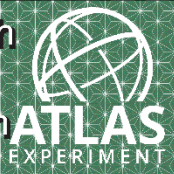
7 signal-rich regions are prepared to
 2jl/2jm/2jt 4jt 5j 6jm/6jt
 cover large mass-range of squark and gluino.

The comparison (counting) between
data and **expected background** in
 each **signal region** is shown in each
 bin.

There is no significance excess.

Please come to listen to more detail!

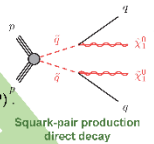
- How to reduce non-collision background
- Selection of control regions
- Limit plot of squark / gluino mass



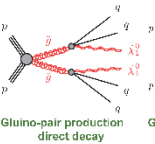
Search for squarks and gluinos with the ATLAS detector in final states with jets and transverse missing momentum using 2015 data

1 Introduction

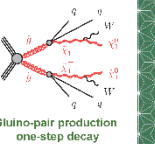
- Search for the supersymmetric partner of the quarks (squarks) and the gluons (gluinos)
- Assume that R -parity is conserved. (a neutralino is the lightest supersymmetric particle (LSP))
- Their cross-sections are expected to be much larger at a centre-of-mass energy of 13TeV at the LHC in Run2.
- Focus on the final state with (2-6) jets & large transverse missing momentum (E_T^{miss})
- Use the 3.2fb^{-1} full data recorded by the ATLAS in 2015.



Squark-pair production direct decay



Gluino-pair production direct decay



Gluino-pair production one-step decay

2 Event selection

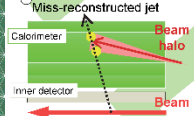
Prepare 7 kinds of selections to enrich signal by changing selections on jet, m_{eff} and E_T^{miss} / m_{eff} .

Signal region : $2j / 2jm / 2jt / 4jt / 5j / 6jm / 6jt$
*The number is the minimum number of jets.

Variable	Selection
Lepton	None
Photon	None
Electron	None
Photon	None
Missing momentum	$> 200 \text{ GeV}$
m_{eff} : Scalar sum of the	$> \text{Depend on region}$

3 Non-collision background

Miss-reconstructed jet

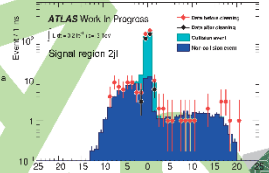


- is miss-reconstructed jet from **Proton beam halo**.
- cannot be reproduced by Monte Carlo.
- ⇒ Needs to be rejected to a **negligible level** in this analysis.
- has
 - small angle with beam axis
 - less matching tracks in inner detector

Veto the event having a jet considered to be non-collision background :

- Large f_{miss} : The maximum fraction of deposit energy in one calorimeter layer.
- Small f_{ch} : The fraction of deposit energy of charged particles (in inner detector).

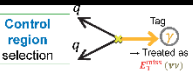
Estimate the amount of non-collision background in



ATLAS Work in Progress

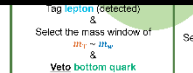
- Standard model background is caused from 4 kinds of process.
- Each process is estimated by using the Monte Carlo.
- Prepare a **control region** for each process to estimate the difference of normalization between the Monte Carlo and data.
- $Z(\rightarrow \nu\nu)$ is reproduced by treating γ as $E_T^{miss}(\nu\nu)$ in γ process since the kinematics of γ resemble that of Z for $p_T(\gamma)$ larger than m_Z .

4 Control region selection



Tag lepton (selected) & Tag lepton (detected)

Select the mass window of $m_{\ell\nu}$ & Veto bottom quark



Tag bottom quark (selected) & Tag bottom quark (detected)

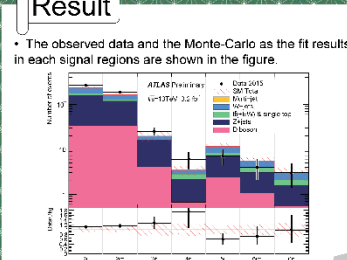
Select the mass window of $m_{b\nu}$ & Tag bottom quark

Multi-jets

Low $\Delta\phi(\text{jet}, E_T^{miss})$ & Low E_T^{miss}/m_{jet}

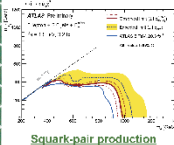
5 Result

• The observed data and the Monte-Carlo as the fit results in each signal regions are shown in the figure.

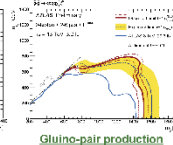


6 Interpretation

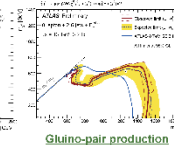
The result is interpreted to the limit for three specific classes of the simplified model :



Squark-pair production direct decay



Gluino-pair production direct decay



Gluino-pair production one-step decay

• These 4 kinds of control regions are prepared for each 7 signal regions. (Total 28 control regions)