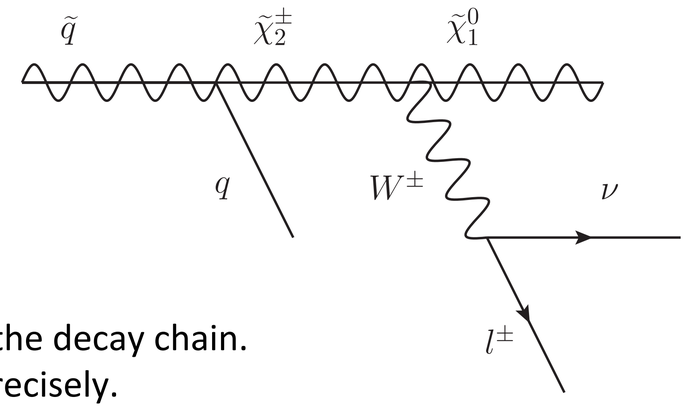
Search for Supersymmetric particles using final state with one lepton, jets and missing transverse momentum with ATLAS detector

1lepton + multijet + E_T^{miss}

Introduction

- Supersymmetry (SUSY) is one of the promising theories which give a natural candidate for dark matter and propose a solution to the hierarchy problem of SM.
- Early searches at ATLAS & CMS have excluded a large extent of the parameter space.
  ➔Need further effort to extend the sensitivity reach.



- Search SUSY indications in 1-lepton channel with 5fb^{-1} data recorded in ALTAS at √s = 7TeV.
- Focus on a colored SUSY particles production, where the lepton is mainly emitted from W or top in the decay chain.
- Lepton requirement can suppress background from multi-jet events, which is difficult to estimate precisely.

Event selections

- Optimize event selections to cover general SUSY topologies, i.e. large m_{eff}, multijets.
- Take two benchmark points in MSUGRA/CMSSM :
  - Large $m_{1/2}$ region -> 3Jet SR (focus on large m_{eff})
  - Large m_0 region -> 4Jet SR (focus on multijets)

$$m_T = \sqrt{2 \cdot p_T^{lep} \cdot E_T^{miss} \left(1 - \cos\Delta\phi(p_T^{lep}, E_T^{miss})\right)}$$

$$m_{eff} = p_T^{lep} + E_T^{miss} + \sum_{p_T > 25GeV} p_T^{jet}$$

Baseline selections

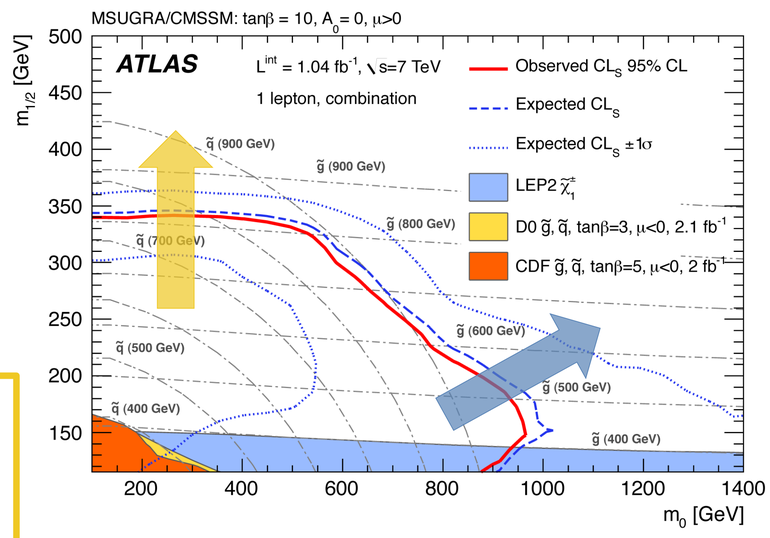
- == 1 electron($p_T \geq 25$GeV) or
  == 1 muon ($p_T \geq 20$GeV)
- Veto on 2nd lepton : $p_T < 10$GeV
- $m_T \geq 100$GeV
- $E_T^{miss} \geq 250$GeV

3Jet SR — ***Dominant BG : W+jets***

- Squark pair/squark-gluino association production.
- Large m_{eff}, less number of jets.

- $p_T^{Jet} \geq 100, 25, 25$ GeV (4th Jet veto : $p_T^{Jet4} < 80$GeV)
- $m_{eff} > 1200$ GeV, $E_T^{miss}/m_{eff} > 0.3$

Previous limit with 1fb^{-1}



4Jet SR — ***Dominant BG : ttbar***

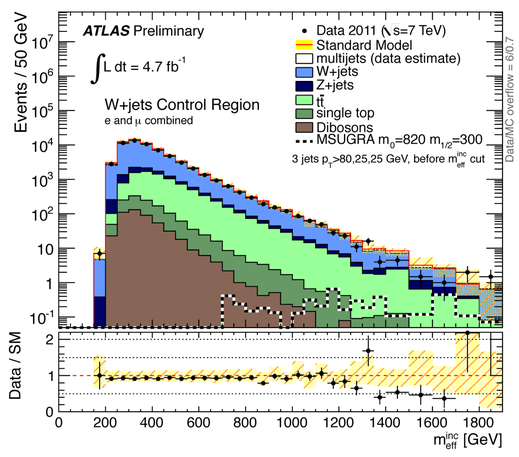
- Gluino pair production.
- Smaller m_{eff}, many number of jets.

- $p_T^{Jet} \geq 80, 80, 80, 80$ GeV
- $m_{eff} > 800$ GeV, $E_T^{miss}/m_{eff} > 0.2$

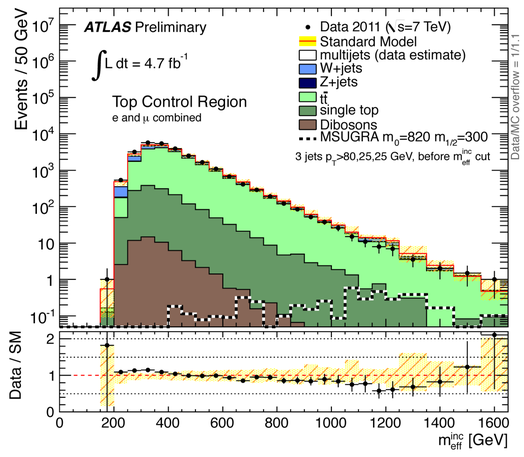
Background estimation

- Both SRs are dominated by W+jets and ttbar:
  3Jet SR : W+jets(60%), ttbar (35%), 4Jet SR : tbart (65%), W+jets(25%)
- W+jets, ttbar are estimated using Monte Calro (MC) simulation.
- Control Region (CR) of W+jets is defined by b-Jet veto and reversed m_T selection (40GeV≤m_T≤80GeV).
- CR of ttbar is defined in a similar way but with b-Jet requirement.
- Normalizations of the background components are determined via a simultaneous fit over all CRs and SRs.
- Use the data shape in CR to constrain the generator uncertainties in the fit.
- Multi-jet background is estimated by a data-driven method, but gives small contributions in the SRs.

m_{eff} in CR(W+jets)



m_{eff} in CR(ttbar)



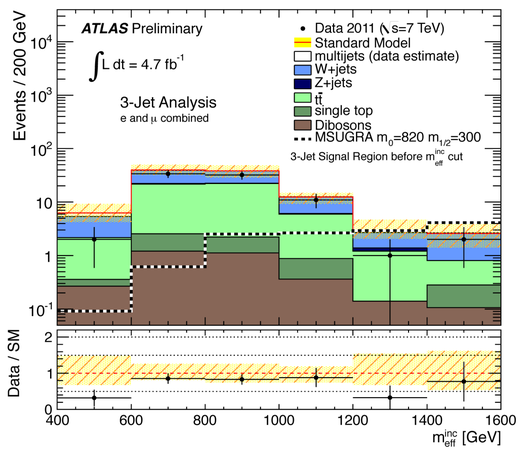
Result

- The numbers of observed events are consistent with SM expectations.
  (The errors on SM expectations in the table below include systematic uncertainties, which mainly come from Jet Energy Scale (JES).)

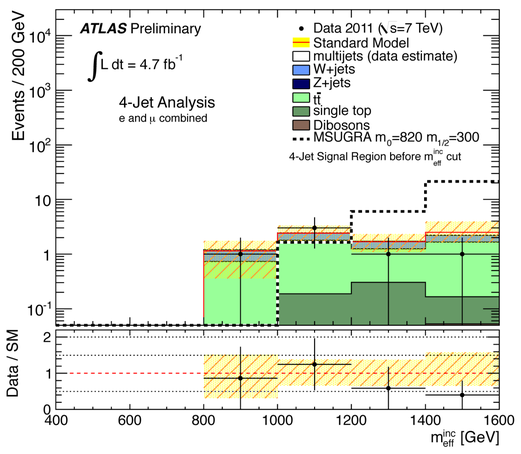
Signal Region	SM expectation	Observed
3Jet SR	5.7±4.0	3
4Jet SR	8.3±3.1	6

- Also, m_{eff} distributions in both SRs do not show any surprise.

m_{eff} in 3Jet SR



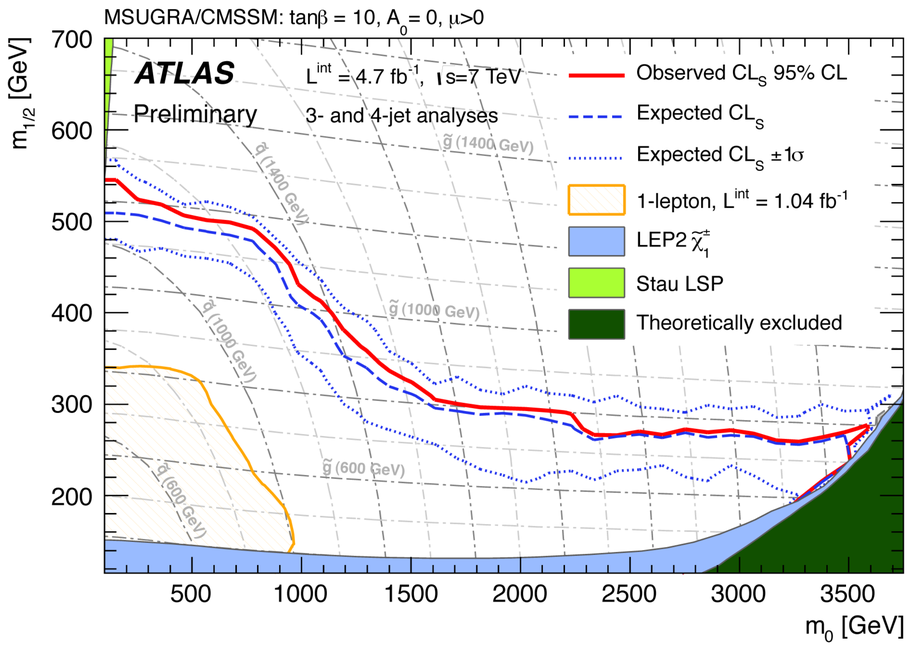
m_{eff} in 4Jet SR



Interpretation

- No SUSY indication so far.
- Define binned likelihood in m_{eff} and calculate 95% C.L. cross-section upper limit.
- Exclude ~1.2TeV (for squark mass), and ~0.8TeV (for gluino mass).

New limit with 5fb^{-1}



Reference
[1], *ATLAS-CONF-2012-041, March 16, 2012*

Physics at LHC 2012, Vancouver, BC, June 4-9, 2012

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