

# Search for Supersymmetry

in events with large missing transverse momentum, at least one b-jet candidate and at least one electron or muon in 7 TeV pp collisions with the ATLAS detector [1]



## Introduction

- Supersymmetry (SUSY) is a well motivated theory for physics beyond the standard model
- might solve the hierarchy problem and provide a dark matter candidate if R-parity is conserved (lightest SUSY particle, LSP)
- leptons and multiple jets can be produced in cascade decays of SUSY particles, LSP leads to high missing transverse energy ( $E_T^{\text{miss}}$ )
- production of third generation squarks favoured in many scenarios, motivation for b-jet search channel
- data sample: integrated luminosity of  $35 \text{ pb}^{-1}$  recorded in 2010 by the ATLAS experiment at the LHC

## Analysis

### Definitions and pre-selection

- jets:  $p_T > 20 \text{ GeV}$
- b-jets:  $p_T > 30 \text{ GeV}$ , signed decay length significance w/ 50% b-tagging efficiency
- electrons:  $p_T > 20 \text{ GeV}$ ,  $|\eta| < 2.5$
- muons:  $p_T > 20 \text{ GeV}$ ,  $|\eta| < 2.4$
- electron and/or muon trigger, fully efficient for 20 GeV leptons
- quality requirements: cleanup for misidentified jets and vertices

### Final selection

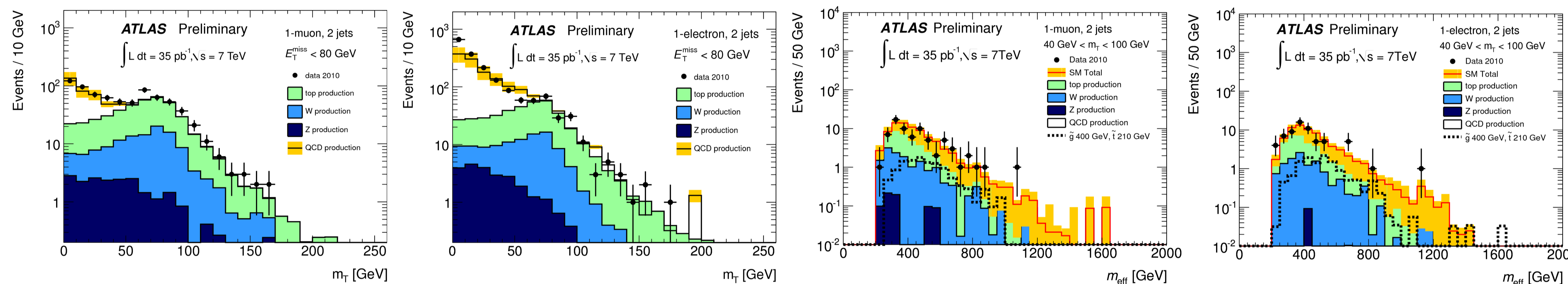
- lepton selection: mutually exclusive electron and muon channel
- $\geq 1$  muon,  $\geq 1$  electron (veto electrons)
- summed for the final results
- $\geq 2$  jets (with  $p_T > 60, 30 \text{ GeV}$ )
- $E_T^{\text{miss}} > 80 \text{ GeV}$
- $m_T > 100 \text{ GeV}$
- $\geq 1$  b tagged jet
- $m_{\text{eff}} > 500 \text{ GeV}$

$$m_{\text{eff}} = \sum_{i \leq 4} (p_T^{\text{jet}})_i + E_T^{\text{miss}} + \sum_I p_T^{\text{lep}}$$

$$m_T = \sqrt{2 p_T^{\text{lep}} E_T^{\text{miss}} - 2 \vec{p}_T \cdot \vec{E}_T^{\text{miss}}}$$

## Background estimation

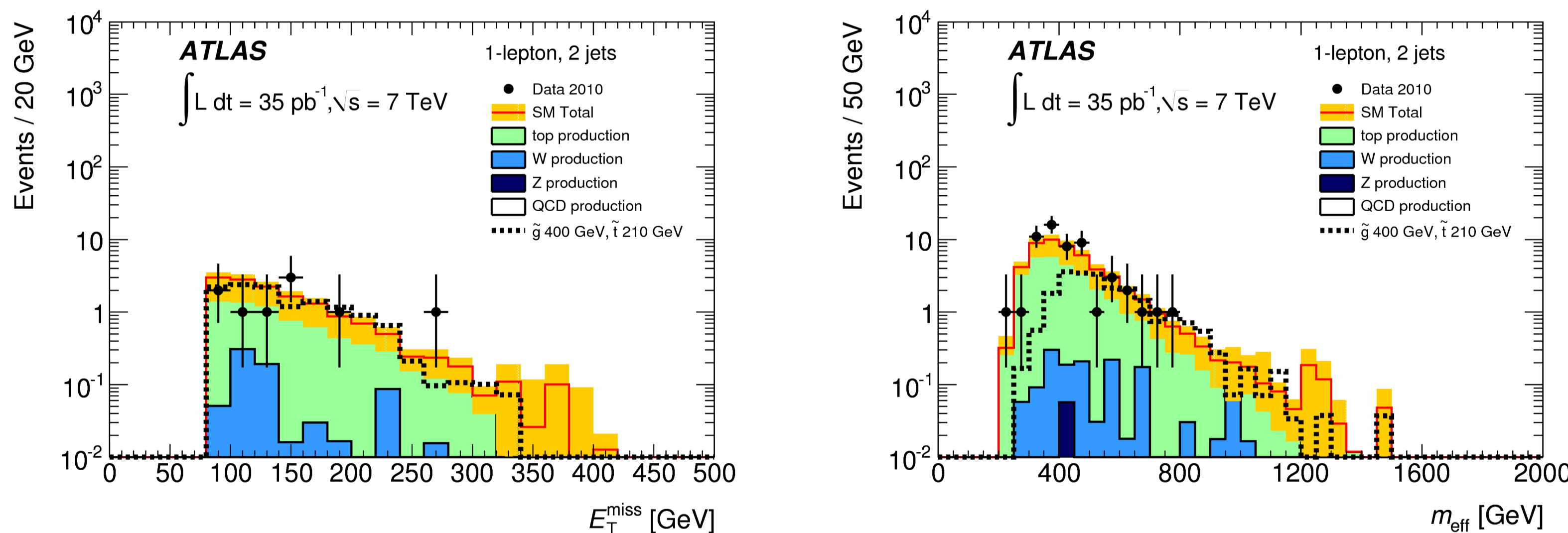
- Main background (~95%) is top production (due to  $E_T^{\text{miss}}$  and the b-jet requirement)
- estimate backgrounds separately
- QCD: data driven matrix method [2]
- non-QCD (top, W, Z, single top)
- data driven ABCD method in  $M_T$ - $m_{\text{eff}}$  plane
- background estimations validated with MC



## Results

- Results are consistent with the SM expectation
- data driven background estimation and MC are consistent

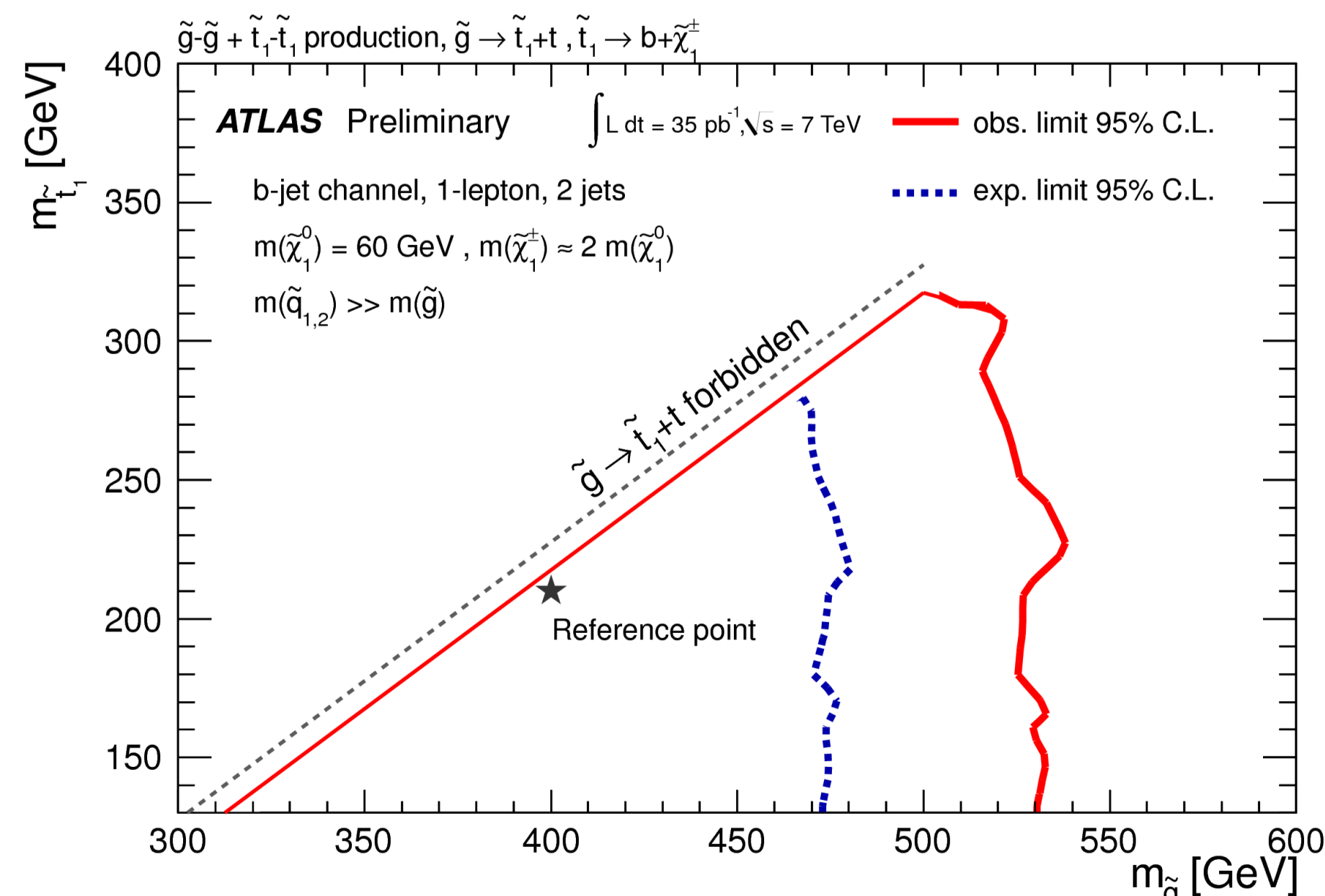
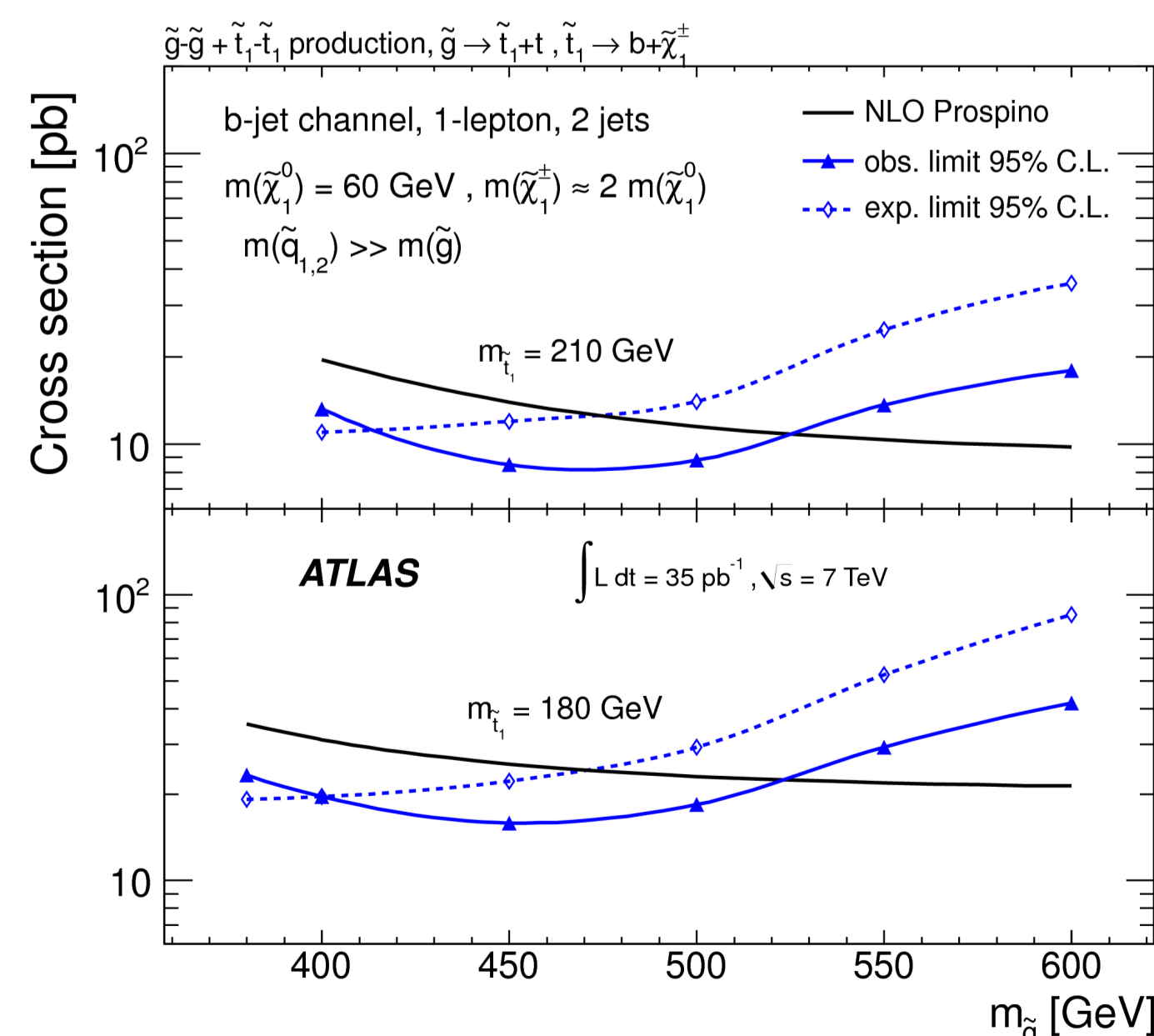
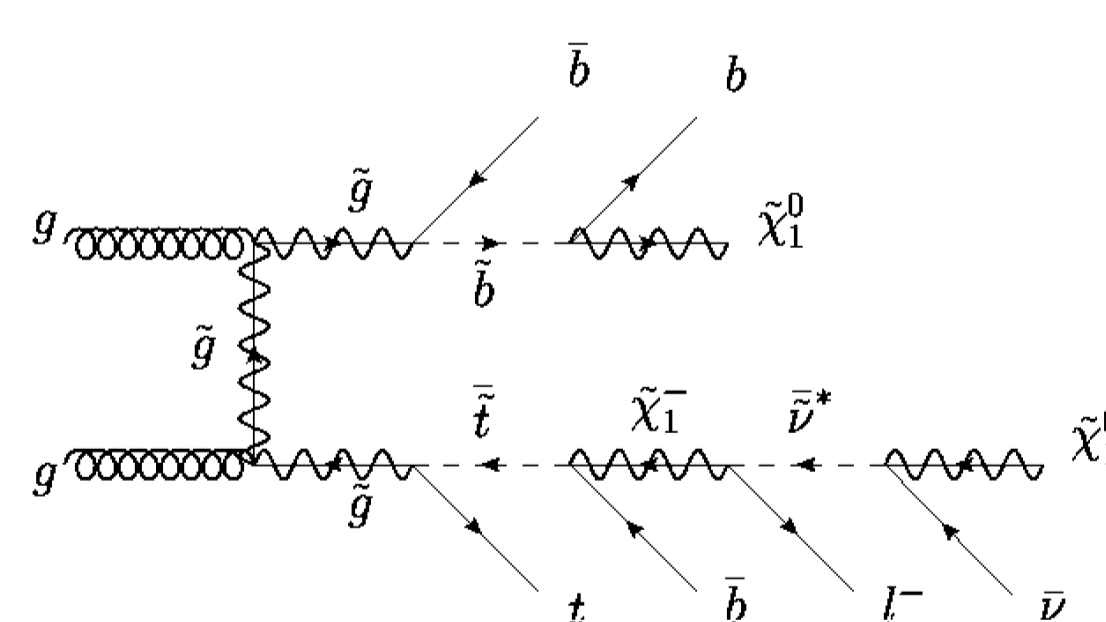
| Selection                          | Expected events (MC) | Expected events (MT) | Measured events |
|------------------------------------|----------------------|----------------------|-----------------|
| $m_T > 100 \text{ GeV}$            | 50 +- 20             | -                    | 55              |
| $m_{\text{eff}} > 500 \text{ GeV}$ | 13.5 +- 4.1          | 14.7+-3.7            | 9               |



## Interpretation

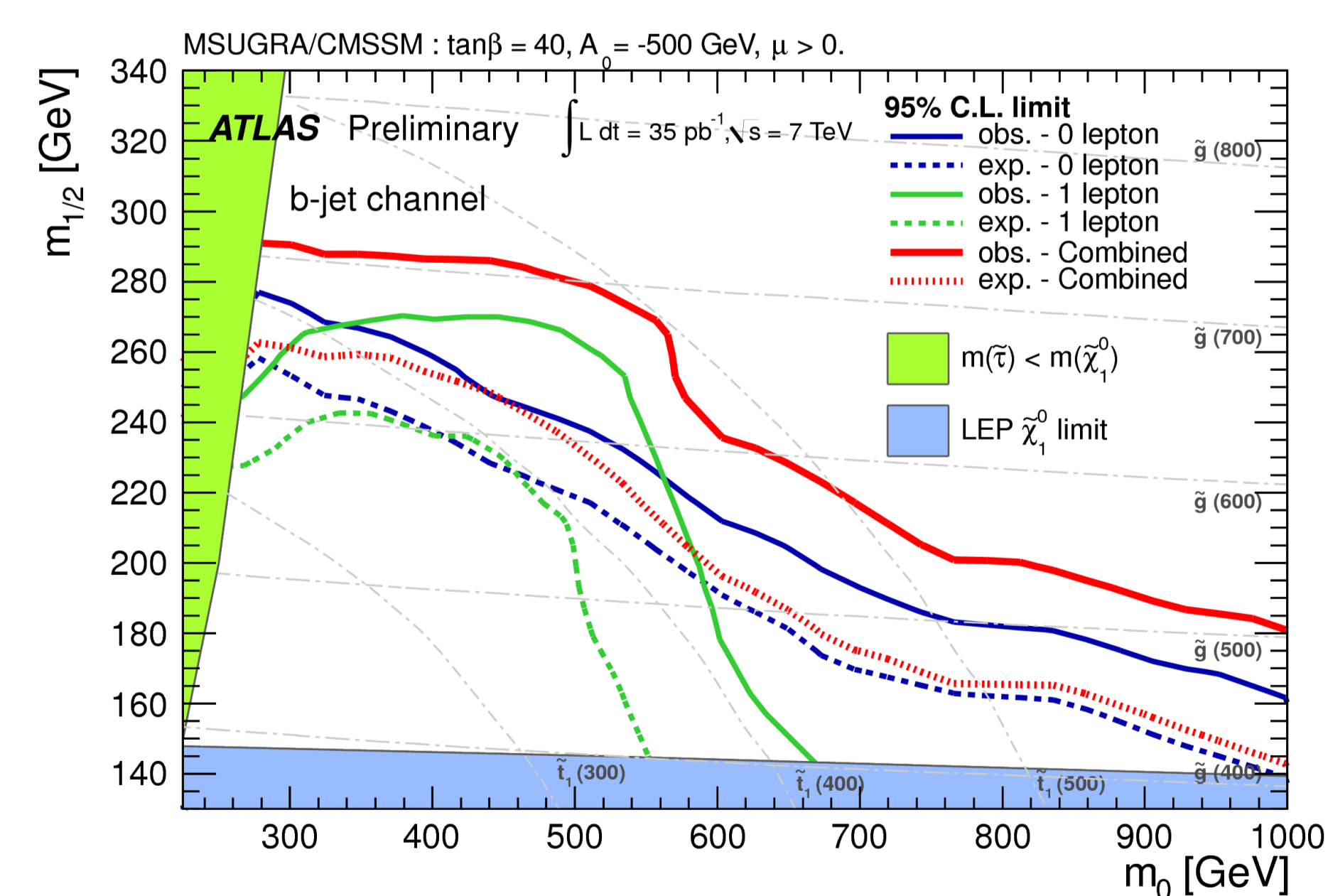
Interpretation under simplifying assumptions:

- $m(\tilde{\chi}_1^0) = 60 \text{ GeV}$  and  $m(\tilde{\chi}_1^\pm)$  about 120 GeV
- mass of lightest stop below 1 TeV, all other sparticles heavy ( $> 1 \text{ TeV}$ )
- lightest stop produced via direct production or gluino mediated
- stop decays exclusively to bottom and  $\tilde{\chi}_1^\pm$



- Limits on gluino mass for two stop masses of 210 and 180 GeV respectively (left)
- Limits in the gluino-stop mass plane (right)
- Exclude gluino masses  $< 520 \text{ GeV}$ , stop masses between 130 and 300 GeV

Interpretation of results in mSUGRA:



- Parameters:  $m_0, m_{1/2}, A_0 = -500 \text{ GeV}, \tan \beta = 40, \text{sgn}(\mu) = +1$
- low stop masses at high  $\tan \beta$  and low  $A_0$

## References

- [1] ATLAS Collaboration, arXiv:1103.4344 [hep-ex].
- [2] ATLAS Collaboration, JHEP 1012 (2010) 060.

