



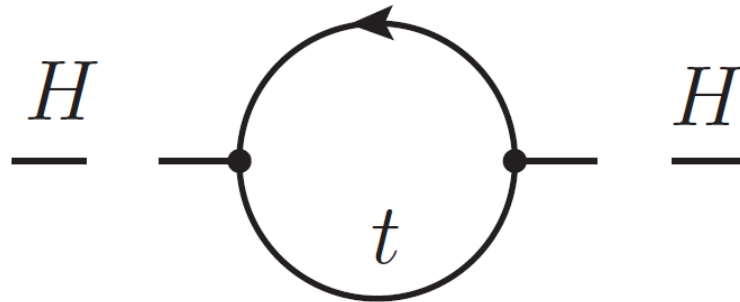
# Search for supersymmetry using events with three leptons, multiple jets, and missing transverse momentum

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10/16/2012

# Horizon of new physics since July 2012

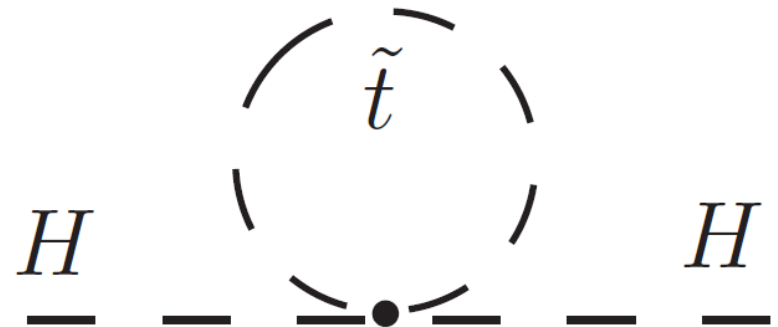
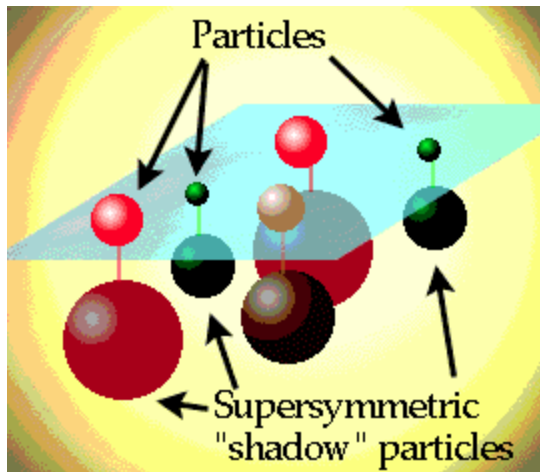
- A Higgs-like particle at 125-126 GeV was discovered.
- Radiative corrections from Higgs boson to the  $M(W)$  make the predicted mass agree with the experimental value
- However, now we need new mechanisms to stabilize the  $M(\text{Higgs})$ 
  - The loop corrections can make the predicted mass inconsistent with 125 GeV



- + terms from the Higgs self-coupling , W- and Z- couplings
- **New particles are required to stabilize the Higgs mass**

# Light Higgs → Messenger of New Physics

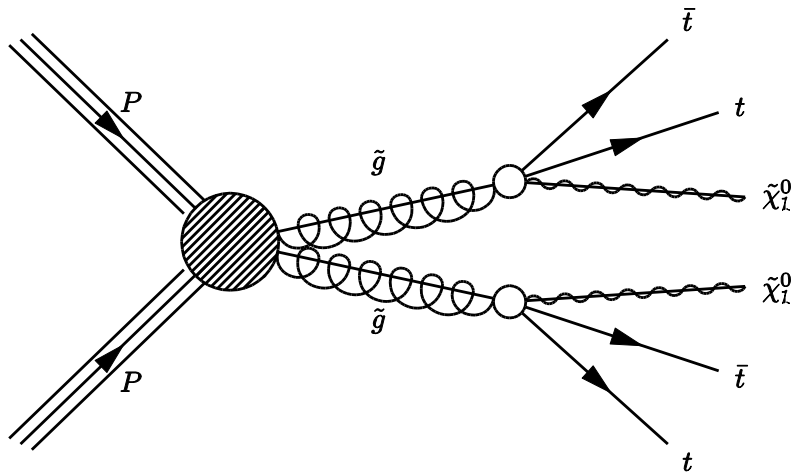
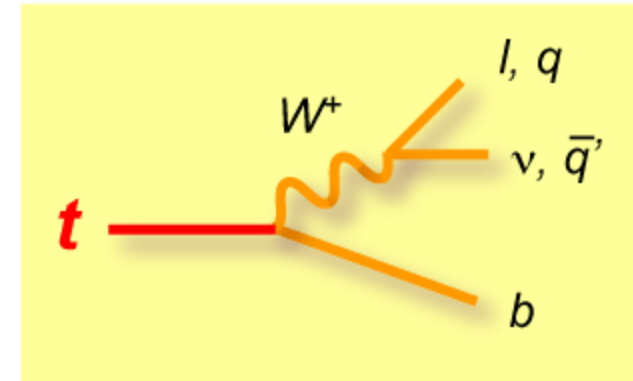
- The super-symmetric (SUSY) top squark is a perfect BSM candidate to solve the Higgs mass problem by canceling out the SM terms:



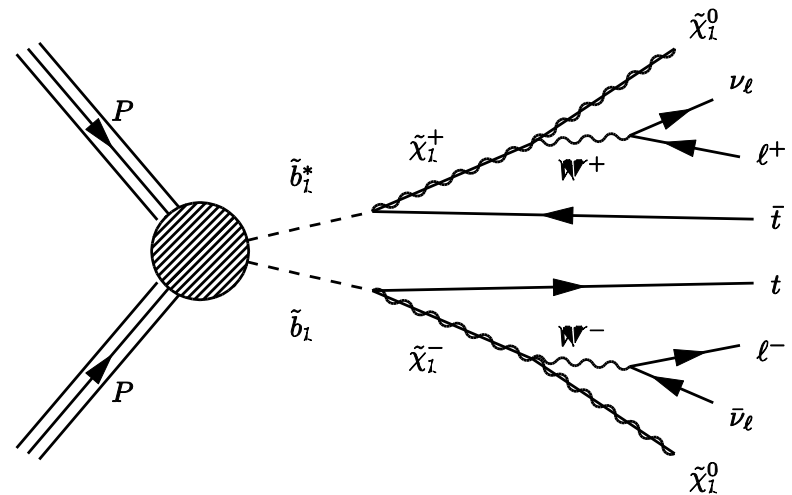
- Gluino and 3<sup>rd</sup>-generation squarks are expected to be light ( $\sim 1$  TeV) for minimal fine-tuning (naturalness)
- Third generation squarks are expected to be the lightest
- → New TeV-scale Physics is within reach of the LHC

# Search Strategy

- We look for final states with four top quarks
  - decay with W-bosons and jets
  - Signature: three or more leptons and multiple jets (four or more jets)
  - Missing transverse momentum



gluino  $\rightarrow$   $t\bar{t}$  + LSP

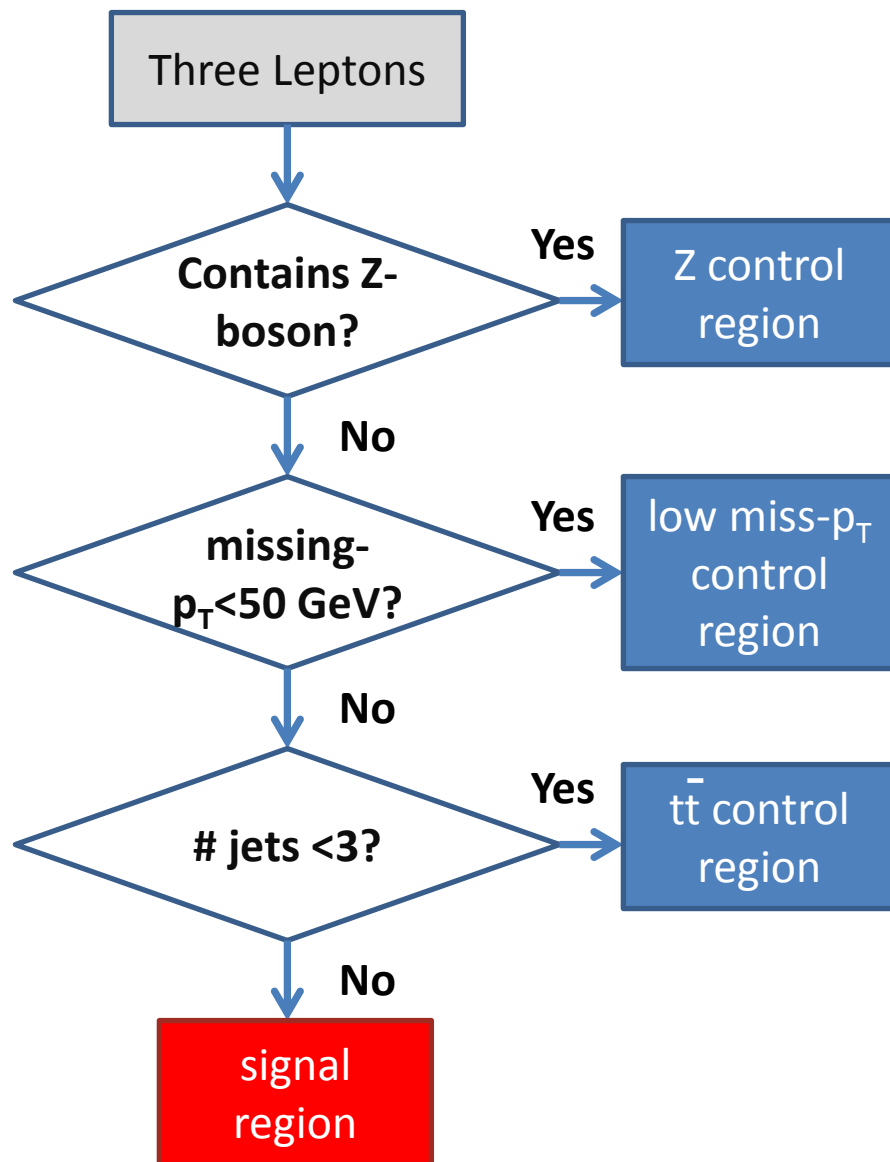
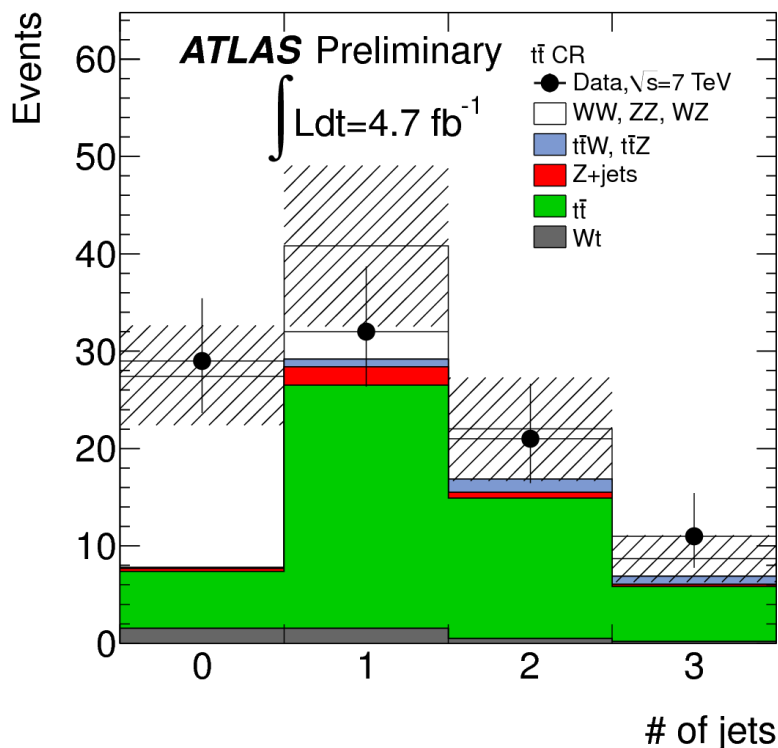


sbottom  $\rightarrow$   $t\bar{t}$  +  $W^+W^-$  + LSP

**3 leptons +  $\geq 4$  jets is an extremely clean final state**  
 **$\rightarrow$  Sensitive to a variety new physics processes (incl. SUSY)**

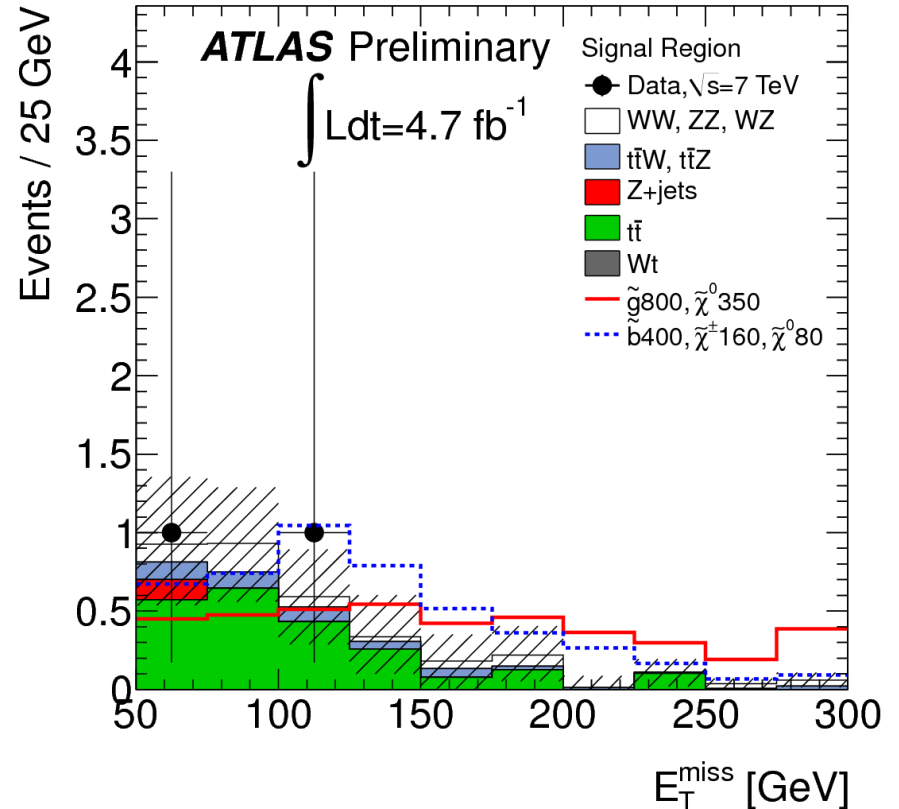
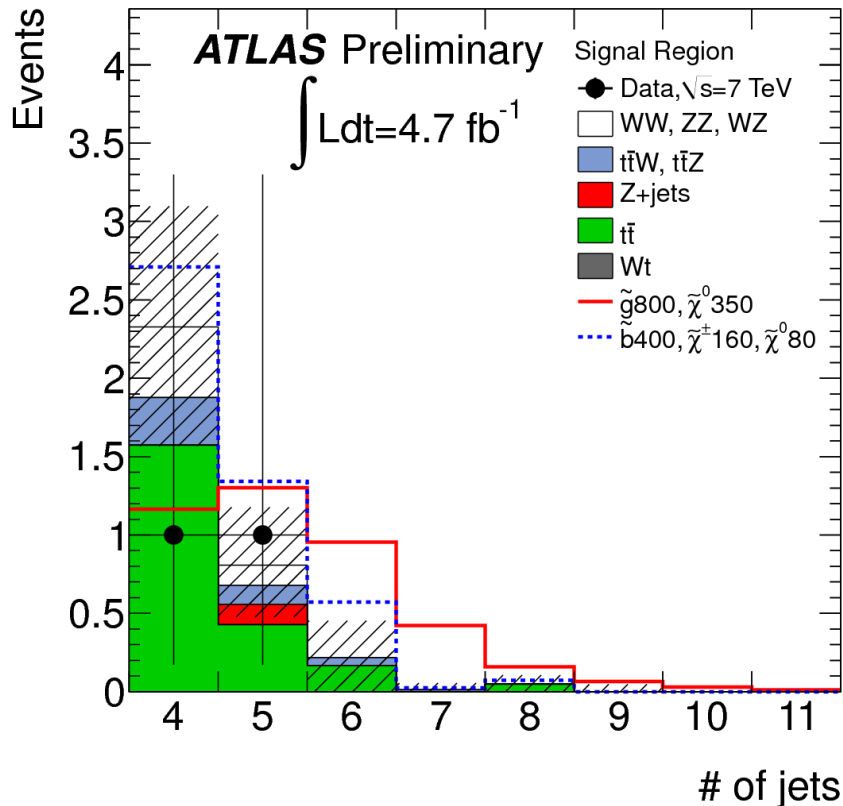
# Signal Control regions

- The 3-lepton dataset is divided into three control regions and a signal region to normalize SM backgrounds
- $t\bar{t}$ ,  $t\bar{t}+V$ , and  $VZ$  are the major backgrounds in the signal region ( $V=W$  or  $Z$ )



# We looked at 5 fb<sup>-1</sup> of data at $\sqrt{s} = 7$ TeV

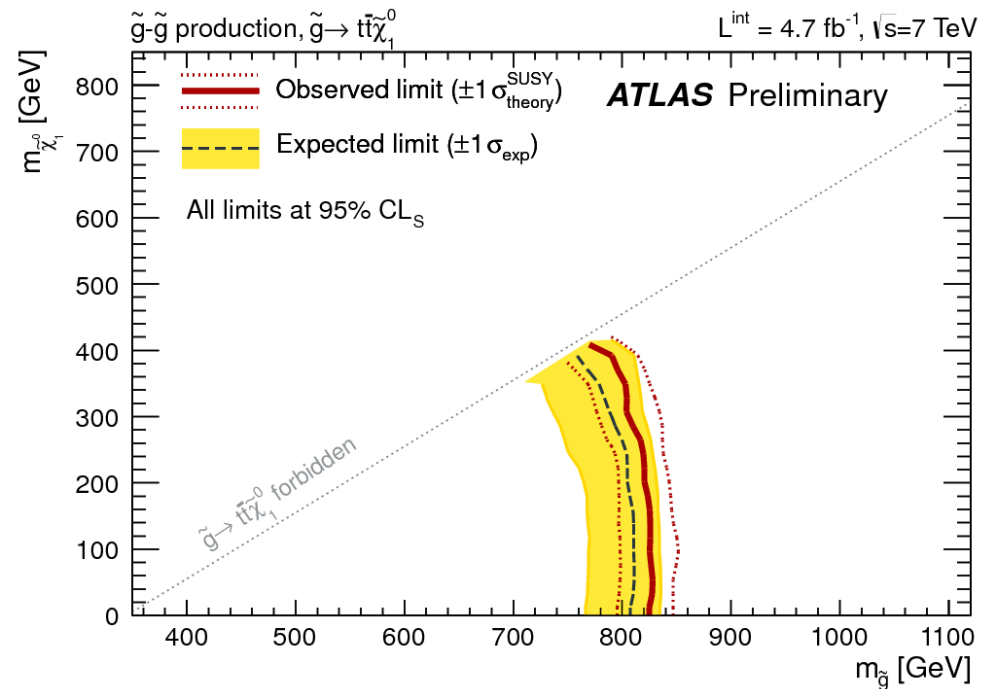
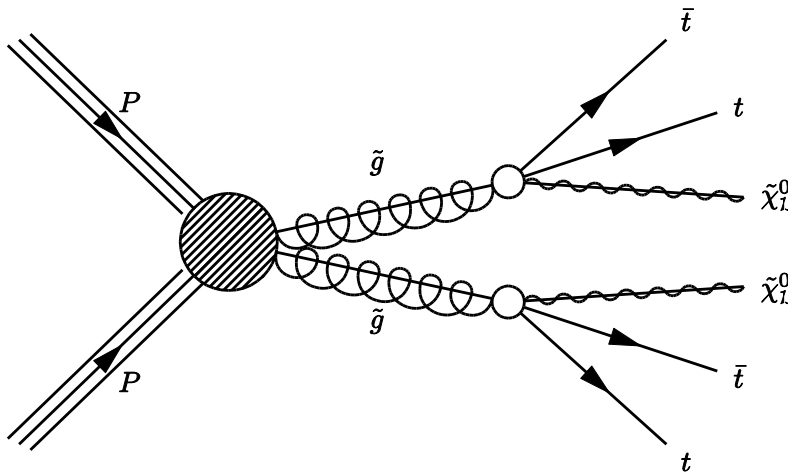
- Alas, data is in agreement with the SM predictions
- The SUSY processes tend to have high jet multiplicity and high missing-transverse momentum



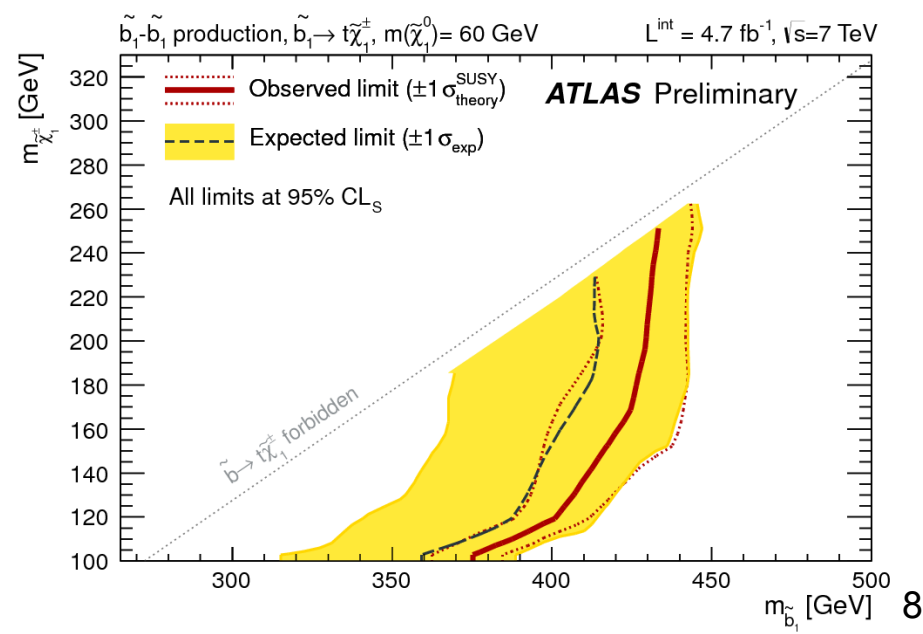
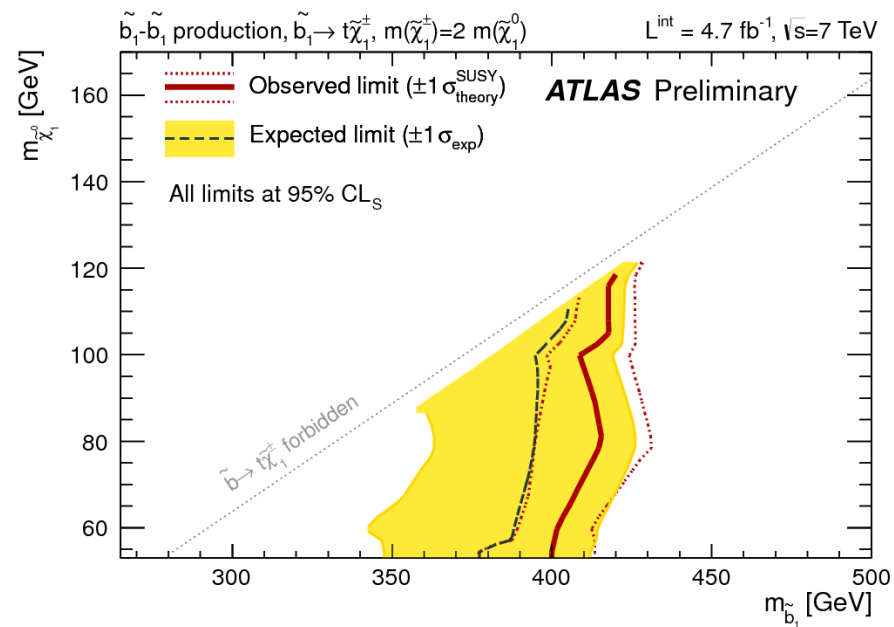
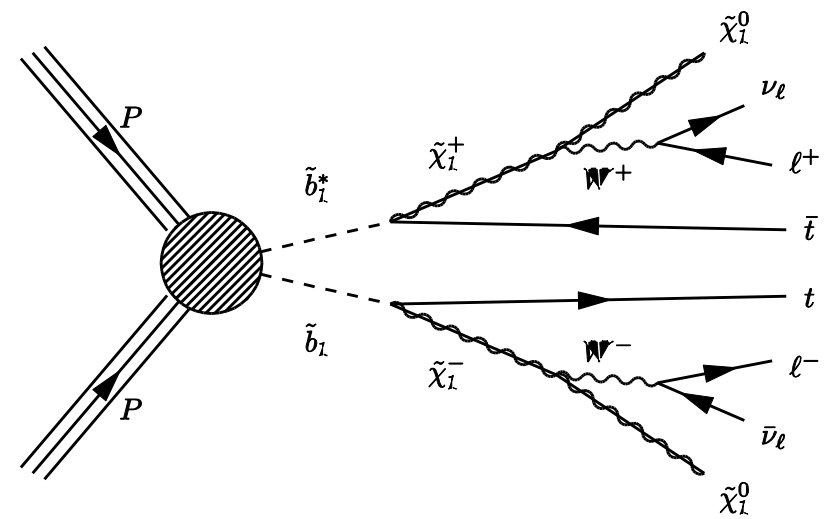
# Limits for gluino-mediated stop

Small losses of signal acceptance in the regime when  $m(\text{gluino}) = 2m(t) + m(\text{LS})$ , close to the diagonal

Conducted a counting experiments to extract the limits



# Limits for direct production of sbottom





# Conclusions and Outlook

- Set limits on 3<sup>rd</sup>-gen SUSY
  - **ATLAS-CONF-2012-108**

- The search is one of the components of the ATLAS' comprehensive program for searches for new physics

- ATLAS searches include other channels that are sensitive to 3<sup>rd</sup> generation SUSY (3b-jets, 2SS leptons, etc)
- A consistent excess in all the relevant channels is key to make a discovery

- Much more data at 8 TeV is up ahead (collected in 2012) → The discovery potential is much improved

