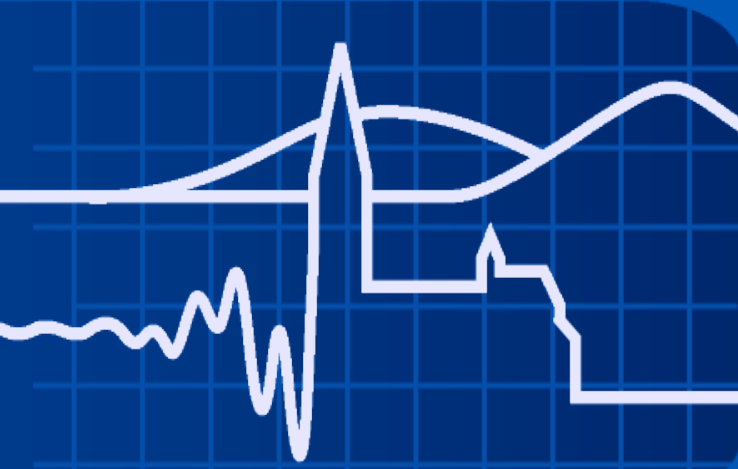


Search for SUSY at 10 TeV and 200 pb⁻¹ at ATLAS

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R-Parity Conserving SUSY (mSUGRA, pMSSM)

Minimal Supersymmetric Model (MSSM)

mSUGRA :

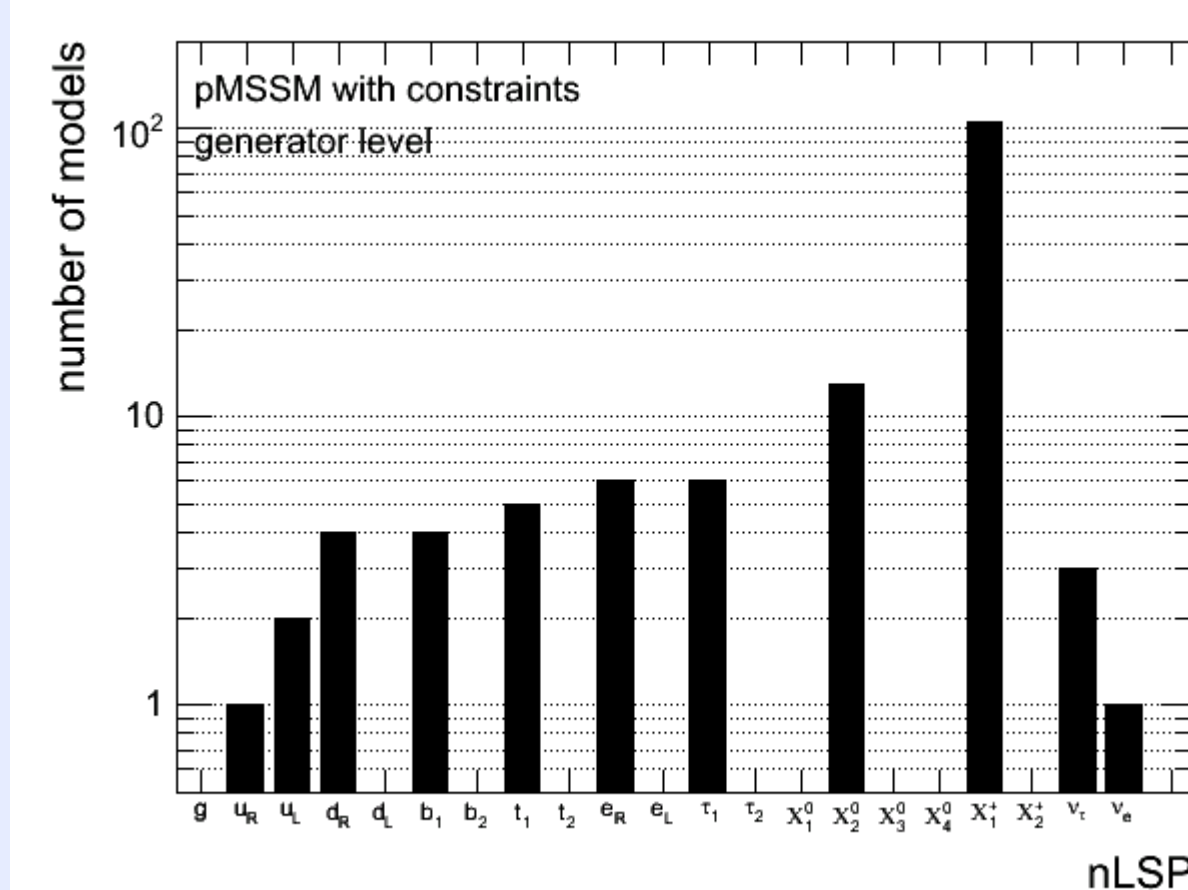
- SUSY breaking is mediated by gravitational interactions.
- 5 parameters describe the model
- m_0 : common boson mass at GUT scale
- $m_{1/2}$: common fermion mass at GUT scale
- models produced with ISAJET-HERWIG-ATLFAST2

phenomenological MSSM²⁾ :

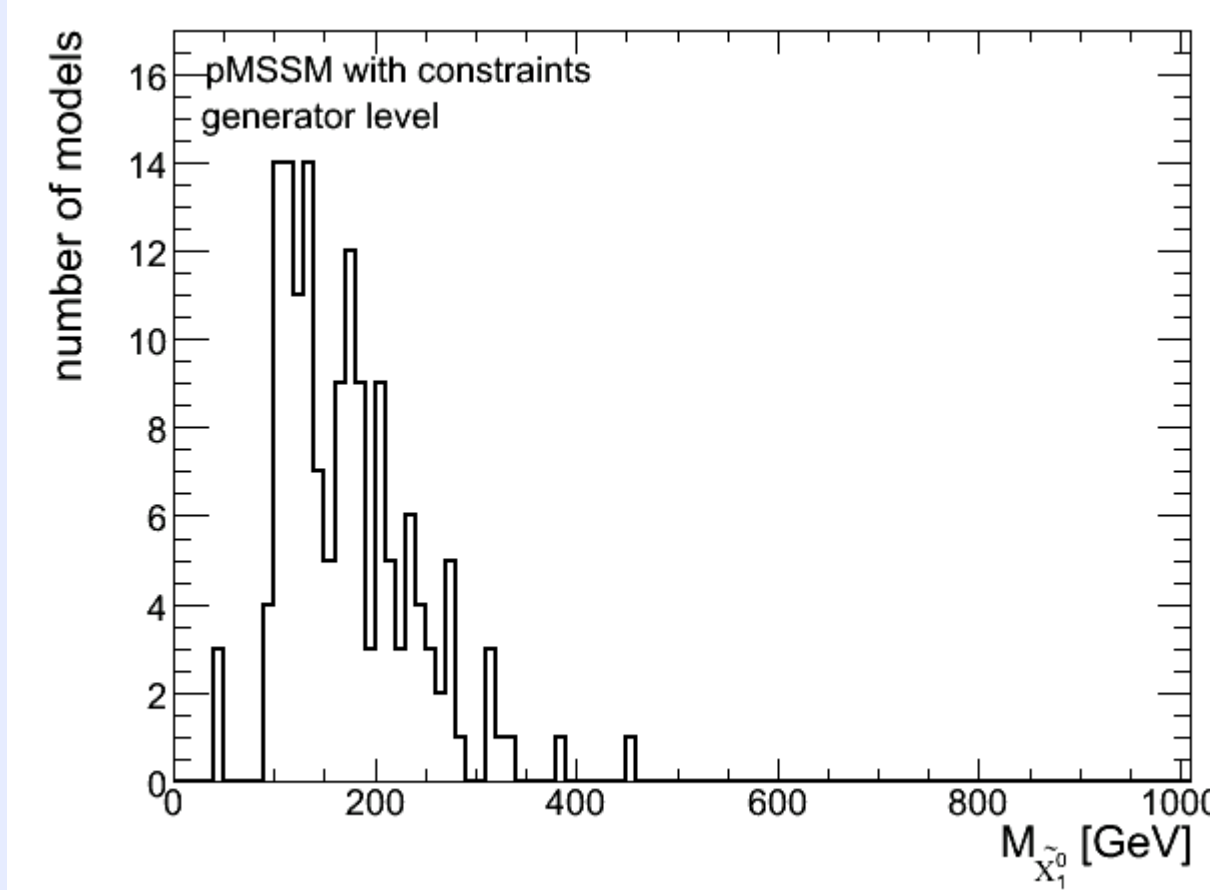
- 19 free parameters
- all mass parameters < 1 TeV
- consider only models which satisfy experimental constraints
- models sampled from flat prior grid
- models produced with PYTHIA-ATLFAST1

- R-Parity quantum number conserved
- SUSY particles produced in pairs
 - decaying into states with lightest supersymmetric particle (LSP)

Next to Lightest Supersymmetric Particle (NLSP) in pMSSM²⁾



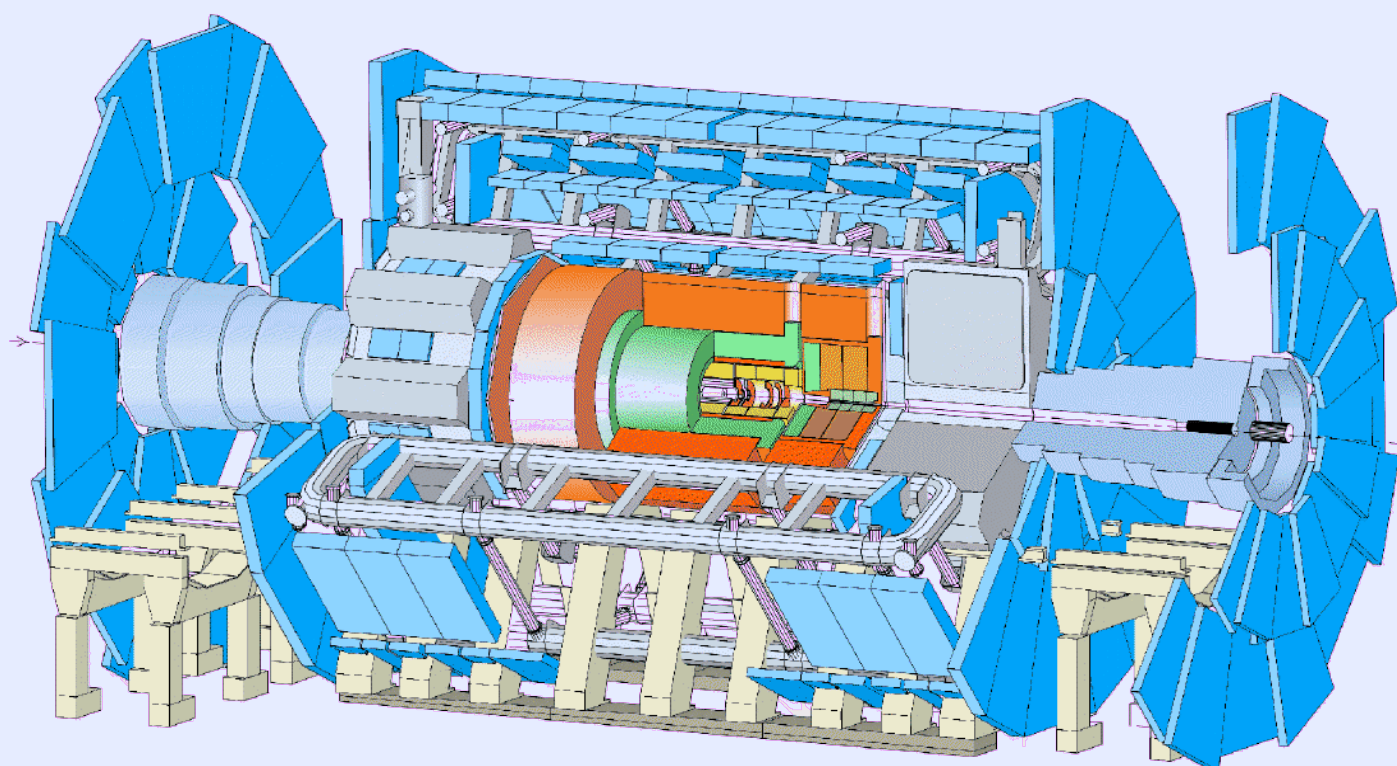
Mass of Neutralino in pMSSM²⁾



Typical signature:
High-energy jets, missing transverse energy and leptons

Multi-channel search at ATLAS

The ATLAS detector :



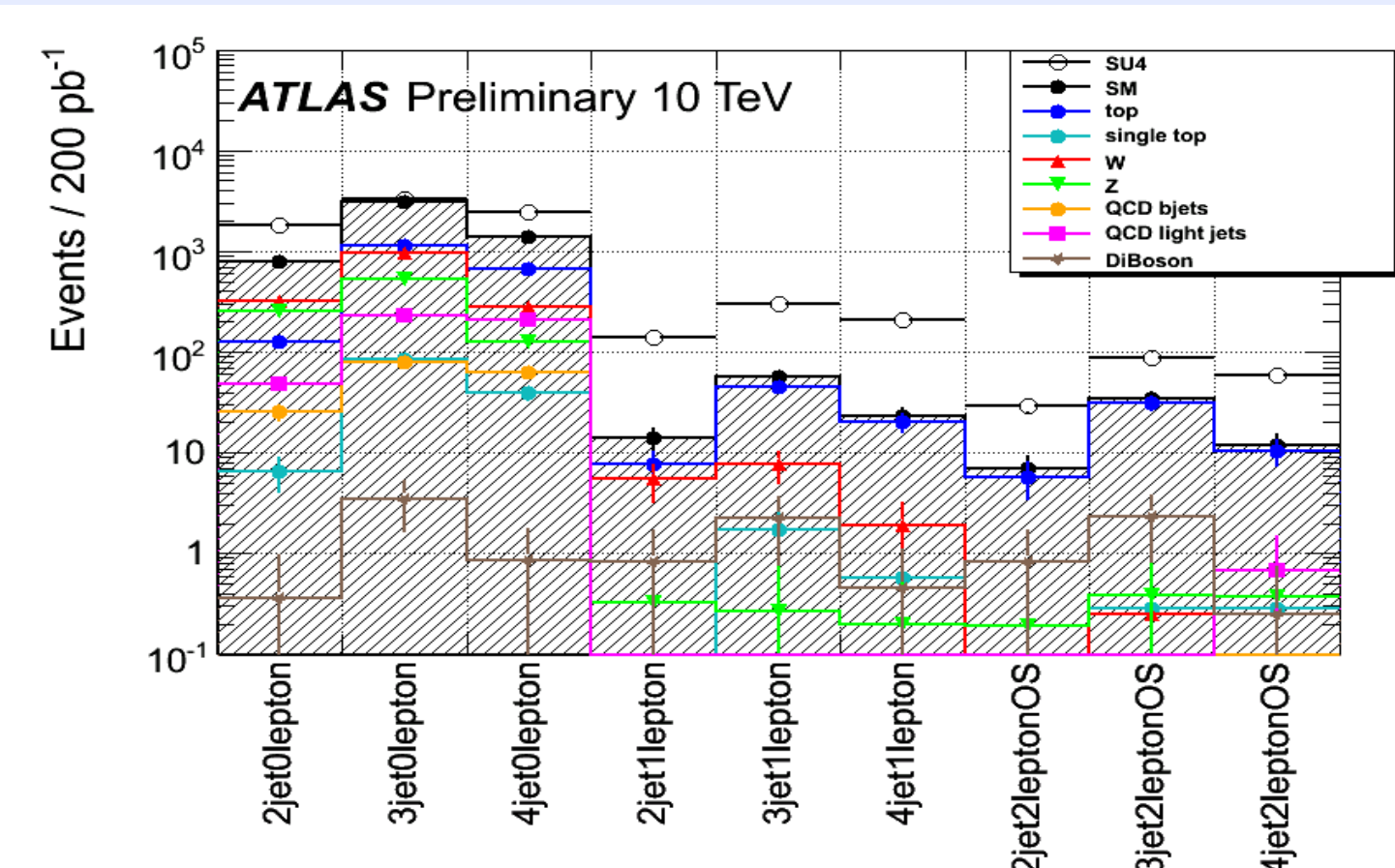
Inclusive 2,3,4 jets selection combined with

| Number of jets | ≥ 2 jets | ≥ 3 jets | ≥ 4 jets |
|--|----------|----------|----------|
| Leading jet P _T (GeV) | > 180 | > 100 | > 100 |
| Jets P _T (GeV) | > 50 | > 40 | > 40 |
| ΔΦ(jet, ME _T) | > 0.2 | > 0.2 | > 0.2 |
| ME _T > f * M _{eff} | f = 0.3 | f = 0.25 | f = 0.2 |

.... exclusive 0,1,2 -lepton selection

| Number of leptons | = 0 | = 1 | = 2(OS) |
|---------------------------|--------------|----------------|----------------|
| lep. P _T (GeV) | no lep. > 20 | 1 lep > 20 GeV | 2 lep > 10 GeV |
| ME _T (GeV) | > 80 | > 80 | > 80 |
| Trans. Sphericity | > 0.2 | > 0.2 | > 0.2 |
| Trans. mass (GeV) | - | - | > 100 GeV |

SM Background for different channels :

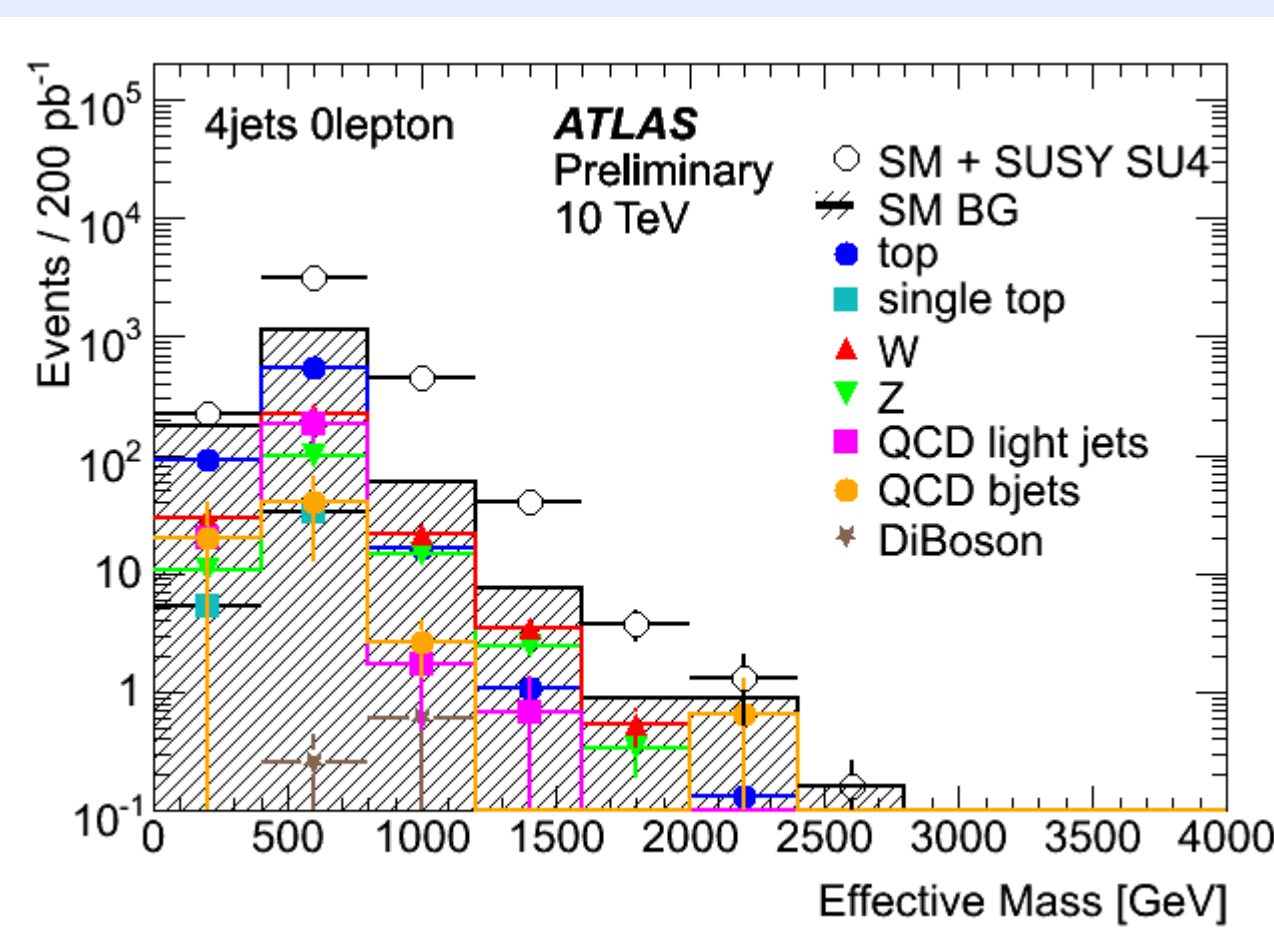


Dominant background:

- 0 lepton channels -- Top, W+ jets, Z+ jets, QCD jets
- 1 lepton channels -- Top, W+ jets
- 2 lepton(OS) channels -- Top, DiBoson

Effective Mass

M_{eff} distribution in the 4jet-0lepton channel:



Typical signatures contain

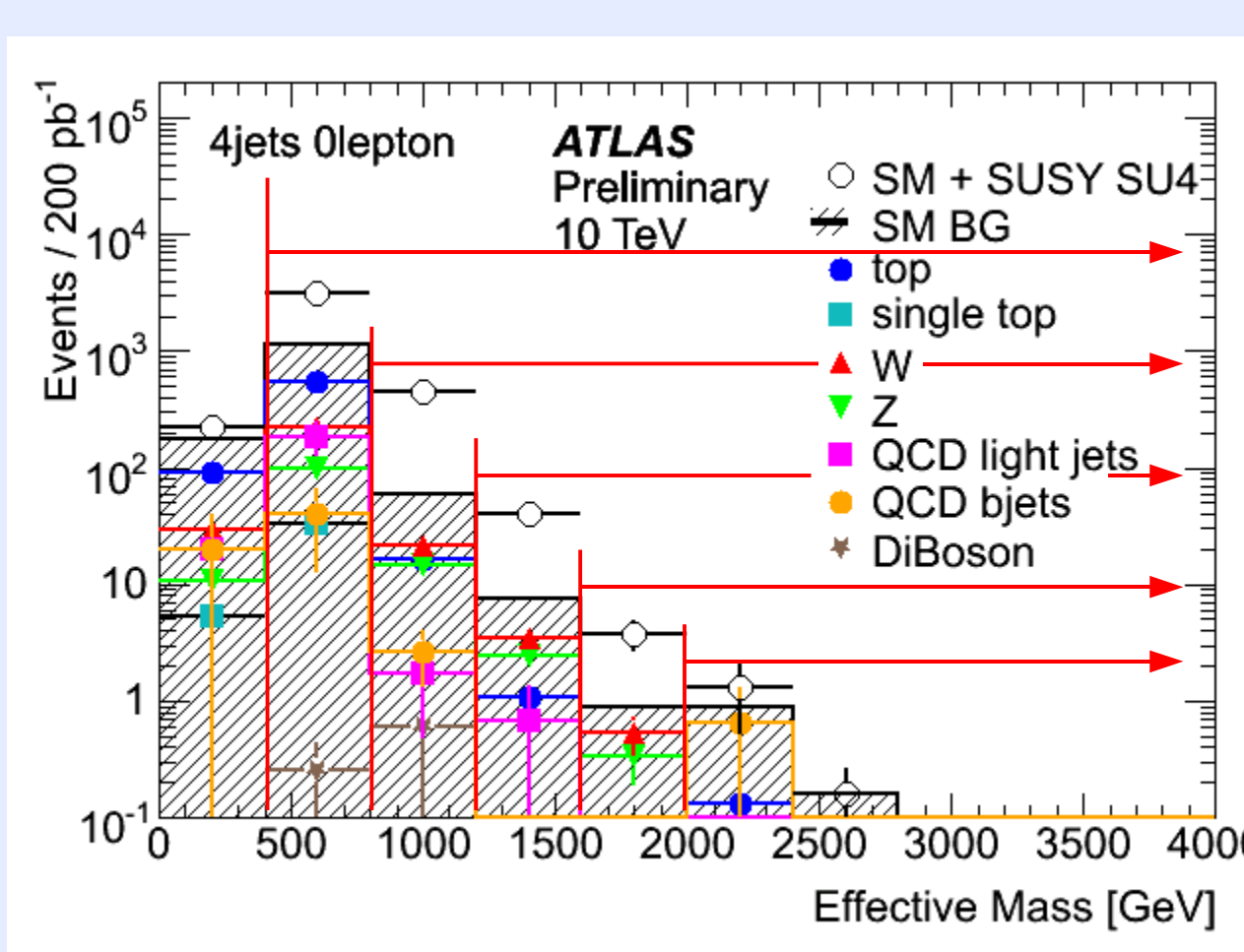
- high energy jets
- missing transverse energy
- leptons

Effective Mass :

$$M_{eff} = \sum_{j=1}^{N_{jets}} p_{T,jets} + \sum_{l=1}^{N_{lep}} p_{T,lep} + ME_T$$

Statistical approach

M_{eff} distribution in the 4jet-0lepton channel:



Finding the optimal cut in M_{eff} :

- Cutting every 400 GeV

- Carry out hypothesis test for every region p-value:

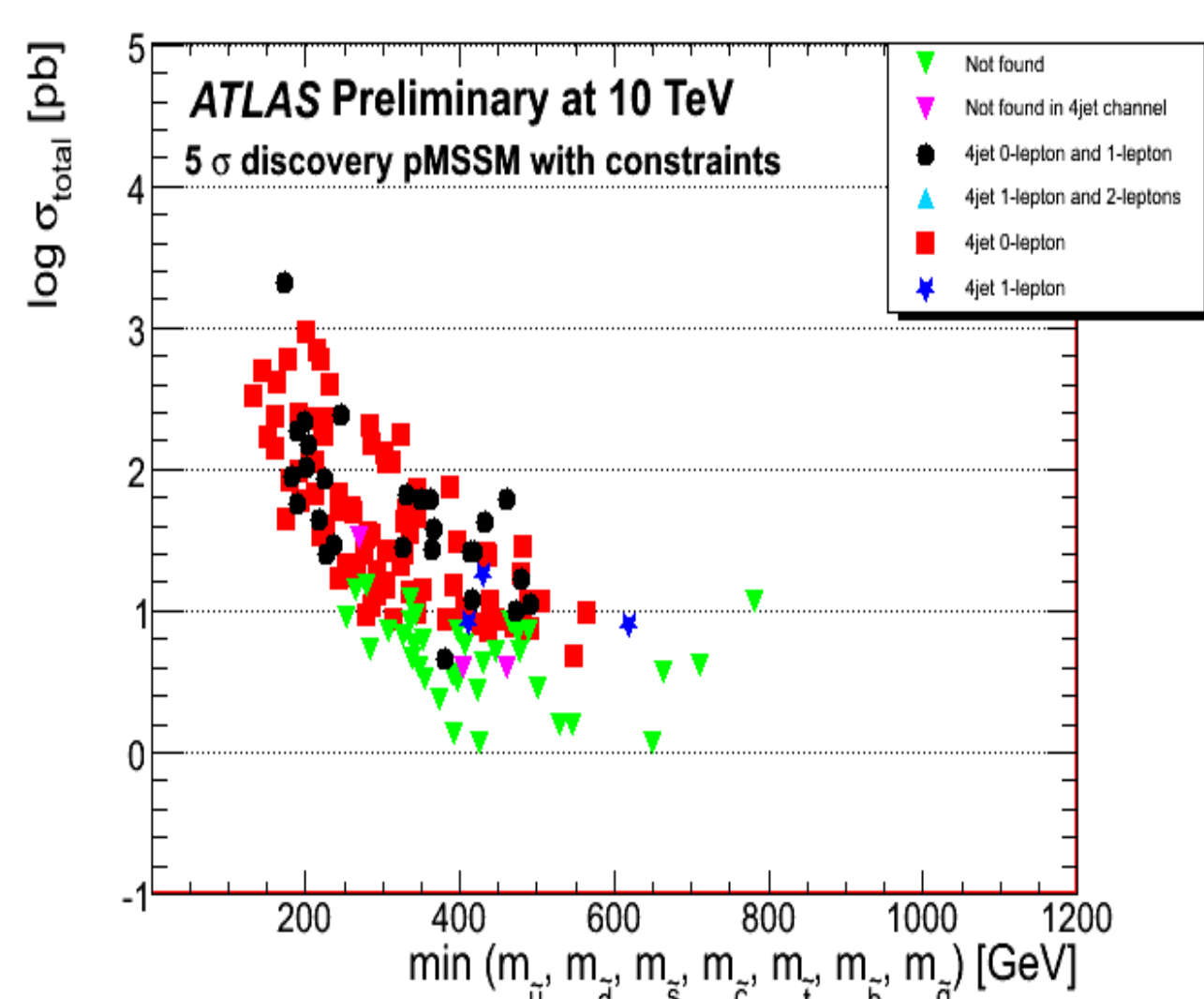
$$p = \int_0^{\infty} db \text{ gauss}(b; N_b, \delta N_b) \sum_{k=N_{obs}}^{\infty} \text{poiss}(b)$$

- Gaussian for systematic error treatment here estimated width is 50 % of SM prediction

- Significance is corrected to due „multiple comparisons“ by Monte Carlo method

Discovery Reach

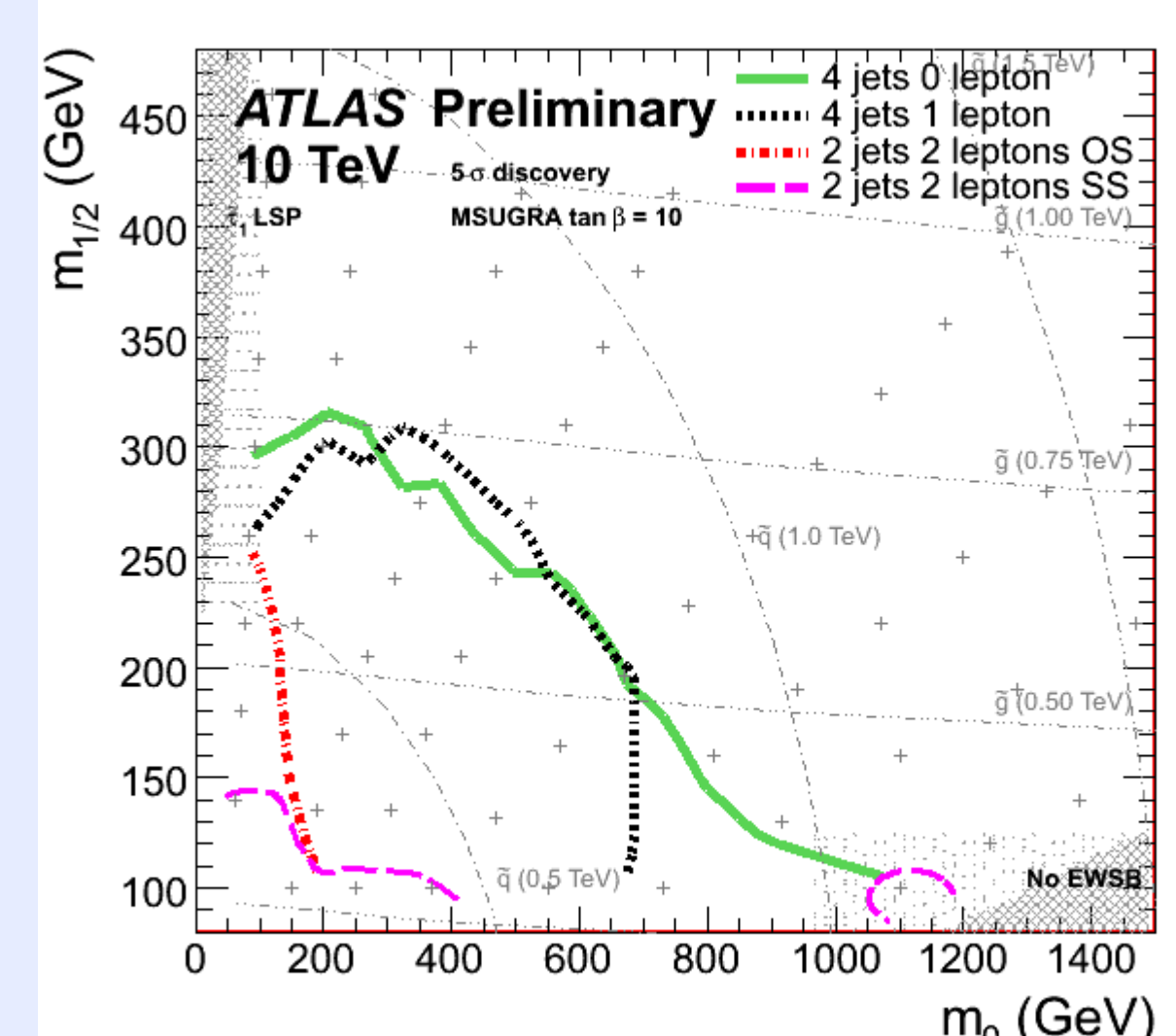
pMSSM discovery reach :



> Most SUSY signals can be discovered with the 4 jet channels if the cross section is > 10 pb and for squark and gluino masses up to 600 GeV.

- For a centre-of-mass energy of 10 TeV and an integrated luminosity of 200 pb⁻¹ ATLAS can discover signals of R-Parity conserving SUSY with squark and gluino masses less than 600-700 GeV in many szenarios.
- There are szenarios where ATLAS does not discover the signal even tough the mass scale is as low as 450 GeV.

mSUGRA discovery reach :



1.) „Prospects for SUSY and UED discovery based on inclusive searches at a 10 TeV centre-of-mass energy with the ATLAS detector“, The ATLAS Collaboration, ATLAS-PHYS-PUB-2009-084
2.) „Supersymmetry without prejudice“, Berger, Gainer, Hewett, Rizzo, JHEP02(2009)023