東京大学
THE UNIVERSITY OF TOKYO

Early Searches for supersymmetry with isolated leptons, jets and missing transverse energy at √s=7TeV with the ATLAS Detector

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On behalf of the ATLAS collaboration

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Outline

- Data, MC samples
- Trigger, Event selection
- Distributions

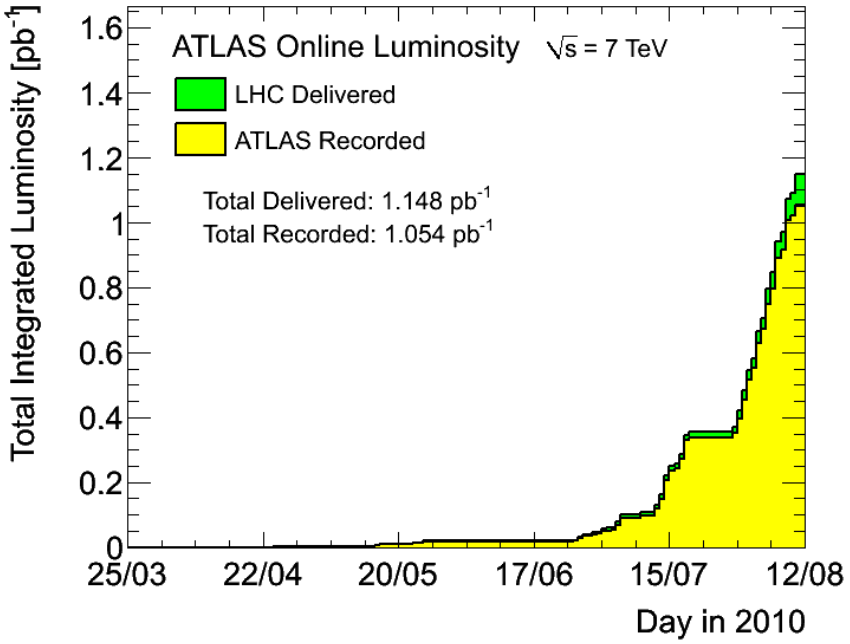
  Missing ET(MET), Transverse Mass(mT),

  Jet multiplicity, Effective Mass(Meff)
- Conclusions

This talk focus on Jets + MET + leptons signature,
Jets + MET + no lepton signature was presented
by Renaud Bruneliere today

Data sample

- ATLAS recorded 1 pb^{-1} by 8th Aug 2010
- This analysis is based on the first 70nb^{-1} of data
- We required nominal conditions of all ATLAS detectors, and also event cleaning before signature selections
- This analysis is the first look at real 7TeV data, and the studies are focused on the understanding of BGs and variables sensitive to SUSY



MC samples

- QCD MC (Pythia) … normalized to data on Missing ET<40GeV && mT<40GeV
  with 50% systematic uncertainty (cross check and studies with Alpgen)

	Data	Monte Carlo	Norm. factor
Electron channel	101	245	0.41+-0.08(stat.)
Muon channel	15	31.4	0.48+-0.12(stat.)

- W+jets MC (Alpgen) … normalized to data on MET=30~50GeV && mT=40~80GeV
  with 50% systematic uncertainty

	Data	W expect.	Other SM	Norm. factor
Electron channel	6	2.2	0.8	2.1+-1.0(stat.)
Muon channel	4	2.1	0.3	

- Z+jets MC (Alpgen) … normalized by Xsec
- tt MC (MC@NLO) … normalized by Xsec

} small contribution

- SUSY MC (Herwig++) … SU4 (m0=200GeV,m1/2=160GeV,A0=-400GeV,tanb=10,mu>0)
  close to Tevatron limits, Msusy=410~420GeV
  but Xsec 60pb is multiplied by a factor 10 in figures
- We assigned luminosity uncertainty of 11%, jet energy scale uncertainty ~ 10% / pT of jet
  (conservative estimation with 2010 data)

Trigger, Event selection

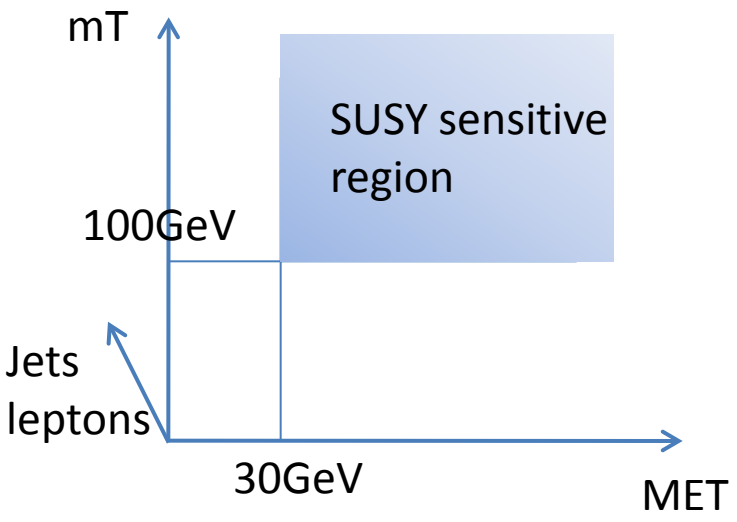
- Trigger
  - Muon channel relies on muon trigger (L1_MU6)
  - Electron channel relies on EM calorimeter trigger (EF_g10_loose)

- Event selection

  baseline cuts
  - Lepton … muon or electron > 20GeV
  - Jets … 2 jets > 30GeV

  additional cuts
  - Missing ET > 30GeV
  - Transverse Mass >100GeV

  di-lepton channel
  - Second lepton … muon or electron > 10GeV



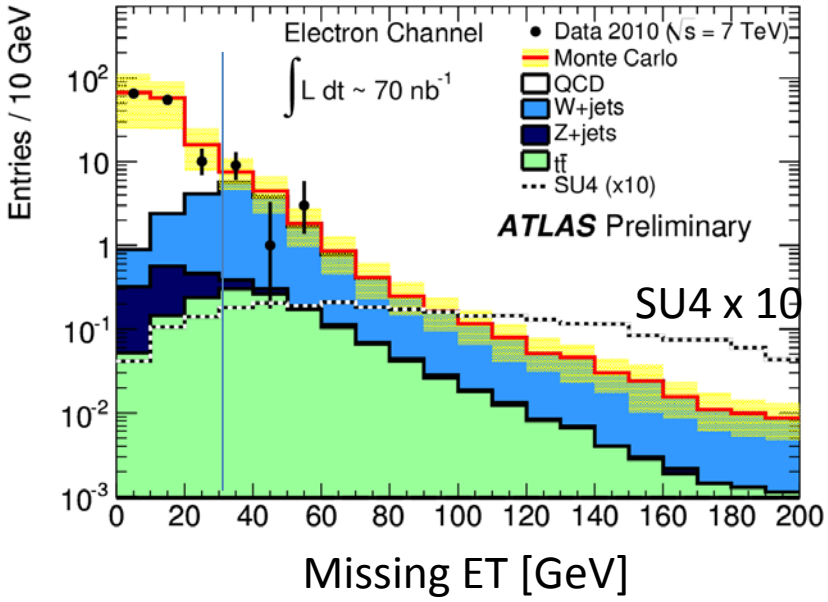
We keep loose selection to understand BG with current luminosity~70nb^{-1}

Missing ET

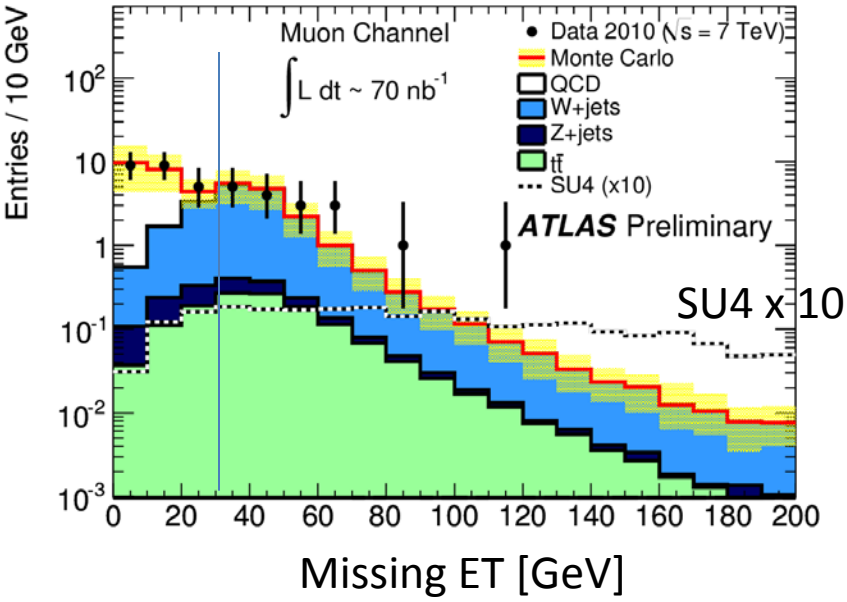
- missing ET defined by vector sum of Calorimeter cells at EM scale and muons

$$\vec{E}_{\mathrm{T}}^{\mathrm{miss}} \equiv (E_x^{\mathrm{miss,calo}}, E_y^{\mathrm{miss,calo}}) - \sum_j \mathbf{p}_{\mathrm{T}}^{\mu,j}$$

Electron Channel 2jets>30GeV



Muon Channel 2jets>30GeV



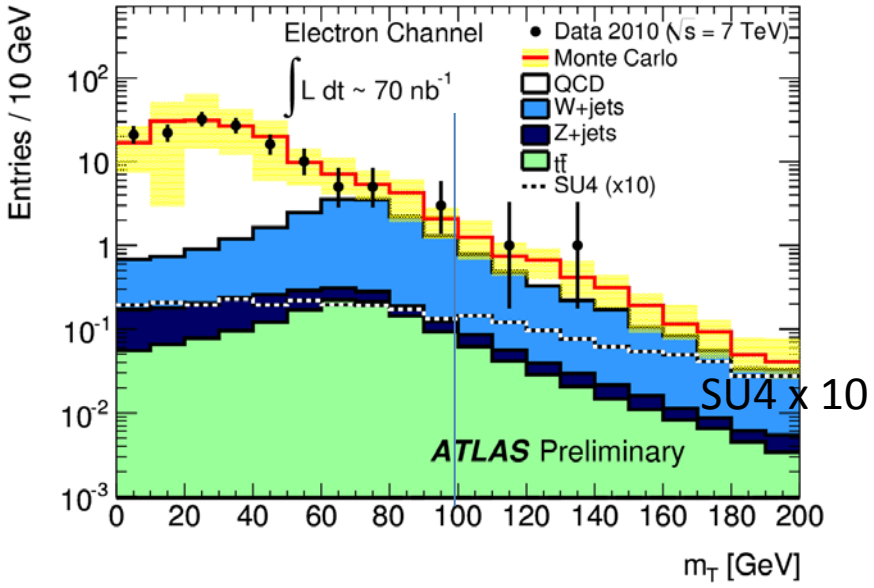
- The data are in agreement with the MC
  for both QCD dominant low MET region and W+jets dominant higher MET region

Transverse Mass

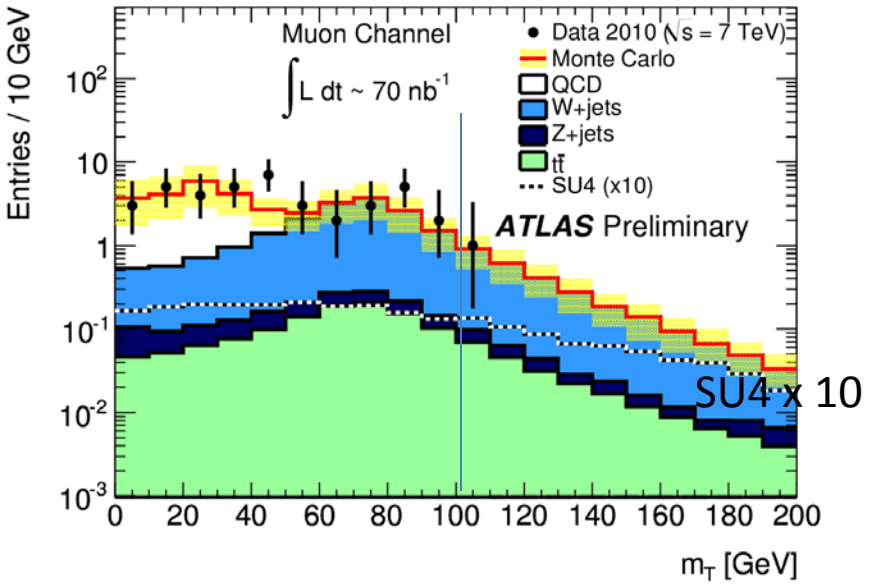
- transverse mass defined by

$$m_{\mathrm{T}}^2 \equiv 2|\mathbf{p}_{\mathrm{T}}^{\ell}||E_{\mathrm{T}}^{\mathrm{miss}}| - 2\mathbf{p}_{\mathrm{T}}^{\ell} \cdot \vec{E}_{\mathrm{T}}^{\mathrm{miss}}$$

Electron Channel 2jets>30GeV



Muon Channel 2jets>30GeV

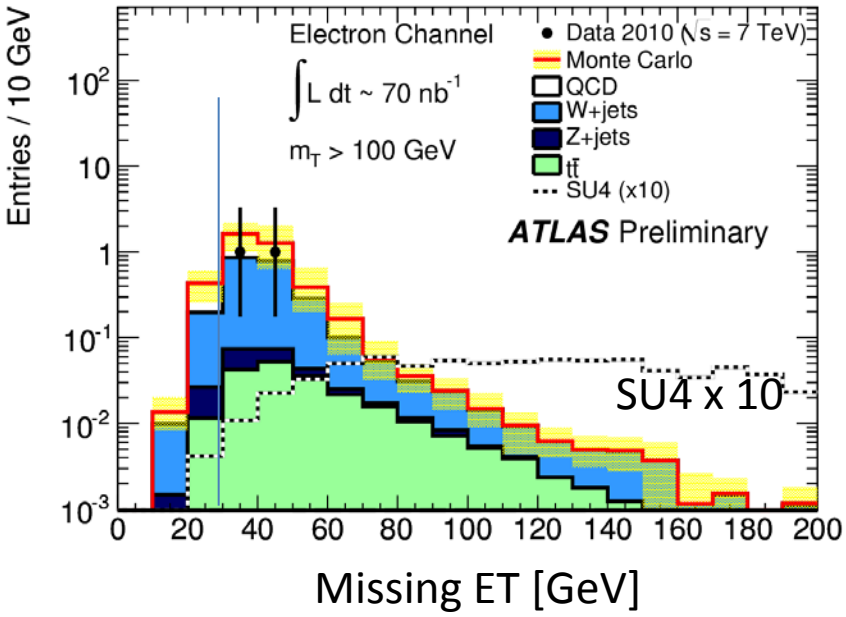


- data are in agreement with MC in which
  - QCD dominate in low mT
  - W+jets dominate ~mW, suppressed in higher mT

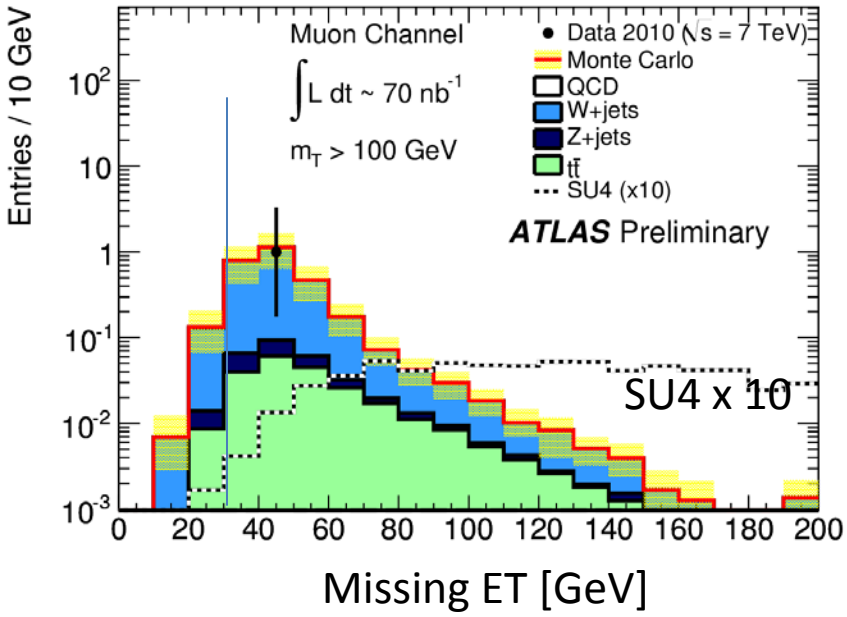
Missing ET after mT cut

- mT cut (>100GeV) suppress QCD, SM BG

Electron Channel 2jets>30, mT>100GeV



Muon Channel 2jets>30, mT>100GeV



- #events in one-lepton channel with MET>30GeV, mT>100GeV

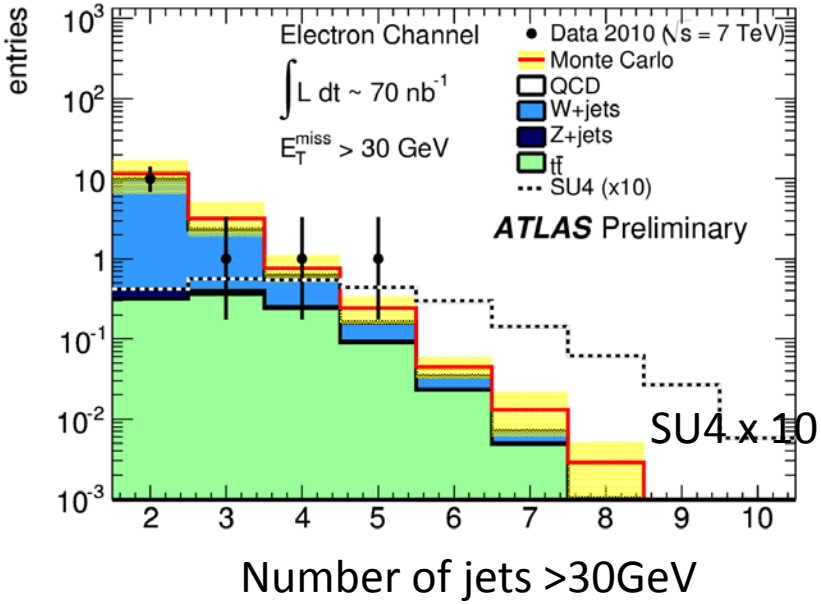
	Data	MC
Electron channel	2 events	3.6+-1.6 events
Muon channel	1 event	2.8+-1.2 event

data is in agreement with MC

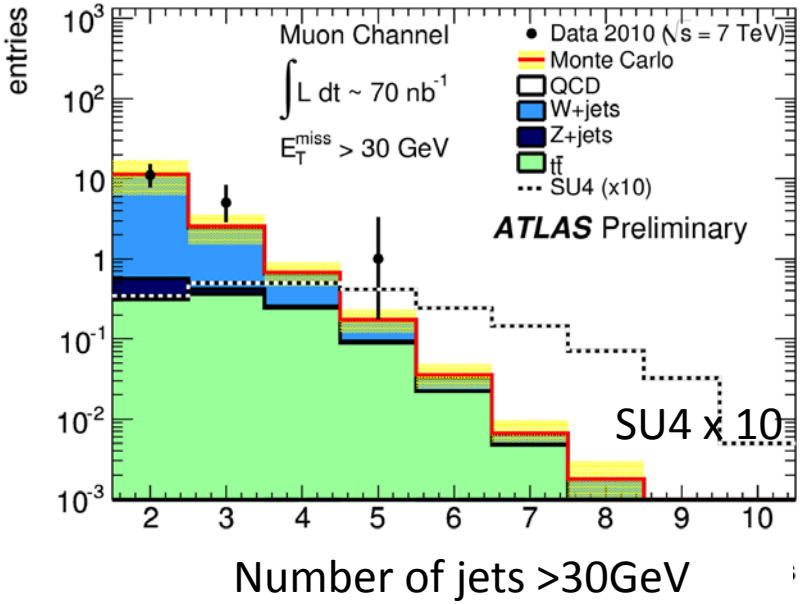
Jet multiplicity

- jet multiplicity with pT>30GeV (AntiKt algorithm, size of jet R=0.4)

Electron Channel MET>30GeV



Muon Channel MET>30GeV



- The data are in agreement with MC

Effective Mass

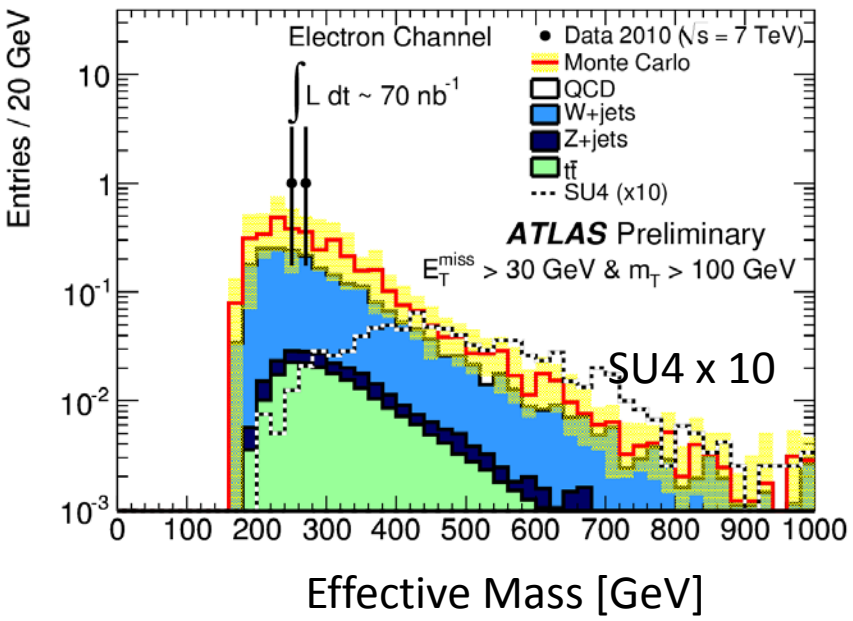
• effective mass defined by scalar sum of pT of jets, leptons and MET, indicating SUSY mass scale

$$M_{\mathrm{eff}} \equiv \sum_{i=1}^{N_{\mathrm{jets}}} p_{\mathrm{T}}^{\mathrm{jet},i} + \sum_{j=1}^{N_{\mathrm{lep}}} p_{\mathrm{T}}^{\mathrm{lep},j} + E_{\mathrm{T}}^{\mathrm{miss}}$$

Njets=2, Nlep=1

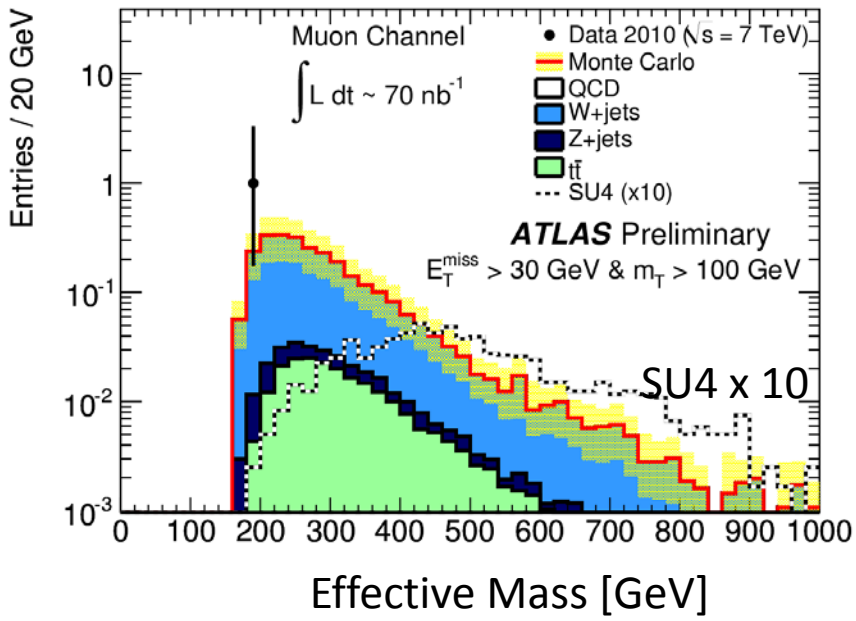
Electron Channel

2jets>30, mT>100
MET>30GeV



Muon Channel

2jets>30, mT>100
MET>30GeV

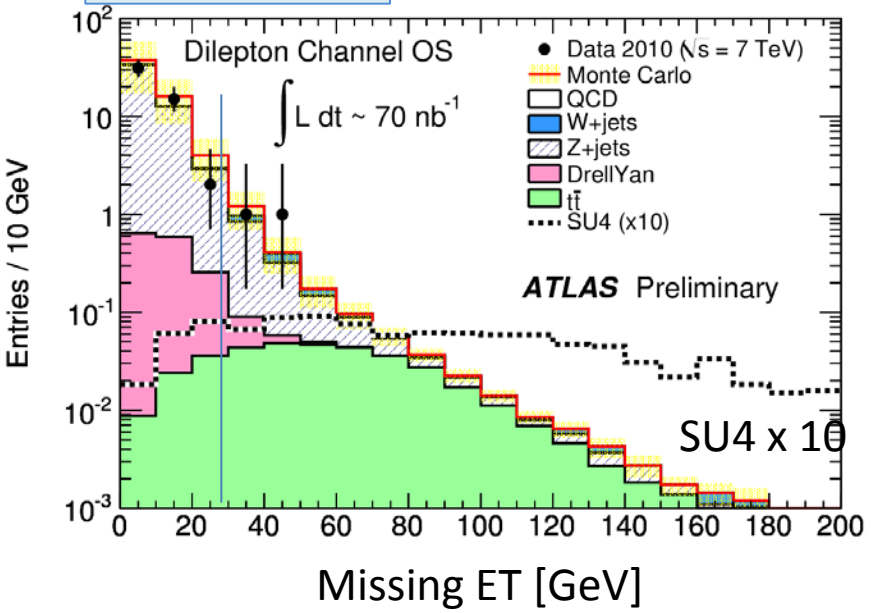


• 2(e), 1(μ) events are in low Effective Mass region, dominated by W+jets

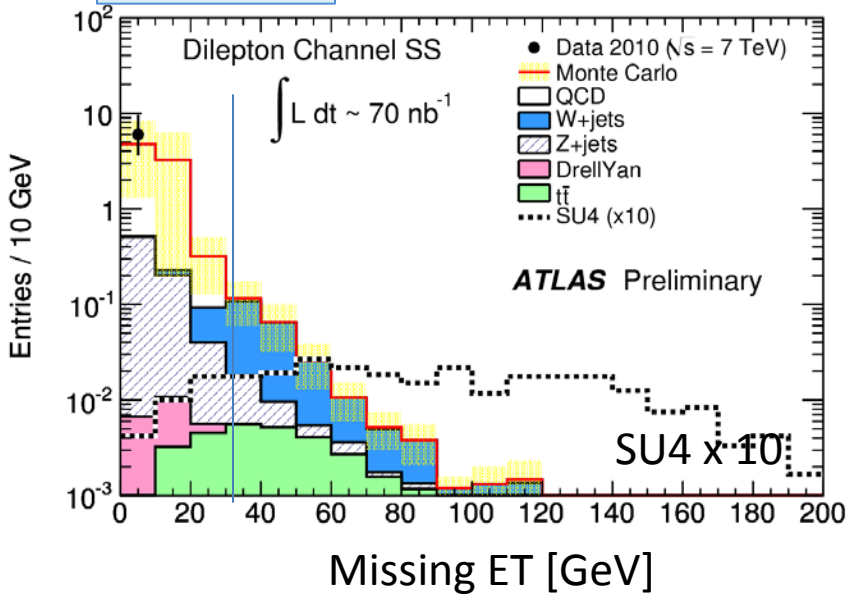
Di-lepton channel

- requirement of second lepton(e or μ) with pT>10GeV

Opposite sign 2jets>30, lepton>20,10GeV



Same sign 2jets>30, lepton>20,10GeV



- #events in di-lepton channel with MET>30GeV

	Data	MC
Opposite sign	2 events	2.0+-0.8 events
Same sign	no events	<0.2 event

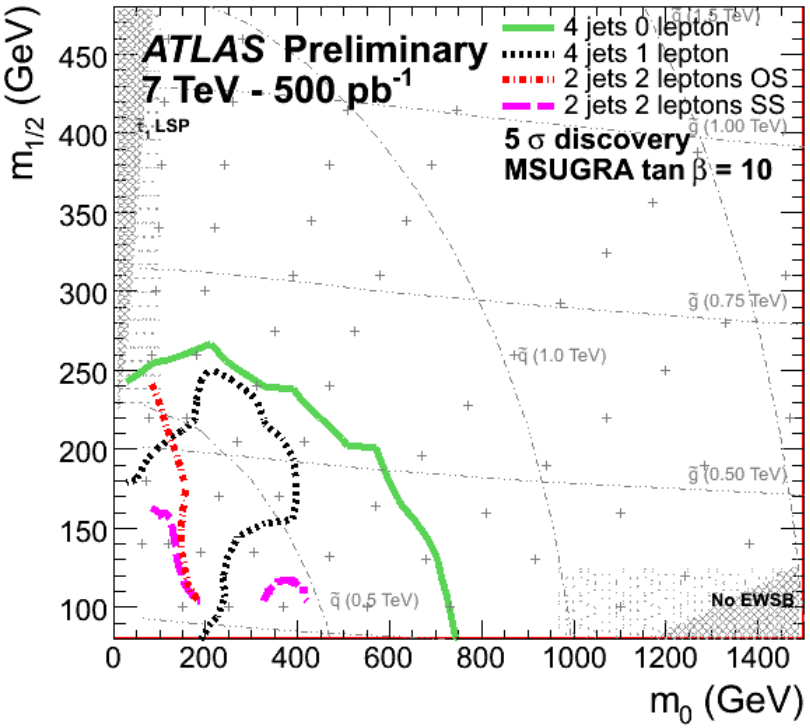
data is in agreement with MC

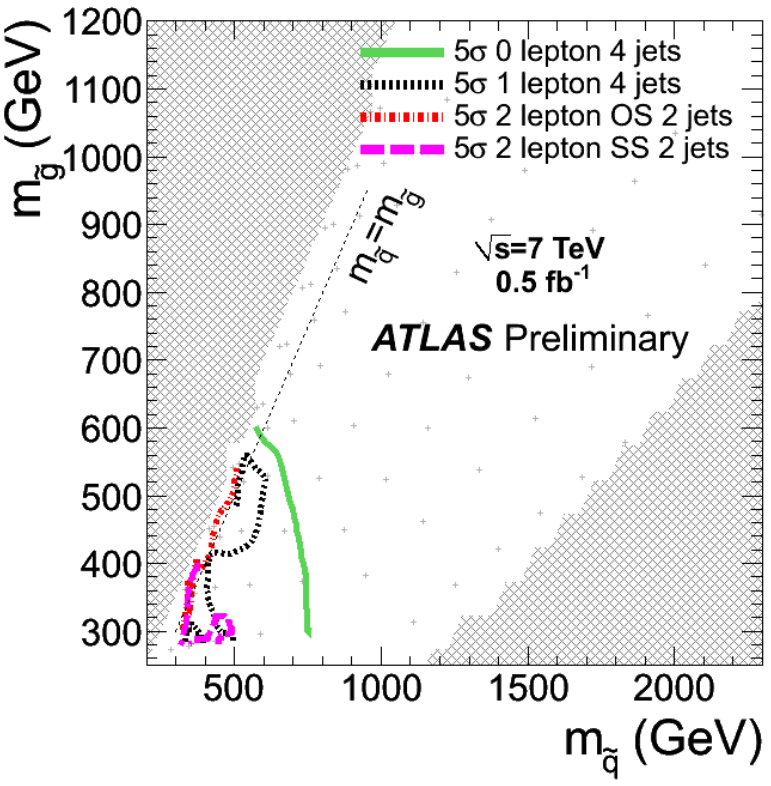
Conclusions

- We are probing the control regions for a SUSY search in jets+missing ET+leptons mode by using the first 70nb^{-1} data
- The distributions of data are in agreement with Monte Carlo predictions, SM BG is under good control so far
- We are going to increase the statistics of data in our analysis,
  and tighten selection cuts to explore the susy-sensitive region
- With increased data samples, the next challenge will be to apply data-driven background estimation methods to minimize reliance on Monte Carlo

backup

Prospects of early SUSY search





4jets 1lepton cut
- MET>80GeV
- Jets>100,40,40,40
- Lepton>20GeV

early data of 500pb^{-1} reaches
Msusy~500GeV in one lepton mode as well