SuperSymmetry

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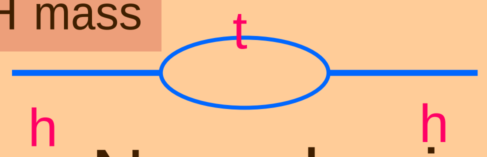
- Framework
- Detector requirements
- Inclusive searches
- Precision measurements
- Other models
- Prospects

Framework

Why SUSY ?

- ✓ The hierarchy problem
  - – SM cannot be valid up to M_{GUT}-M_{PL}

H mass



Λ ~O(1TeV)

$$\delta m^2_{h|top} = \frac{3G_F}{\sqrt{2}\pi^2} m_t^2 \Lambda^2 \sim (0.3\Lambda)^2$$

  - – New physics O(1TeV) to stabilize masses
- ✓ SUSY: Boson-Fermion symmetry
  - – Established @ M_{PL} (Superstring theory)
  - – Includes Gravity
  - – Natural stabilization of masses
    - ~ exact cancellation of HO corrections due to opposite sign contribution of particle/sparticle

SUSY : Pros & Cons

- Pros
  - EW symmetry breaking included
    - From large top mass
  - SUSY fits with GUTs
    - Precise matching of gauge couplings at M_{GUT} fails in SM and works in SUSY
    - Proton decay too fast without SUSY
- Cons
  - All particle spectrum doubled
  - Lack of signal @ LEP + $m_h > 114$ GeV
    - Problem for Minimal SUSY

SUSY models (1)

✓ MSSM

M_1, M_2, M_3 Gaugino SUSY-breaking mass terms (give masses to χ^0, $\chi^\pm$, g)

$m_{\tilde{\ell}_R}, m_{\tilde{\ell}_L}, m_{\tilde{\nu}_L}, m_{\tilde{q}_R}, m_{\tilde{q}_L}$ Sfermion SUSY-breaking mass terms

m_A Pseudoscalar Higgs boson mass

$\tan\beta$ Ratio of VEV of 2 Higgs doublets

μ Higgs mixing parameter

A_t, A_b, A_τ, Stop/sbottom/stau/... mixing parameters

- Higgs sector
  - 2 Higgs doublets
  - 5 final states

> 100 parameters → not very predictive

✓ CMSSM (Constrained)

- Gaugino masses unify to common gaugino mass $m_{1/2}$ at GUT scale
- Sfermion masses unify to a common scalar mass m_0 at GUT scale
- Use RGE to evoluate from GUT scale to EW scale

Parameters: $m_{1/2}$, m_0, m_A, $\tan\beta$, μ, $A_{t,b,\tau...}$

SUSY models (2)

✓Minimal SuperGravity mSUGRA

- Unify Higgs & sfermion sector @ GUT scale → m_A fixed by m_0
- Unify all trilinear couplings @ GUT scale to common A_0
- Radiative EWSB → only sign of μ is free

5 parameters: $m_{1/2}$, m_0, $\tan\beta$, sign(μ), A_0
Lightest SUSY Particle (LSP) = χ_1

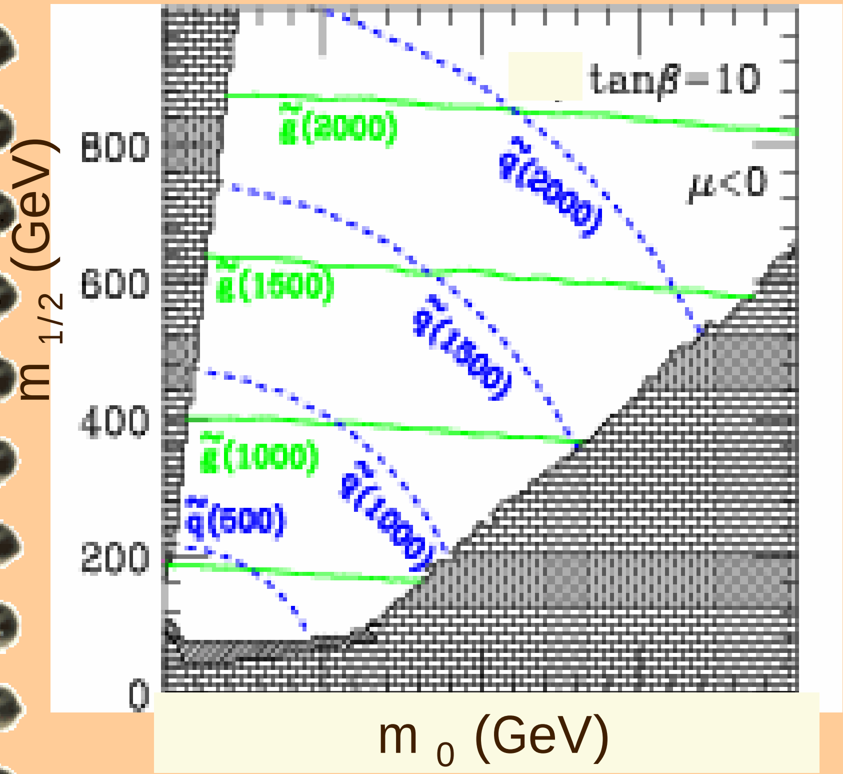
✓Gauge mediated SUSY breaking GMSB

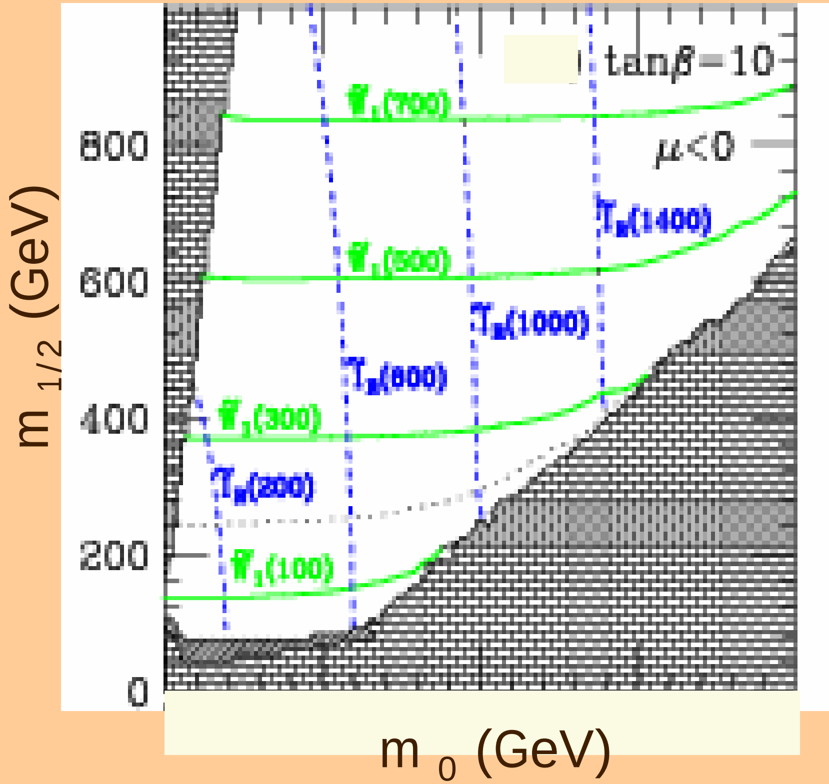
- SUSY breaking @ much lower scale
- $\mathrm{LSP} \equiv \tilde{G}$ $\quad m(\tilde{G}) < \mathrm{KeV}$ escapes detection

✓R-parity breaking models

- $R_p = (-1)^{3(B-L)+S}$ conserved -> B&L conserved
- Investigate R_p-violation

Mass isolines in mSUGRA





$$m(\tilde{g}) \approx 3m_{1/2}$$

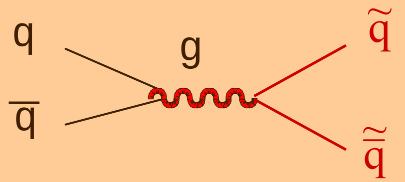
$$m(\tilde{q}) \approx \sqrt{m_0^2 + 6m_{1/2}^2}$$

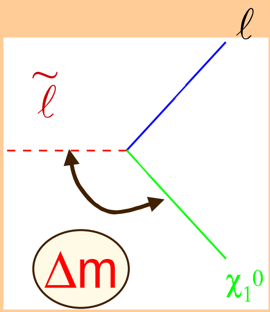
$$m(\chi_1^0) \approx 0.5\, m_{1/2}; \quad m(\chi_2^0, \chi^\pm) \approx m_{1/2};$$

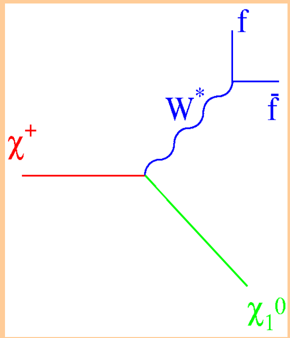
$$m(\tilde{\ell}_L^\pm, \tilde{\ell}_R^\pm) \approx \sqrt{m_0^2 + (0.5, 0.15)\, m_{1/2}^2}$$

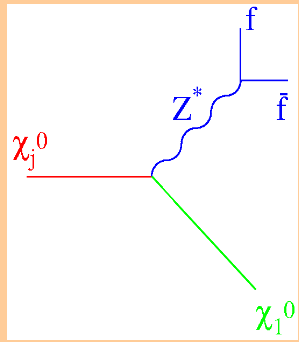
Couplings & processes

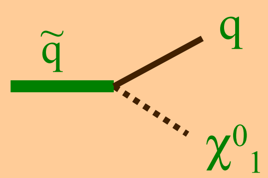
R-parity conserved
-> Sparticle Pair production

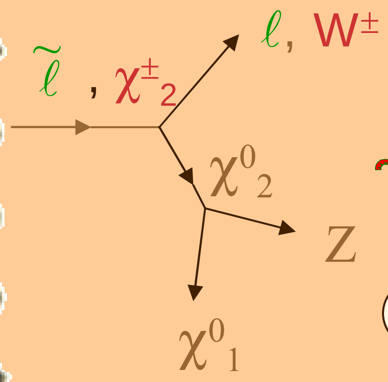


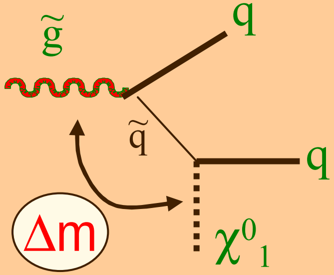


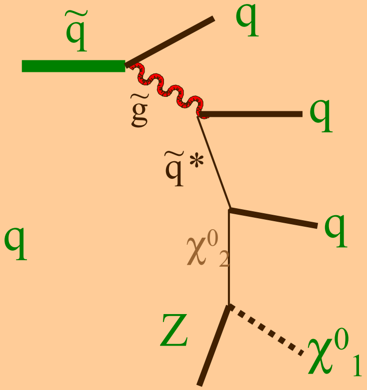












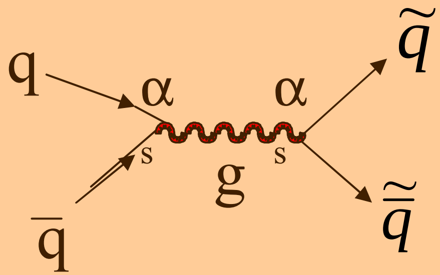
$\chi^0_1 \equiv$ LSP
stable, weakly interacting
→ not detected
→ missing E in final state

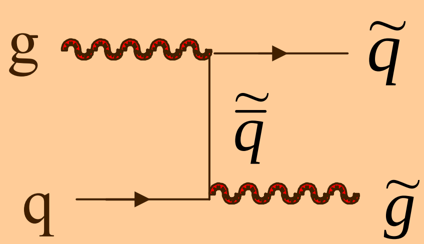
Small Δm : little visible energy in final state

Sparticle production at LHC

✓ Squarks and gluinos

- Produced via strong processes $\rightarrow$ large x-section



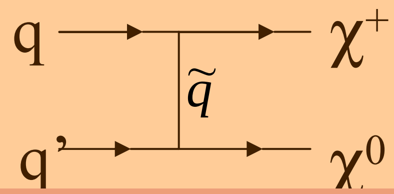


M (GeV)	*σ (pb)*	*Evts/yr*
500	100	10^6-10^7
1000	1	10^4-10^5
2000	0.01	10^2-10^3

✓ Charginos, neutralinos, sleptons

- Direct production occurs via electroweak processes $\rightarrow$ much smaller rate
- Produced more widely in squark and gluino decays

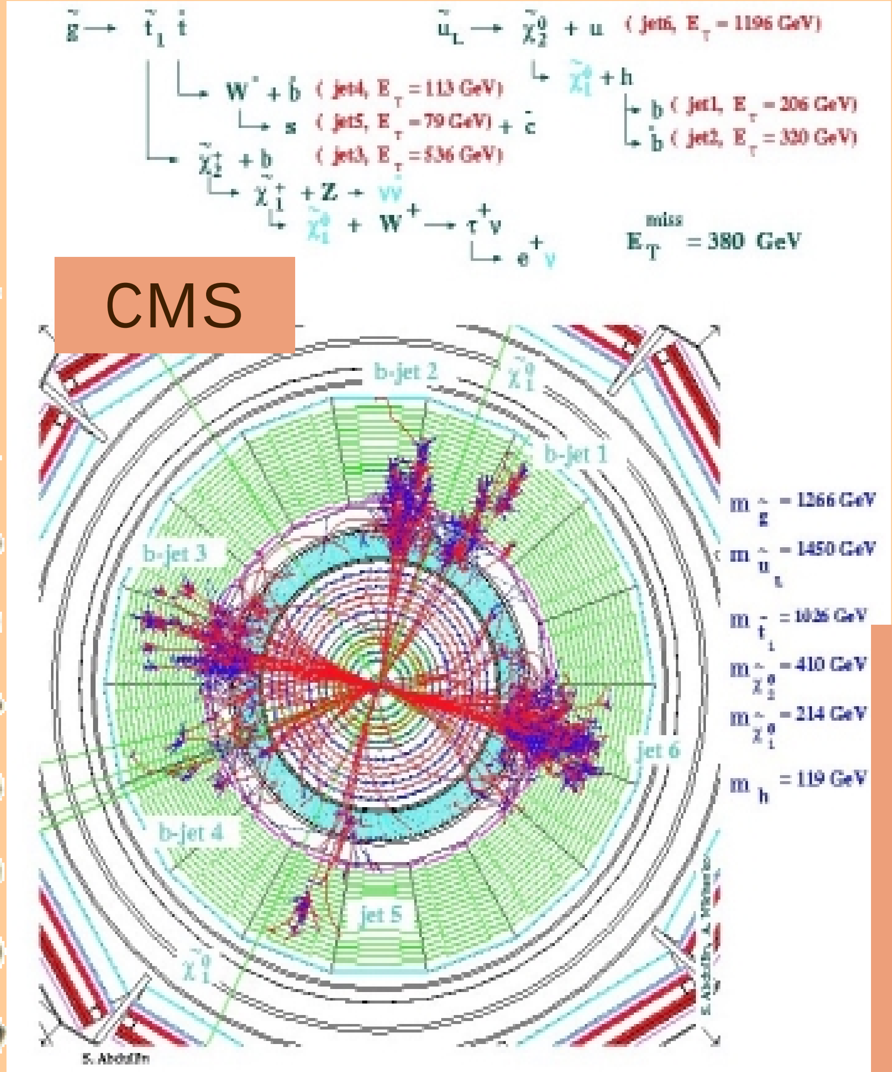
E.g.



$\sigma \approx$ pb $\quad m_\chi \approx 150$ GeV

$\tilde{q}\tilde{q}, \tilde{q}\tilde{g}, \tilde{g}\tilde{g}$ production are **dominant** SUSY proc's @ LHC

Squark & Gluino decays



✓$\tilde{q}, \tilde{g}$ heavy

→ cascade decays favoured

$$m(\tilde{q}, \tilde{g}) \sim 1\,\mathrm{TeV}$$

m_0 = 1000 GeV
$m_{1/2}$ = 500 GeV
$\tan\beta = 35$ $\mu > 0$ $A_0 = 0$

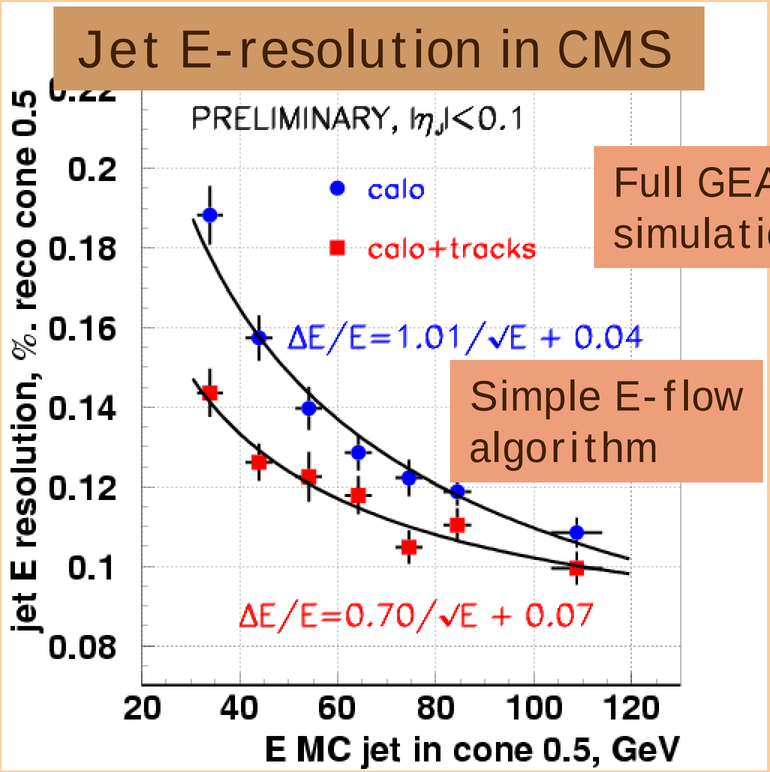
→ Spectacular signatures
→ Jets, b-jets, leptons, missing E_T
→ Easy to extract SUSY from SM backgrounds

Detector requirements

Good Hadronic resolution

- Reduces fake MET from detector resolution in QCD multijet events
- Narrow mass peaks : W → jj, h → bb, t → bjj from SUSY cascade decays; A/H →ττ, etc.

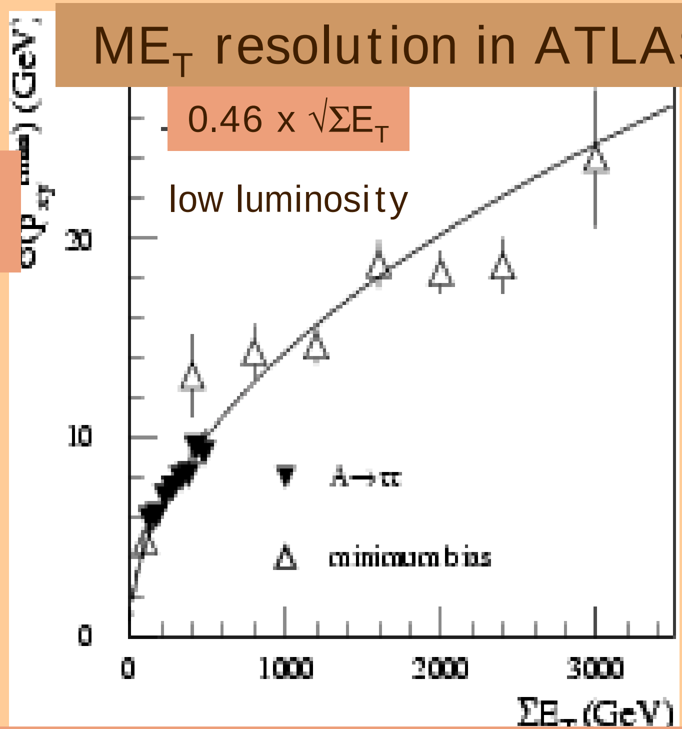
Jet E-resolution in CMS



Full GEANT simulations

Simple E-flow algorithm

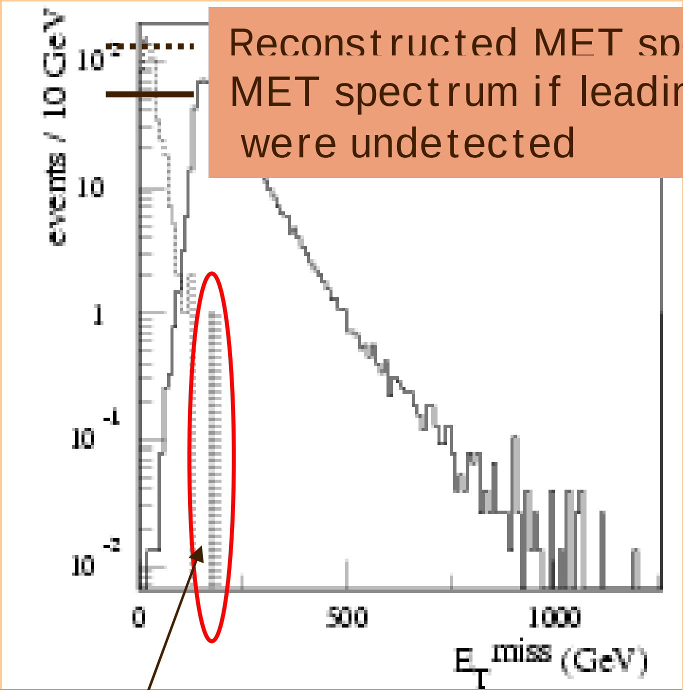
ME_T resolution in ATLAS



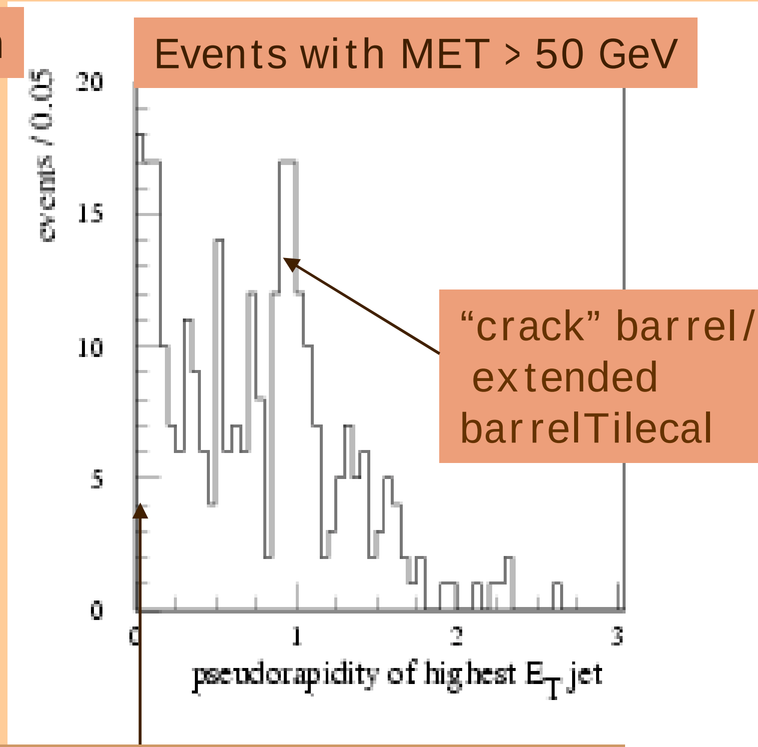
High lumi: MET resolution is ~ 2 worse

Hermetic calorimetry coverage

- ✓ $|\eta| < 5$, minimal cracks & dead material
  - Minimise fake MET from lost / badly measured jets
  - ATLAS $Z \rightarrow \mu\mu$ + jet(s) full sim. (p_T (Z) > 200 GeV)



2 events with MET > 200 GeV contain a high-p_T neutrino

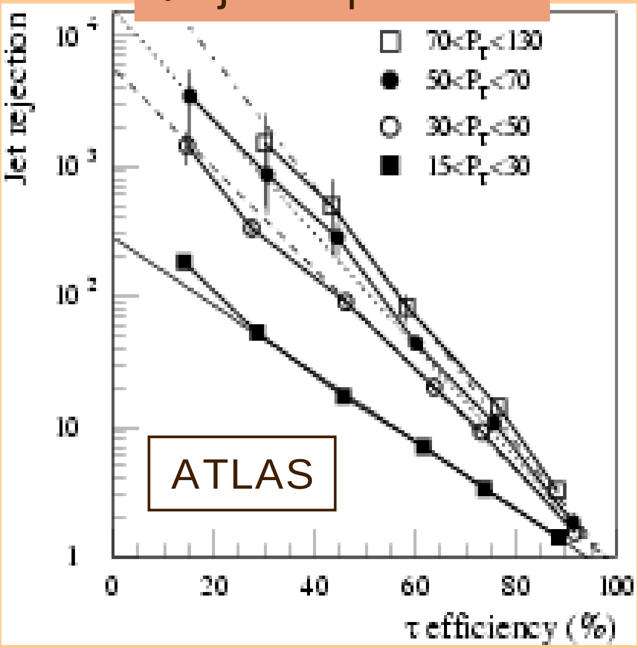


Particles parallel to Tilecal scintillating tiles

Good b-tag & τ-identification

- τ's and b-jets expected in sparticle and SUSY Higgs decays (especially at large tanβ)

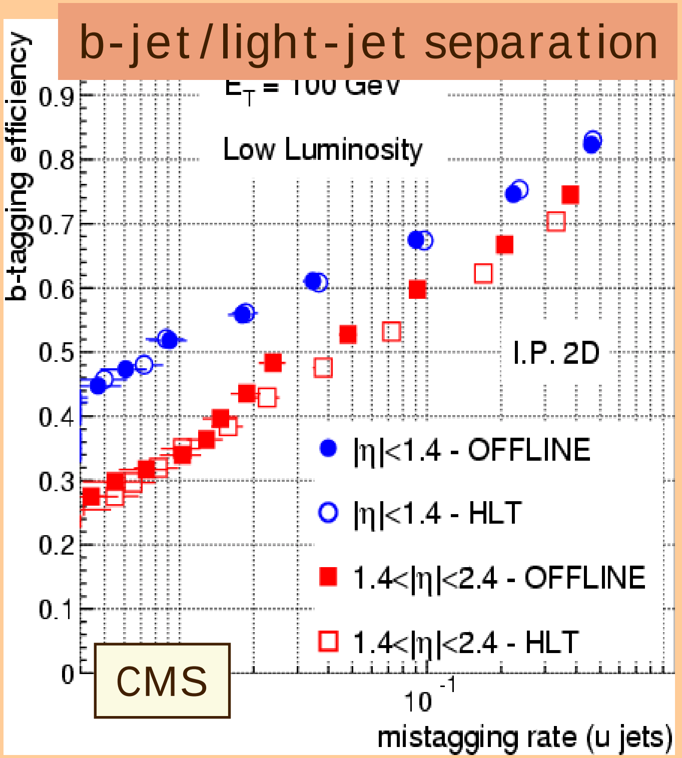
τ /jet separation



- Full sim of τ's from A → ττ & QCD jets
- τ's ID: narrow & low multiplicity jets in calorimeters & tracker

- From full sim QCD b-jets & u-jets
- b-jets ID: from tracks with large impact parameter

b-jet/light-jet separation



$l^{\pm}$, jet, MET absolute E-scale

✓ For precise measurements of SUSY events, e.g. end-points of kinematic distributions, $A/H \to \mu\mu$ mass,;etc. *(in many cases statistical error is negligible)*

- Can only be achieved with *in situ* calibration with data samples

✓ ℓ-scale

- Mainly from $Z \to \ell\ell$ events (1 evt/s per spec. @ 10^{33})
  - ~ 1 ‰ uncertainty achieved by CDF, D0 (dominated by statistics of control samples)
  - LHC goal : 0.2 ‰ to measure m_W to ~ 15 MeV

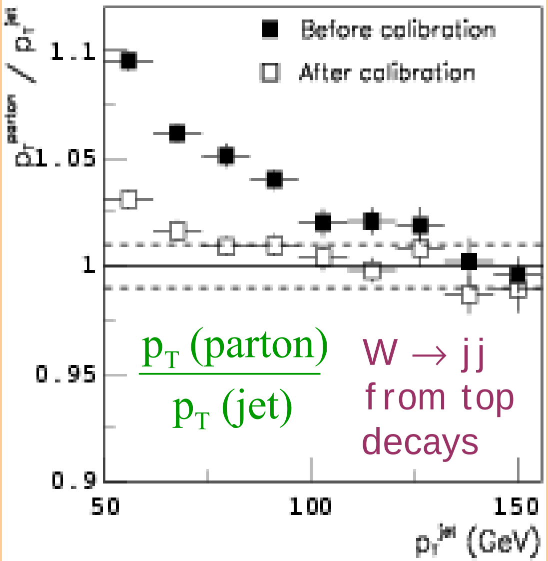
Source	Requirement	Uncertainty on scale
Material in Inner Detector	Known to 1%	< 0.01%
Inner bremsstrahlung	Known to 10%	< 0.01%
Underlying event	Calibrate and subtract	<< 0.03%
Pile-up at low luminosity	Calibrate and subtract	<< 0.01%
Pile-up at high luminosity	Calibrate and subtract	<< 0.01%

ATLAS: full simulation study of uncertainty on $Z \to ee$ scale

$l^{\pm}$, jet, MET absolute E-scale

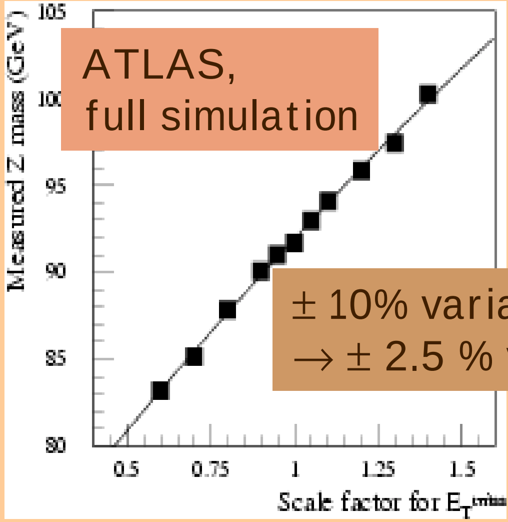
✓ Jet-scale

- From Z (→ ℓℓ) + 1 jet asking p_T (jet) = p_T (Z)
- From W → jj in tt → bℓν bjj evts asking $m_{jj} = m_W$
  - ~ 3 % by CDF, D0 (stat. Limited) / LHC goal : ~ 1 %



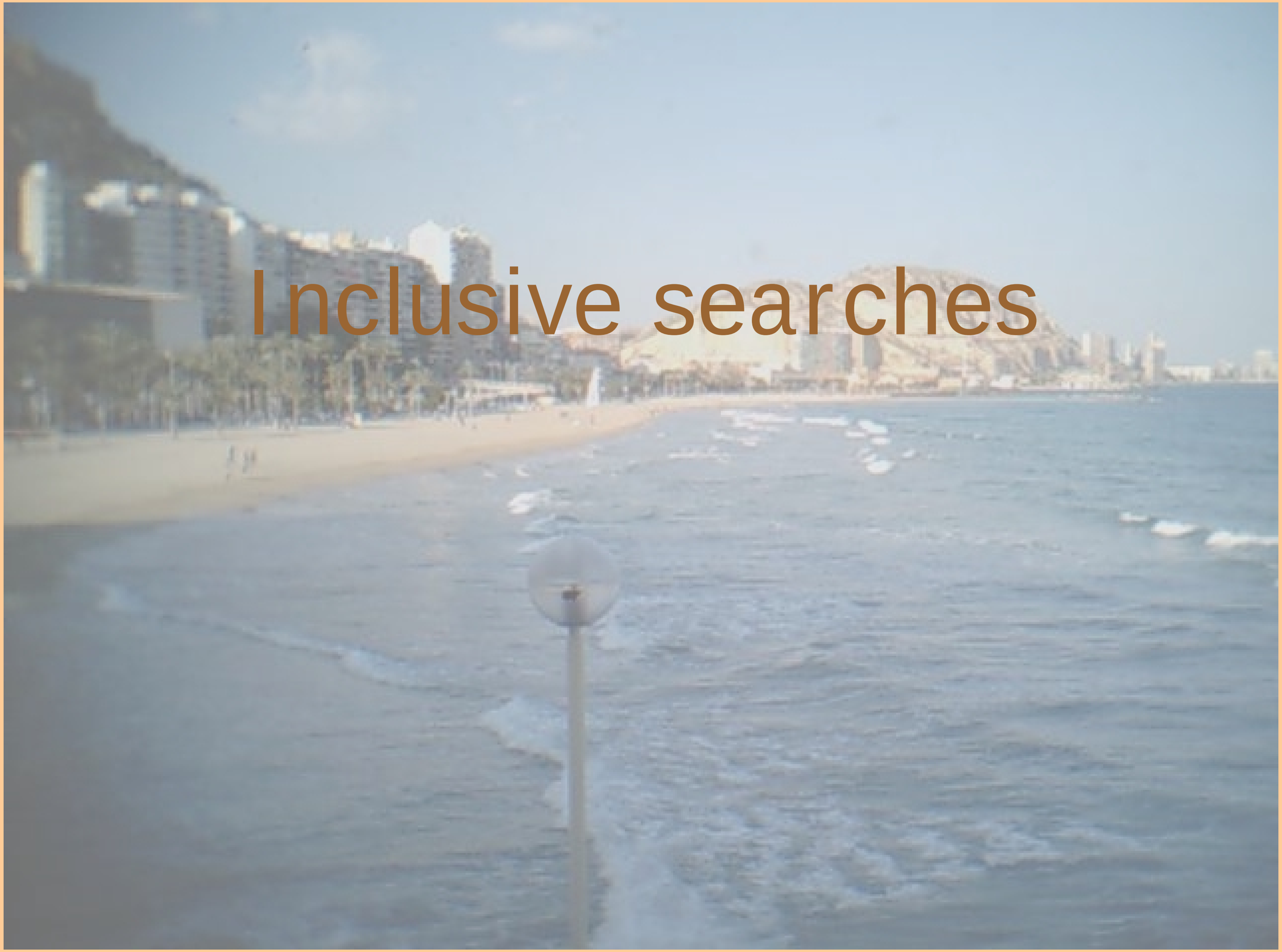
✓ MET scale

- From Z → ττ → ℓ-hadrons + ν 's
  - Recons'ted Z mass vs MET scale



m_Z can be measured to 1% with 4k evts (30 fb^{-1})
→ MET scale constrained to ~ 5%

Inclusive searches

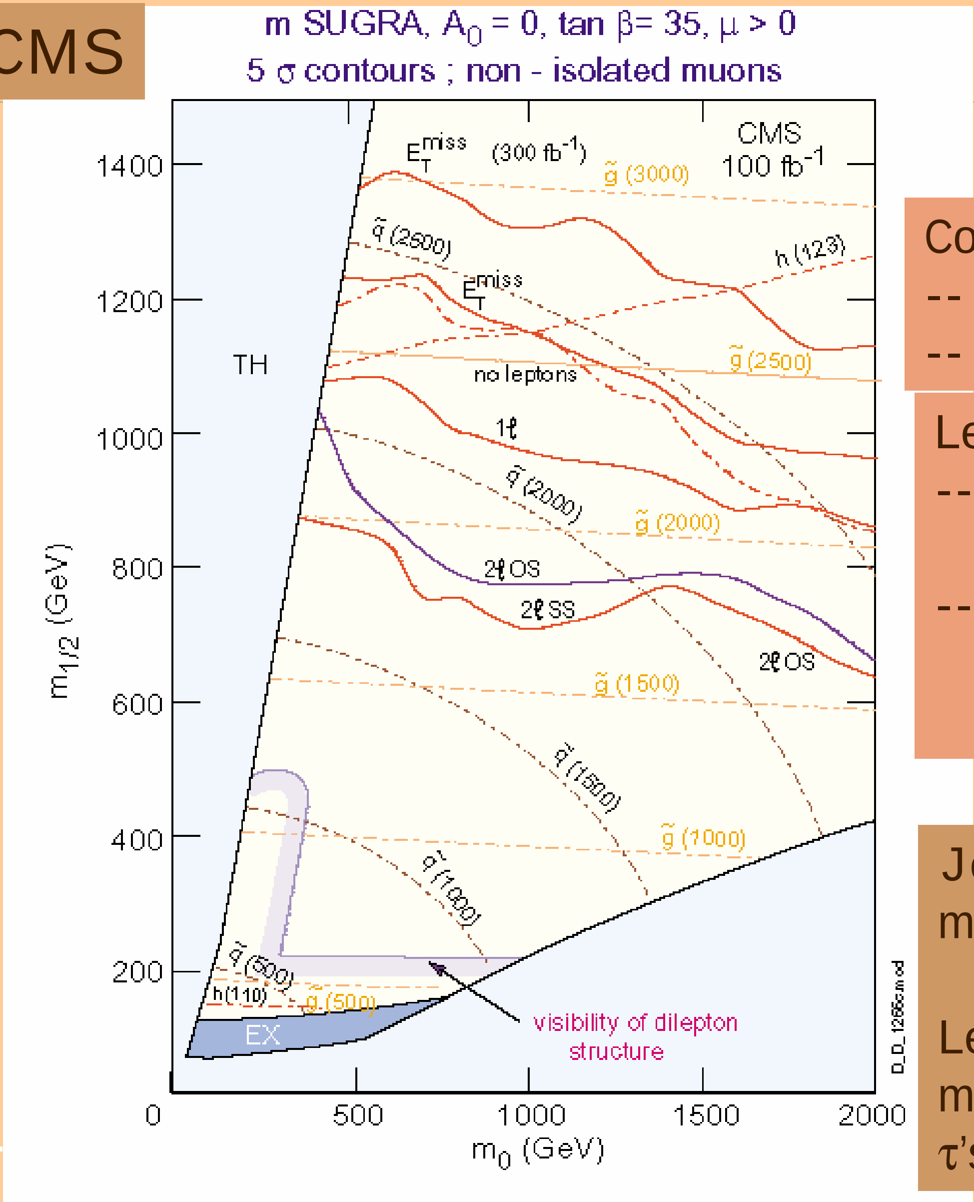


Inclusive SUSY searches ($\tilde{q}$,$\tilde{g}$)

- ✓ Easy, model-independent discovery
- ✓ Analysis
  - Topologies studied (from cascade decays)
    - Jets + MET — no lepton requirement
    - 0ℓ — no leptons
    - 1ℓ — 1 lepton
    - 2ℓOS — 2 opposite-sign leptons
    - 2ℓSS — 2 same-sign leptons
    - 3ℓ — 3 leptons
  - Backgrounds
    - tt, W/Z + jets, QCD multijets
  - Cuts
    - # & E_T of jets, MET & MET isolation, transverse sphericity
  - Yield
    - SUSY scale & x-section, evts properties, exclusive studies

CMS

Reach (1)



Common cuts:

-- ≥ 2 jets, $E_T^{\,j}$ > 40 GeV |η| <3

-- MET > 200 GeV

Leptons :

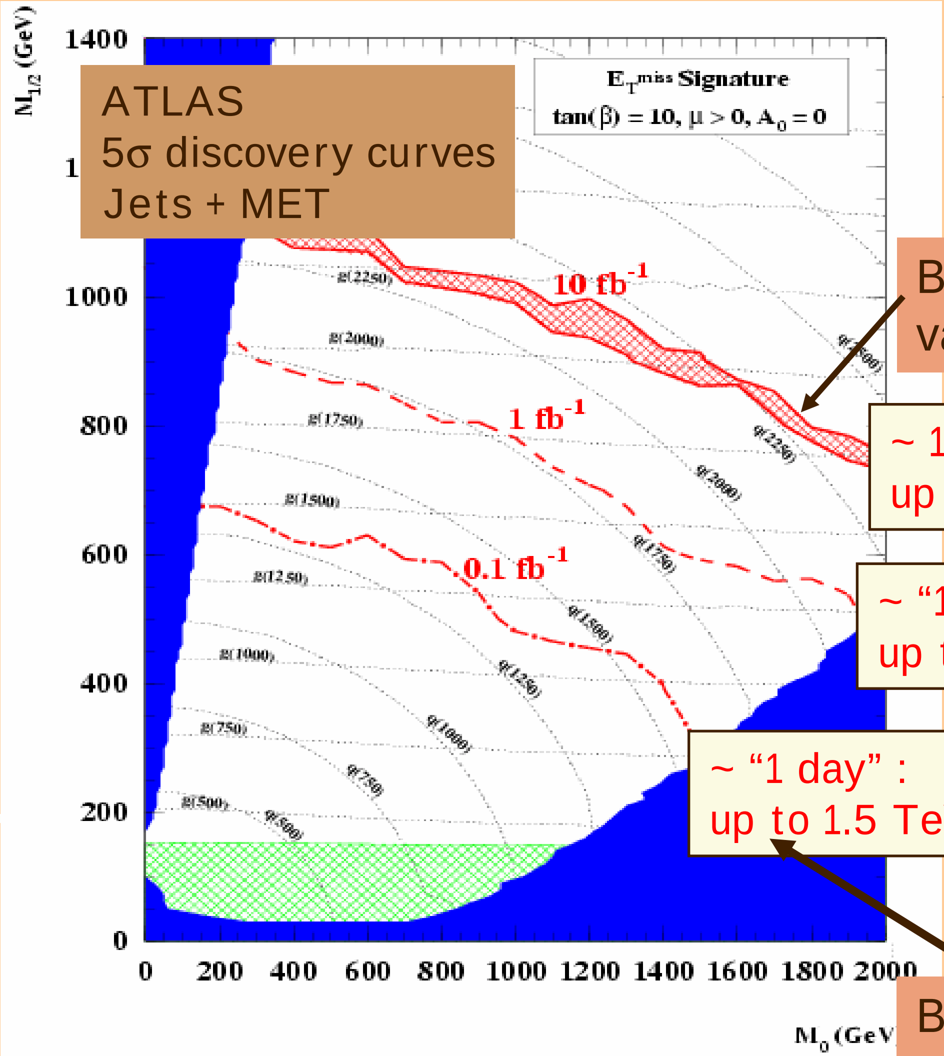
-- $e^{\pm}$: $E_T^{\,e}$ > 20 GeV |η| <2.5 (isolated)

-- $\mu^{\pm}$: $E_T^{\,\mu}$ > 10 GeV |η| <2.5 (isolated or not)

Jets + MET gives highest (and most model-independent) reach

Lepton signatures are more model-dependent (e.g. a lot of τ's at large tanβ)

Reach (2)



Band indicates factor ± 2 variation in background estimate

~ 100 days : up to 2.3 TeV

~ "10 days" : up to 2 TeV

~ "1 day" : up to 1.5 TeV

But it will take a lot time to understand the detectors and the backgrounds ...

Backgrounds estimates

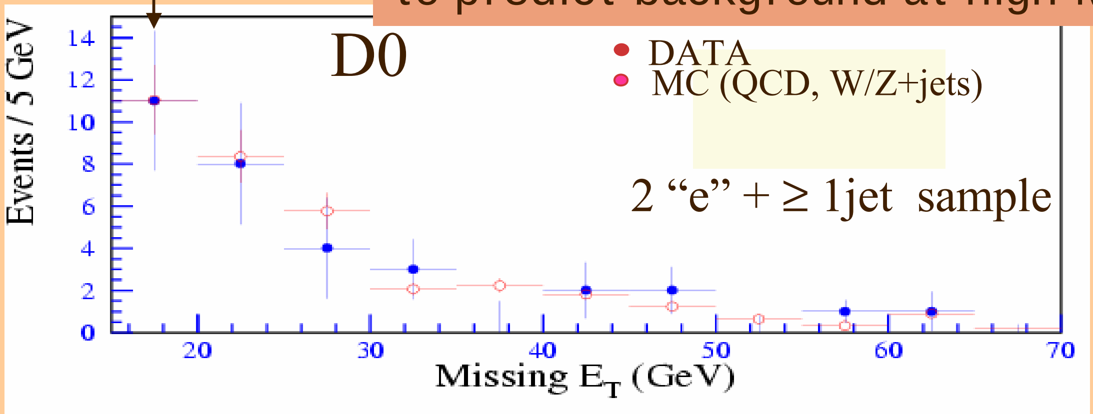
Background process (examples ….)	Control samples (examples ….)
Z (→ νν) + jets W (→ τν) + jets tt→ bℓνbjj QCD multijets	Z (→ ee, μμ) + jets W (→ eν, μν) + jets tt→ bℓν bℓν Lower E_T sample

Backgrounds estimated using as much as possible data (control samples) & simulation

Additional handles by
-> changing(loosening ..) cuts, varying number of leptons, …
-> change background composition

normalization point

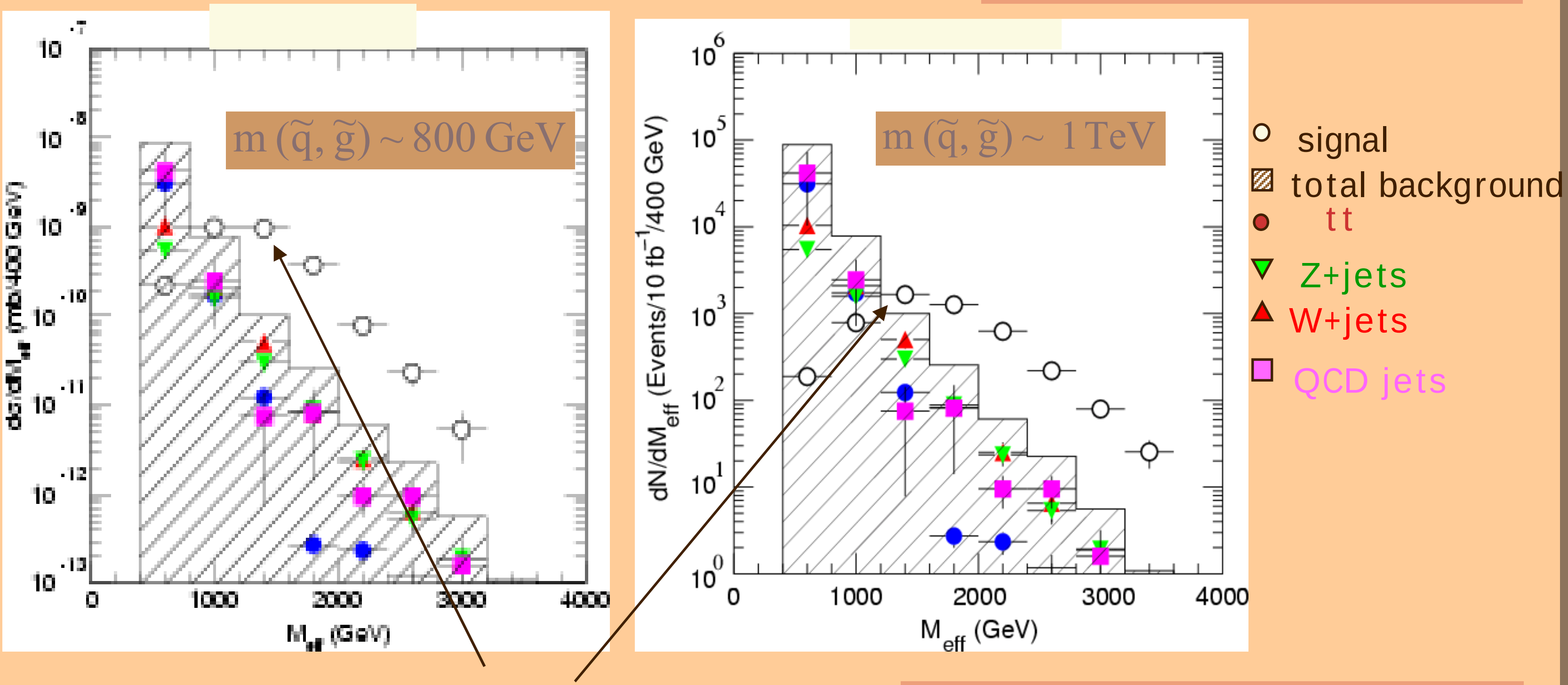
Normalize MC to data at low MET and use it to predict background at high MET in “signal” region



A lot of data will most likely be needed

SUSY mass scale

- Best sensitivity from Jets+ MET+ 0ℓ topology
  - Use "Effective mass" $M_{eff} = E_T^{miss} + \sum_{i=1}^{4} p_T(jet_i)$ (GeV)

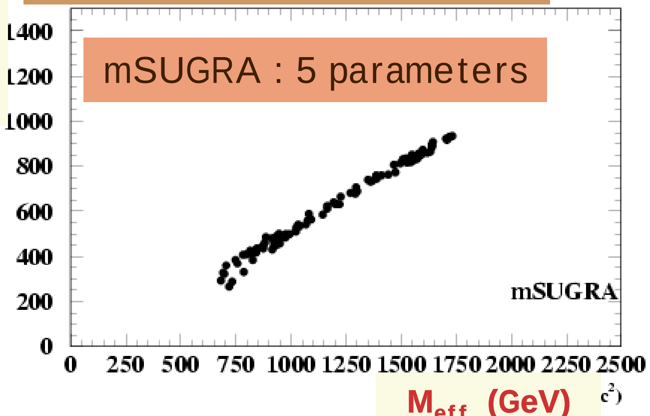


- Peak position correlated to $M_{SUSY} \approx \min(m(\tilde{q}), m(\tilde{g}))$
- Area under peak correlated to SUSY x-section

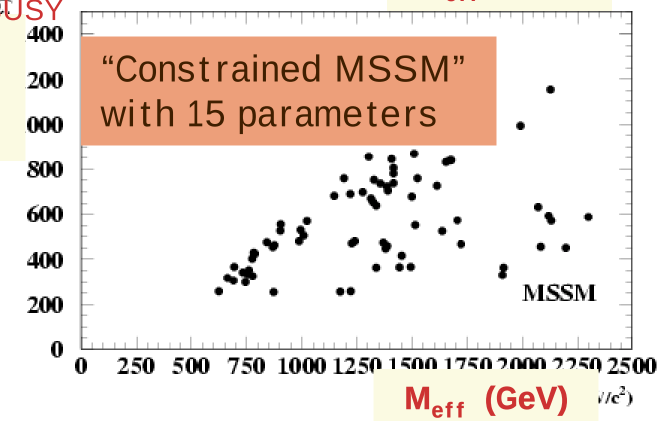
SUSY mass scale vs models

M_{SUSY} (GeV) vs M_{eff}

mSUGRA : 5 parameters

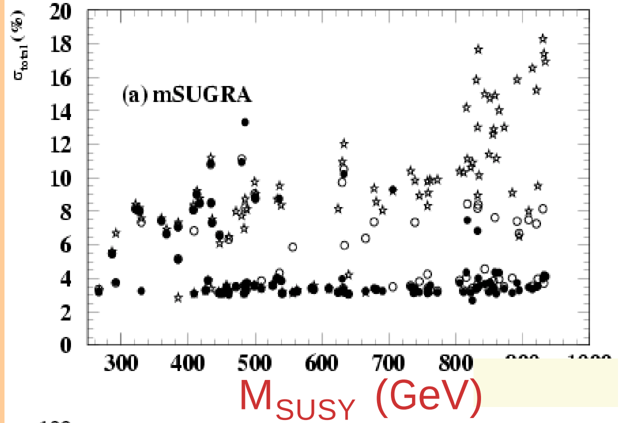


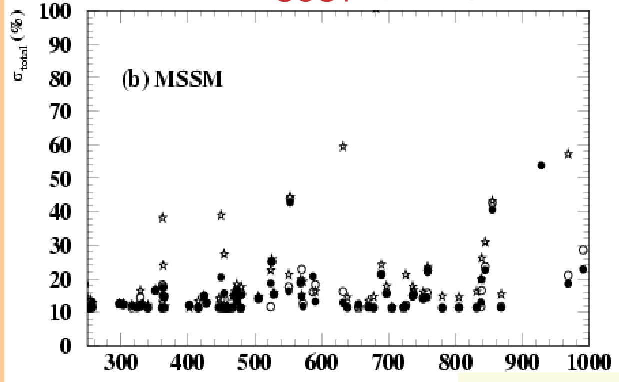
“Constrained MSSM” with 15 parameters



Intrinsic spread from parameters (infinite statistics, no exp'al error)
~ 2 % mSUGRA, ~10 % CMSSM

% precision on M_{SUSY} vs M_{SUSY}





* 10 fb^{-1}
o 100 fb^{-1}
• 300 fb^{-1}

Including exp'al uncertainties (~50% from bckd subtraction, ~1.5% from E-scale)
≤ 20% (10%) mSUGRA for 10 (100) fb^{-1}
≤ 60% (30%) CMSSM for 10 (100) fb^{-1}

Precise measurements

General strategy

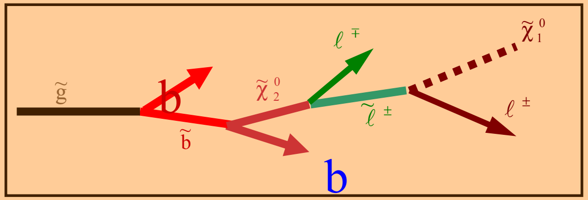
✓ Inclusive

- SUSY proof, scale & σ, Model hints

✓ Go beyond inclusive measurements

- Measure sparticle (masses, decays)
- Constrain the theory parameters

✓ General strategy



- Select exclusive decay chains
- χ^0_1 invisible → no direct mass peak
- Constrain masses by measuring mass distributions of visible sparticles decay
  - Start from end of the chain, usually $\tilde{\chi}^0_2$
  - Then go up the chain to primary squark and gluino

Example: Point 5

✓ $\tilde{\chi}^0_2$ decay modes

$\chi^0_2 \to h\,\chi^0_1$

$\chi^0_2 \to Z\,\chi^0_1 \to \ell\ell\,\chi^0_1$

$\chi^0_2 \to \tilde{\ell}\ell \to \ell\ell\,\chi^0_1$ (gives enhanced leptonic BR

$\chi^0_2 \to \ell\ell\,\chi^0_1$ 3−body decay through $Z^*, \tilde{\ell}^*$

In particular $\chi^0_2 \to \tilde{\tau}\tau$ can dominate at large $\tan\beta$

✓ mSUGRA Point 5

m_0 = 100 GeV, $m_{1/2}$ = 300 GeV,
A_0 = 300 GeV, $\tan\beta$ = 2, μ > 0

$m_{\tilde{q}_L}$ = 690 GeV	$m_{\tilde{g}}$ = 770 GeV
$m_{\tilde{q}_R}$ = 660 GeV	$m_{\tilde{b}_1}$ = 630 GeV
$m_{\tilde{t}_1}$ = 490 GeV	$m_{\tilde{t}_2}$ = 710 GeV
$m_{\tilde{\ell}_R}$ = 157 GeV	$m_{\tilde{\ell}_L}$ = 240 GeV
$m_{\tilde{\chi}^0_1}$ = 121 GeV	$m_{\tilde{\chi}^0_3}$ = 232 GeV
m_h = 93 GeV	m_H = 640 GeV

Decay			BR
$\tilde{g}$	→	$\tilde{q}q$	65 %
		$\tilde{b}b$	25 %
		$\tilde{t}_1 t$	15 %
$\tilde{q}_L$	→	$\tilde{\chi}^0_2 q$	33 %
		$\tilde{\chi}^+_1 q'$	65 %
$\tilde{q}_R$	→	$\tilde{\chi}^0_1 q$	100 %
$\tilde{t}_1$	→	$\tilde{\chi}^0_1 t$	70 %
		$\tilde{\chi}^0_2 t$	9 %
		$\tilde{\chi}^+_1 b$	21 %
$\tilde{\chi}^0_2$	→	$\tilde{\chi}^0_1 h$	68 %
		$\tilde{\ell}_R l$	27 %
$\tilde{\chi}^\pm_1$	→	$\tilde{\chi}^0_1 W$	98 %
$\tilde{\ell}$	→	$\tilde{\chi}^0_1 l$	100 %
h	→	$b\bar{b}$	88 %

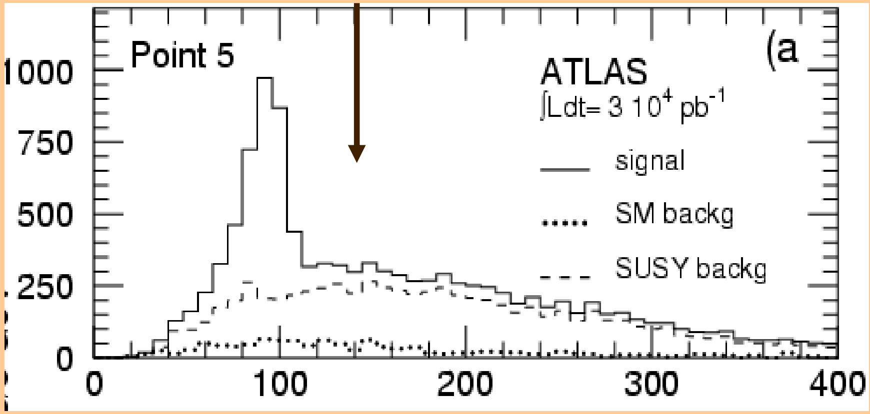
$\chi^0_2 \to h\,\chi^0_1 \to bb\,\chi^0_1$

$\chi^0_2 \to \tilde{\ell}_R\,\ell \to \ell\ell\,\chi^0_1$

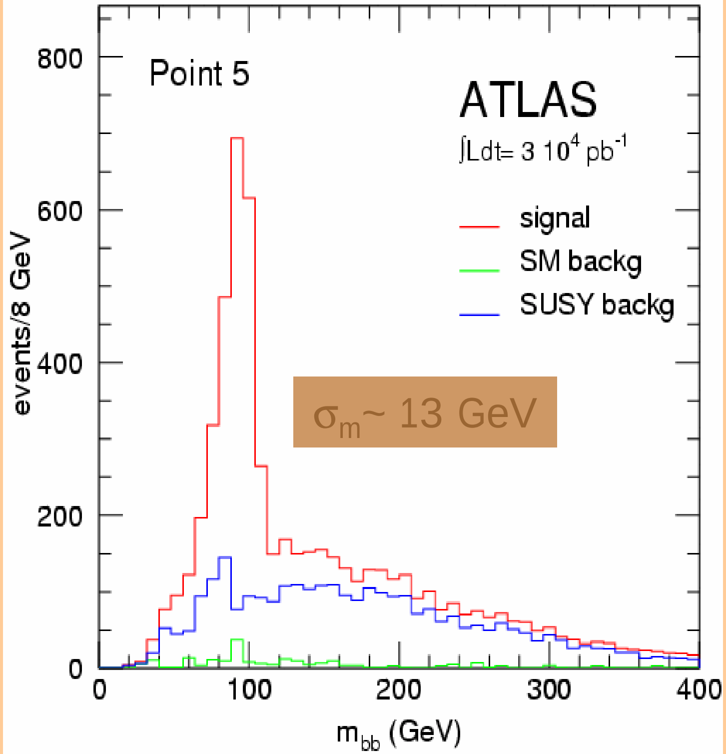
Main source of χ^0_2 : $\tilde{q}_L \to q\chi^0_2$

Reconstruction of h -> $b\bar{b}$

- Event selection (model-independent)
  - MET > 300 GeV
  - 2 b-tagged jets p_T > 50 GeV



After additional cuts (e.g. lepton veto)



- m_h measurement
  - ~ 1% from h → bb (dominated by systematics on b-jet scale)
  - ~ 2‰ from h → γγ (γ scale known to 1‰ but low rate → need 300 fb^{-1})

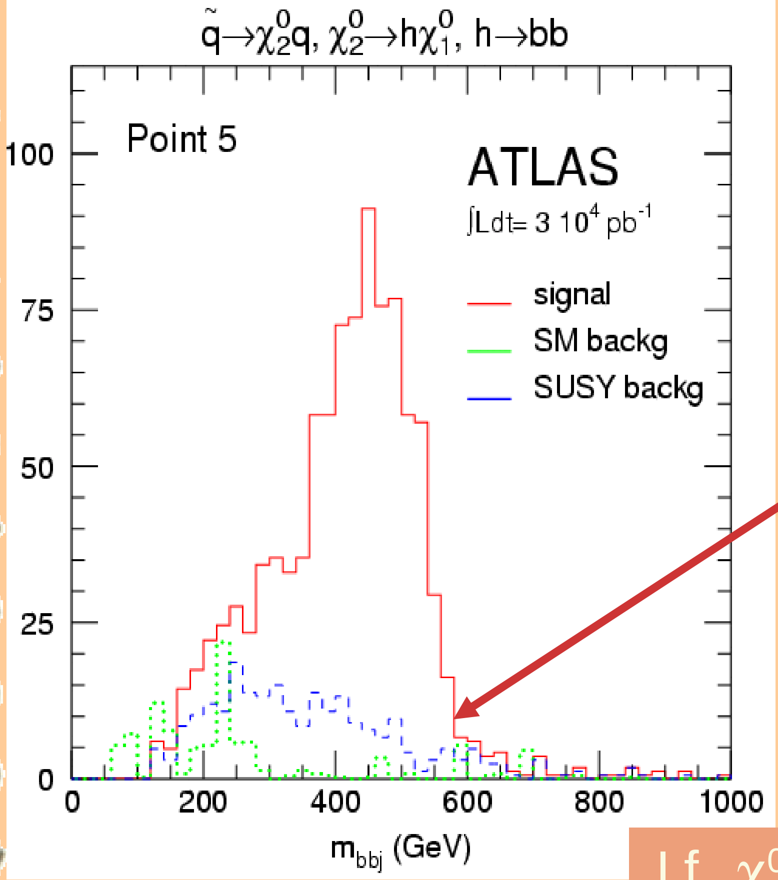
In general, for exclusive channels main background to SUSY is SUSY !

Reconstruction of

$\tilde{q}_L \rightarrow q\ \chi^0_2$
$\quad\hookrightarrow h\ \chi^0_1$
$\quad\quad\hookrightarrow bb$

$m(\tilde{q}_L, \chi^0_2, \chi^0_1) = 690, 232, 121\,\text{GeV}$

$\tilde{q}_L$ from $\tilde{q}_L\tilde{q}, \tilde{q}_L\tilde{g}, \tilde{g}\tilde{g}\ (\tilde{g} \rightarrow \tilde{q}_L q)$ production



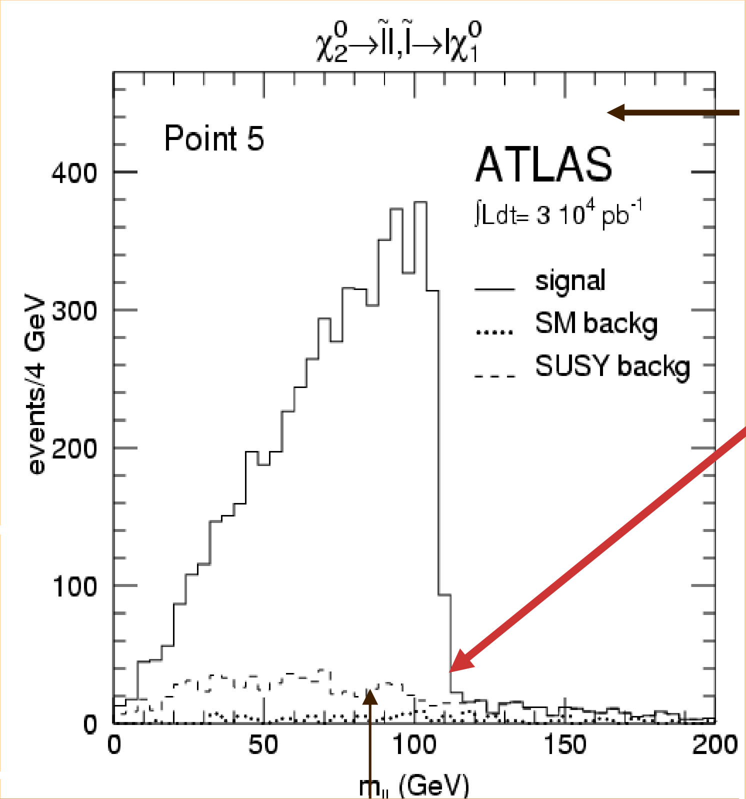
- **Selection**
  - Evts with $m_{bb} = m_h \pm 25$ GeV
  - Form invariant mass of bb pair with 2 hardest final jets
  - Plot minimum 2 m_{bbj} masses
- **End-point**
  - Due to 2-body kinematics
  - Can be measured to $\approx$ 1.5% for 30 fb^{-1}
  - $\rightarrow$ Constraint on combination of $\tilde{q}_L, \chi^0_2, \chi^0_1$ masses

If $\chi^0_{1,2}$ masses known, squark left mass measured to $\pm$ 7 GeV for 300 fb^{-1}

Reconstruction of $\chi^0_2 \rightarrow \tilde{\ell}_R \, \ell$, $\tilde{\ell}_R \rightarrow \ell \, \chi^0_1$

ℓ = e, μ

$m(\chi^0_2, \tilde{\ell}_R, \chi^0_1) = 232, 157, 121$ GeV



Background subtraction using OS-0F pairs $e^+e^- + \mu^+\mu^- - (e^+\mu^- + e^-\mu^+)$

- **Selection**
  - MET > 300 GeV
  - ≥ 2 jets p_T > 150 GeV
  - 2 opposite-sign same-flavour leptons p_T > 10 GeV
- **End-point**
  - Due to 2-body kinematics
  - Can be measured to ≈ 0.5% for 30 fb^{-1}

  → constraint on combination of $\chi^0_2, \tilde{\ell}_R, \chi^0_1$ masses

If $\chi^0_{1,2}$ masses known, slepton right measured to ± 0.5 GeV for 300 fb^{-1}

Reconstruction of $\tilde{q}_L \to q\,\chi^0_2$

$\hookrightarrow \tilde{\ell}_R\,\ell$

$\hookrightarrow \ell\,\chi^0_1$

$m(\tilde{q}_L, \chi^0_2, \tilde{\ell}_R, \chi^0_1) = 690, 232, 157, 121\,\text{GeV}$

$\Delta m(\tilde{q}_L - \chi^0_2) \approx 460\,\text{GeV}$

$\Delta m(\tilde{q}_R - \chi^0_1) \approx 540\,\text{GeV}$

$\Delta m(\tilde{g} - \tilde{q}_L) \approx 80\,\text{GeV}$

hardest jets in event from $\tilde{q}_{L,R}$ decays

$\tilde{q}_L$ produced from
- -- $\tilde{q}_L\,\tilde{q}_L$
- -- $\tilde{q}_L\,\tilde{q}_R$ $(\tilde{q}_R \to q\chi^0_1)$
- -- $\tilde{g}\tilde{g}, \tilde{g}\tilde{q}$ with $\tilde{g} \to \tilde{q}_L\,q$

✓ Cascade study

1. $m(\ell^+\ell^-)$ distribution constrains $m(\chi^0_2)$, $m(\tilde{\ell}_R)$, $m(\chi^0_1)$

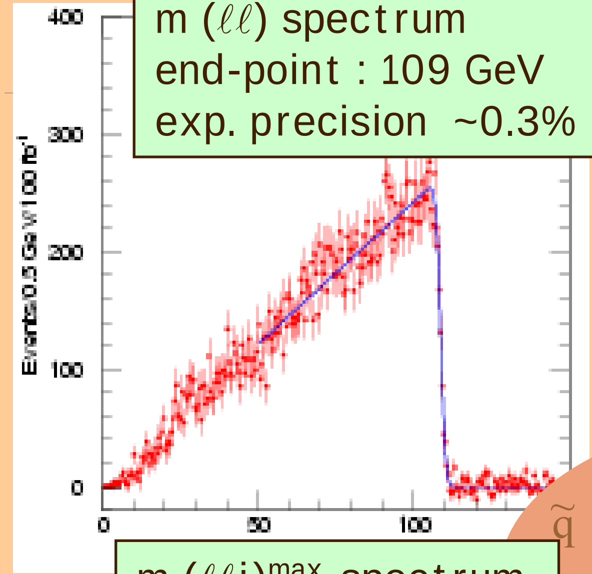
2. Combine $\ell^+\ell^-$ with each of two hardest jets $\to m(\ell^+\ell^- j)$
   - o $m(\ell^+\ell^- j)$ min smaller than end-point of $\tilde{q}_L$ decay chain
   - o $m(\ell^+\ell^- j)$ max larger than “threshold” of $\tilde{q}_L$ decay chain

   $\to$ these mass spectra & edges constrain combination of $m(\tilde{q}_L)$, $m(\chi^0_2)$, $m(\tilde{\ell}_R)$, $m(\chi^0_1)$

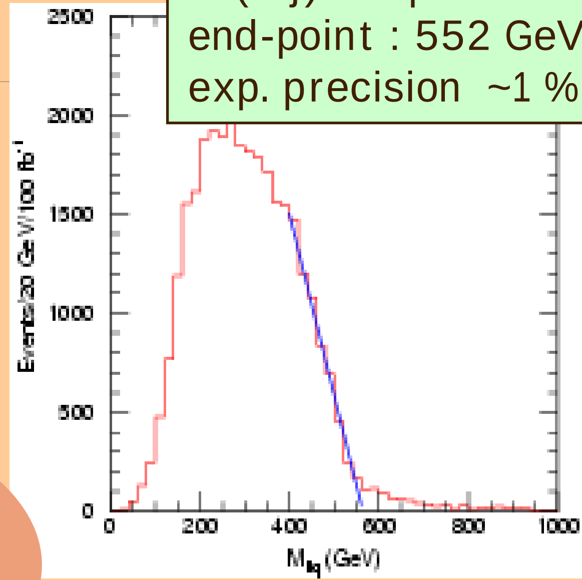
3. For smaller $m(\ell^+\ell^- j)$ combination, plot 2 $m(\ell^\pm j)$ combinations $\to$ distribution constrains (through the “right” combination where ℓ is from χ^0_2) constrains $m(\tilde{q}_L)$, $m(\chi^0_2)$, $m(\tilde{\ell}_R)$

ATLAS
100 fb^{-1}

m ($\ell\ell$) spectrum
end-point : 109 GeV
exp. precision ~0.3%

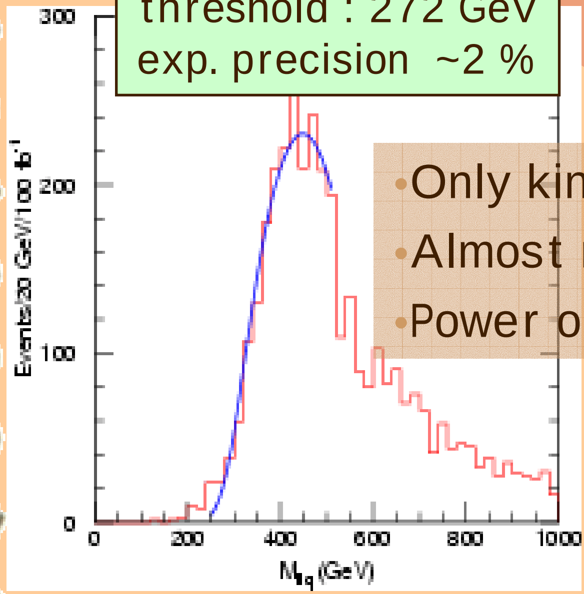


m ($\ell\ell$j)^{min} spectrum
end-point : 552 GeV
exp. precision ~1 %



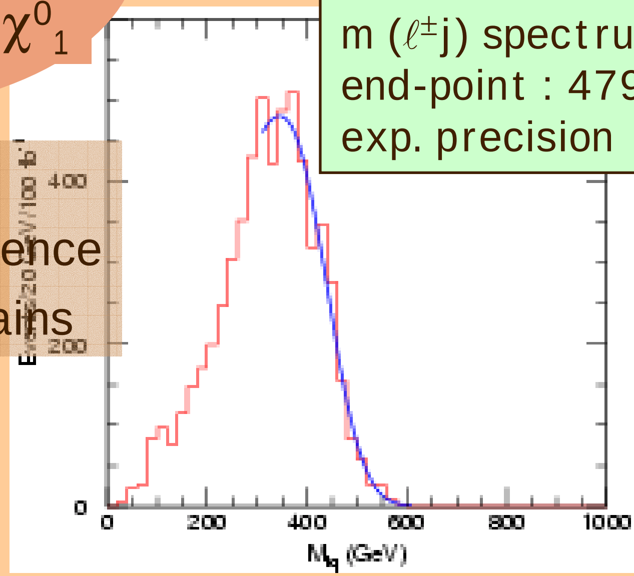
$\tilde{q}_L \to q\,\chi^0_2$
$\tilde{\ell}_R\,\ell$
$\ell\,\chi^0_1$

m ($\ell\ell$j)^{max} spectrum
threshold : 272 GeV
exp. precision ~2 %



- Only kinematic inputs
- Almost no model-dependence
- Power of long decays chains

m ($\ell^{\pm}$j) spectrum
end-point : 479 GeV
exp. precision ~1 %



Reconstruction of $pp \to \tilde{\ell}^+ \tilde{\ell}^- \to \ell\chi^0{}_1\, \ell\chi^0{}_1$

$BR(\tilde{\ell} \to \ell\chi^0{}_1) = 100\%$ $m(\tilde{\ell}_R, \tilde{\ell}_L) = 157{,}240\,GeV$

$\rightarrow$ look for 2 acoplanar leptons and no jet activity

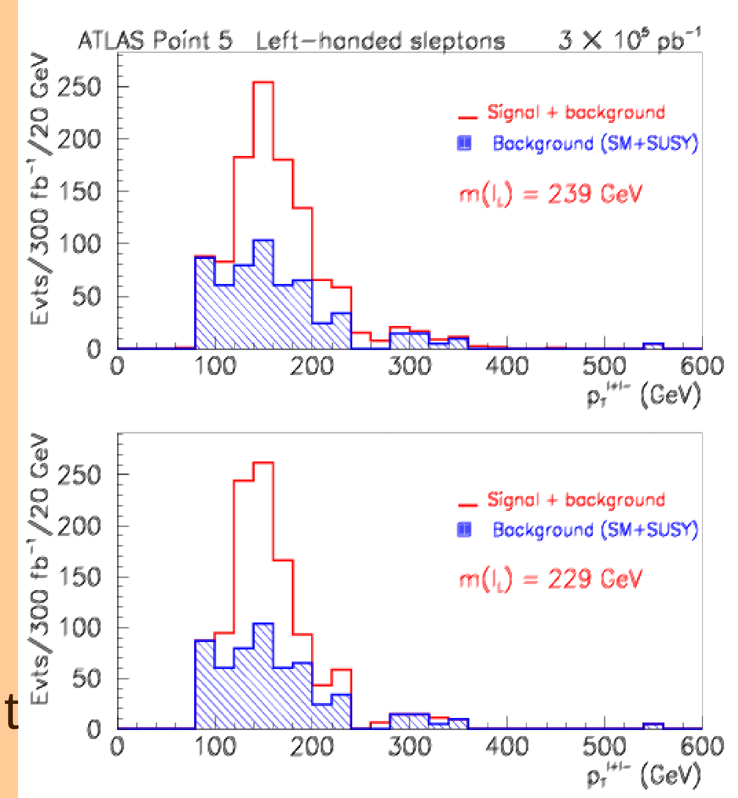
✓ Event selection

Hard cuts kill $\tilde{\ell}_R \tilde{\ell}_R$

- MET > 120 GeV
- 2 OS-SF leptons p_T > 30 GeV
- $\Delta\varphi_{\ell\ell}$ < 2.5 (to reject WW)
- no jets p_T > 40 GeV (to reject tt, SUSY b)

✓ Yield

- S = 600 B = 280 for 300 fb^{-1} $\rightarrow$ need ultimate LHC luminosity
- Lepton-pair p_T-distribution -> constrain on $\tilde{\ell}_L, \chi^1_0$ masses
- If $\chi^0{}_1$ mass known, slepton left mass measured to few GeV



Some remarks

- ✓ Repeated for various set of parameters
  - $m_{1/2}$ to few %, m_0 1 to 25%, tanβ to few %, Sign(μ) OK, A_0 unconstrained
- ✓ Only mass distributions used (cons'tive)
  - Can use x-sections, BR, extra distributions
- ✓ Set of models
  - mSUGRA may be artificially too good
  - Situation easier in GMSB (longer chains)
  - Allow to assess analysis strategies, detector performance

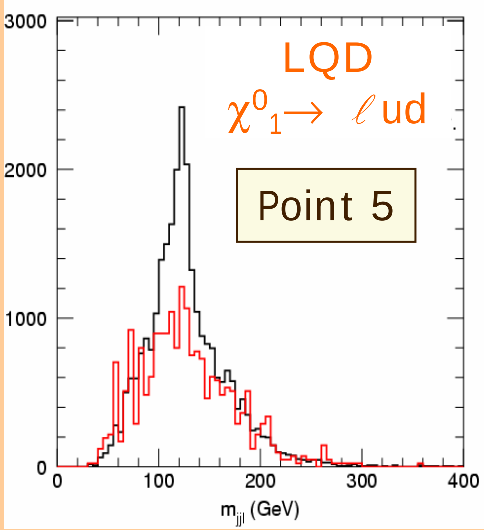
Other

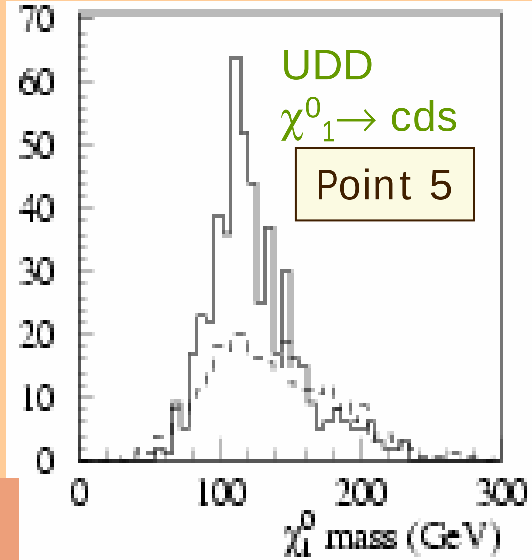
R-parity violating SUSY

✓Here: only χ^0_1 decays violating R-parity

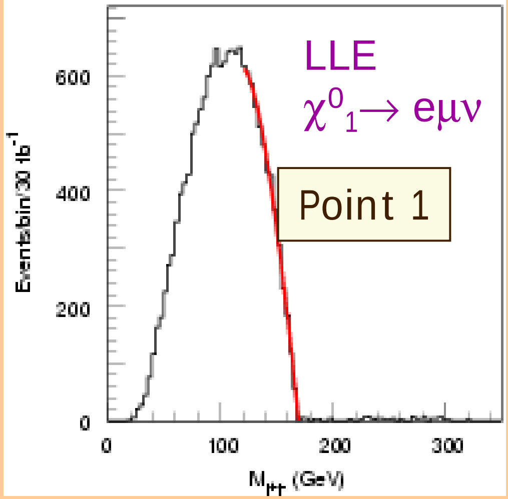
- MET signature lost
- But χ^0_1 mass can be reconstructed in decay chain

•Precision measurements ~ as in R_P-conserved SUGRA





More work needed to optimise $\chi^0_1 \to$ jjj reconstruction (algorithms, etc.) for light masses (~100 GeV)



χ^0_1 measured to (30 fb^{-1})

≈ % UDD

≈ % LQD

≈ ‰ LLE

Gauge Mediated SUSY Breaking

- GMSB $\mathrm{LSP} \equiv \tilde{G}$ escapes detection
- Depends on what is NLSP

$\mathrm{NLSP} \equiv \tilde{\ell} \rightarrow \ell \tilde{G}$

$c\tau \ll L_{det}$ leptons + MET
$c\tau \approx L_{det}$ kinks in inner detector
$c\tau \gg L_{det}$ heavy stable charged particles

$\mathrm{NLSP} \equiv \chi_1^0 \rightarrow \gamma \tilde{G}$

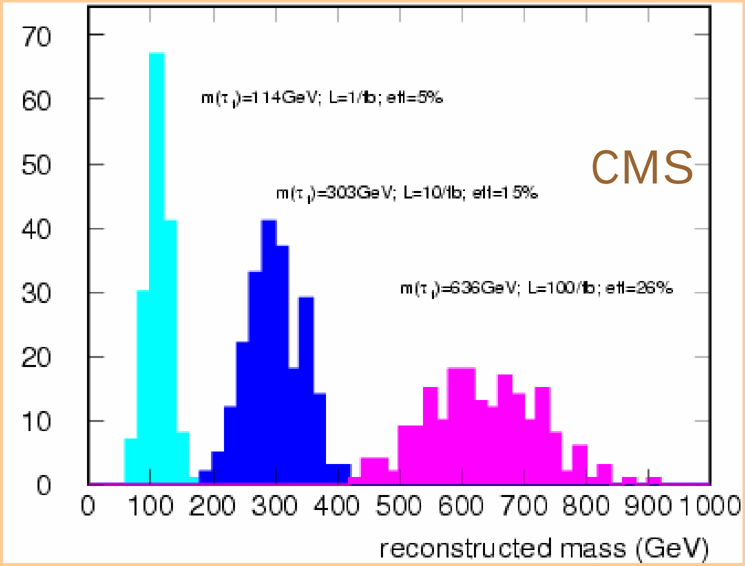
$c\tau \ll L_{det}$ two photons + MET
$c\tau \approx L_{det}$ non-pointing photons
$c\tau \gg L_{det}$ missing E_T

- Usually easier than SUGRA
  - Additional/exotic signatures from NLSP decay
  - Long decay chains

$\rightarrow$ parameters constrained to ~ %

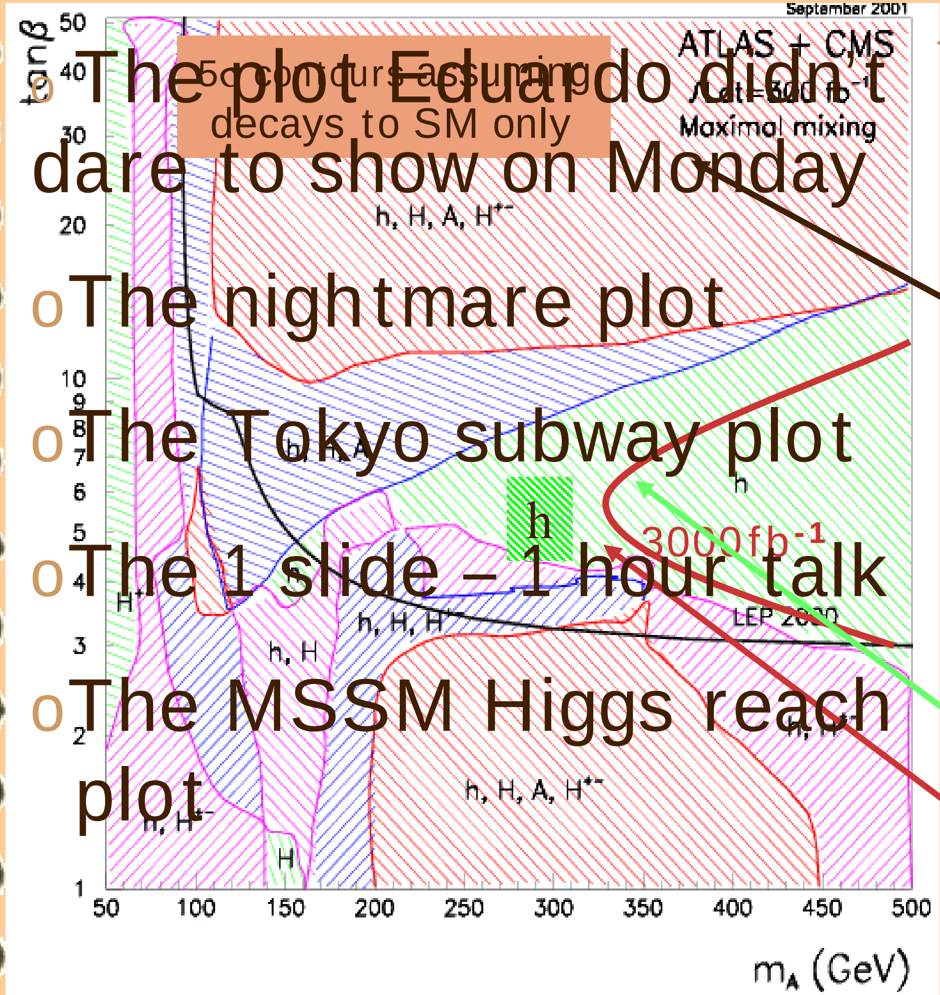
$\mathrm{NLSP} \equiv \tilde{\tau}_1, c\tau \sim 1\,\mathrm{Km}$

Stable, slow ($\beta < 1$) charged particles $\rightarrow$
delayed signal in muon chambers ($\sigma_t \sim 1$ ns)



SUSY Higgs sector (1)

- o The plot Eduardo didn't dare to show on Monday
- o The nightmare plot
- o The Tokyo subway plot
- o The 1 slide – 1 hour talk
- o The MSSM Higgs reach plot



✓ Higgs sector

- 5 states h, A, H, H^{+-}
- Results in $(m_A, \tan\beta)$

H, A $\rightarrow$ $\mu\mu$, $\tau\tau$
$H^{\pm} \rightarrow \tau\nu$, tb

- 4 Higgs observable
- 3 Higgs observable
- 2 Higgs observable
- 1 Higgs observable

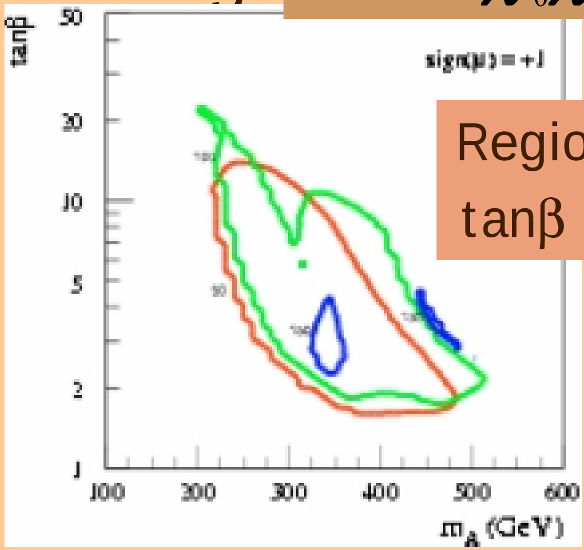
✓ Here only 1 higgs

- SM-like - Problem !
- Zone reduced if SLHC ($3000 fb^{-1}$)

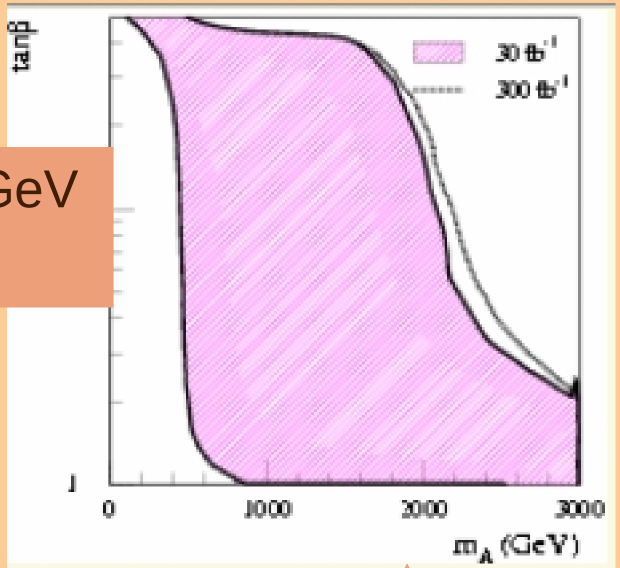
✓ But SUSY !

SUSY Higgs sector (2)

- ✓ Decay into SUSY particles
  - e.g. $H/A \to \tilde{\chi}^2_0 \tilde{\chi}^2_0 \to ll \tilde{\chi}^1_0 ll \tilde{\chi}^1_0$



Region m_A ~200-400 GeV
tanβ ~ 2-20 covered



- ✓ Higgs in SUSY cascade decays
  - E.g. $\tilde{\chi}^2_0 \to h \tilde{\chi}^1_0$ h -> bb
  - No leptons -> no SM

Region m_A > 500 GeV
tanβ > 5 covered
(no sensivity in MSSM)

Prospects (1)

- If SUSY at TeV scale, discovery easy
  - Ultimate reach m(squark, gluino) ~ 2.5 TeV
- Challenge is assessing SUSY
  - Full spectrum & Precision measurements
- Tools have been developped
  - Model-independent searches
  - Analysis techniques
- -> Goal seems reachable
  - Almost granted for h, squarks, gluino

Prospects (2)

- ✓ What LHC cannot do
  - Observing H/A/H^{+-} over full parameter space
  - Observing full gaugino spectrum ($\chi^{\pm}$)
  - Performing measurements to < 1%
- ✓ Complementarity of LHC & Linear Collider