HIGGS and SUSY in ATLAS

- overview on physics prospects -

- Introduction, Detector Aspects
- Standard Model Higgs Search
- Determination of Higgs Parameters
- Higgs Search in the MSSM
- Search for SUSY signals
  - general SUSY signatures
  - Study of SUGRA models
  - Higgs in SUGRA

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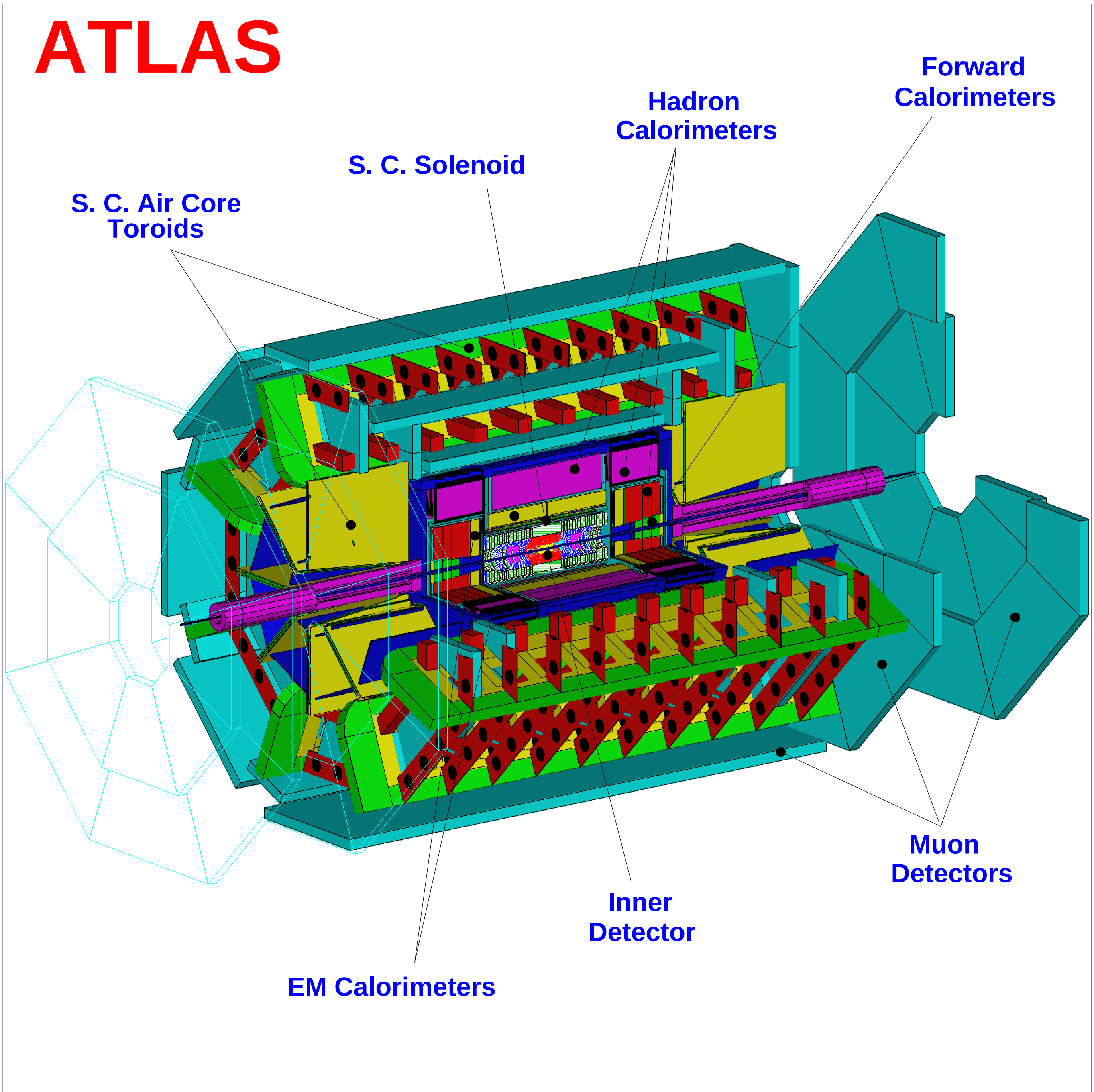
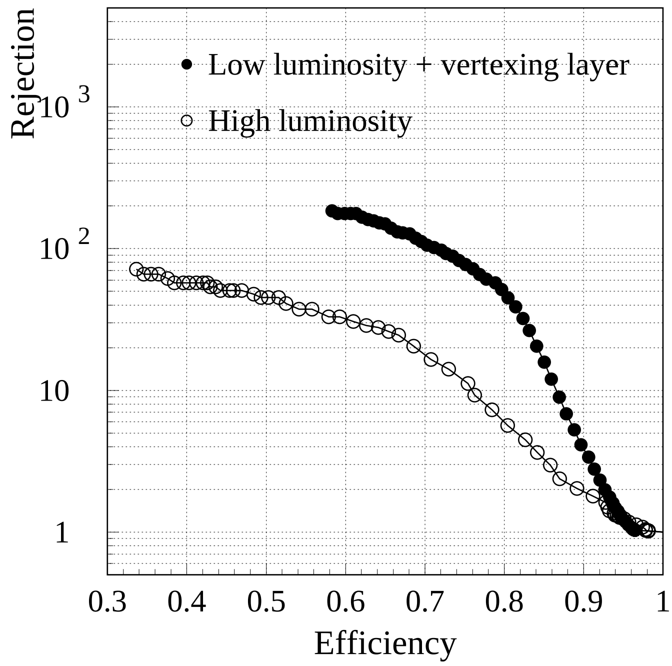
The ATLAS Detector



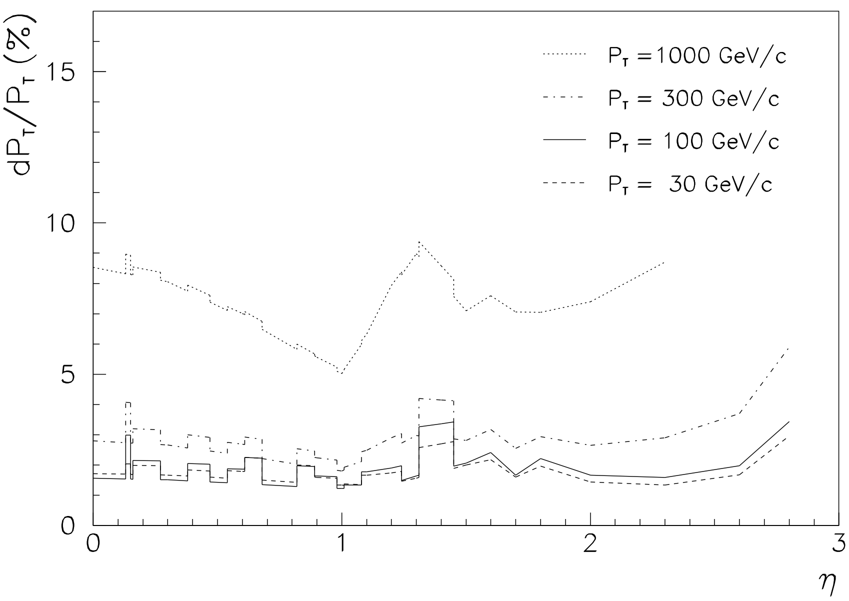
Important Detector Parameters

Detector component	resolution,characteristics	η coverage	
		Measurement	Trigger
e.m. calorimetry	$10\%/\sqrt{E} \oplus 0.7\%$	± 3	± 2.5
Preshower detection	Enhanced γ–π^0 and γ–jet separation, direction measurements, and b-tagging with electrons	± 2.4	
Jet and missing E_T Calorimetry			
barrel and end-cap	$50\%/\sqrt{E} \oplus 3\%$	± 3	± 3
forward	$100\%/\sqrt{E} \oplus 10\%$	$3 < \lvert\eta\rvert < 5$	$3 < \lvert\eta\rvert < 5$
Inner detector	30% at $p_T = 500$ GeV	± 2.5	
	Enhanced electron identification (TRT)	± 2.5	
	b-tagging	± 2.5	
	Secondary vertex detection	± 2.5	
Muon detection	10% at $p_T = 1$ TeV in stand-alone mode at highest luminosity	± 3	± 2.2

b-tagging performance:



Muon resolution, stand alone toroid:



Running Scenarios and Luminosities

starting date: $\sim$ 2005 $\sqrt{s} = 14$ TeV

initial luminosity: $\mathcal{L} = 1.0\ 10^{33}\ \text{cm}^{-2}\ \text{sec}^{-1}$

$\int \mathcal{L}dt \;=\; 10\ fb^{-1}$ per year

$\Rightarrow$ expected period of 3 years

high luminosity: $\mathcal{L} = 1.0\ 10^{34}\ \text{cm}^{-2}\ \text{sec}^{-1}$

$\int \mathcal{L}dt \;=\; 100\ fb^{-1}$ per year

ultimate reach:

$\int \mathcal{L}dt \;=\; 300\ fb^{-1}$ $<$ 10 years

Simulation Framework

- PYTHIA 5.7 Monte Carlo
  SPYTHIA and ISAJET for SUSY studies

- K factors not included

  K-factors are not known for many background processes,

  conservative, as long as $K_{Signal}/\sqrt{K_{Backgr.}} > 1$.

- Higgs branching ratios: HDECAY program

- CTEQ-2 structure function parametrizations

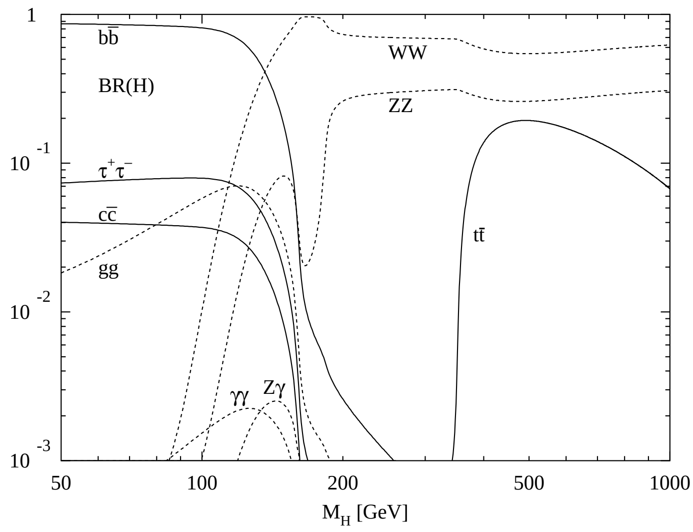
- Detector Simulation

  Many results based on fast detector simulation;

  Critical parameters (mass resolutions, background rejections) determined in full GEANT simulations

  Detector performance has been varified in many test-beam measurements with prototyp modules

Standard Model Higgs decays



Important channels at LHC:

- $H \to \gamma\gamma$
- $WH, t\bar{t}H, \qquad H \to \gamma\gamma,\ H \to b\bar{b}$
- $H \to Z\ Z^{(*)} \to l^+l^-\ l^+l^-$ (*)
- $H \to W\ W^* \to l^+\nu\ l^-\nu$
- $H \to Z\ Z \to l^+l^-\ \nu\bar{\nu}$ (**)
- $H \to Z\ Z \to l^+l^-\ jet\ jet$
- $H \to W\ W \to l\nu\ jet\ jet$

(*) see talk of Th.Trefzger (Tuesday 3:40 pm) for details
(**) see talk of D.Costanzo (Monday 4:20 pm) for details

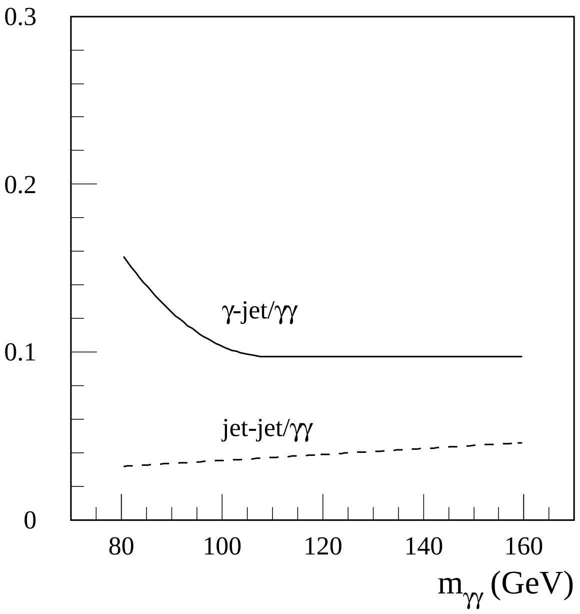
$H \to \gamma\gamma$

Signal — $\sigma Br = 43$ fb ($m_H = 100$ GeV)

$\gamma\gamma$- background (irreducible) — $\frac{d\sigma}{dm_{\gamma\gamma}} \sim 1200$ fb/GeV ($m_{\gamma\gamma} = 100$ GeV)

QCD Jet background (reducible) — $\frac{\sigma_{\gamma,jet}}{\sigma_{\gamma\gamma}} \sim 1000$, $\frac{\sigma_{jet,jet}}{\sigma_{\gamma\gamma}} \sim 2 \cdot 10^6$

Background rejection study:



- based on 10^6 fully simulated jet events
- P_T >20 GeV: jet rejection $\sim 10^3$ (isolation, had. leakage, shower profile)
- add. π^0 rejection with first calo. sampling, fine η segmentation

QCD background at the level of 10% of the $\gamma\gamma$ continuum background

$\gamma\gamma$ Mass Resolution

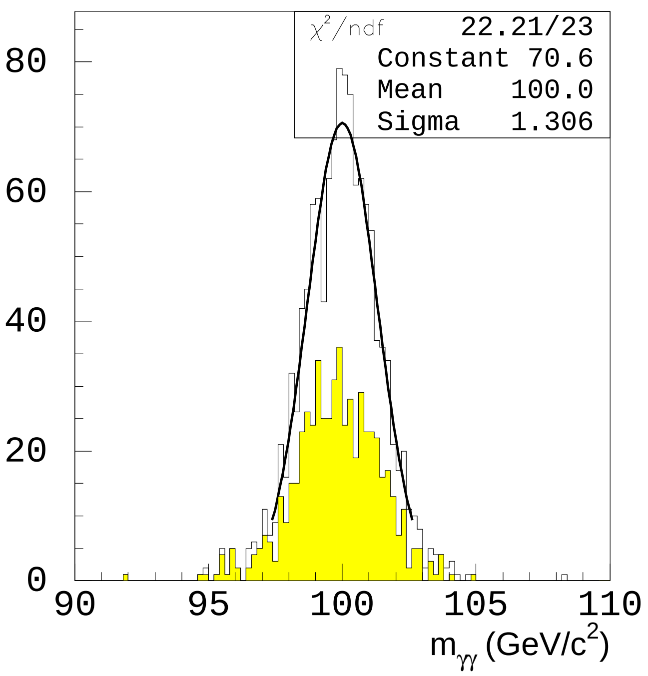
Mass resolution depends on:

(i) Energy resolution
angular resolution (due to vertex spread)

$$\frac{\sigma_M}{M} = \frac{1}{2}\left(\frac{\sigma_{E_1}}{E_1} \oplus \frac{\sigma_{E_2}}{E_2} \oplus \frac{\sigma_\Theta}{\tan\theta/2}\right)$$

(ii) Degradation of performance due to detector material (conversions...)

Energy resolution	low L	$\frac{10\%}{\sqrt{E}} \oplus 0.5\% \oplus \frac{0.200}{E}$
	high L	$\frac{10\%}{\sqrt{E}} \oplus 0.5\% \oplus \frac{0.350}{E}$
cluster size		0.075×0.175
angular resolution		40 mrad / $\sqrt{E}$ first 2 comp.
γ efficiency		80 % incl. conversions



mass resolution from full simulation:

$\sigma_m = 1.31$ GeV

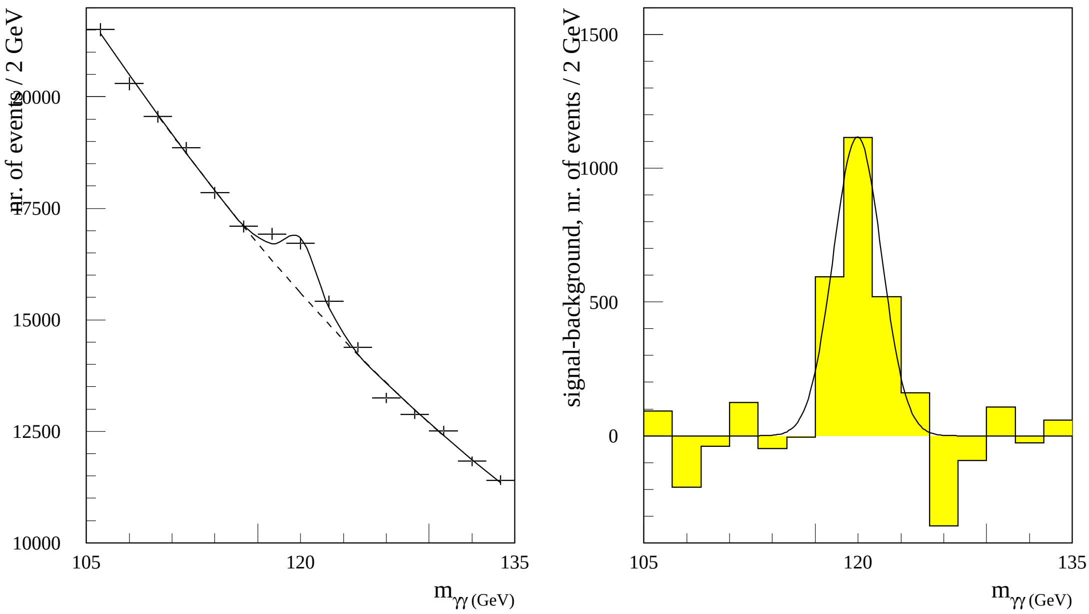
for $m_H = 100$ GeV

unconverted and converted (shaded) γ's

$H \to \gamma\gamma$ Signals

Analysis cuts:

- Two isolated photons
  $P_T^1 > 40$ GeV and $P_T^2 > 25$ GeV, $|\,\eta\,| < 2.5$
- exclude barrel - endcap transition region
  $1.42 < |\,\eta\,| < 1.57$



Signal significance: 100 fb^{-1}

m_H (GeV)	100	120	140
Signal events	960	1200	930
$\gamma\gamma$ background	44700	30300	20800
γ-jet, jet-jet background	6700	4400	3900
Stat. significance	4.7 σ	6.9 σ	6.3 σ

Associated Production

$WH \to \gamma\gamma\ l$

$t\bar{t}H \to \gamma\gamma\ l$

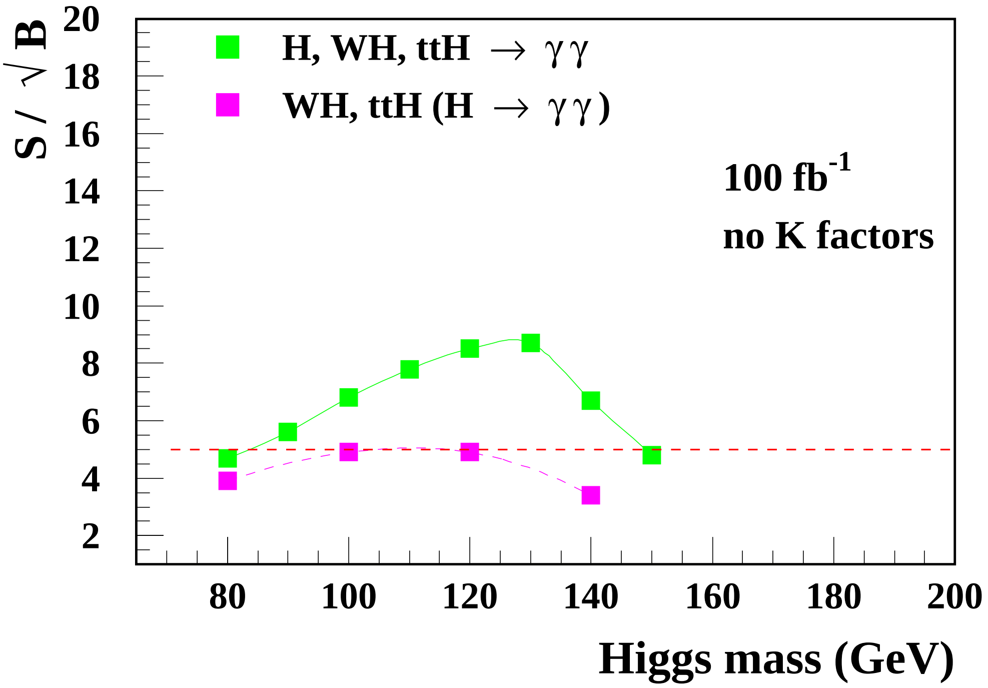
- additional lepton, ⇒ improved S/B ratio
- however low rates:

  Example: $m_H = 100$ GeV, $\int \mathcal{L}dt = 100\ fb^{-1}$

Expected signal:	15.6 events
background:	6.6 events
Stat. significance (Poisson):	4.9 σ

- irreducible background ($W\gamma\gamma$, $Z\gamma\gamma$, $t\bar{t}\gamma\gamma$) dominant

⇒ additional confirmation of a low mass Higgs signal



Additional Channels for a low mass Higgs?

$t\bar{t}H, \ \ H \rightarrow b\bar{b}$

$$t\bar{t}\ H \ \rightarrow \ Wb\, W\bar{b} \ \ b\bar{b} \ \rightarrow \ l\nu b \quad q\bar{q}\bar{b} \ \ b\bar{b}$$

- Isolated Lepton: (provides the trigger)
  Electrons: $P_T > 20$ GeV , $\mid \eta \mid < 2.5$
  Muon : $P_T > 6$ GeV , $\mid \eta \mid < 2.5$

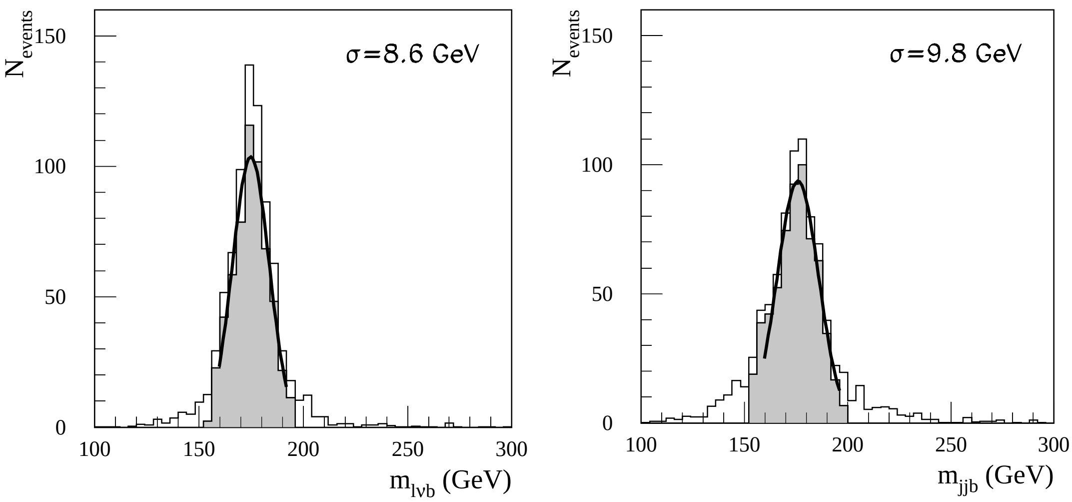
- Full reconstruction of the top quarks

  require: 4 tagged b jets, $P_T > 15 GeV$, $\mid \eta \mid < 2.5$
  2 non-b jets, $P_T > 15 GeV$, $\mid \eta \mid < 2.5$

  reconstruct both W's from the $q\bar{q}$ and $l - P_T^{miss}$-system, use W-mass constraint in case of neutrino

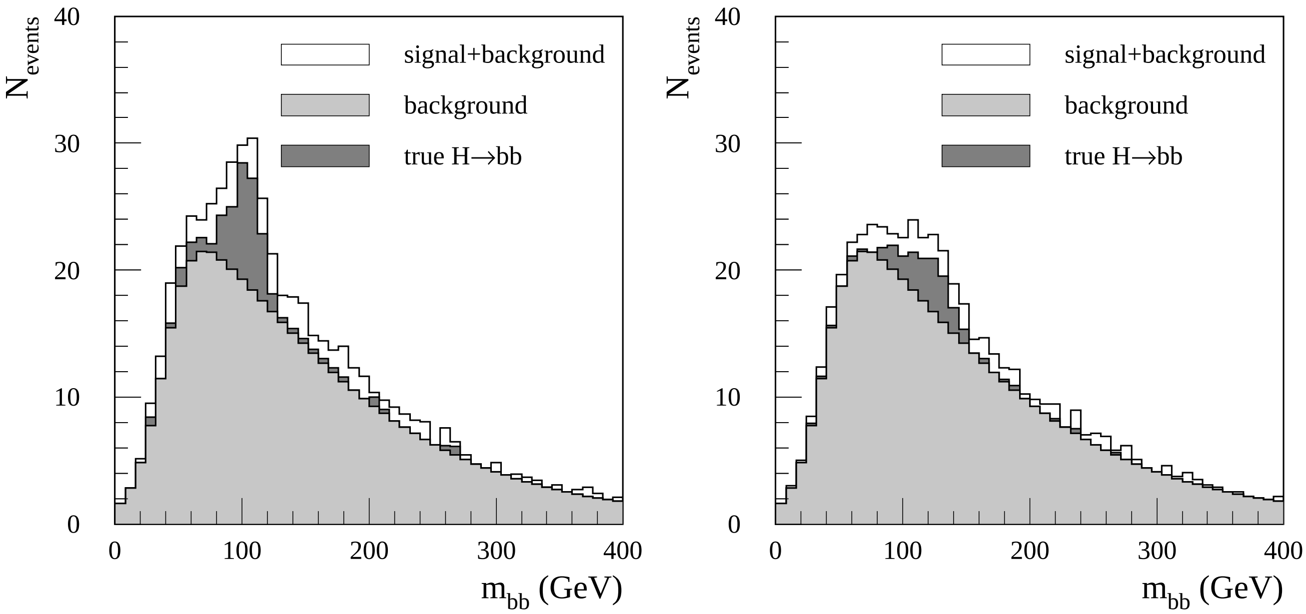
- Pair two b-jets with the two W's
  select that pairing that minimizes
  $$\chi^2 \ = \ (M_{qqb} - M_{top})^2 \ + \ (M_{l\nu b} - M_{top})^2$$

- require both rec. top masses to be in a window of $m_{top} \pm 2\sigma_m$



top reconstruction efficiency: $\sim 50\%$

reconstructed $b\bar{b}$-mass distribution



Expected Rates for 30 fb^{-1}

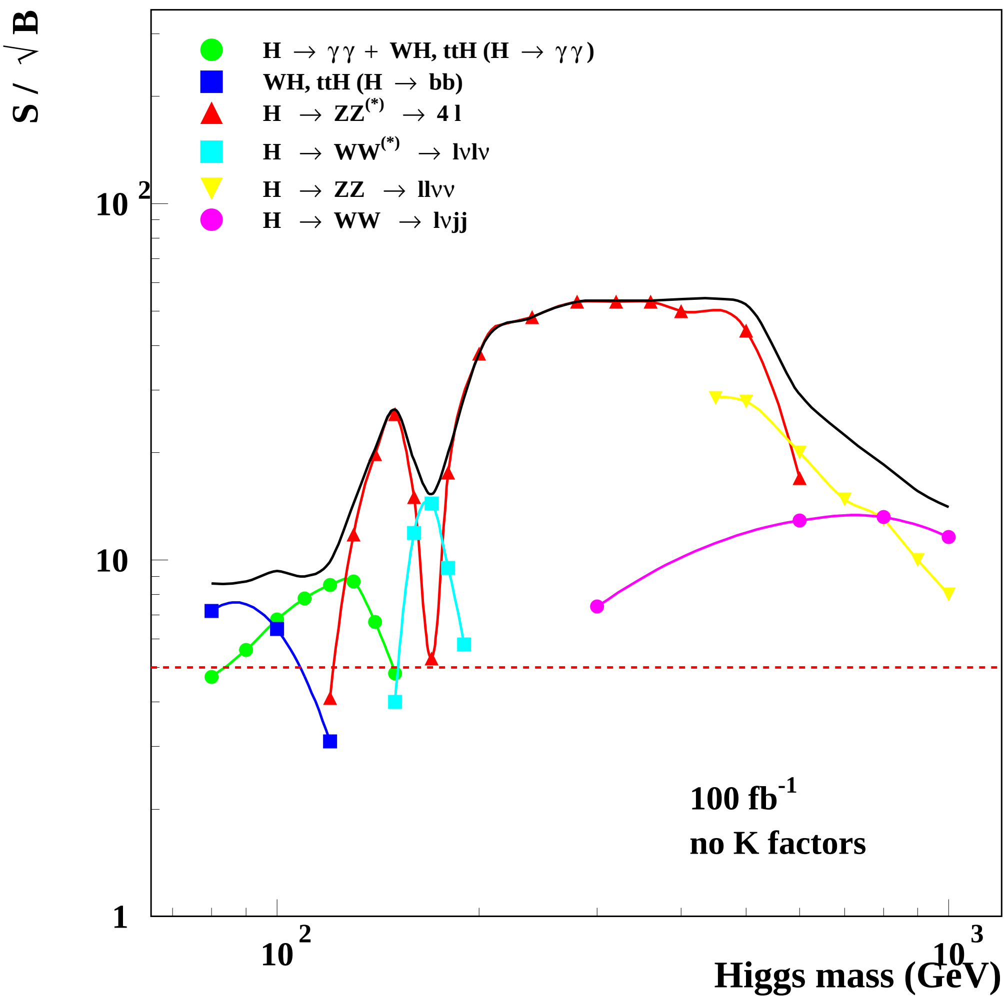
m_H (GeV)	80	100	120
Signal events	80	60	40
total background ($t\bar{t}jj$, ...)	145	150	130
Stat. sign. 30 fb^{-1}	6.7σ	5.0σ	3.6σ
Stat. sign. 100 fb^{-1}	7.2σ	6.4σ	3.1σ

Conclusion:

- Signal extraction in low mass region looks possible
- Good b-tagging is essential
- Knowledge of the background shape is important at low mass
  (dominant background is $t\bar{t}jj \Leftarrow$ input from top analysis)

Summary of the Standard Model Higgs Search

Scenario after 100 fb^{-1}:

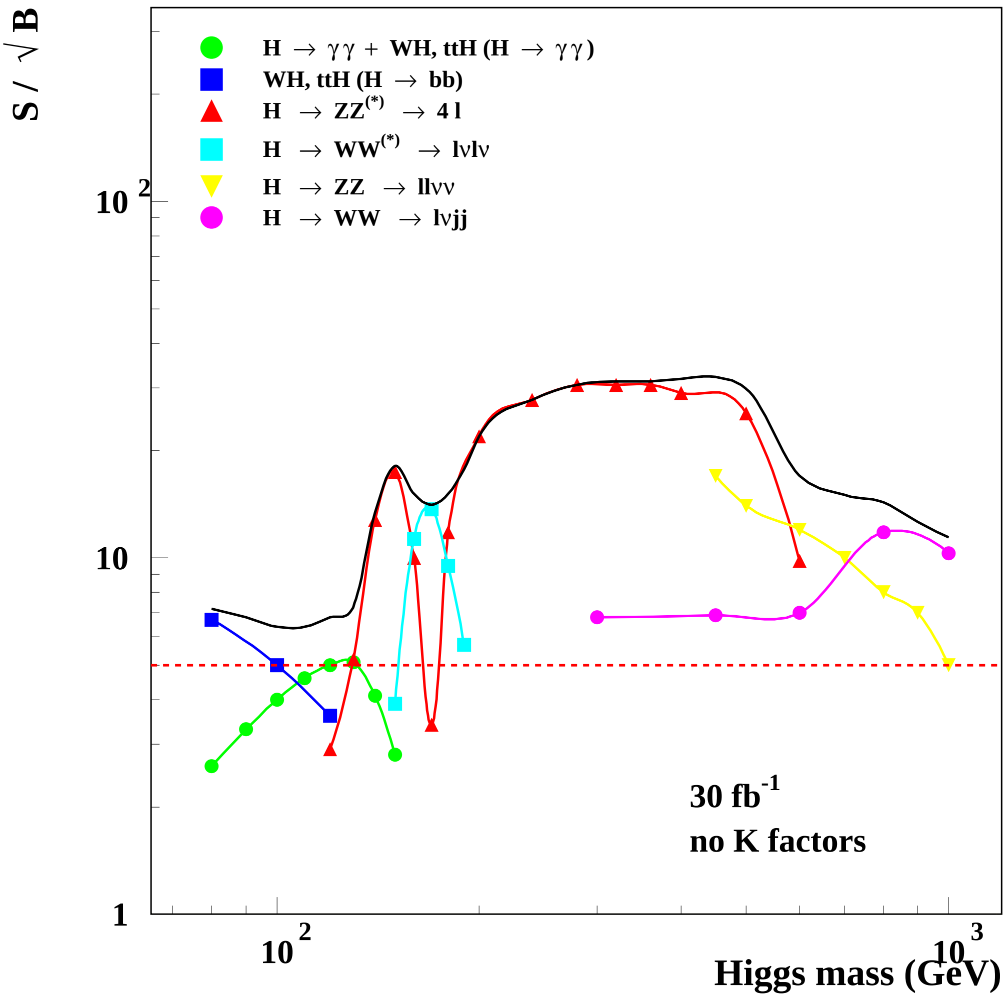


- ATLAS has a good sensitivity over the full mass range from 90 GeV to ∼ 1 TeV

- In most of the mass range two channels are available

Summary of the Standard Model Higgs Search

Scenario after 30 fb^{-1}:



- The full mass range can already be covered by ATLAS after running three years at low luminosity

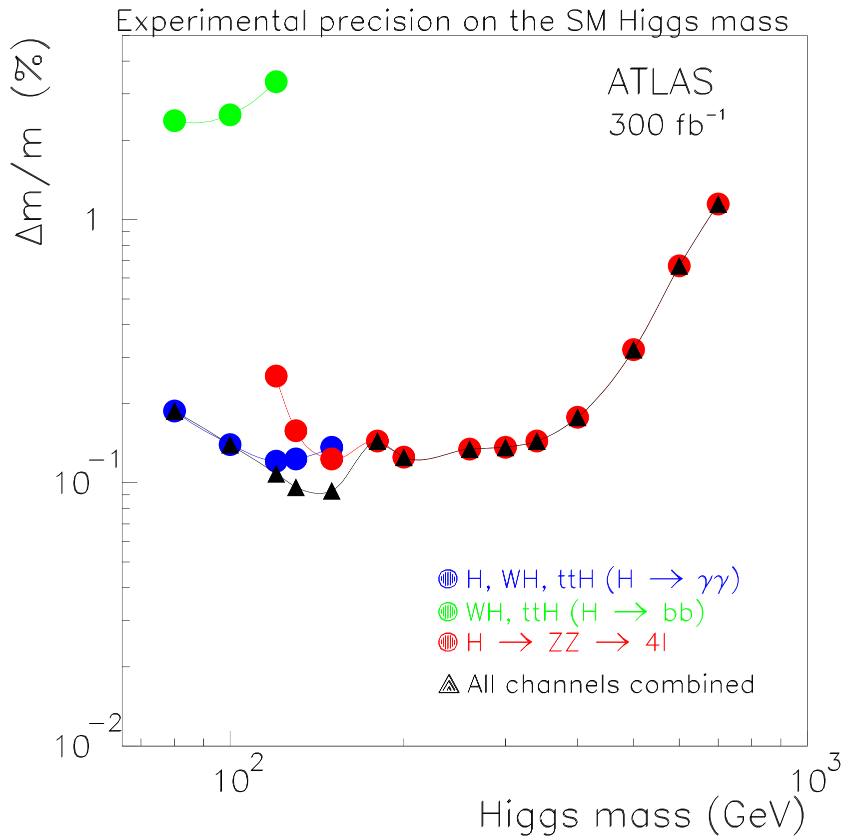
Determination of Higgs Parameters

Mass, width, rates, branching ratios,......

- combine the information from the various channels
- errors considered:
  - statistical errors
  - errors on the background subtraction
  - systematic error on absolute energy scale,

    assumed uncertainty:
    $\pm 0.1\%$ for lepton/photon channels (conservative)
    $\pm 1.0\%$ for hadronic channels
  - systematic error on the momentum resolution
    (based on calibration with Z events)

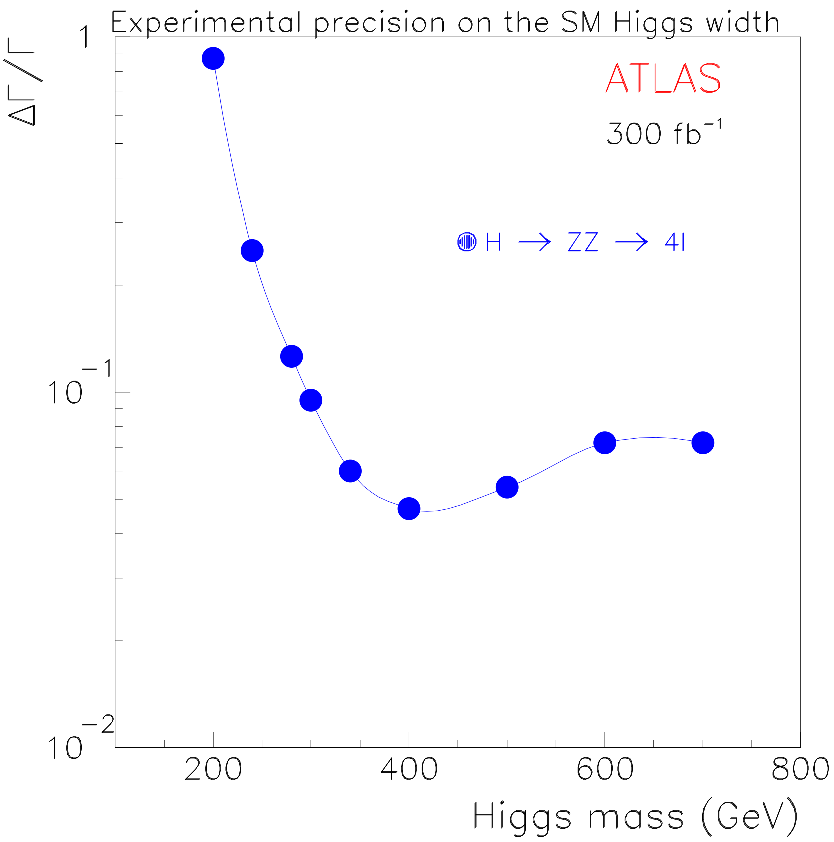
Precision on the Higgs mass:



- Higgs mass can be measured with a precision of 0.1% up to masses of ∼400 GeV
- still at the level of ± 1% at 700 GeV
- no theoretical errors taken into account (mass shifts due to interference effects between resonant and non-resonant production)
- uncertainty from structure functions is expected to be small

Precision on the Higgs width:

- exp. measurement of width of Higgs signal;
  unfold detector resolution $\Rightarrow \Gamma_{Higgs} \pm \Delta\Gamma_{Higgs}$
- measurement only possible if $\Gamma_{Higgs} \sim \Gamma_{exp.}$,
  i.e. $m_H > 200$ GeV

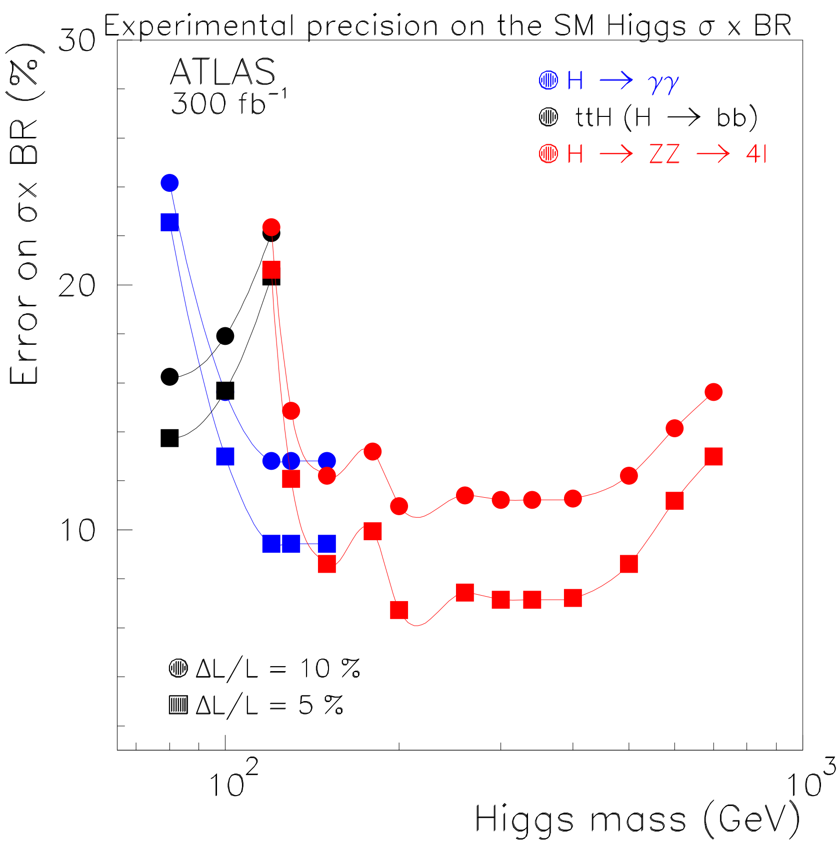


main uncertainties:

- energy/momentum resolution
- uncertainties due to radiative decays of the Z (calibration of the resolution function using Z decays, $\pm 1.5\%$)

Higgs rates and branching ratios:

- deduce $\sigma \cdot Br$ from measured signal rates
- main uncertainty: absolute error on the luminosity
  LHC goal: $\pm 5\%$
- assume an add. uncertainty of $\pm 10\%$ on the background subtraction



- uncertainty on $\sigma \cdot Br$ is at the level of $\pm 7\%$ over a large mass range, if 5% uncertainty on the luminosity can be achieved

work ongoing on: branching ratios, spin .....

The supersymmetric Higgs sector

5 Higgs particles: h, H, A
H^+,H^-

The MSSM Higgs sector is determined by two parameters: generally chosen to be: m_A, $\tan\beta$

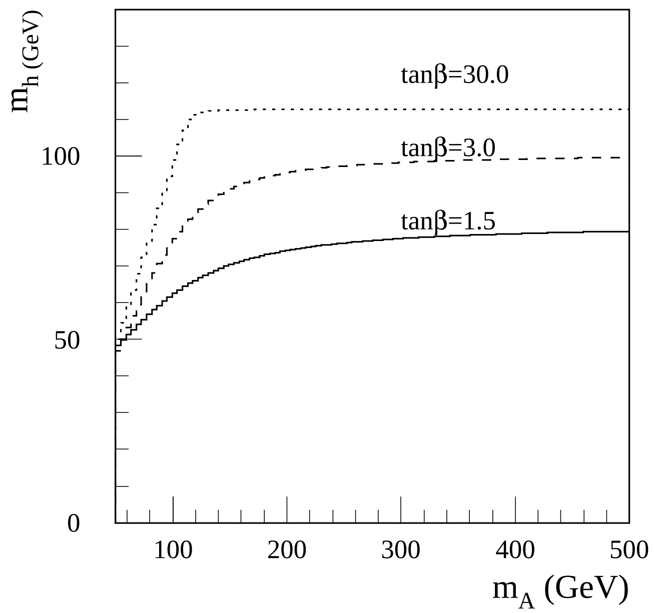
tree level mass relations are significantly modified by radiative corrections

LEP/LHC interest: upper mass bound for the lightes SUSY higgs:

$m_h < 115$ GeV   for $A_t = 0$

i.e. no mixing scenario, conservative assumption for LHC

dependence on m_A and $\tan\beta$:



accessible at LHC through the $\gamma\gamma$ and $b\bar{b}$ (associated production) decay mode.

ATLAS studies of the MSSM Higgs sector concentrate on two scenarios:

1. SUSY particle masses are large, $m_{SUSY} = 1$ TeV,
   Higgs boson decays to SUSY particles are kinematically forbidden

2. Studies in the framework of SUGRA models

   - SUSY particles are light and appear in Higgs decays, competing with SM decay modes

   - Light Higgs particles appear in decays of SUSY particles
     Search for the $h \to b\bar{b}$ decay

     later: after SUSY discussion

Important Channels in the MSSM Higgs search

- The Standard Model decay channels
  - $h \rightarrow \gamma\gamma$
  - $h \rightarrow b\bar{b}$
  - $H \rightarrow ZZ^{*} \rightarrow l^{+}l^{-}l^{+}l^{-}$

  ($\gamma\gamma$ and $ZZ*$ decay modes are suppressed w.r.t. SM)

  evaluation of performace based on SM results

- Modes strongly enhanced at large $\tan\beta$:
  - $H/A \rightarrow \tau^{+}\tau^{-}$
  - $H/A \rightarrow \mu^{+}\mu^{-}$

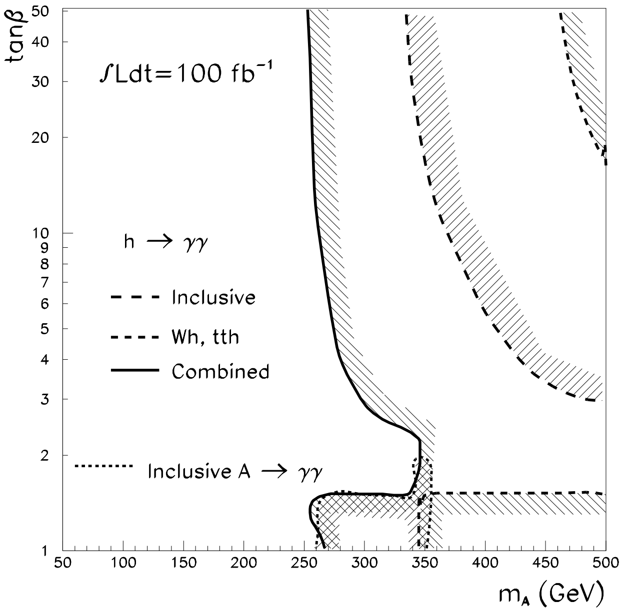
- Other interesting channels:
  - $H/A \rightarrow t\bar{t}$
  - $H/A \rightarrow Zh \rightarrow l^{+}l^{-}\ \gamma\gamma$
    $\rightarrow l^{+}l^{-}\ b\bar{b}$
  - $H \rightarrow hh$
  - $t \rightarrow H^{+}b, \quad H^{+} \rightarrow \tau\nu$

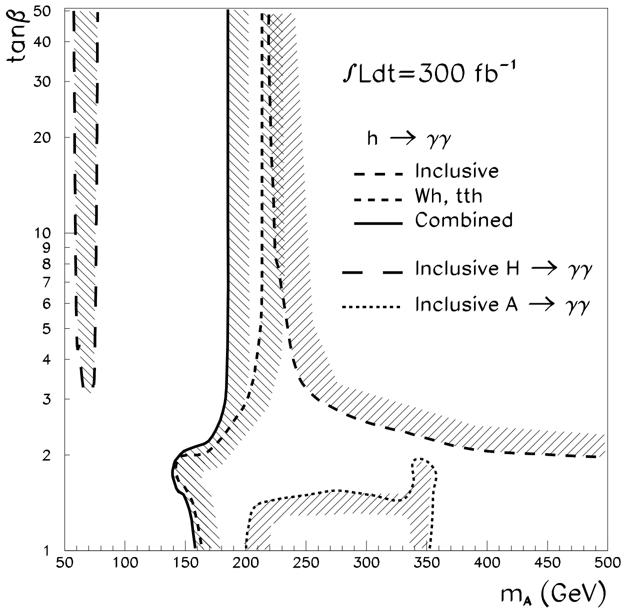
assume: $m_{SUSY} = 1$ TeV
$m_{top} = 175$ GeV
$A_t = 0.$ (pessimistic for LHC)

i.e. no mixing, SUSY particles do not appear in Higgs decays

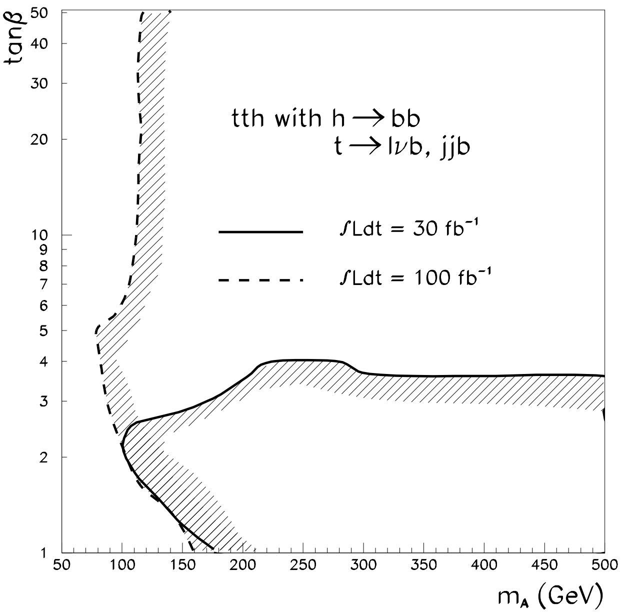
The three main channels

$h \to \gamma\gamma$

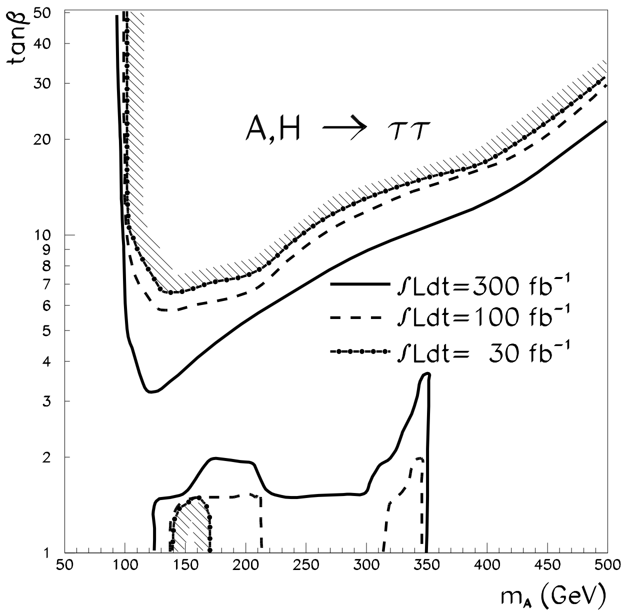




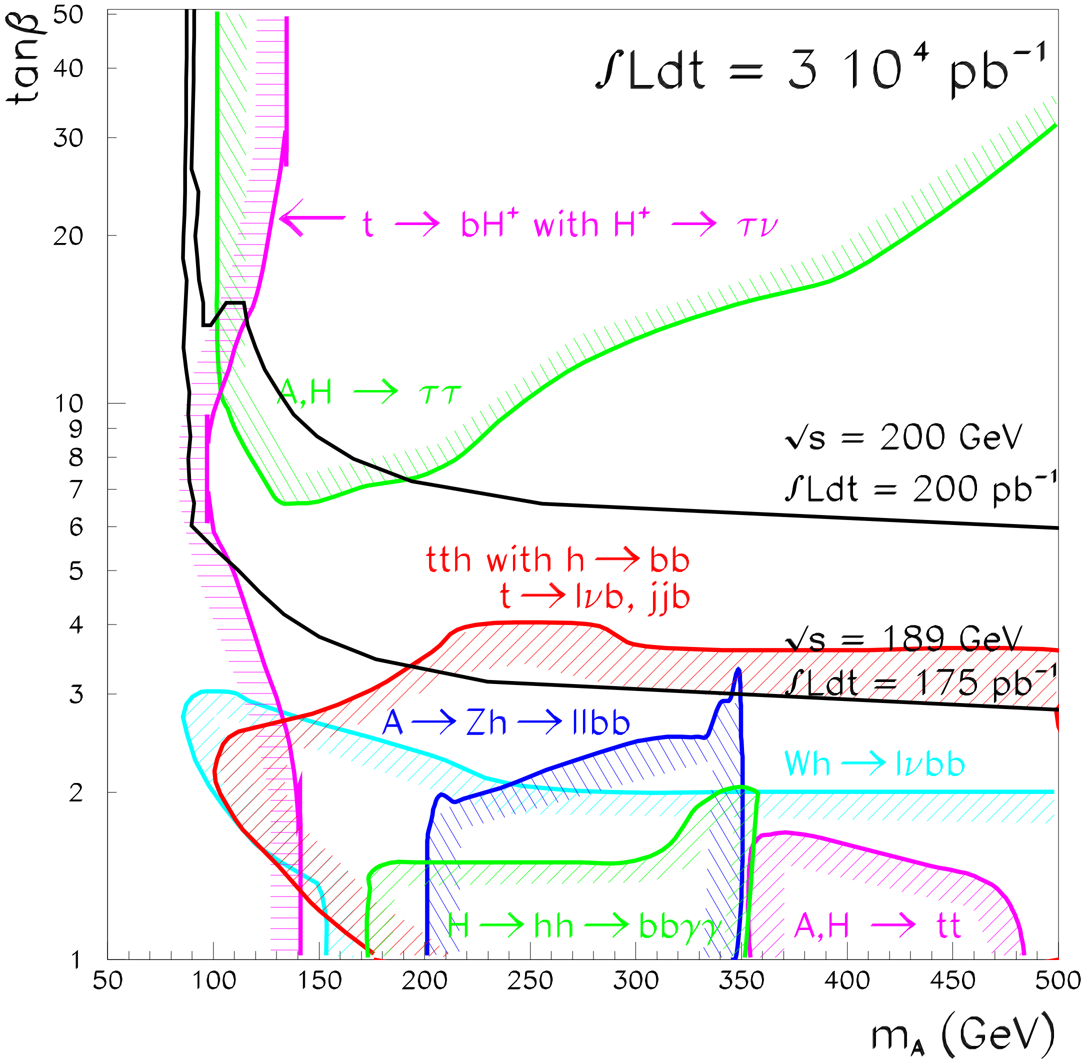
$t\bar{t}h, h \to b\bar{b}$



$A, H \to \tau\tau$

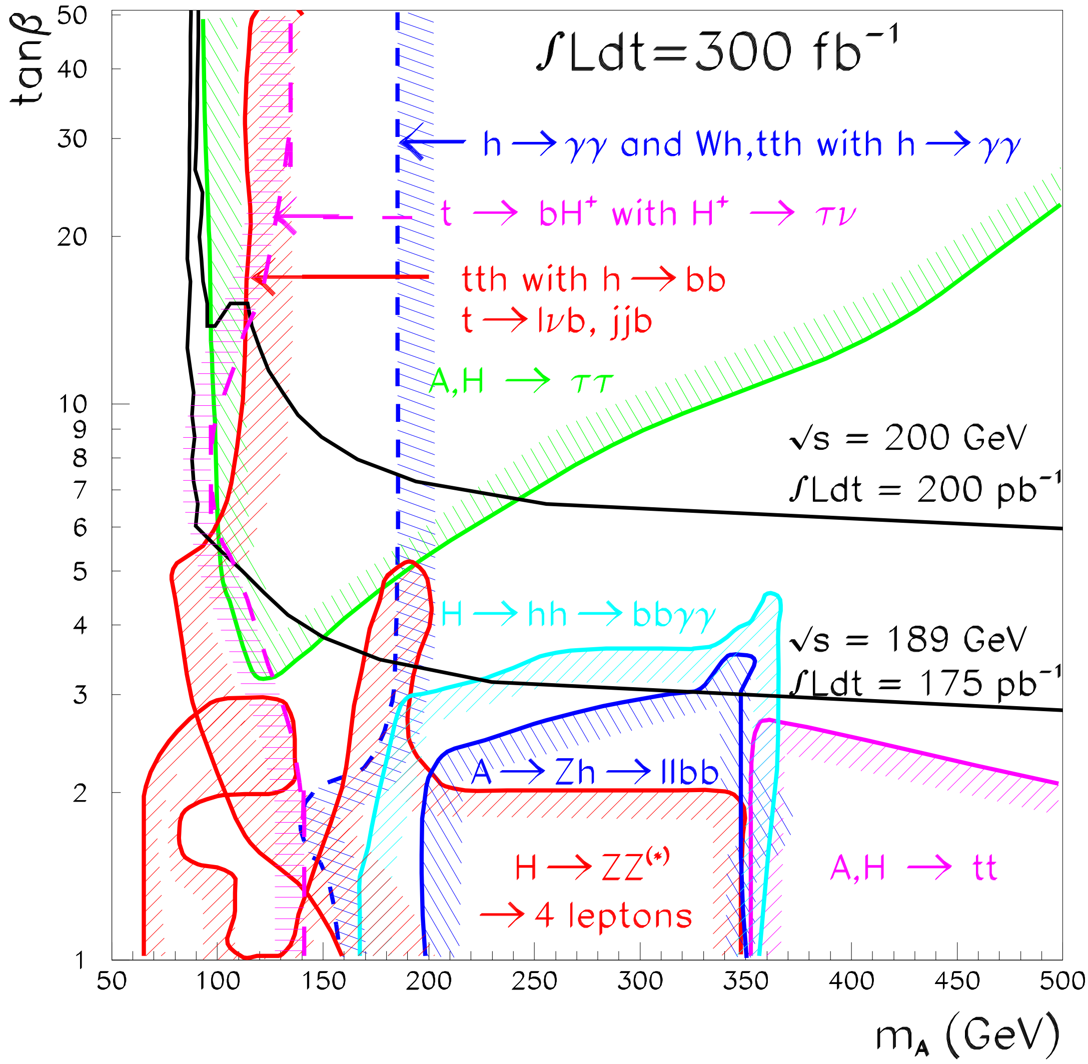


Summary of the MSSM Higgs Search



after 3 years at low luminosity: ~80% of the parameter space can be covered

Summary of the MSSM Higgs Search



- Full parameter space covered, SM and MSSM can be distinguished for almost all cases

- Most part of the parameter space covered by at least two channels, except low m_A region (covered by LEP200)

- if h discovered at LEP200: $\Rightarrow$ heavy Higgs bosons (A/H) should be observable at LHC for $m_A <\sim 2\ m_{top}$

- if A,h discovered at LEP200:
  the charged Higgs should be seen at LHC

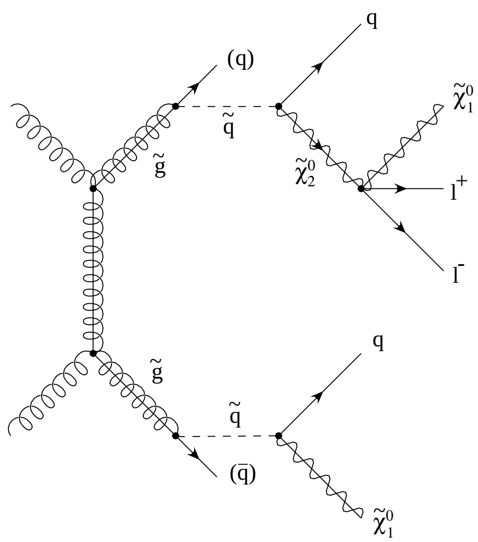
- Discovery of heavy Higgses ($m_A > 500$ GeV) seems to be difficult ($t\bar{t}$ decay mode)

The Search for SUSY

- If SUSY exists at the electroweak scale, a discovery at LHC should be easy

- Gluinos and squarks are strongly produced.

  They decay through cascades to the lightest SUSY particle $\tilde{\chi}_1^0$
  $\Rightarrow$ combination of Jets, Leptons, E_T^{miss}



- 1.Step:
  Look for deviations from the Standard Model
  Example: Multijet + E_T^{miss}-Signature

- 2. Step:
  Establish SUSY mass scale, use inclusive variables
  Example: effective mass distribution

- 3. Step:
  Determine Model parameters

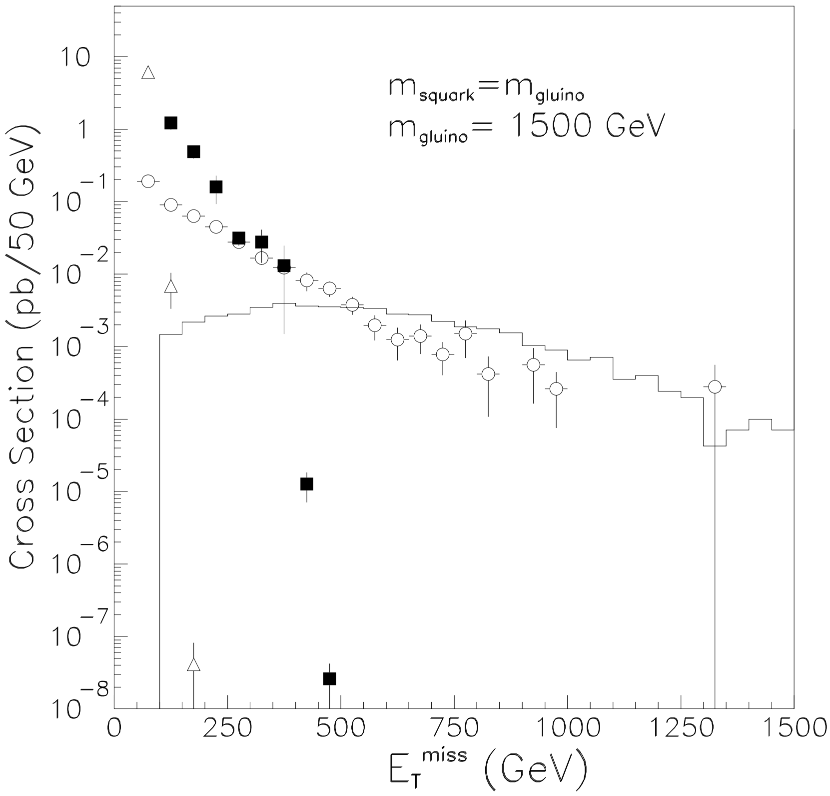
Squarks and Gluinos

Experimental signature:

Several jets with large transv. momentum
missing transverse energy

background:

top production
W + Jet- , Z + jet-production



	$\int \mathcal{L} dt \;=$
$m_{\tilde{q}} = 2\ m_{\tilde{g}}$	1050
$m_{\tilde{q}} \sim m_{\tilde{g}}$	1800
$m_{\tilde{q}} = m_{\tilde{g}}\ /\ 2$	2600

SUSY Mass scale

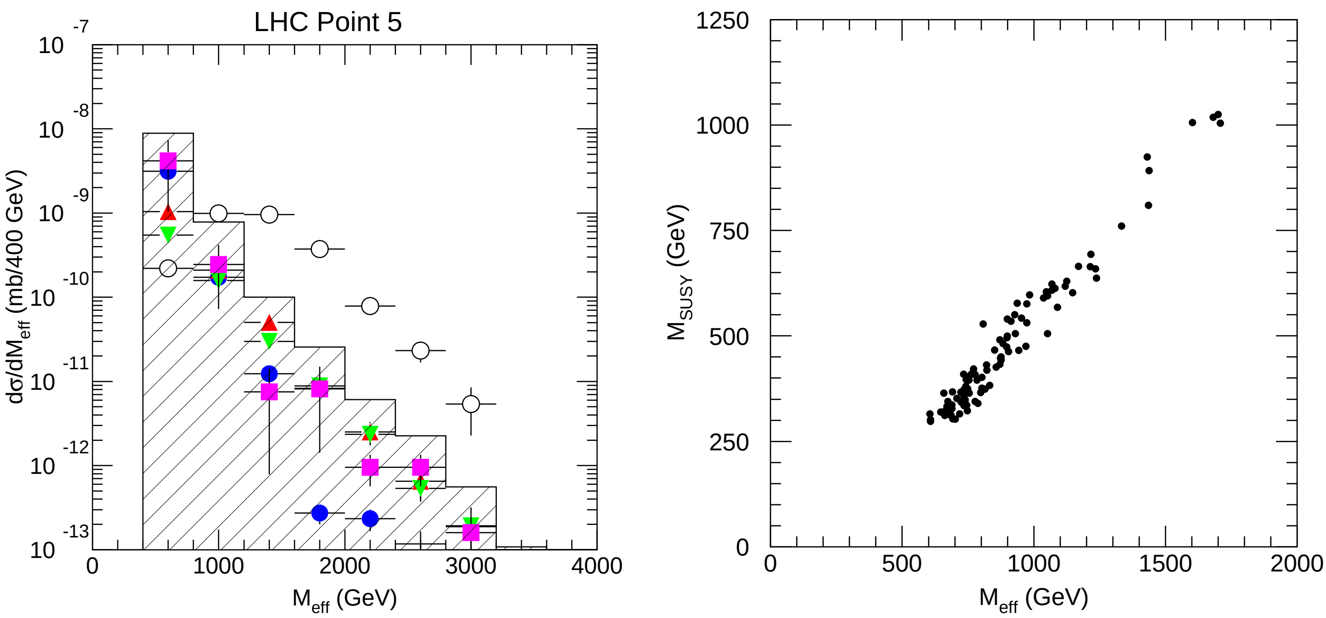
Simple experimental cuts:

- $E_T^{miss} > \min(100 \text{ GeV}, 0.2\ M_{eff})$
- At least 4 jets with $E_T > 50$ GeV and $P_T^1 > 100$ GeV
- Transverse sphericity $S_T > 0.2$
- No μ or isolated e with $P_T > 20$ GeV and $|\,\eta\,| < 2.5$

define effective mass:

$$M_{eff} = E_T^{miss} + P_T^1 + P_T^2 + P_T^3 + P_T^4$$

$$M_{SUSY} = \min\,(M_{\tilde{g}},\ M_{\tilde{u}_R})$$

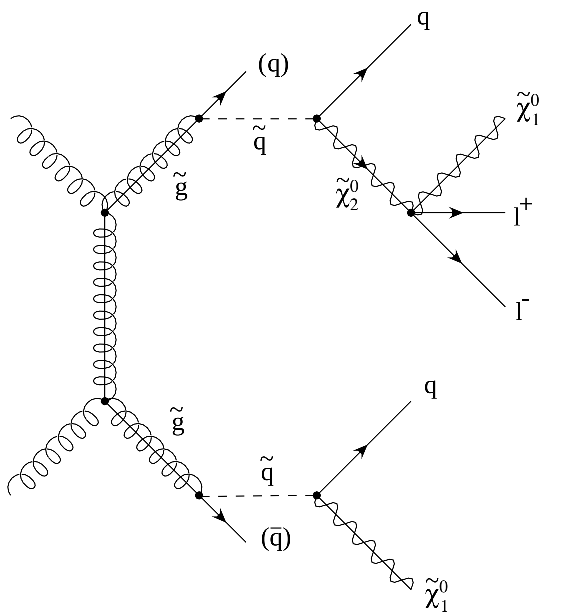


- good correlation between M_{eff} and M_{SUSY} (spread is shown for 100 minimal SUGRA models selected at random, $m_0, m_{1/2}$ and A_0 varied)

Determination of Model Parameters

- Determination of model parameters is difficult (two missing $\tilde{\chi}_1^0$, not enough constraints to reconstruct mass peaks)

- Reconstruct partially the decay chain



possible starting points:

$\tilde{\chi}_2^0 \quad \rightarrow \tilde{\chi}_1^0 h \quad \rightarrow \tilde{\chi}_1^0 \; b\bar{b}$

$\tilde{\chi}_2^0 \quad \rightarrow \tilde{l}^{\pm} l^{\mp} \quad \rightarrow \tilde{\chi}_1^0 \; l^+ l^-$

$\tilde{\chi}_1^{\pm} \quad \rightarrow \tilde{\chi}_1^0 W \quad \rightarrow \tilde{\chi}_1^0 \; q\bar{q}$

- start at the bottom of the decay chain, work backwards
  example: endpoint of $m(l^+l^-)$ determines (m$\tilde{\chi}_2^0$ - m$\tilde{\chi}_1^0$)

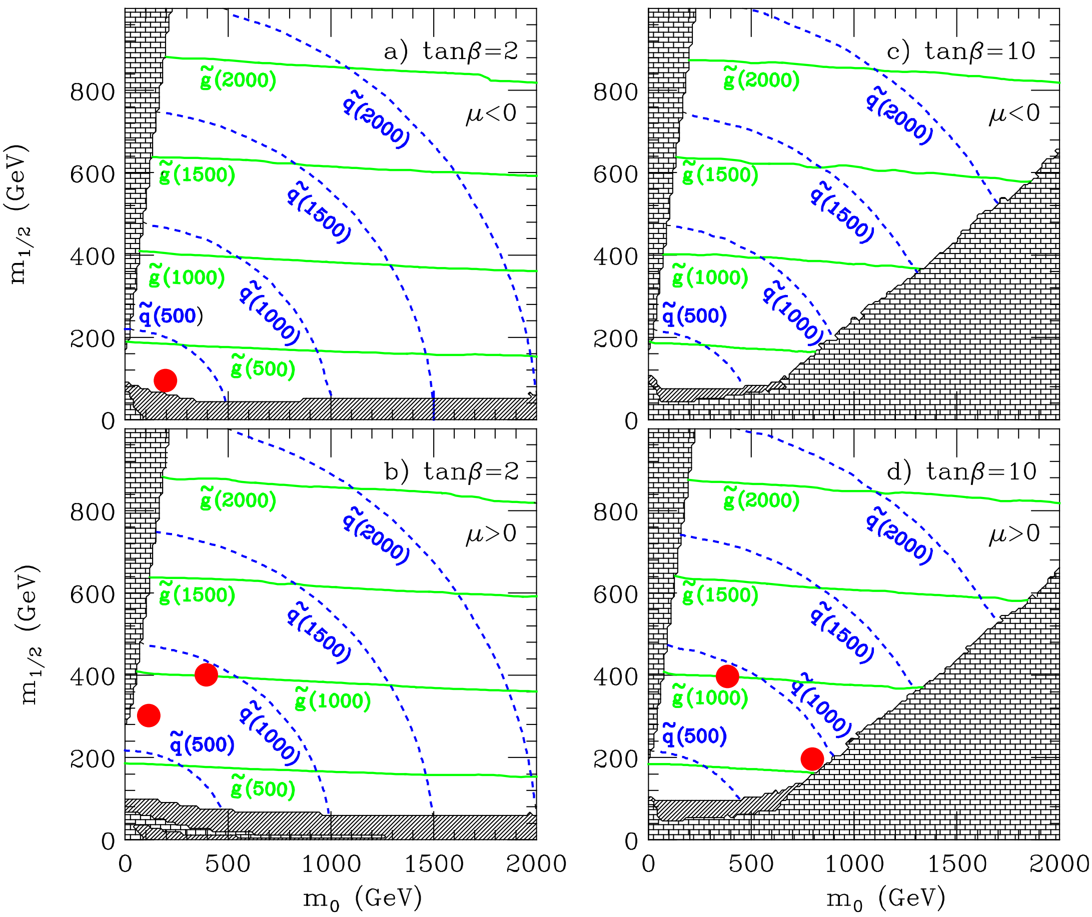
- measure combinations of masses precisely

- global fit $\Rightarrow$ constrain model parameters

Which modes are available depends on the SUSY model and parameters.

ATLAS: discussed in framework of SUGRA models,
LHCC studies, 1996

The LHCC SUGRA Points



bricked and cross-hatched regions are excluded by theoretical constraints or by experimental data

SUGRA parameters:

m_0	common scalar mass at GUT scale
$m_{1/2}$	common gaugino mass at the GUT scale
$\tan\beta$	
A_0	common trilinear term
$sgn(\mu)$	sign of Higgsino mass parameter

use *point 5 to illustrate the methods*

Point 5: Mass Spectrum and decay modes

SUGRA Parameters

$m_0 = 100$ GeV
$m_{1/2} = 300$ GeV
$A_0 = 300$ GeV
$\tan\beta = 2.1$
$sign(\mu) = +$

Particle	Mass (GeV)
$\tilde{g}$	770
$\tilde{q}_L$	690
$\tilde{q}_R$	660
$\tilde{t}_1$	490
$\tilde{\ell}_L$	240
$\tilde{\ell}_R$	157
χ_1^0	121
χ_2^0	232
h	93
H	640

total cross section is dominated by $\tilde{q}\tilde{q}$, $\tilde{q}\tilde{g}$, and $\tilde{g}\tilde{g}$ -production;
large SUSY cross section: $\sigma_{SUSY} = 20$ pb

Decay modes of $\tilde{\chi}_2^0$:

Br $(\tilde{\chi}_2^0 \to \tilde{\chi}_1^0 h) = 70\%$
Br $(\tilde{\chi}_2^0 \to \tilde{l}_R l) = 10\%$ per lepton flavour

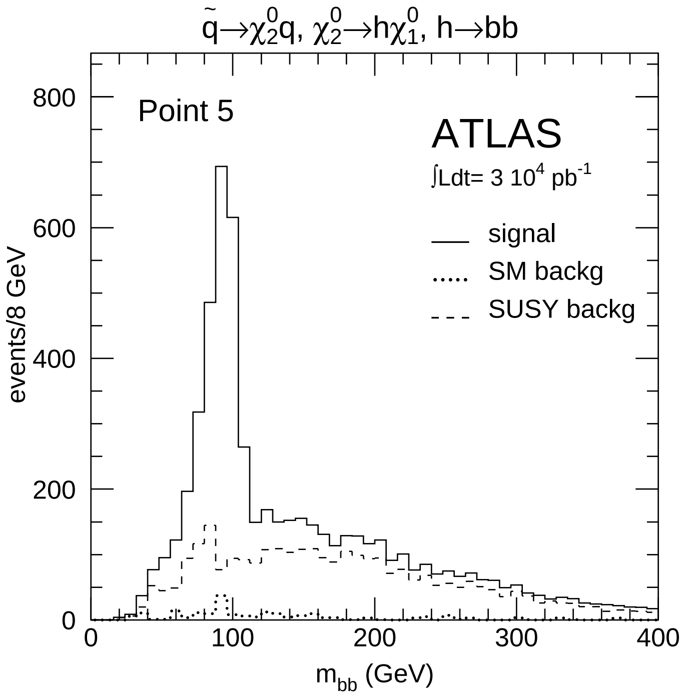
$pp \to \tilde{q}_L \tilde{q}_R$: $\tilde{q}_R \to \tilde{\chi}_1^0 q$

$\tilde{q}_L \to \tilde{\chi}_2^0 q \to \tilde{\chi}_1^0 h q \quad \to \tilde{\chi}_1^0 b\bar{b} q$

The $h \to b\bar{b}$ is a clean signature/tag in SUSY events;
E_T^{miss}-cut can be used to suppress the large SM background

<u>Selection cuts:</u>

- 2 tagged b-jets, $P_T > 50$ GeV
- veto 3. b-jet
- 2 non b-jets (jet_1, jet_2) $P_T > 100$ GeV
- $E_T^{miss} > 300$ GeV
- veto isolated leptons



Integrated Luminosity:	30 fb^{-1}
1940 signal events	
620 SUSY background	$\Rightarrow m_h = 93 \pm 1$ GeV
75 SM background	

next steps:

- select events in mass window around the h-mass pair b-jets with two other jets (veto add. jets $\Rightarrow \tilde{q}_L \tilde{q}_R$ enriched):

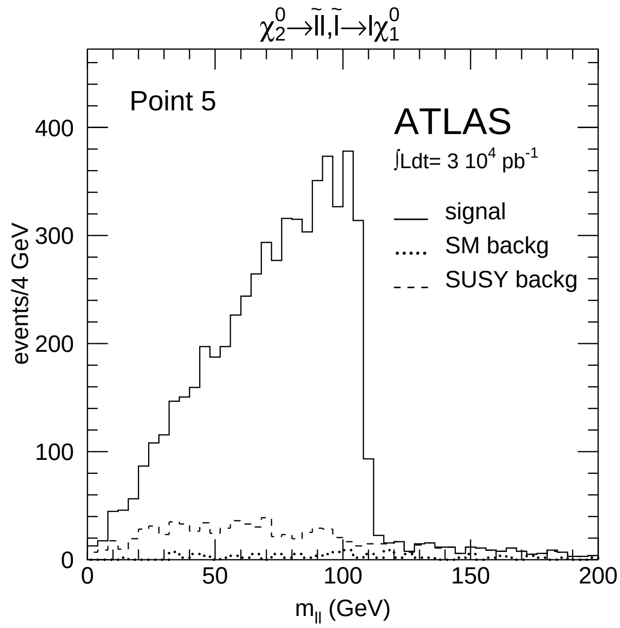
- $m(bb, jet_2)$ is sensitive to $\tilde{q}_L$ -mass
  $\Delta m_{\tilde{q}_L} = \pm 1.5\%$

- $P_T(jet_1)$ (hardest jet) is sensitive to $\tilde{q}_R$-mass
  $\Delta m_{\tilde{q}_R} = \pm 20$ GeV

$\tilde{\chi}_2^0 \rightarrow \tilde{l}_R l \rightarrow \tilde{\chi}_1^0 l l$

Selection cuts:

- 2 leptons, same flavour, opp. charge
- large jet multiplicity
- $E_T^{miss} > 300$ GeV



very sharp edge on invariant mass of two leptons:

$$m_{l^+l^-}^{max} = m_{\tilde{\chi}_2^0} \sqrt{1 + \frac{m_{\tilde{l}_R}^2}{m_{\tilde{\chi}_2^0}^2}} \sqrt{1 + \frac{m_{\tilde{\chi}_1^0}^2}{m_{\tilde{l}_R}^2}}$$

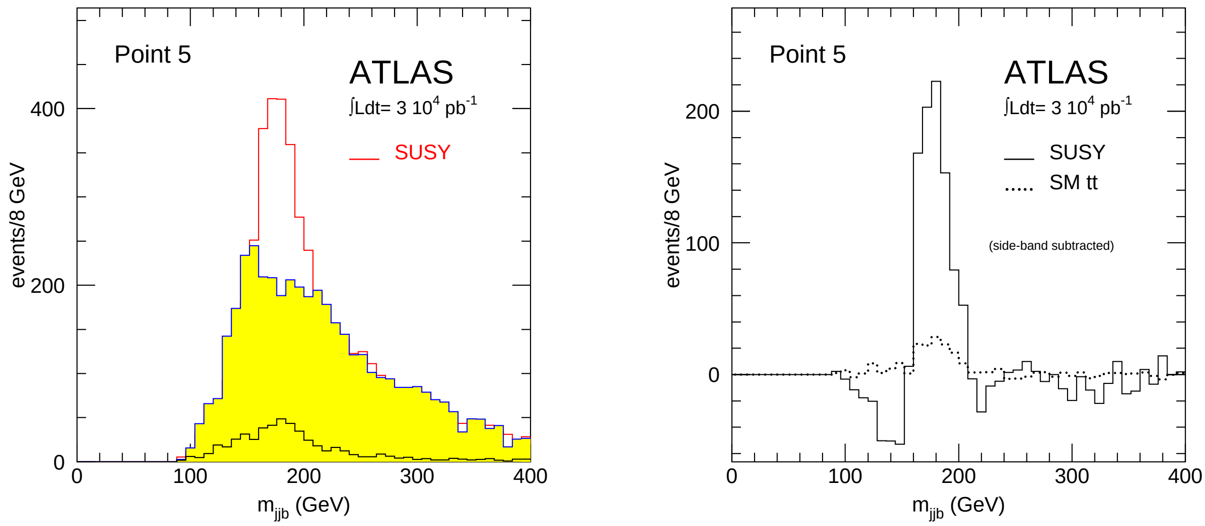
- endpoint can be measured with a precision of $\pm$ 500 MeV
  $\Rightarrow$ provides constraint in global fit $(m_{\tilde{\chi}_1^0}, m\tilde{\chi}_2^0, m_{\tilde{l}_R})$
- ratio of P_T of the two leptons is sensitive to the $\tilde{l}_R$ mass

Top production in decays of $\tilde{g}, \tilde{t}, \tilde{b}$

Select inclusive $t\bar{t} \to WWb\bar{b} \to q\bar{q}\ q\bar{q}\ b\bar{b}$ signal:

(two tagged b-jets, four add. jets, consistent with WW mass hypothesis, E_T^{miss} cut)

use sidebands of the W-mass spectrum to subtract the combinatorial background



Examples:

1. $\tilde{t}_1\tilde{t}_1 \to t\tilde{\chi}_1^0\ t\tilde{\chi}_1^0$

   P_T(top) is sensitive to $m_{\tilde{t}_1}$
   (needs high luminosity)

2. $\tilde{q}_R\tilde{g}, \qquad \tilde{g} \to \tilde{t}t \to\ tt\tilde{\chi}_1^0$

   m_{tt} is sensitive to $m_{\tilde{g}}$

Summary of Measurements in Point 5

Measurement	Expected value (GeV)	Error for 30 fb^{-1} (GeV)	Error for 300 fb^{-1} (GeV)
m_h	93	±1.0	±0.2
$m_{\ell^+\ell^-}$ edge	109	±0.5	±0.2
$m_{\tilde{\ell}_R}$	157	±1.9	±0.5
$m_{\tilde{\ell}_L}$	240	±10	±3
$m_{\tilde{q}_L}$	690	±12	±7
$m_{\tilde{q}_R}$	660	±20	±10
$m_{\tilde{g}}$	770	±20	±11
$m_{\tilde{t}_1}$	490		±50

Results of final parameter fit:

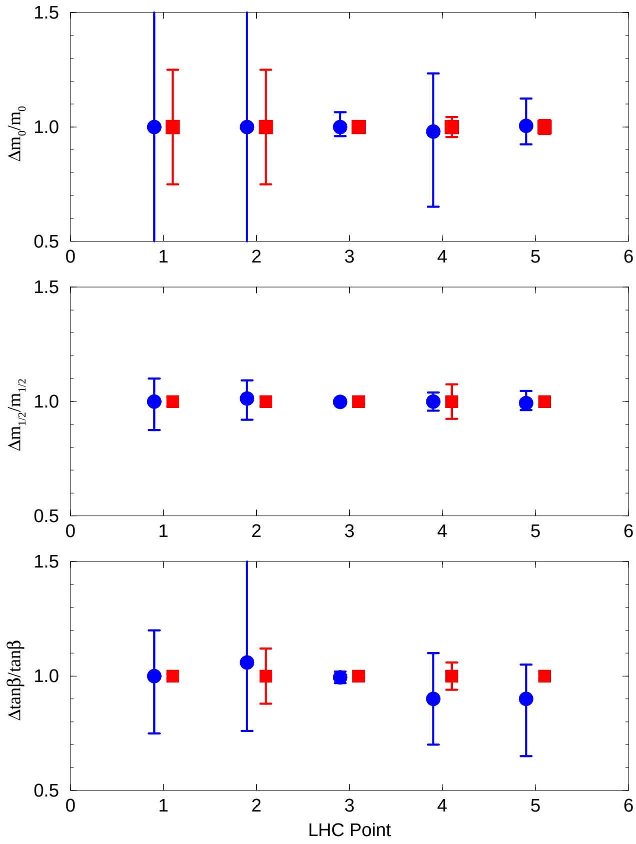
SUGRA parameter	Error for 30 fb^{-1}	Error for 300 fb^{-1}
$m_0 = 100$ GeV	±5 GeV	±3 GeV
$m_{1/2} = 300$ GeV	±8 GeV	±4 GeV
tanβ= 2.1	±0.11	±0.02

– m_0, $m_{1/2}$ and tan β can be determined with a precison at the percent level

– $sgn\ \mu$ unambiguously determined $(Br(\tilde{\chi}_2^0 \to \tilde{\chi}_1^0 h))$

– A_0 remains unconstraint, due to small influence on the phenomenology at the el.weak scale

Similar results have been obtained for the other points:



I. Hinchliffe et al., Phys.Rev. D55, 5520

ultimate fit:
D.Froidevaux et al., LHCC workshop, Okt. 1996

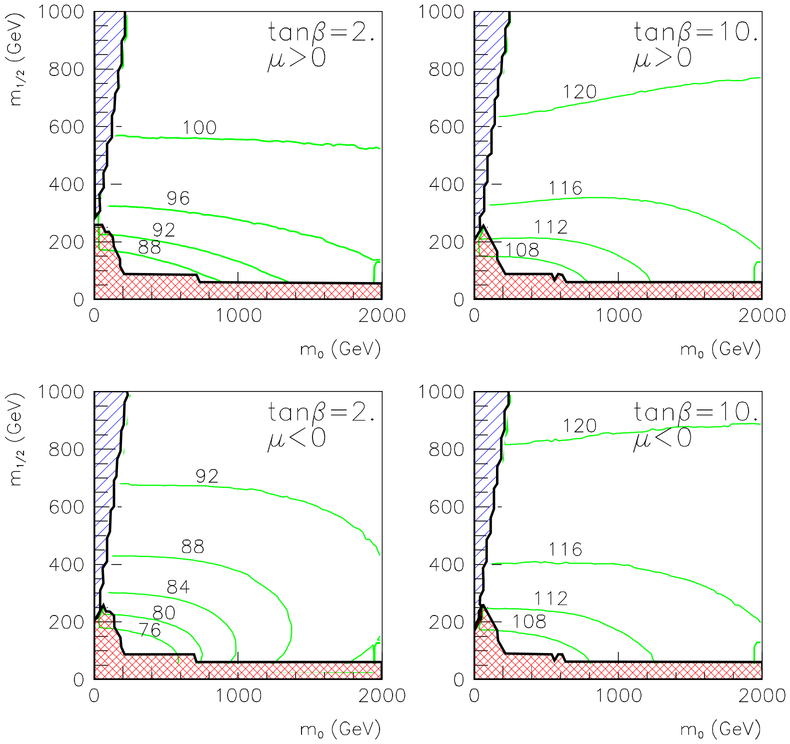
More on ATLAS SUSY:

I.Hinchliffe, Gauge Mediated SUSY Breaking, Tuesday 4:15 pm

F.Paige, More on SUGRA signatures, Thursday 9:35 am

Higgs in SUGRA

Lightest Higgs h:



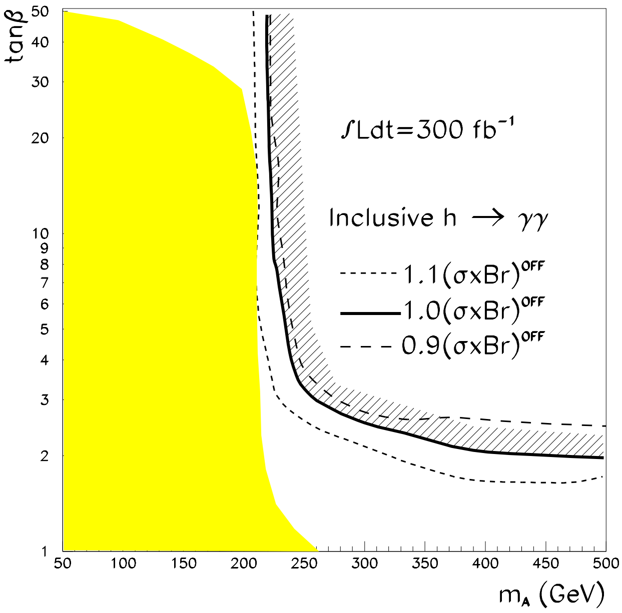
– Decay of $h \to \tilde{\chi}_1^0 \tilde{\chi}_1^0$ is kinematically closed in the allowed SUGRA parameter space

– SUSY particles in loops affect the production and decays

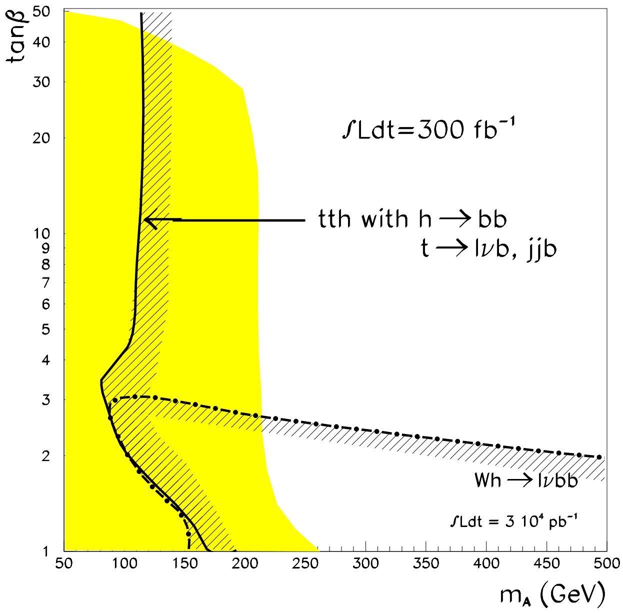
$\sigma \cdot Br(h \to \gamma\gamma)$ is found to be in the range of $\pm 10\%$ of the SM value

Observation of h in the SM channels is preserved

$h \to \gamma\gamma$



$t\bar{t}h, h \to b\bar{b}$



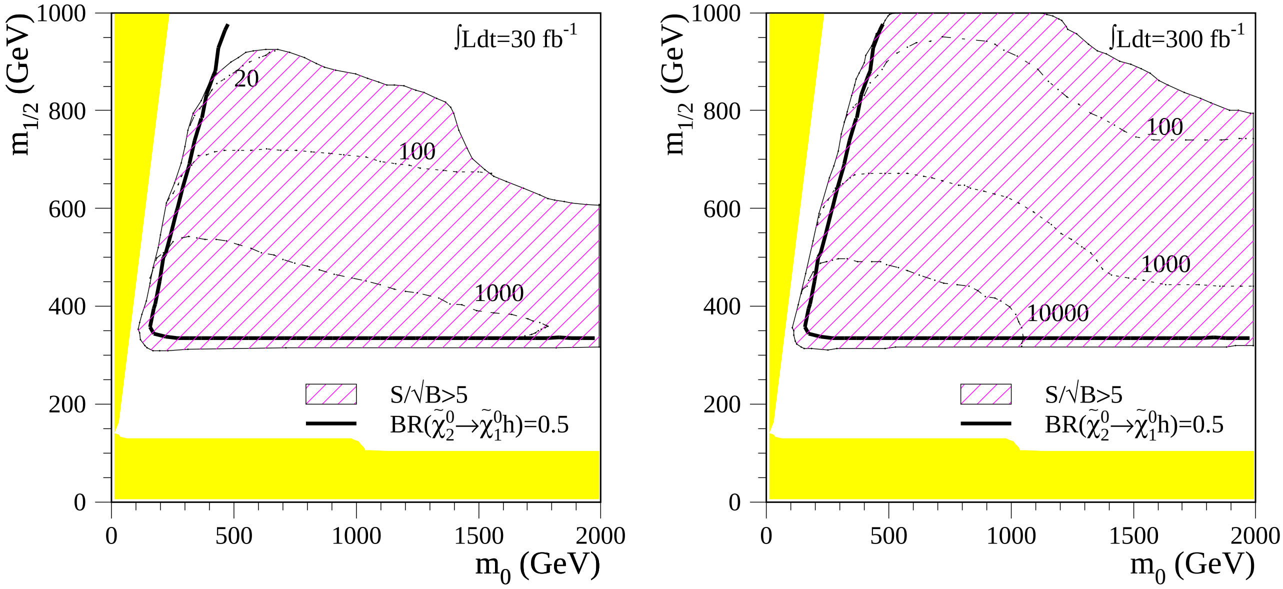
h $\to b\bar{b}$

* Use h $\to b\bar{b}$ decay mode in SUSY events to discover the h

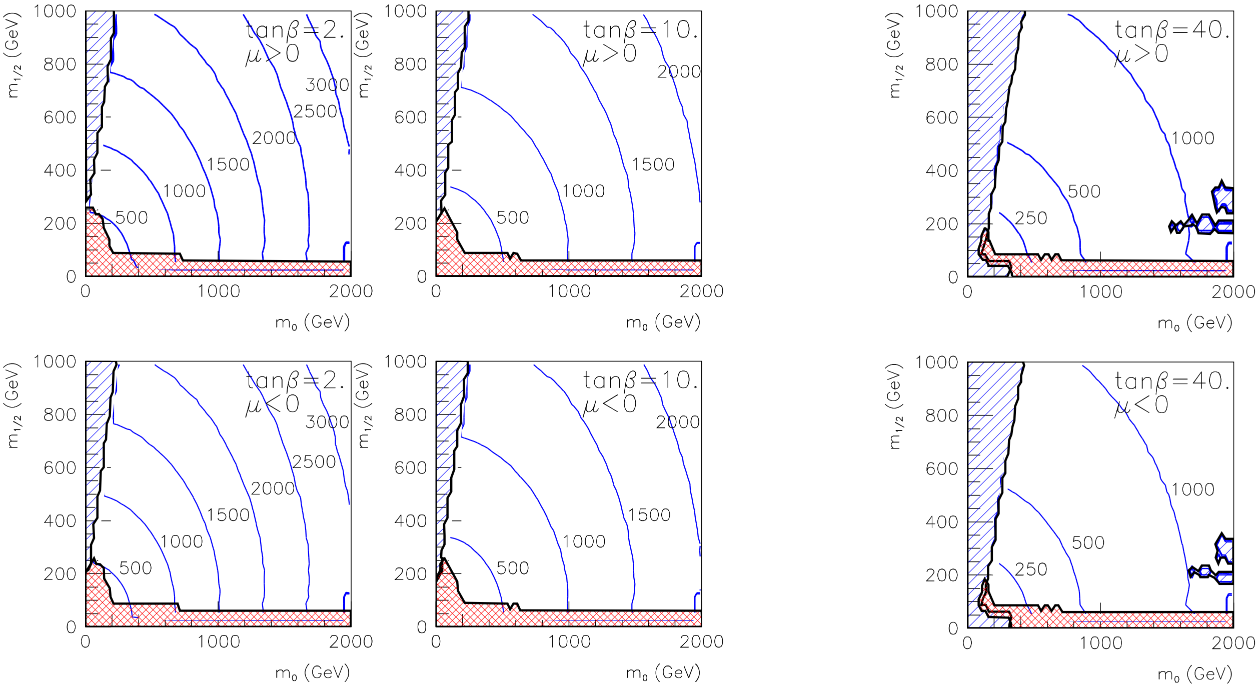
* Analysis as described above for SUGRA point 5

excluded regions in the SUGRA parameter space

$\tan\beta = 10, \ \mu > 0$



Heavy Higgses H/A:



∗ H and A Higgs bosons are heavy in many SUGRA models

∗ Decay modes are strongly affected by SUSY particles

∗ $H, A \to \tilde{\chi}_1^0\tilde{\chi}_1^0, \tilde{\chi}_1^\pm\tilde{\chi}_1^\pm$ decay channels are open over a significant fraction of the SUGRA parameter space

H,A $\rightarrow$ Neutralinos

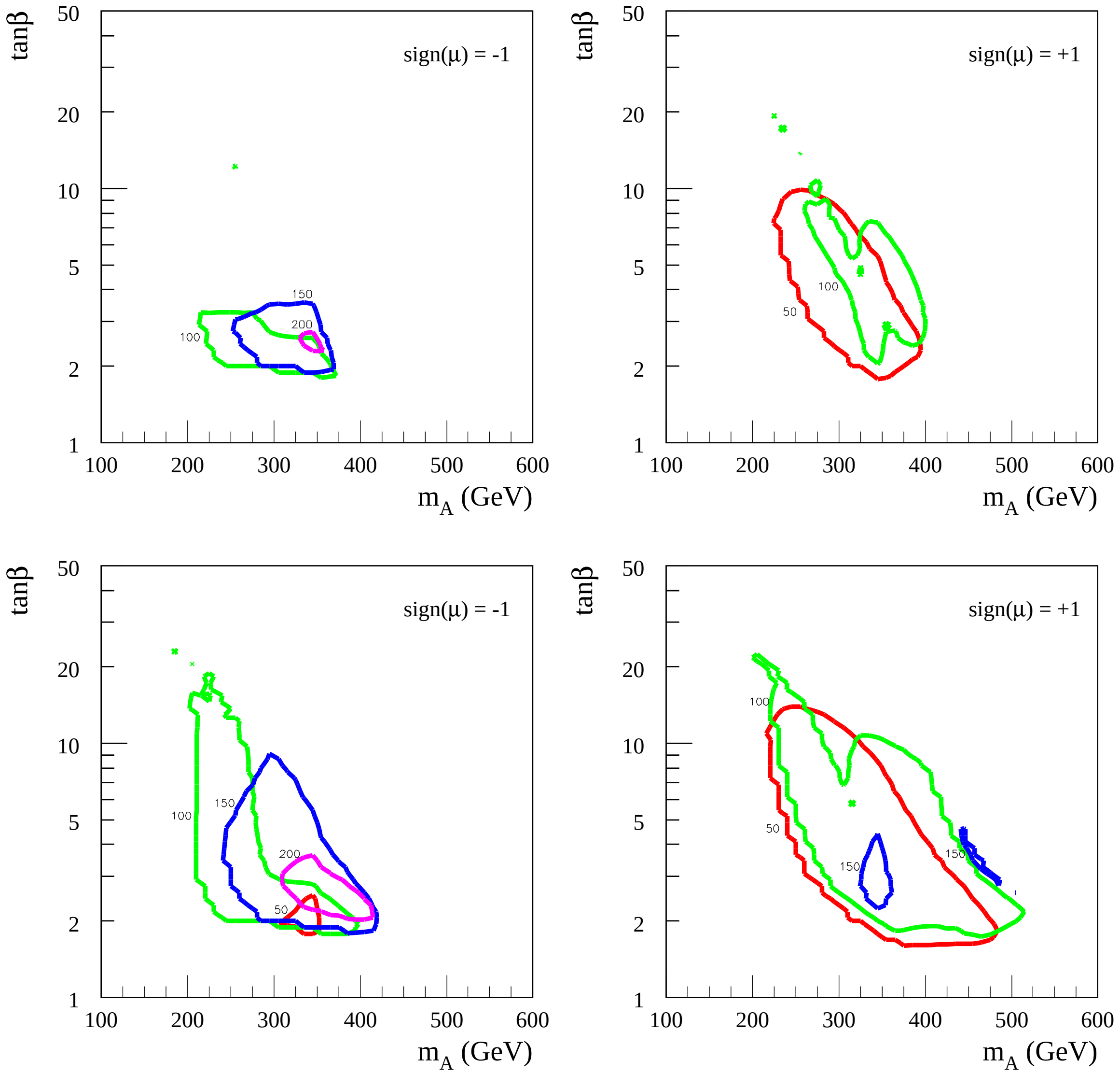
Decay mode: $H, A \rightarrow \tilde{\chi}_2^0 \tilde{\chi}_2^0 \rightarrow \tilde{\chi}_1^0 l^+ l^- \tilde{\chi}_1^0 l^+ l^-$

* Search for four leptons, 2 pairs SF,OS ($P_T > 20$ GeV (1.,2.lepton), $P_T > 7$ GeV (3.,4.lepton))

* tight jet veto to suppress SUSY background

* E_T^{miss} cut to suppress SM background

excluded regions in the SUGRA parameter space



Conclusions

The ATLAS experiment at the LHC can make substantial contributions in the Search for Higgs and SUSY:

* The discovery of a SM Higgs is possible over the full mass range (90 GeV $< m_H <$ 1 TeV) after a few years of running

* The MSSM Higgs sector is challenging for LHC experiments
(em calorimetry, b-tagging, τ-identification, E_T^{miss}-resolution and jet-spectroscopy)

  · With moderate luminosity (30 fb^{-1}) about 80% of the (m_A, tan β) plane can be covered.

  · Full coverage at high luminosity

* ATLAS has a large potential to discover SUSY particles and to measure their masses

* The Parameters of the SUSY model can be determined or largely constraint by many measurements