Electroweak Precision Physics

Georg Weiglein

IPPP Durham

Durham, 01/2005

1. Introduction
2. Electroweak precision observables
3. Precision tests: Standard Model and Supersymmetry
4. Conclusions

1. Introduction

Electroweak precision measurements:

$M_{\rm W}[\,\rm GeV]$	$=$	80.425 ± 0.034	0.04%
$\sin^2\theta_{\rm eff}^{\rm lept}$	$=$	0.23150 ± 0.00016	0.07%
$\Gamma_{\rm Z}[\,\rm GeV]$	$=$	2.4952 ± 0.0023	0.09%
$M_{\rm Z}[\,\rm GeV]$	$=$	91.1875 ± 0.0021	0.002%
$G_\mu[\,\rm GeV^{-2}]$	$=$	$1.16637(1)\,10^{-5}$	0.0009%
$m_{\rm t}[\,\rm GeV]$	$=$	178.0 ± 4.3	2.4%
$\ldots$			

1. Introduction

Electroweak precision measurements:

$M_{\mathrm{W}}[\,\mathrm{GeV}]$	$=$	80.425 ± 0.034	0.04%
$\sin^2\theta_{\mathrm{eff}}^{\mathrm{lept}}$	$=$	0.23150 ± 0.00016	0.07%
$\Gamma_{\mathrm{Z}}[\,\mathrm{GeV}]$	$=$	2.4952 ± 0.0023	0.09%
$M_{\mathrm{Z}}[\,\mathrm{GeV}]$	$=$	91.1875 ± 0.0021	0.002%
$G_\mu[\,\mathrm{GeV}^{-2}]$	$=$	$1.16637(1)\,10^{-5}$	0.0009%
$m_{\mathrm{t}}[\,\mathrm{GeV}]$	$=$	178.0 ± 4.3	2.4%
$\ldots$			

Quantum effects of the theory:

Loop corr. to “pseudo-observables” M_{W}, $\sin^2\theta_{\mathrm{eff}}$, $\ldots$: $\sim \mathcal{O}(1\%)$

1. Introduction

Electroweak precision measurements:

$$
\begin{array}{llll}
M_{\mathrm{W}}[\,\mathrm{GeV}] & = & 80.425 \pm 0.034 & 0.04\% \\
\sin^2\theta_{\mathrm{eff}}^{\mathrm{lept}} & = & 0.23150 \pm 0.00016 & 0.07\% \\
\Gamma_{\mathrm{Z}}[\,\mathrm{GeV}] & = & 2.4952 \pm 0.0023 & 0.09\% \\
 & & & \\
M_{\mathrm{Z}}[\,\mathrm{GeV}] & = & 91.1875 \pm 0.0021 & 0.002\% \\
G_\mu[\,\mathrm{GeV}^{-2}] & = & 1.16637(1)\,10^{-5} & 0.0009\% \\
m_{\mathrm{t}}[\,\mathrm{GeV}] & = & 178.0 \pm 4.3 & 2.4\% \\
\ldots & & &
\end{array}
$$

Quantum effects of the theory:

Loop corr. to "pseudo-observables" M_{W}, $\sin^2\theta_{\mathrm{eff}}$, $\ldots$: $\sim \mathcal{O}(1\%)$

$\Rightarrow$ EW prec. measurements test quantum effects of the theory

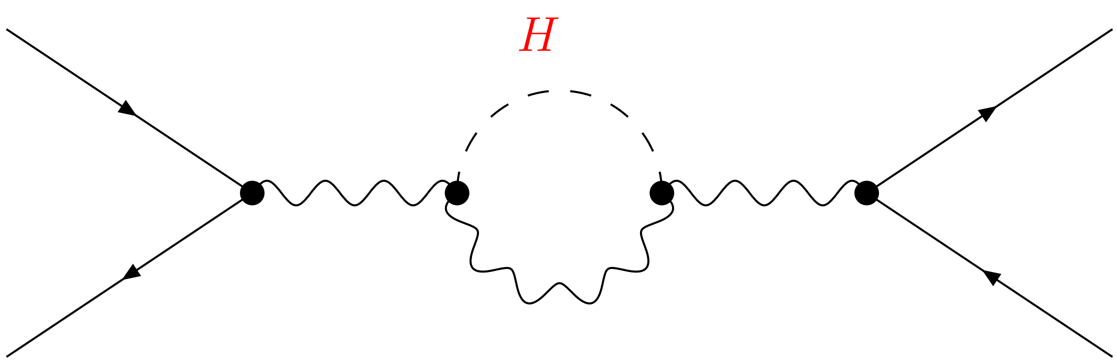
Comparison of electroweak precision data with theory predictions:

EW precision data:
$M_Z, M_W, \sin^2\theta_{\rm eff}^{\rm lept}, \ldots$

Theory:
SM, MSSM, ...

$\Downarrow$

Test of theory at quantum level: sensitivity to loop corrections



$\Downarrow$

Indirect constraints on unknown parameters: $M_H, \ldots$

Effects of “new physics”?

Example: indirect determination of m_{t} from precision data vs. direct measurement

Indirect det. of m_{t} from precision data: $m_{\mathrm{t}} = 180.3^{+11.7}_{-9.2}$ GeV

Direct measurement: $m_{\mathrm{t}} = 178.0 \pm 4.3$ GeV

Example: indirect determination of m_{t} from precision data vs. direct measurement

Indirect det. of m_{t} from precision data: $m_{\mathrm{t}} = 180.3^{+11.7}_{-9.2}$ GeV

Direct measurement: $m_{\mathrm{t}} = 178.0 \pm 4.3$ GeV

Leading corrections to precision observables:

$$\sim m_{\mathrm{t}}^2$$

$$\sim \ln M_{\mathrm{H}}$$

Example: indirect determination of $m_{\rm t}$ from precision data vs. direct measurement

Indirect det. of $m_{\rm t}$ from precision data: $m_{\rm t} = 180.3^{+11.7}_{-9.2}$ GeV

Direct measurement: $m_{\rm t} = 178.0 \pm 4.3$ GeV

Leading corrections to precision observables:

$$\sim m_{\rm t}^2$$

$$\sim \ln M_{\rm H}$$

$\Rightarrow$ Very high accuracy of measurements and theoretical predictions needed

Example: indirect determination of m_{t} from precision data vs. direct measurement

Indirect det. of m_{t} from precision data: $m_{\mathrm{t}} = 180.3^{+11.7}_{-9.2}$ GeV

Direct measurement: $m_{\mathrm{t}} = 178.0 \pm 4.3$ GeV

Leading corrections to precision observables:

$$\sim m_{\mathrm{t}}^2$$

$$\sim \ln M_{\mathrm{H}}$$

$\Rightarrow$ Very high accuracy of measurements and theoretical predictions needed

Theoretical uncertainties:

– unknown higher-order corrections

– experimental error of input parameters: m_{t}, $\Delta\alpha_{\mathrm{had}}$, ...

Observables vs. "pseudo-observables":

Couplings, masses, mixing angles, etc. are not (directly) physical observables $\Rightarrow$ "pseudo-observables"

Actual observables: σ, BRs, asymmetries, ...

Need deconvolution procedure (unfolding) to determine masses, partial widths, etc. from measured cross sections

$\Rightarrow$ pseudo-observables are not strictly model-independent

Observables vs. "pseudo-observables":

Couplings, masses, mixing angles, etc. are not (directly) physical observables $\Rightarrow$ "pseudo-observables"

Actual observables: σ, BRs, asymmetries, ...

Need deconvolution procedure (unfolding) to determine masses, partial widths, etc. from measured cross sections

$\Rightarrow$ pseudo-observables are not strictly model-independent

What is a suitable definition of model parameters?

need some compromise between

– simple interpretation within given model
– model independence

Experimental determination of model parameters (masses, couplings, . . .):

Particle masses: relatively small model dependence

Experimental determination of model parameters (masses, couplings, . . .):

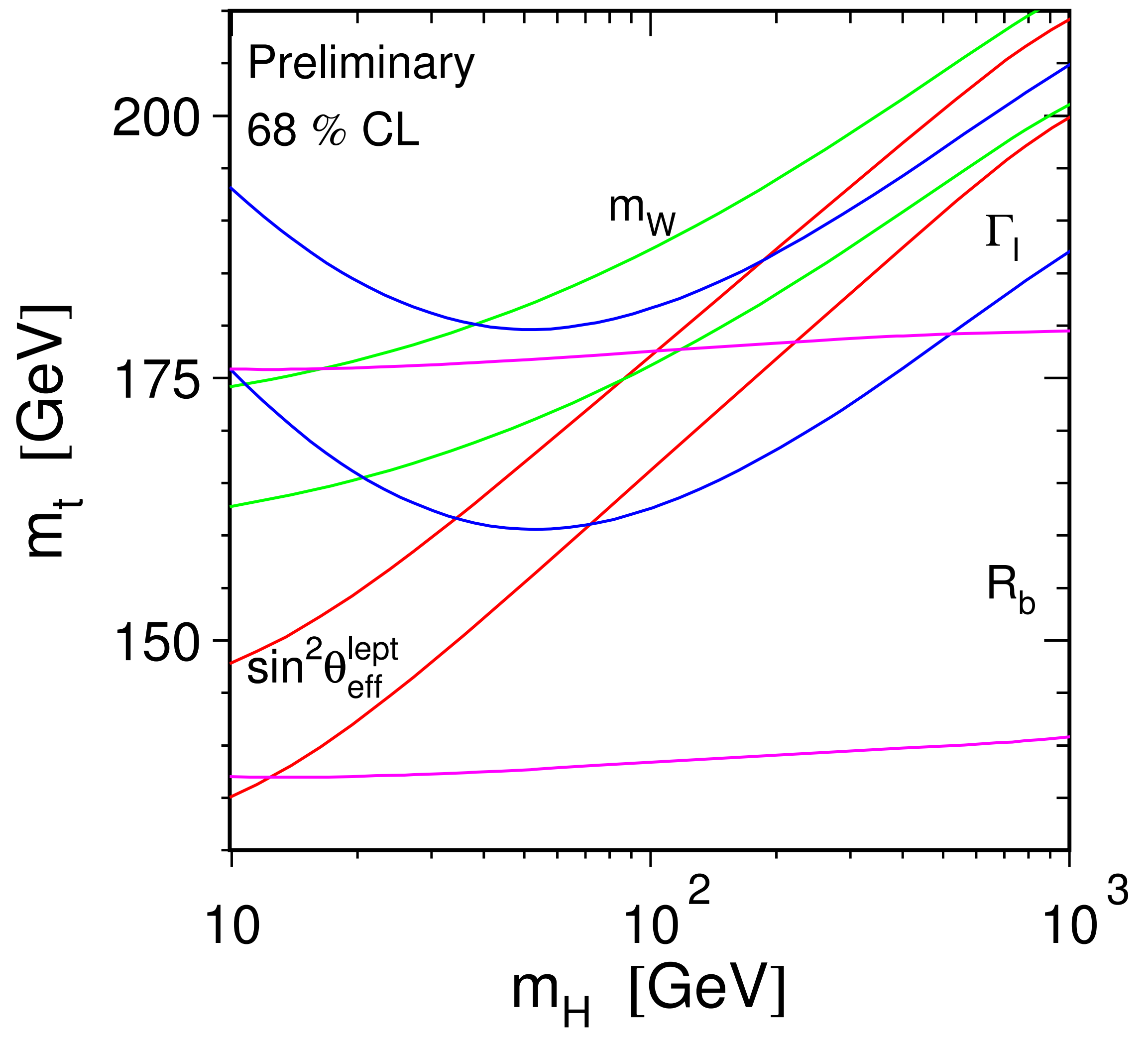
Particle masses: relatively small model dependence

⇒ The experimental value of M_{Z} (slightly) depends on the value of the SM Higgs mass

($\delta M_{\mathrm{Z}} = \pm 0.2$ MeV for $100\ \mathrm{GeV} \leq M_{\mathrm{H}} \leq 1\ \mathrm{TeV}$)

Couplings, mixing angles, etc.: relatively large model dependence

Sensitivity of different (pseudo-)observables to the Higgs mass in the SM



[*LEPEWWG '04*]

$\Rightarrow$ highest sensitivity from $\sin^2\theta_{\rm eff}$ and $M_{\rm W}$

Comparison of current and anticipated future experimental errors

Present errors vs. Run II of Tevatron, LHC, and ILC with and without low-energy running mode (GigaZ):

	now	Tevatron	LHC	ILC	GigaZ
$\delta \sin^2 \theta_{\mathrm{eff}} (\times 10^5)$	16	—	14–20	—	1.3
δM_{W} [MeV]	34	20	15	10	7
δm_{t} [GeV]	4.3	2.5	1–2	0.1	0.1
δm_{h} [MeV]	—	—	200	50	50

$\Rightarrow$ Large improvement at next generation of colliders

2. Electroweak precision observables

Sensitivity to quantum effects (loop corrections) of new physics:

- Precision measurements resolve %-level loop effects:
  M_W, $\sin^2\theta_\mathrm{eff}$, Γ_Z, $\ldots$

2. Electroweak precision observables

Sensitivity to quantum effects (loop corrections) of new physics:

- Precision measurements resolve %-level loop effects:
  $M_{\rm W}$, $\sin^2\theta_{\rm eff}$, $\Gamma_{\rm Z}$, ...

- Loop-induced processes $\Leftrightarrow$ new physics contribution doesn't compete with large SM lowest-order prediction:
  $(g-2)_\mu$, $b \to s\gamma$, $B_{\rm s} \to \mu^+\mu^-$, EDMs, ...

2. Electroweak precision observables

Sensitivity to quantum effects (loop corrections) of new physics:

- Precision measurements resolve %-level loop effects: $M_{\rm W}$, $\sin^2\theta_{\rm eff}$, $\Gamma_{\rm Z}$, $\ldots$
- Loop-induced processes $\Leftrightarrow$ new physics contribution doesn't compete with large SM lowest-order prediction: $(g-2)_\mu$, $b \to s\gamma$, $B_{\rm s} \to \mu^+\mu^-$, EDMs, ...
- Future precision measurements, possibly very large loop effects: $m_{\rm h}$, other Higgs-sector observables

Theoretical predictions for M_W***,*** $\sin^2\theta_\mathrm{eff}$***:***

Comparison of prediction for muon decay with experiment (Fermi constant G_μ)

$$\Rightarrow \quad M_\mathrm{W}^2\left(1-\frac{M_\mathrm{W}^2}{M_\mathrm{Z}^2}\right)=\frac{\pi\alpha}{\sqrt{2}G_\mu}\left(1+\Delta r\right),$$

$\Updownarrow$

loop corrections

$\Rightarrow$ Theo. prediction for M_W in terms of M_Z, α, G_μ, $\Delta r(m_\mathrm{t}, M_\mathrm{H}, \ldots)$

Theoretical predictions for M_W, $\sin^2\theta_\mathrm{eff}$:

Comparison of prediction for muon decay with experiment (Fermi constant G_μ)

$$\Rightarrow \quad M_\mathrm{W}^2\left(1-\frac{M_\mathrm{W}^2}{M_\mathrm{Z}^2}\right)=\frac{\pi\alpha}{\sqrt{2}G_\mu}\left(1+\Delta r\right),$$

$\Updownarrow$

loop corrections

$\Rightarrow$ Theo. prediction for M_W in terms of M_Z, α, G_μ, $\Delta r(m_\mathrm{t}, M_\mathrm{H}, \ldots)$

Effective couplings at the Z resonance:

$$\Rightarrow \quad \sin^2\theta_\mathrm{eff}=\frac{1}{4}\left(1-\mathrm{Re}\,\frac{g_V}{g_A}\right)=\left(1-\frac{M_\mathrm{W}^2}{M_\mathrm{Z}^2}\right)\mathrm{Re}\,\kappa_l(s=M_\mathrm{Z}^2)$$

Theoretical predictions for M_W, $\sin^2\theta_{\rm eff}$:

Current status in the SM: complete two-loop result known for M_W, fermionic two-loop corrections known for $\sin^2\theta_{\rm eff}$

Necessary diagrams for evaluation of 2-loop corrections to $\sin^2\theta_{\rm eff}$:

- Renormalisation: $\delta M_W^2 = {\rm Re}\Sigma^W_{T(2)}(M_W^2) + \ldots$

  $\Rightarrow$ 2-loop self-energies with arbitrary momentum and masses

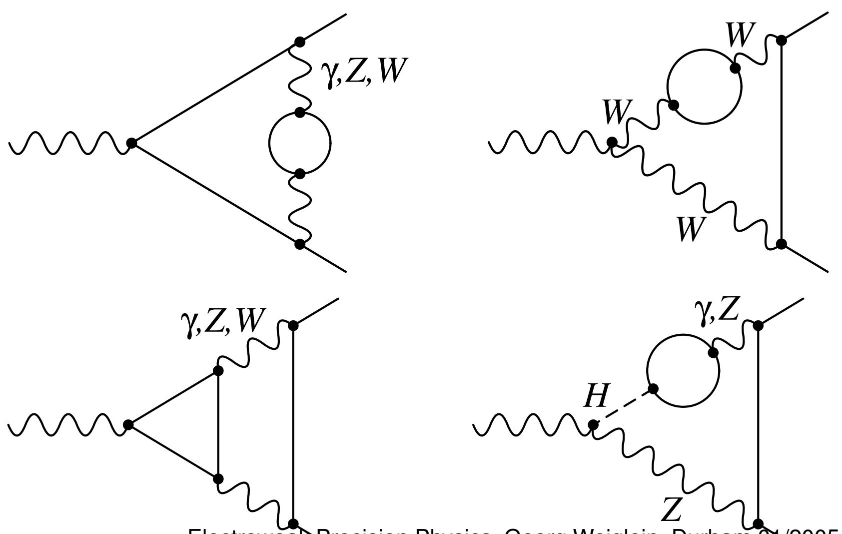
  No analytical results available for general case

  $\Rightarrow$ numerical integration

- Two-loop vertex diagrams:

  two classes:

  top, light fermions



Evaluation with different methods

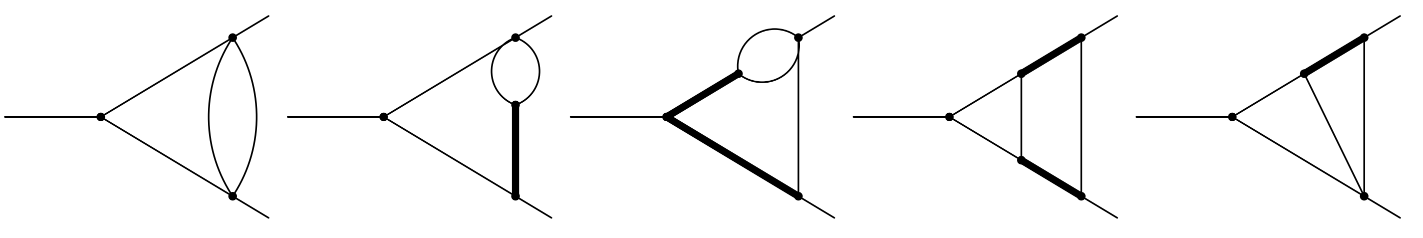
Top-quark contributions: expansion in M_Z^2/m_t^2

$\Rightarrow$ expansion up to $(M_Z^2/m_t^2)^5$ yields intrinsic precision of 10^{-7}

Light fermion contributions:

depend on only one variable $\Rightarrow$ reduction to master integrals using integration by parts and Lorentz invariance identities

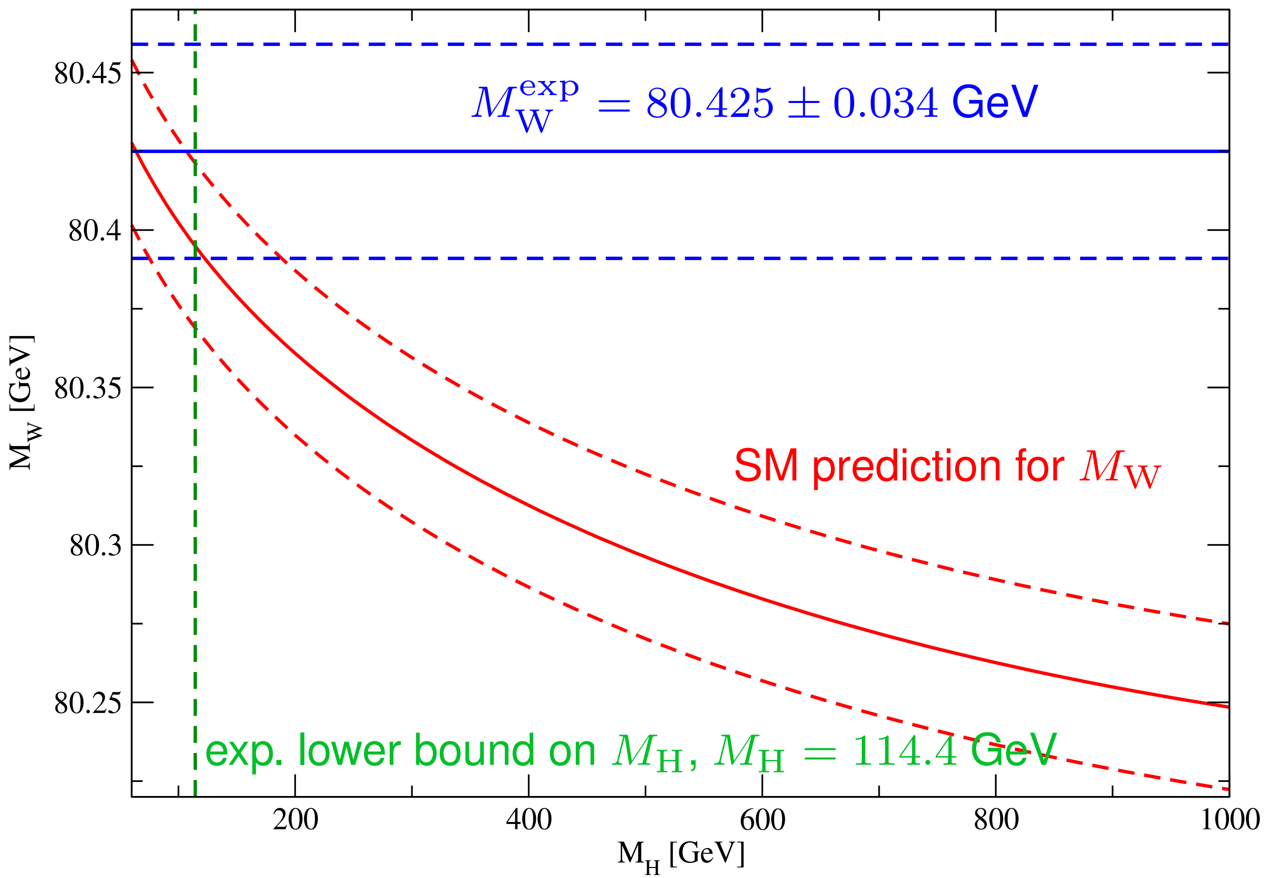
[*Chetyrkin, Tkachov '81*] [*Gehrmann, Remiddi '00*] [*Laporta '00*]



Analytical results for master integrals via differential equations

SM prediction for M_W (complete 2-loop result) vs. experimental result

[M. Awramik, M. Czakon, A. Freitas, G.W. '04]



Main source of theo. uncertainty:

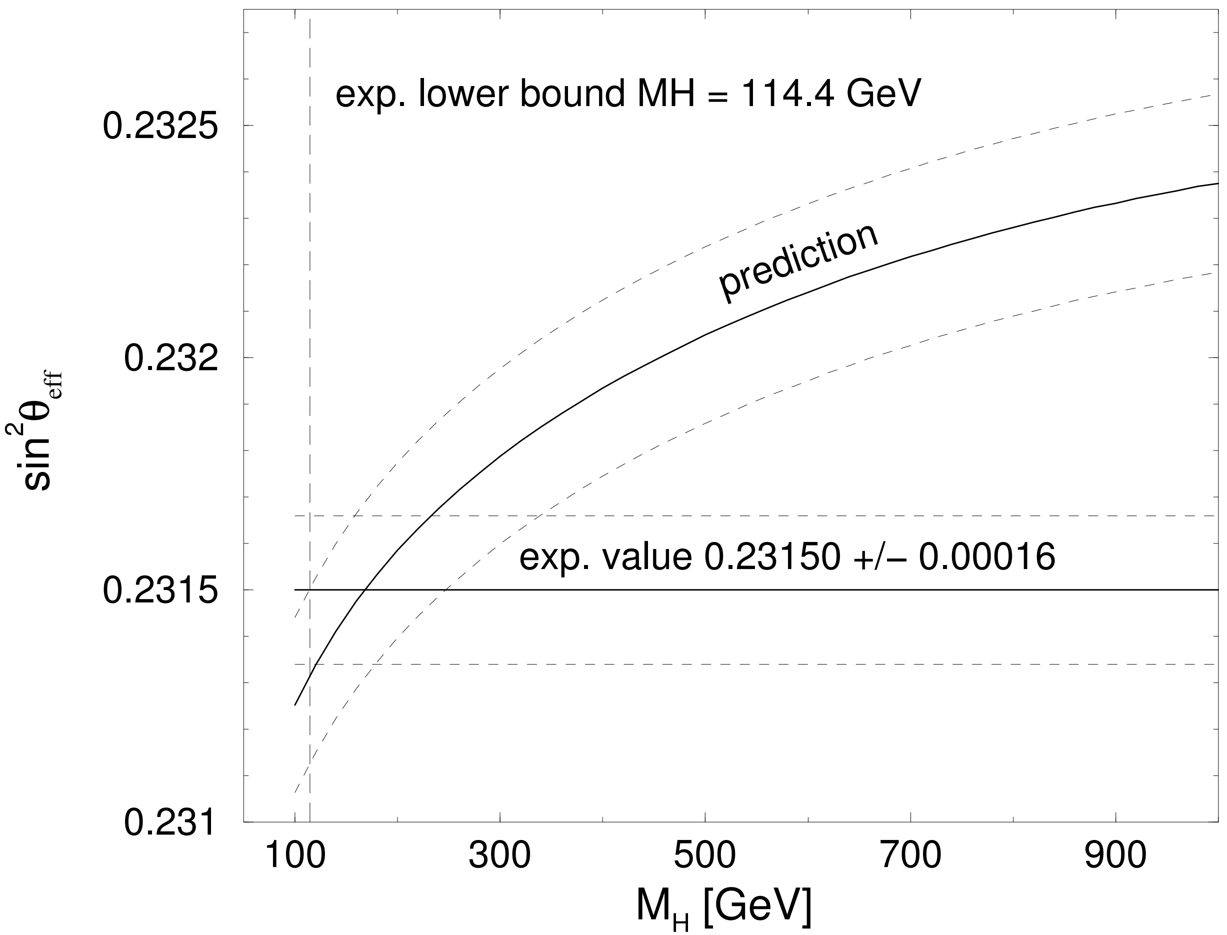
$\delta m_t = 4.3$ GeV

$\Rightarrow \Delta M_W^{para} \approx 26$ MeV,

$\Delta \sin^2 \theta_{eff}^{para} \approx 14 \times 10^{-5}$

$\Rightarrow$ Preference for light Higgs

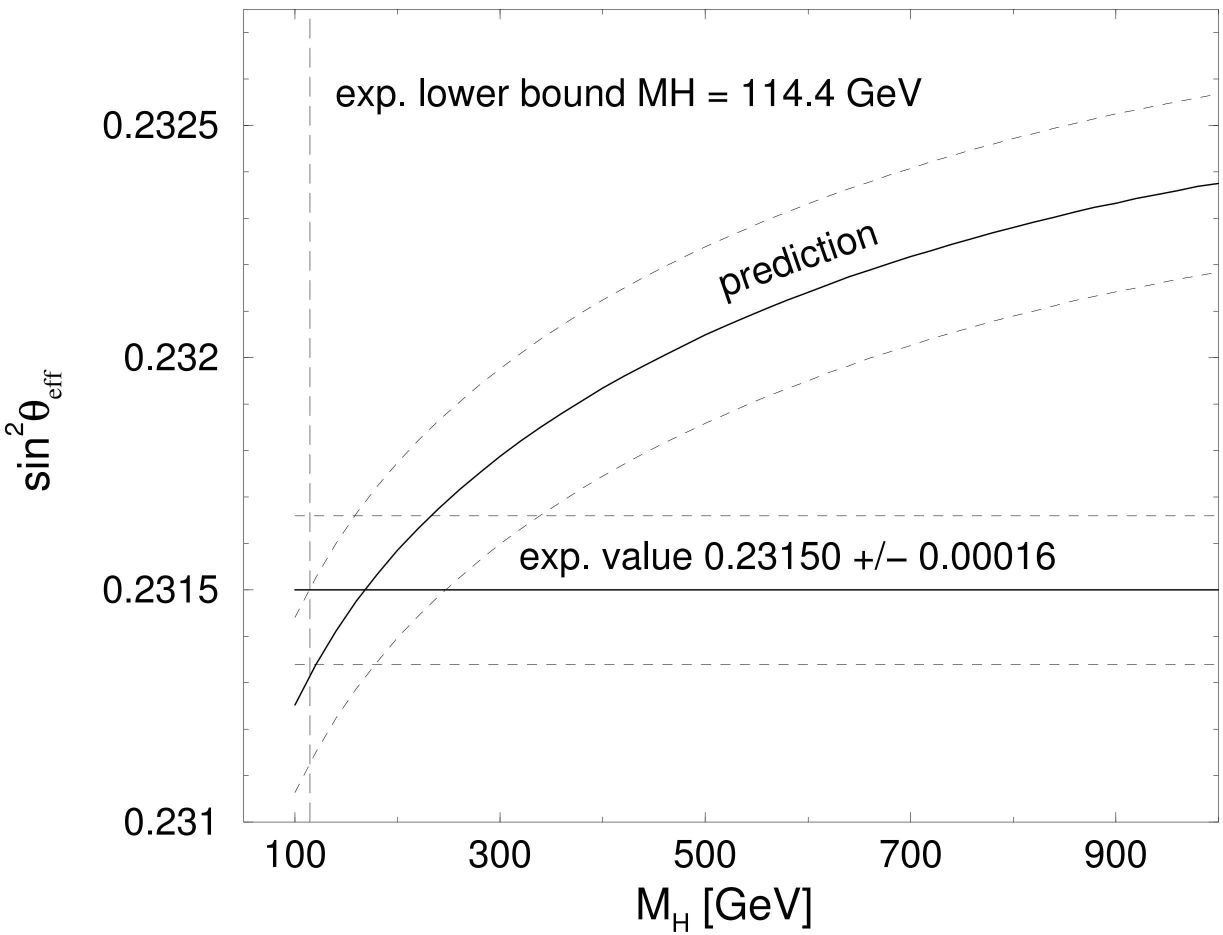
SM prediction for $\sin^2\theta_{\mathrm{eff}}$ *(fermionic 2-loop result) vs. experimental result*



[*M. Awramik, M. Czakon, A. Freitas, G.W. '04*]

$\Rightarrow$ Preference for light Higgs

SM prediction for $\sin^2\theta_{\rm eff}$ *(fermionic 2-loop result) vs. experimental result*



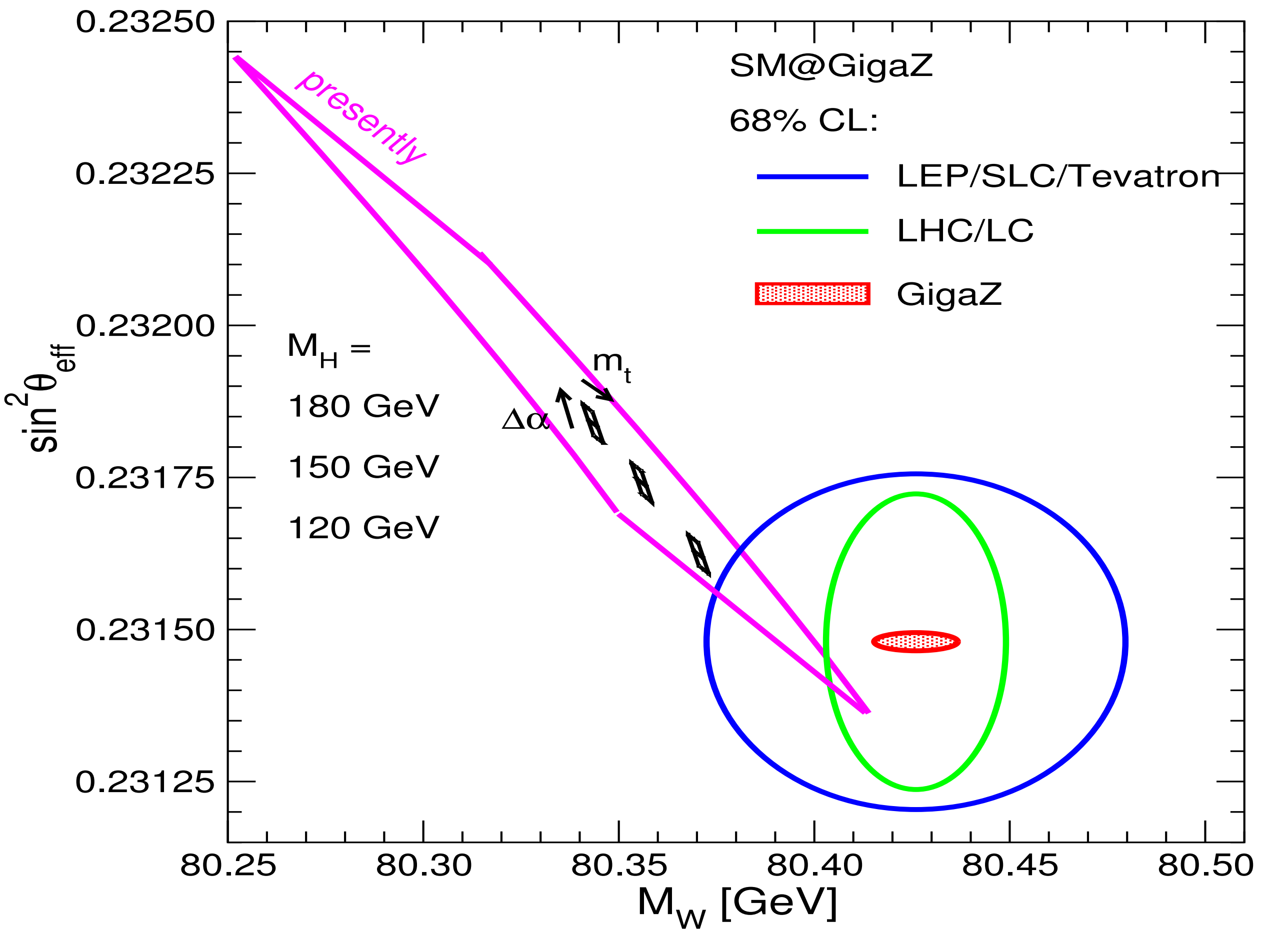
[M. Awramik, M. Czakon, A. Freitas, G.W. '04]

$\Rightarrow$ Preference for light Higgs

However: experimental value for $\sin^2\theta_{\rm eff}$ contains average over $A_{\rm l} = 0.23098 \pm 0.00026$ (SLD) and $A_{\rm fb}^{0,\rm b} = 0.23210 \pm 0.00030$ (LEP)

SM prediction for M_{W} and $\sin^2\theta_{\mathrm{eff}}$ vs. current experimental result (LEP2/Tevatron) and prospective accuracies at the LHC and a LC with low-energy option (GigaZ):

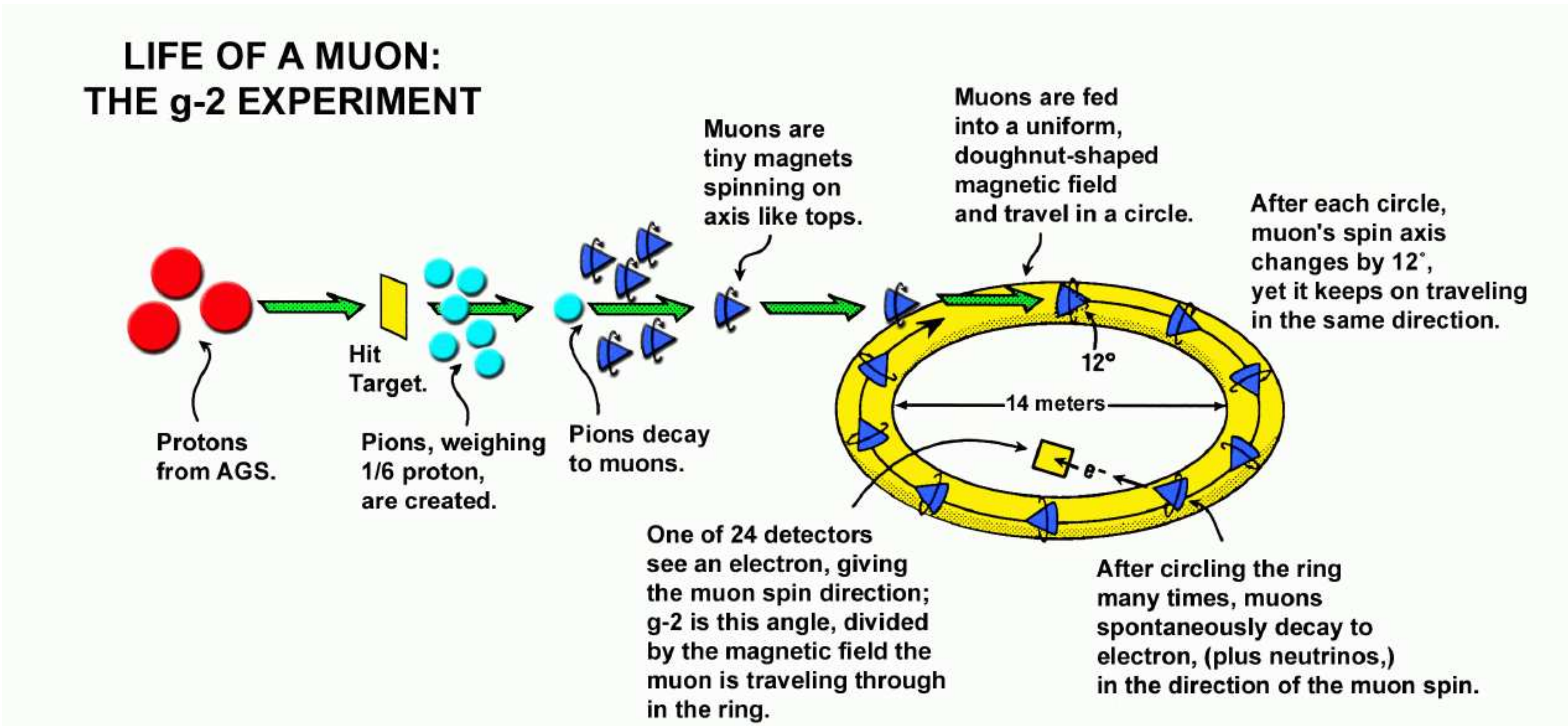
[J. Erler, S. Heinemeyer, W. Hollik, G.W., P. Zerwas '00]



$\Rightarrow$ Highly sensitive test of electroweak theory:
improved accuracy of observables and input parameters

The anomalous magnetic moment of the muon:

$$(g-2)_\mu \equiv 2a_\mu$$



Coupling of muon to magnetic field: $\mu - \bar{\mu} - \gamma$ coupling

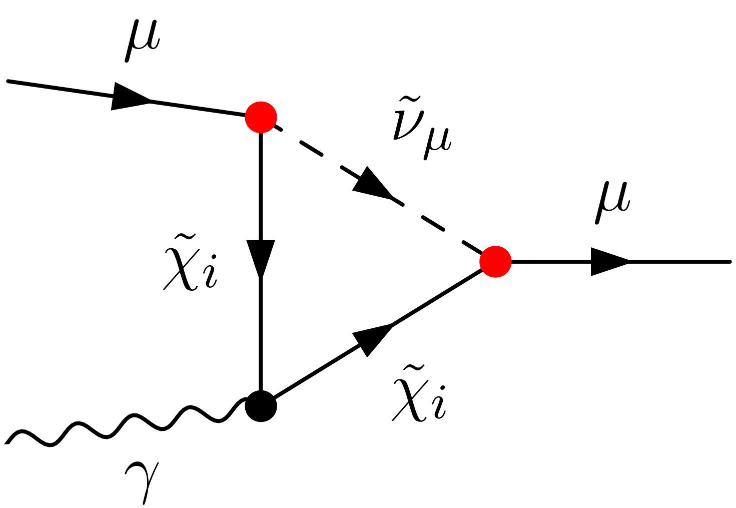
$$\bar{u}(p') \left[\gamma^\mu F_1(q^2) + \frac{i}{2m_\mu} \sigma^{\mu\nu} q_\nu F_2(q^2) \right] u(p) A_\mu \qquad F_2(0) = (g-2)_\mu \equiv 2a_\mu$$

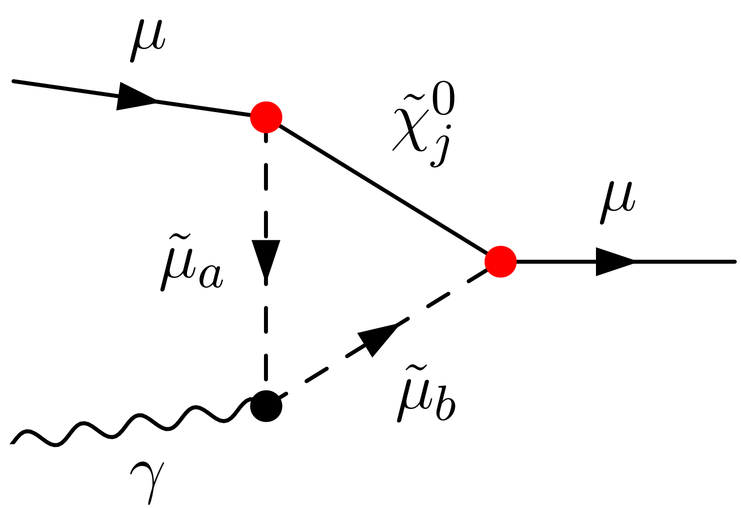
a_μ: experimental result vs. SM prediction

$$a_\mu^{\text{exp}} - a_\mu^{\text{theo}} = (25.2 \pm 9.2) \times 10^{-10} \;:\; 2.7\,\sigma \; .$$

Better agreement between theory and experiment possible in models of physics beyond the SM

Example: one-loop contributions of superpartners of fermions and gauge bosons





SUSY contributions to a_μ

[*S. Heinemeyer, D. Stöckinger, G. W. '04*]

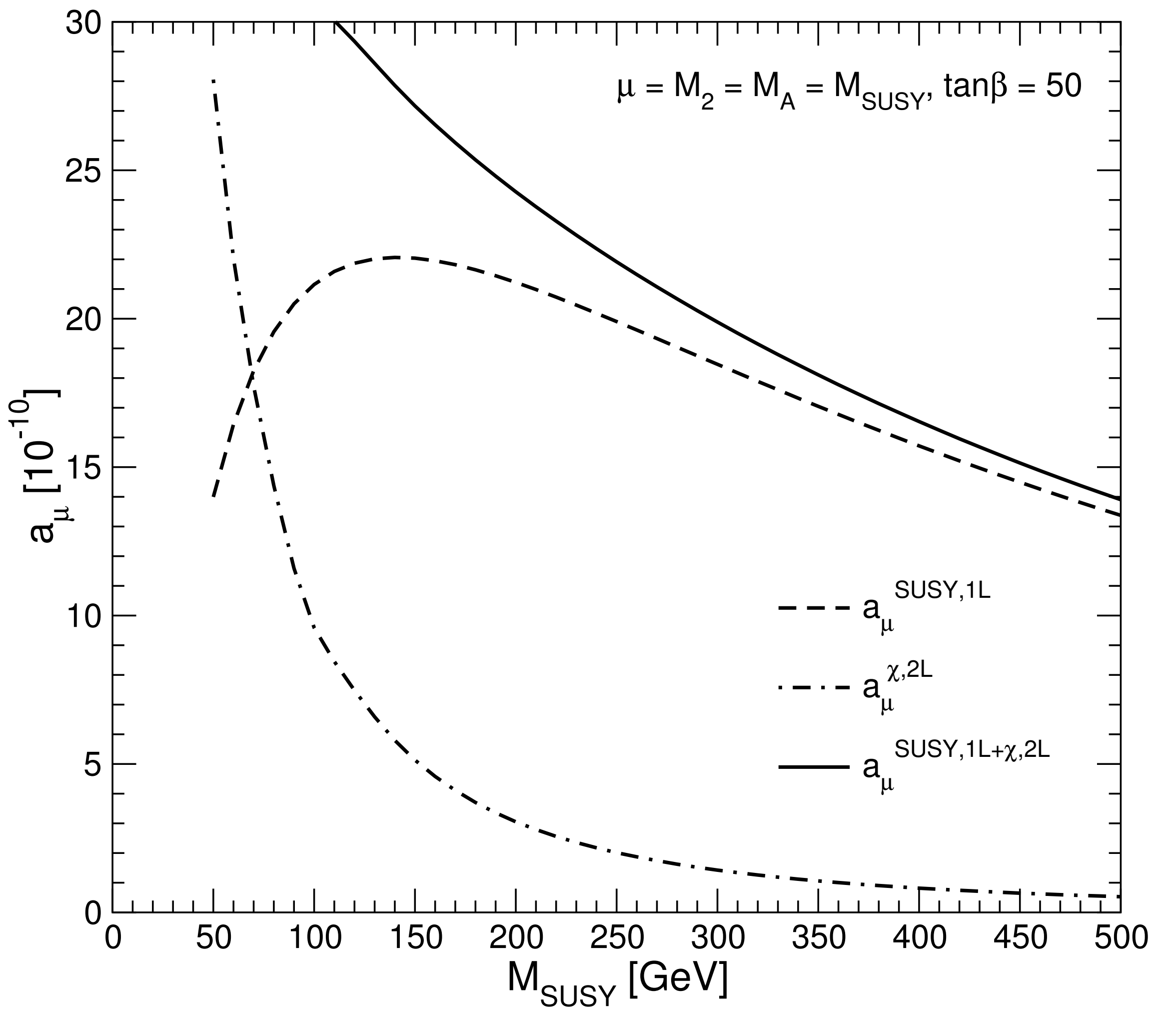
One-loop SUSY contribution (dashed),

two-loop chargino/neutralino contributions (dash-dotted)

and the sum (full line)

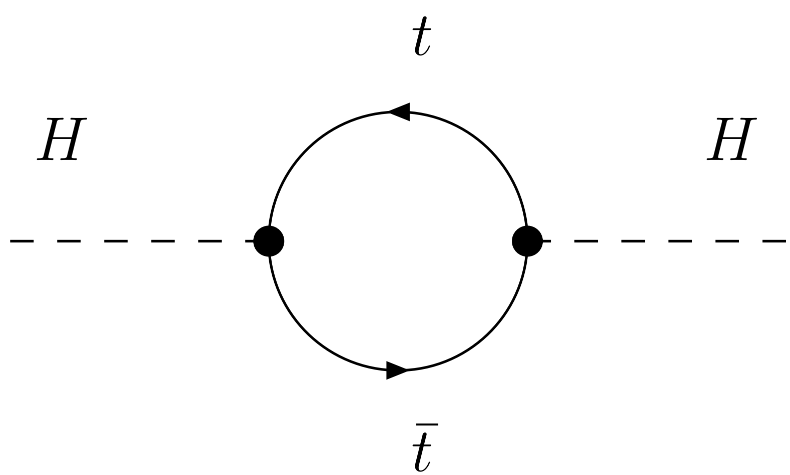
for

$\mu = M_2 = M_A \equiv M_{\rm SUSY}$,
$m_{\tilde f} = 1$ TeV, $\tan\beta = 50$:



Precision Higgs physics

Large coupling of Higgs to top quark

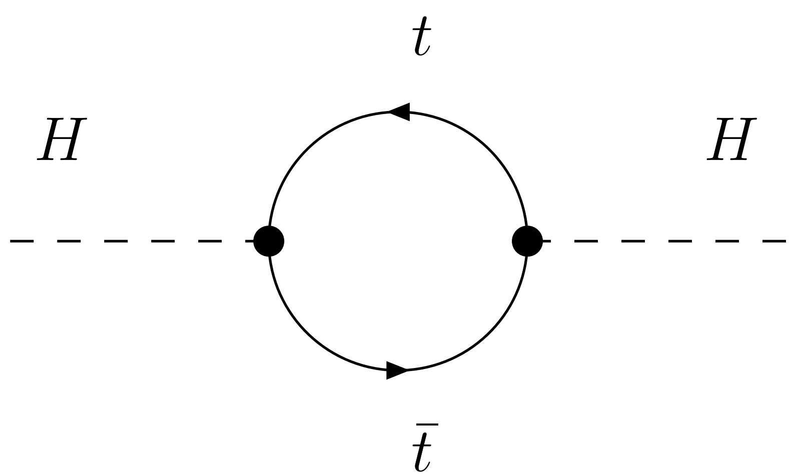


One-loop correction $\sim G_\mu m_\mathrm{t}^4$

$\Rightarrow$ M_H depends sensitively on m_t in all models where M_H can be predicted (SM: M_H is free parameter)

Precision Higgs physics

Large coupling of Higgs to top quark



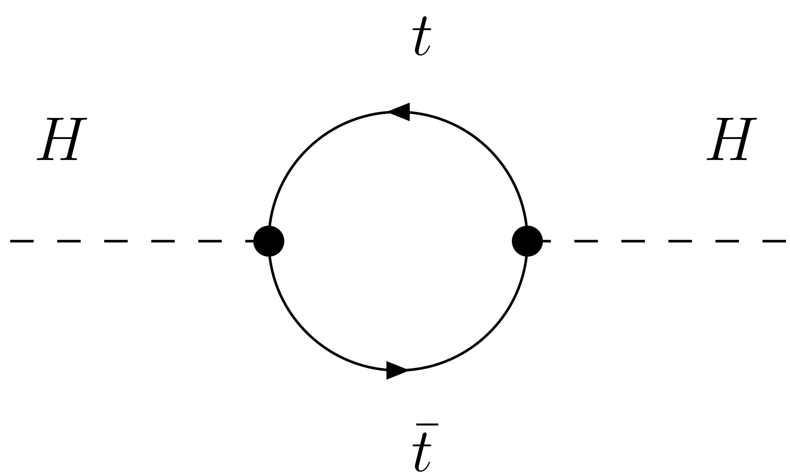
One-loop correction $\sim G_\mu m_t^4$

$\Rightarrow$ M_H depends sensitively on m_t in all models where M_H can be predicted (SM: M_H is free parameter)

SUSY as an example: $\Delta m_t \approx \pm 4$ GeV $\Rightarrow$ $\Delta m_h \approx \pm 4$ GeV

Precision Higgs physics

Large coupling of Higgs to top quark



One-loop correction $\sim G_\mu m_t^4$

$\Rightarrow$ M_H depends sensitively on m_t in all models where M_H can be predicted (SM: M_H is free parameter)

SUSY as an example: $\Delta m_t \approx \pm 4$ GeV $\Rightarrow$ $\Delta m_h \approx \pm 4$ GeV

$\Rightarrow$ Precision Higgs physics needs precision top physics (ILC: $\Delta m_t \lesssim 0.1$ GeV)

Higgs mass bound in the MSSM:

⇒ Prediction for $m_{\rm h}$, $m_{\rm H}$, ...

Tree-level result for $m_{\rm h}$, $m_{\rm H}$:

$$m^2_{\rm H,h} = \frac{1}{2}\left[M_{\rm A}^2 + M_{\rm Z}^2 \pm \sqrt{(M_{\rm A}^2 + M_{\rm Z}^2)^2 - 4M_{\rm Z}^2 M_{\rm A}^2 \cos^2 2\beta}\right]$$

⇒ $m_{\rm h} \leq M_{\rm Z}$ at tree level

MSSM tree-level bound (gauge sector): excluded by LEP!

Large radiative corrections (Yukawa sector, ...):

Yukawa couplings: $\frac{{\rm e}\, m_{\rm t}}{2M_{\rm W}s_{\rm W}}$, $\frac{{\rm e}\, m_{\rm t}^2}{M_{\rm W}s_{\rm W}}$, ...

⇒ Dominant one-loop corrections: $G_\mu m_{\rm t}^4 \ln\left(\frac{m_{\tilde{\rm t}_1} m_{\tilde{\rm t}_2}}{m_{\rm t}^2}\right)$, $\mathcal{O}(100\%)$!

Higgs mass bound in the MSSM:

Present status of m_{h} prediction in the MSSM:

Complete one-loop $+$ “almost complete” two-loop result available

Higgs mass bound in the MSSM:

Present status of m_{h} prediction in the MSSM:

Complete one-loop $+$ "almost complete" two-loop result available

Upper bound on m_{h}:

'Unconstrained' MSSM: M_{A}, $\tan\beta$, 5 param. in $\tilde{\mathrm{t}}$-$\tilde{\mathrm{b}}$ sector, μ, $m_{\tilde{\mathrm{g}}}$, M_2

$$m_{\mathrm{h}} \lesssim 136\,\mathrm{GeV}$$

[*S. Heinemeyer, W. Hollik, G. W. '99*], [*M. Frank, S. Heinemeyer, W. Hollik, G. W. '02*] [*G. Degrassi, S. Heinemeyer, W. Hollik, P. Slavich, G. W. '02*]

Higgs mass bound in the MSSM:

Present status of m_h prediction in the MSSM:

Complete one-loop $+$ “almost complete” two-loop result available

Upper bound on m_h:

‘Unconstrained’ MSSM: M_A, $\tan\beta$, 5 param. in $\tilde{\mathrm{t}}$-$\tilde{\mathrm{b}}$ sector, μ, $m_{\tilde{\mathrm{g}}}$, M_2

$$m_\mathrm{h} \lesssim 136\,\mathrm{GeV}$$

[*S. Heinemeyer, W. Hollik, G. W. ’99*], [*M. Frank, S. Heinemeyer, W. Hollik, G. W. ’02*] [*G. Degrassi, S. Heinemeyer, W. Hollik, P. Slavich, G. W. ’02*]

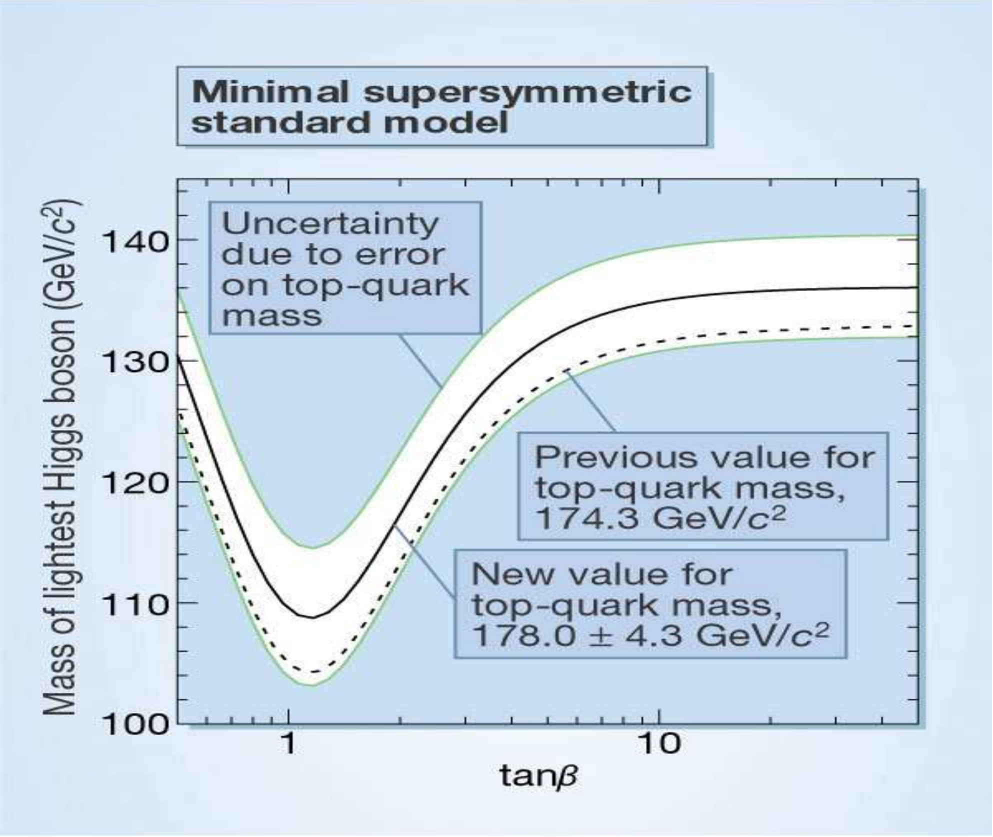
for $m_\mathrm{t} = 178\,\mathrm{GeV}$, no theoretical uncertainties included

Remaining theoretical uncertainties in prediction for m_h*:*

[*G. Degrassi, S. Heinemeyer, W. Hollik, P. Slavich, G. W. '02*]

– From unknown higher-order corrections: $\Rightarrow \Delta m_\mathrm{h} \approx \pm 3$ GeV

– From input parameters: $\Delta m_\mathrm{t} \approx \pm 4$ GeV $\Rightarrow \Delta m_\mathrm{h} \approx \pm 4$ GeV

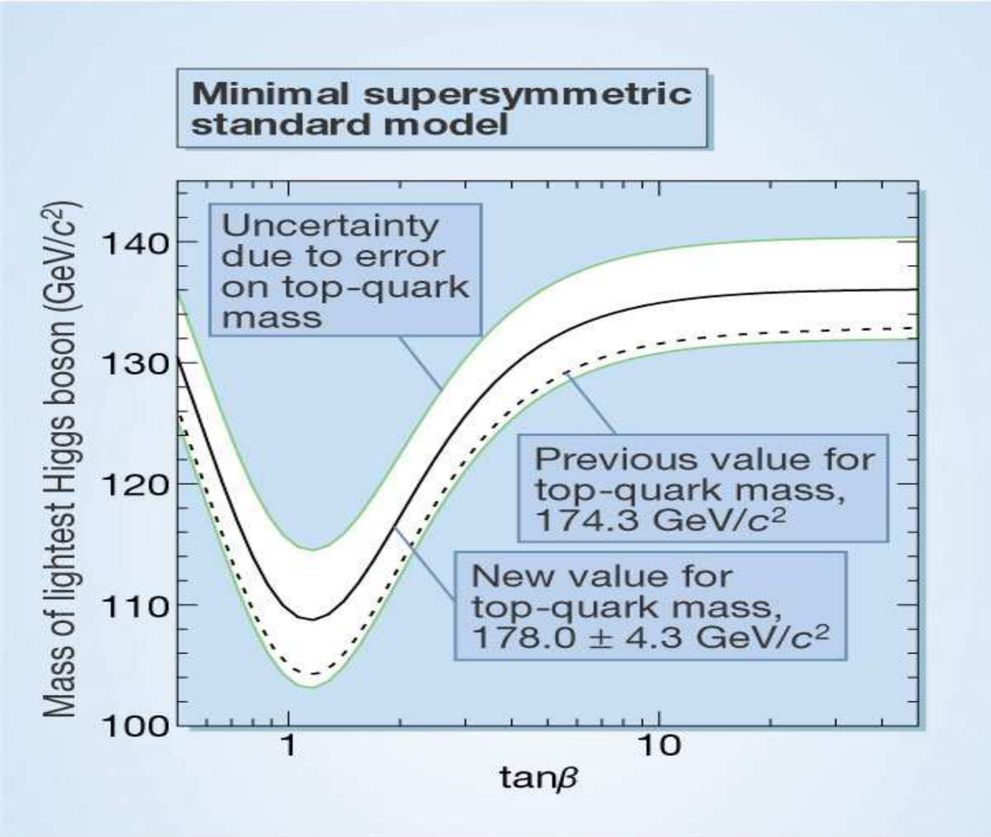


Remaining theoretical uncertainties in prediction for m_h:

[*G. Degrassi, S. Heinemeyer, W. Hollik, P. Slavich, G. W. '02*]

– From unknown higher-order corrections: $\Rightarrow \Delta m_h \approx \pm 3$ GeV

– From input parameters: $\Delta m_t \approx \pm 4$ GeV $\Rightarrow \Delta m_h \approx \pm 4$ GeV



For 1-σ range of m_t:

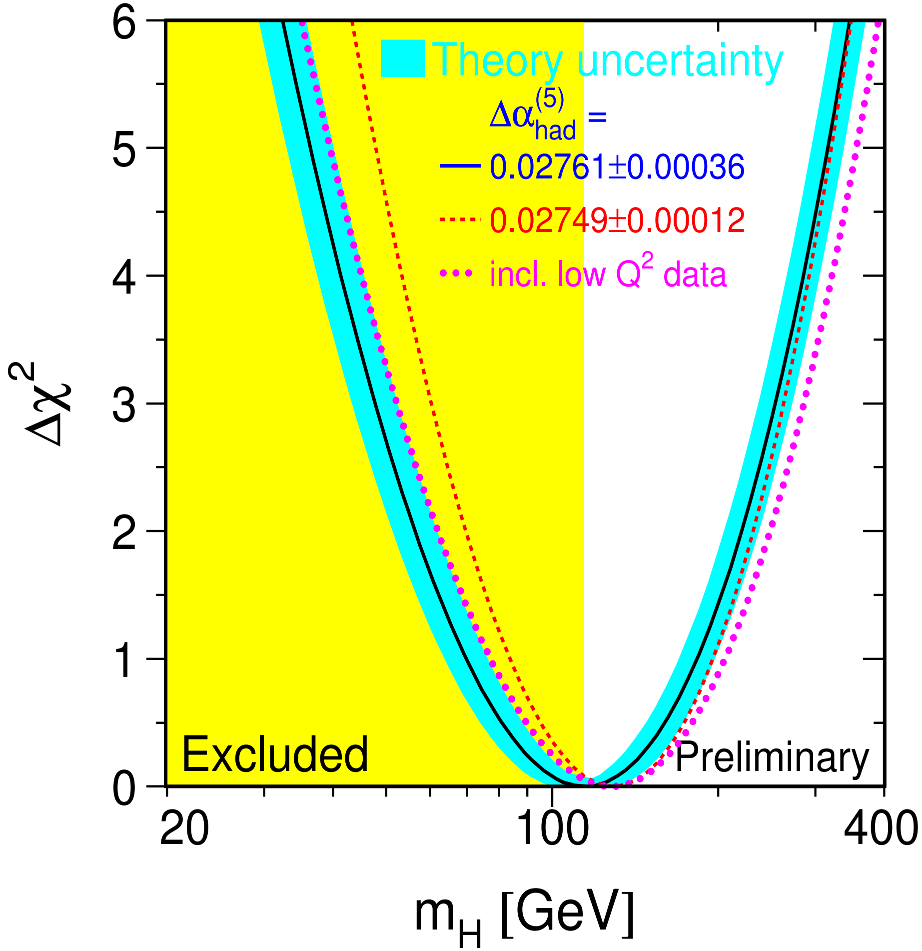
$\Rightarrow$ upper bound beyond $m_h = 140$ GeV

LEP does not exclude any $\tan\beta$ value!

3. Precision tests: Standard Model and Supersymmetry

- Global fit in the SM
- SM vs. MSSM
- Fit to precision observables in the constrained MSSM (mSUGRA) with dark matter constraints

Global fit to all data in the SM



[*LEPEWWG '04*]

Theoretical uncertainties:

– exp. error of input parameters:

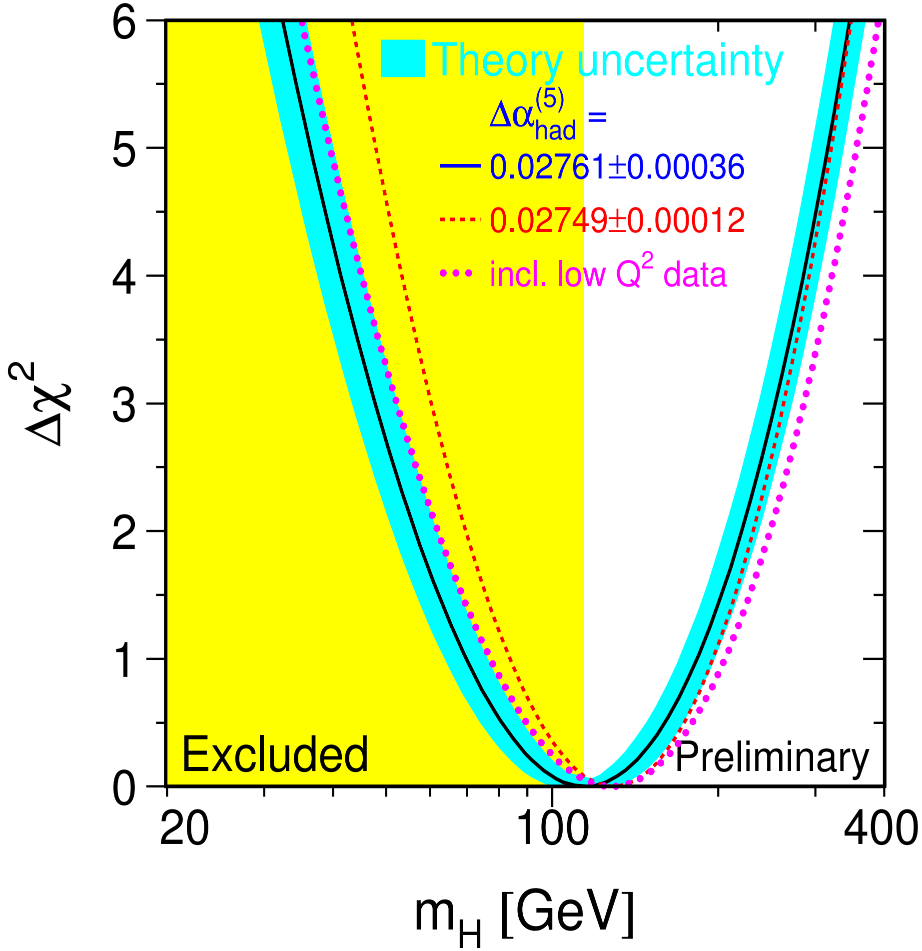
m_t, $\Delta\alpha_{had}$, ...

⇒ large m_t–M_H correlation

– unknown higher-order corrections

⇒ "blue band"

Global fit to all data in the SM



[*LEPEWWG '04*]

Theoretical uncertainties:

– exp. error of input parameters:

$m_t, \Delta\alpha_{had}, \ldots$

$\Rightarrow$ large m_t–M_H correlation

– unknown higher-order corrections

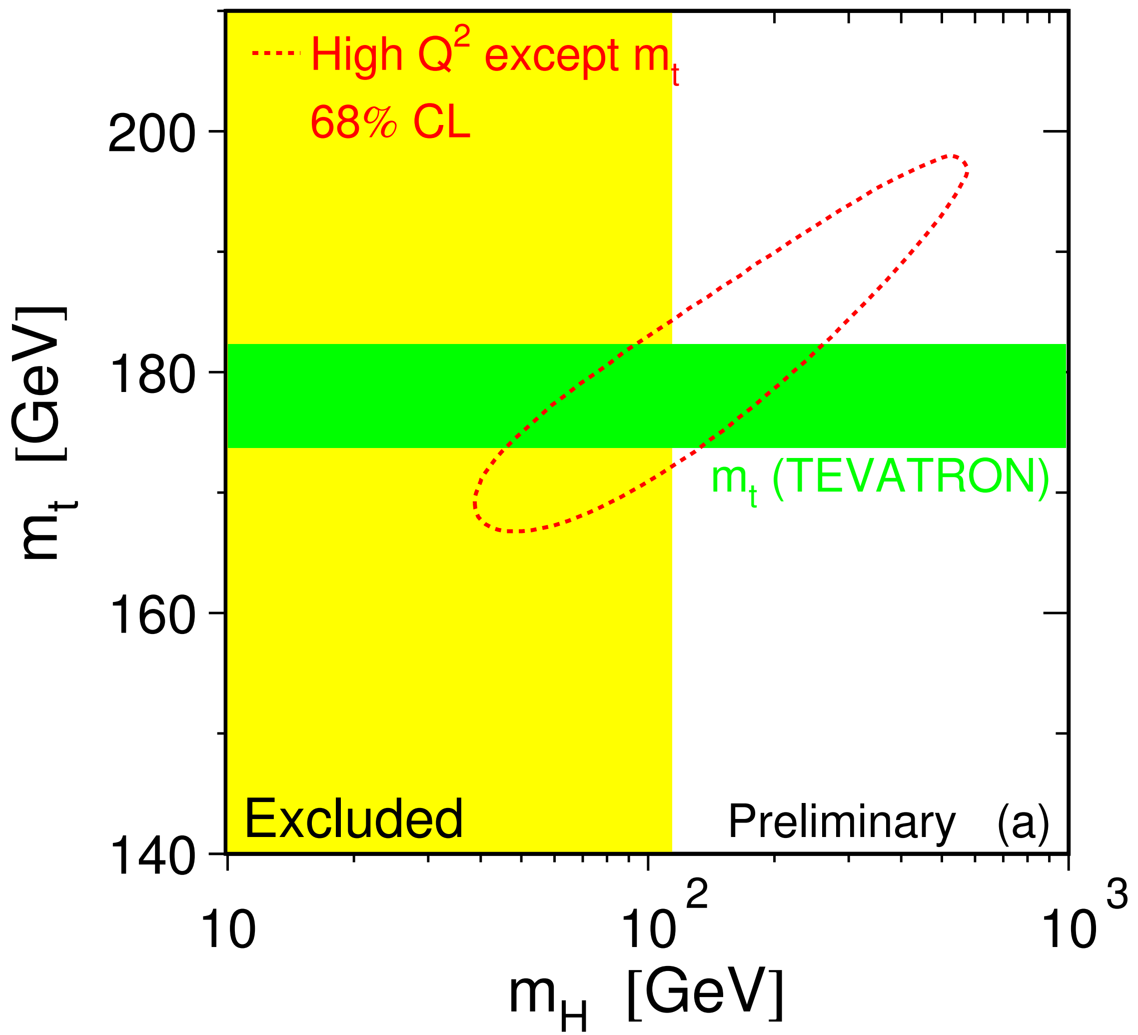
$\Rightarrow$ "blue band"

New m_t value, $m_t = 178.0 \pm 4.3$ GeV, new result for $\sin^2\theta_{eff}$

$\Rightarrow M_H = 114^{+69}_{-45}$ GeV, $M_H < 260$ GeV, 95% C.L.

Correlation between M_{H} and m_{t} in the fit:

[*LEPEWWG '04*]



⇒ Precise knowledge of m_{t} crucial for constraining M_{H}

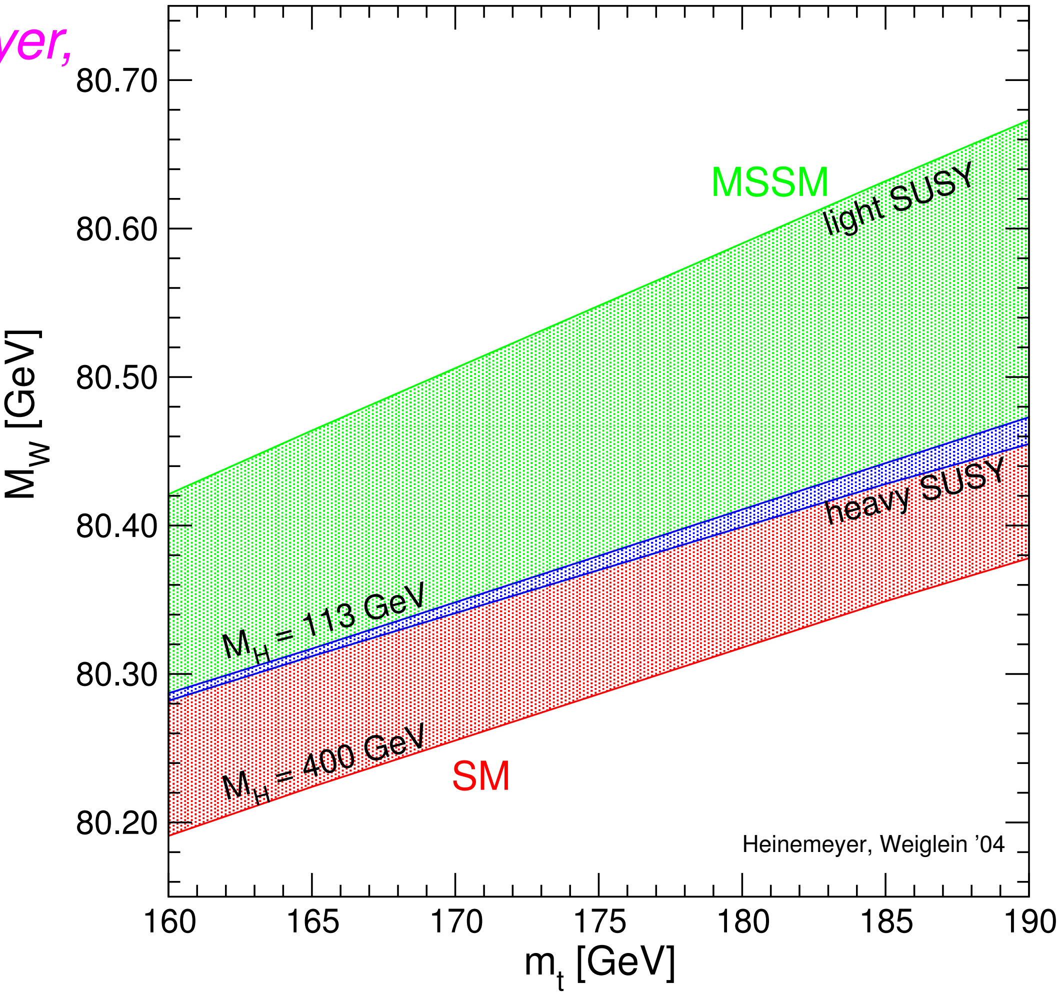
Electroweak precision tests: SM vs. MSSM

Prediction for M_{W} in the SM and the MSSM:

[*A. Djouadi, P. Gambino, S. Heinemeyer, W. Hollik, C. Jünger, G. W. '97*]

[*S. Heinemeyer, W. Hollik, G. W. '98*]

[*S. Heinemeyer, G. W. '02*]



SM: M_{H} varied

MSSM: SUSY parameters varied

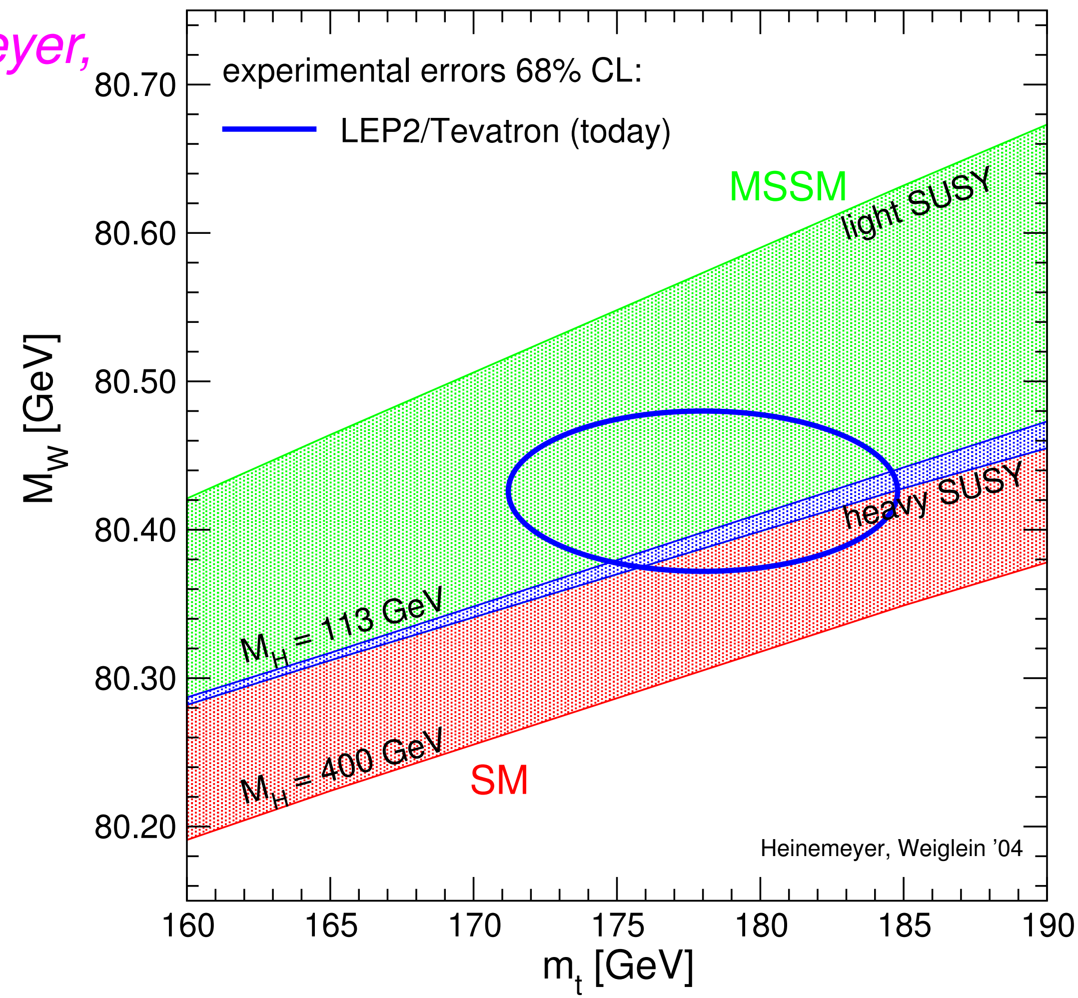
Electroweak precision tests: SM vs. MSSM

Prediction for M_{W} in the SM and the MSSM:

[*A. Djouadi, P. Gambino, S. Heinemeyer, W. Hollik, C. Jünger, G. W. '97*]

[*S. Heinemeyer, W. Hollik, G. W. '98*]

[*S. Heinemeyer, G. W. '02*]



SM: M_{H} varied

MSSM: SUSY parameters varied

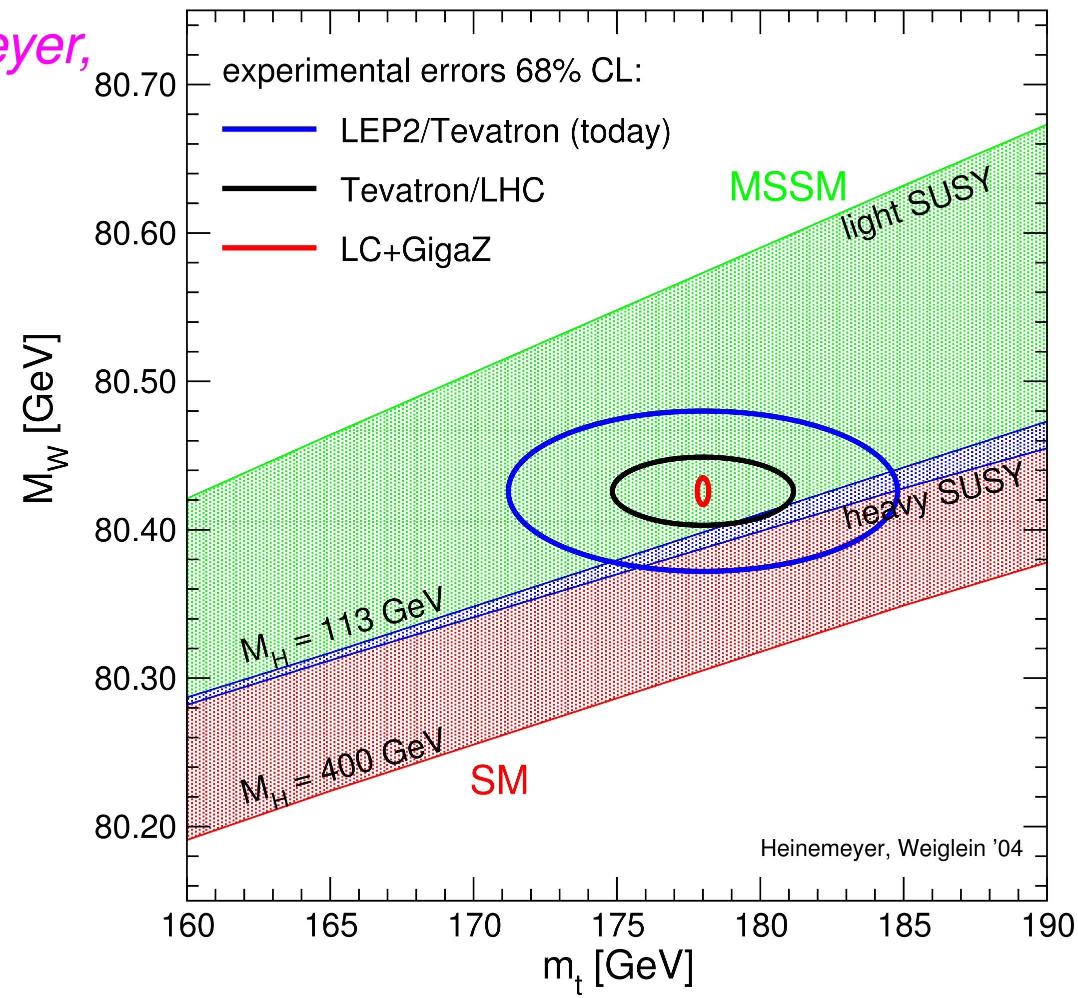
Electroweak precision tests: SM vs. MSSM

Prediction for M_{W} in the SM and the MSSM:

[A. Djouadi, P. Gambino, S. Heinemeyer, W. Hollik, C. Jünger, G. W. '97]

[S. Heinemeyer, W. Hollik, G. W. '98]

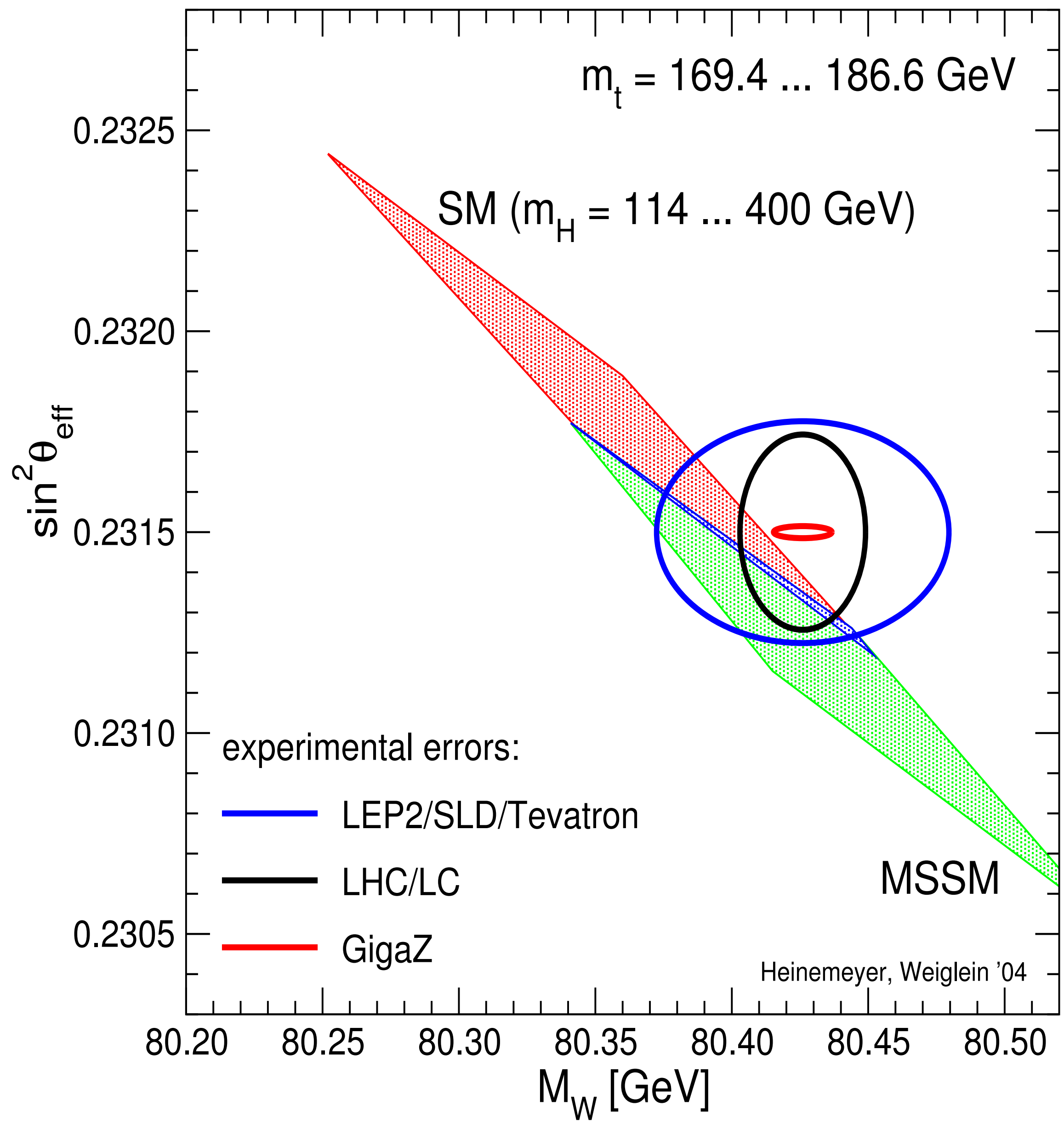
[S. Heinemeyer, G. W. '02]



SM: M_{H} varied

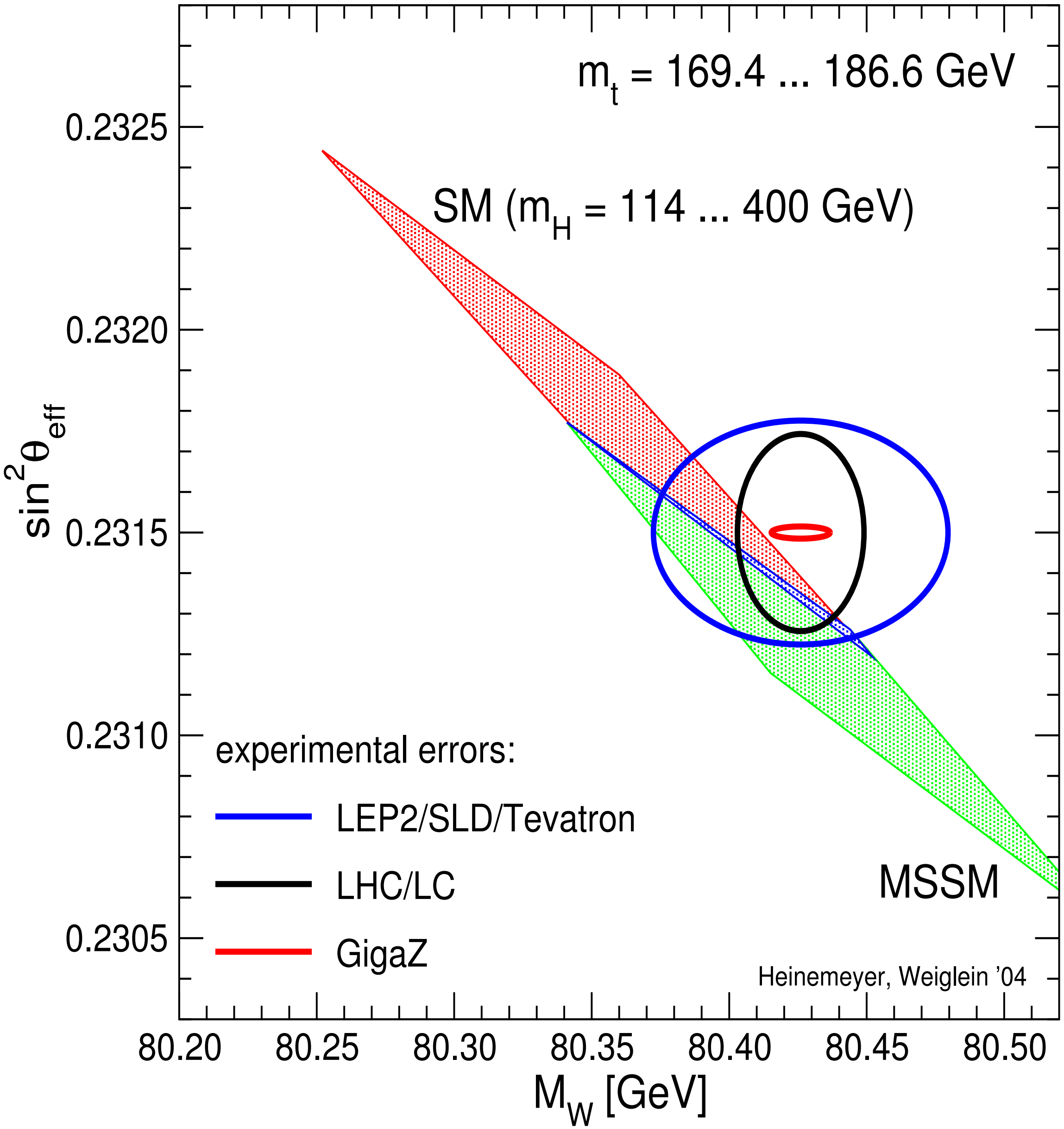
MSSM: SUSY parameters varied

Prediction for M_W, $\sin^2\theta_\mathrm{eff}$ in SM and MSSM:



[S. Heinemeyer, W. Hollik, G. W. '04]

Prediction for M_W, $\sin^2\theta_{\rm eff}$ in SM and MSSM:



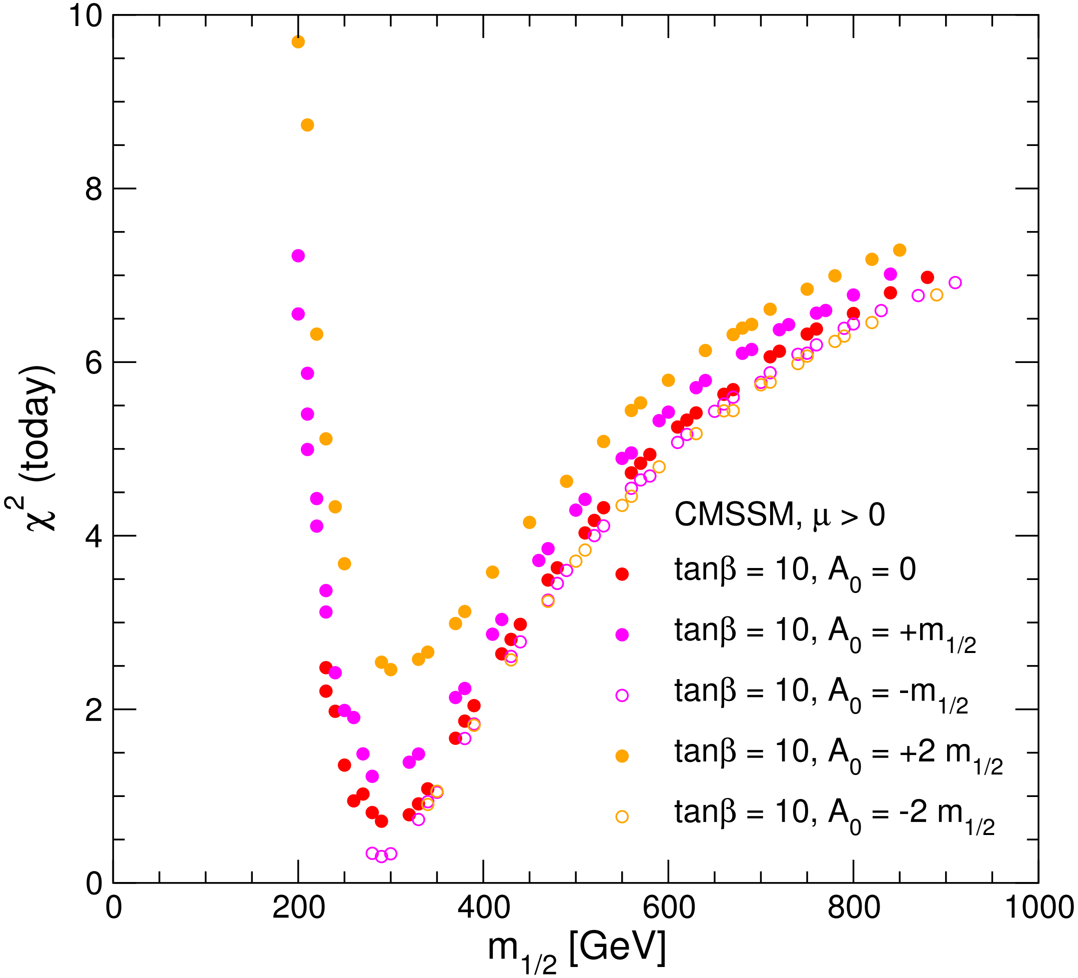
[S. Heinemeyer, W. Hollik, G. W. '04]

$\Rightarrow$ High sensitivity to deviations from both the SM and the MSSM

χ^2 fit in mSUGRA with dark matter constraints: M_W, $\sin^2\theta_{\text{eff}}$, $(g-2)_\mu$, $\text{BR}(b \to s\gamma)$

[J. Ellis, S. Heinemeyer, K. Olive, G. W. '04]

$\tan\beta = 10$:



$\Rightarrow$ very good description of the data

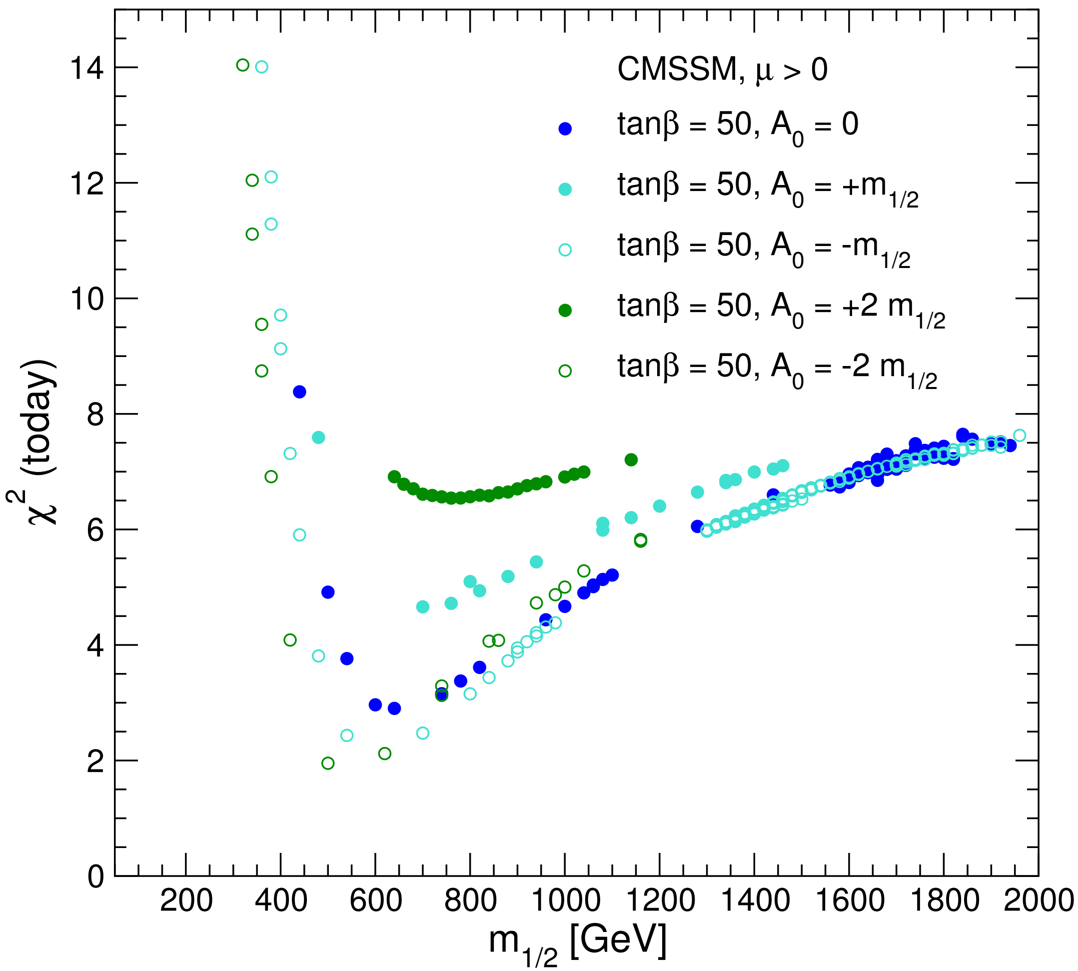
preference for relatively small mass values

χ^2 *fit in mSUGRA with dark matter constraints:*

M_W, $\sin^2\theta_{\text{eff}}$, $(g-2)_\mu$, $\text{BR}(b \to s\gamma)$

[*J. Ellis, S. Heinemeyer, K. Olive, G. W. '04*]

$\tan\beta = 50$:



$\Rightarrow$ worse fit quality

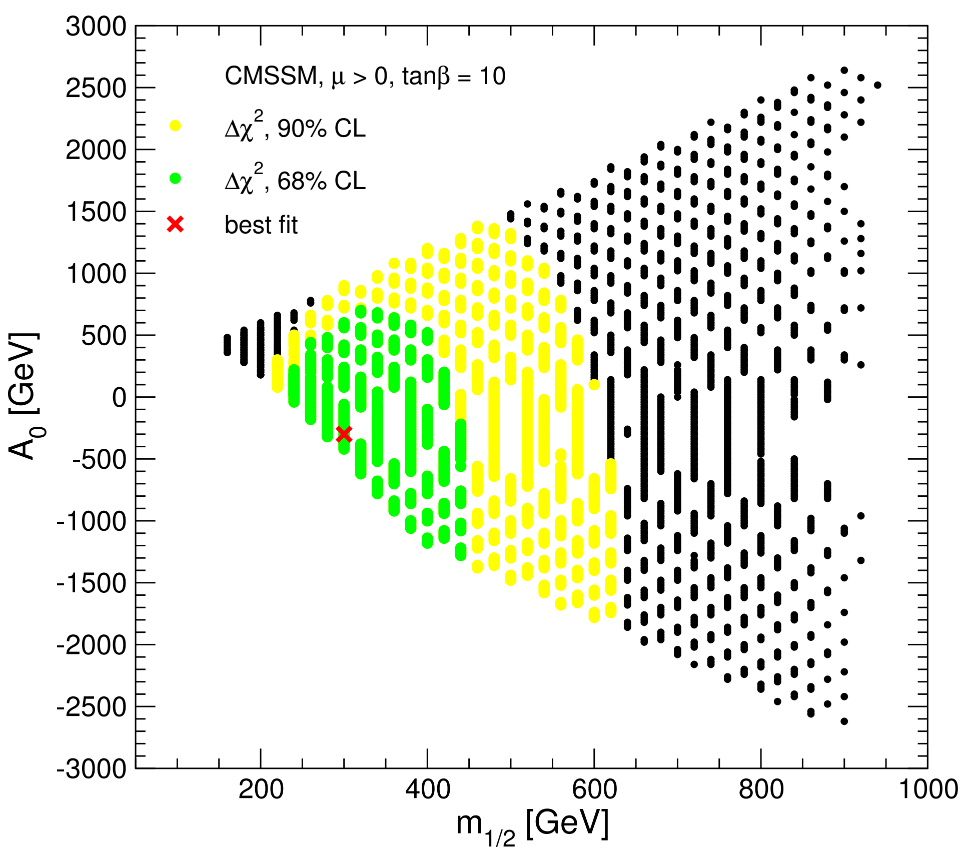
preferred $m_{1/2}$ values larger by 200–300 GeV compared to $\tan\beta = 10$ case

χ^2 *fit in mSUGRA with dark matter constraints:*
M_W, $\sin^2\theta_{eff}$, $(g-2)_\mu$, $BR(b \to s\gamma)$

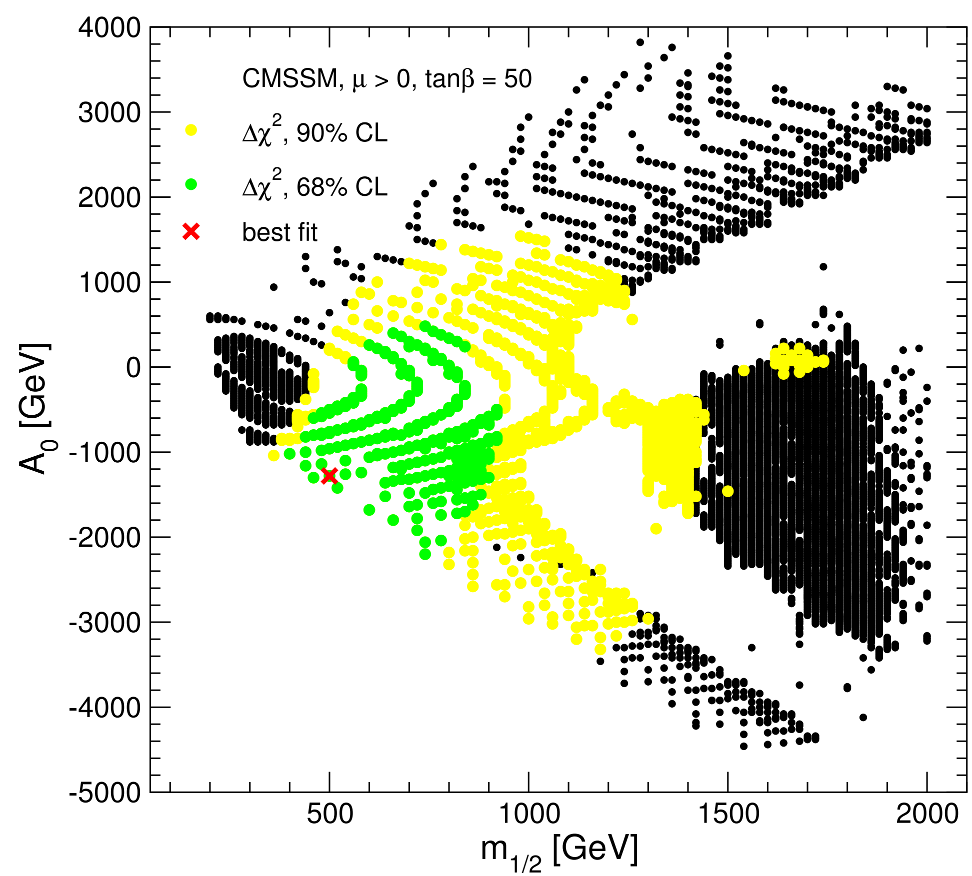
68% and 90% C.L. regions in $m_{1/2}$–A_0 plane:

[*J. Ellis, S. Heinemeyer, K. Olive, G. W. '04*]

$\tan\beta = 10$:



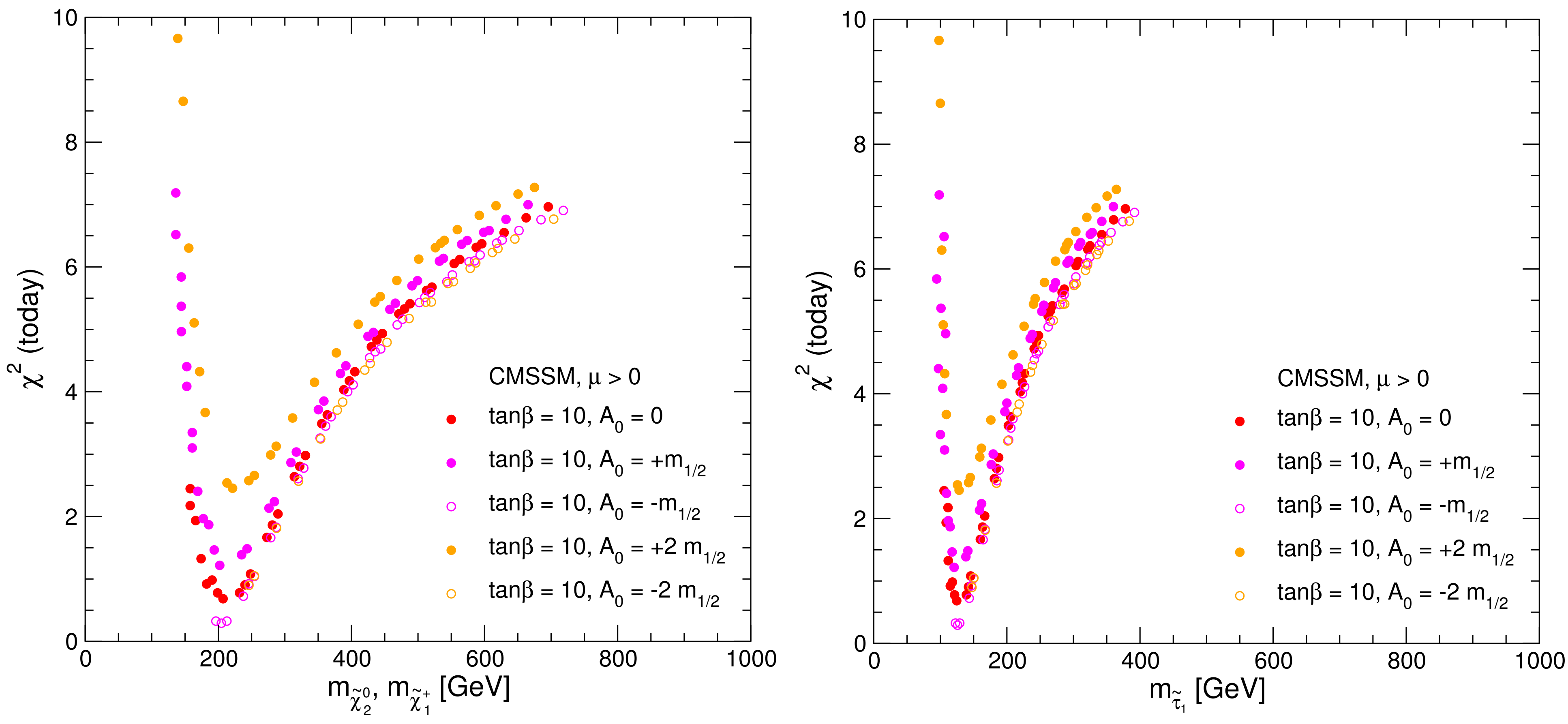
$\tan\beta = 50$:



Fit results for particle masses, $\tan\beta = 10$*:*

$$m_{\tilde{\chi}_1^+} \approx m_{\tilde{\chi}_2^0}, \quad m_{\tilde{\tau}_1}$$

[*J. Ellis, S. Heinemeyer, K. Olive, G. W. '04*]



$\Rightarrow$ Good prospects for the LHC and ILC

4. Conclusions

- Global SM fit

  $\Rightarrow$ preference for light Higgs, $M_{\mathrm{H}} \lesssim 260\ \mathrm{GeV}$

  strong m_{t}–M_{H} correlation

4. Conclusions

- Global SM fit

  $\Rightarrow$ preference for light Higgs, $M_{\rm H} \lesssim 260$ GeV

  strong $m_{\rm t}$–$M_{\rm H}$ correlation

- Fit in mSUGRA with dark matter constraints:

  $\Rightarrow$ very good description of the data

  preference for relatively small SUSY masses

  good prospects for LHC and ILC

4. Conclusions

- Global SM fit

  $\Rightarrow$ preference for light Higgs, $M_{\rm H} \lesssim 260~\rm GeV$

  strong $m_{\rm t}$–$M_{\rm H}$ correlation

- Fit in mSUGRA with dark matter constraints:

  $\Rightarrow$ very good description of the data

  preference for relatively small SUSY masses

  good prospects for LHC and ILC

- At Tevatron, LHC, ILC: improved accuracy of prec. observables

  $M_{\rm W}$, $\sin^2\theta_{\rm eff}$, $m_{\rm h}$, ... and input parameters $m_{\rm t}$, $m_{\tilde{\rm t}}$, ...

  $\Rightarrow$ Very sensitive test of electroweak theory