
We still believe in supersymmetry
You must be joking

SUSY Higgs Bosons the LHC and ILC/CLIC

Sven Heinemeyer, IFT/IFCA (CSIC, Madrid/Santander)

Corfu, 09/2018

- Motivation & Models
- Experimental data & Tools
- Where are SUSY Higgs Bosons
- A Higgs Boson at 96 GeV?!
- Conclusions

1. Motivation & Models

Fact:

The SM cannot be the ultimate theory!

1. gravity is not included

2. the hierarchy problem

3. Dark Matter is not included

4. neutrino masses are not included

5. anomalous magnetic moment of the muon shows a $\sim 4\,\sigma$ discrepancy

$\Rightarrow$ Time to get ready for BSM physics

Which model should we focus on?

Some "recent" measurements:

– top quark mass
– Higgs boson mass
– Higgs boson "couplings"
– Dark Matter (properties)

Which model should we focus on?

Some “recent” measurements:

– top quark mass
– Higgs boson mass
– Higgs boson “couplings”
– Dark Matter (properties)

Simple SUSY models predicted correctly:

– top quark mass
– Higgs boson mass
– Higgs boson “couplings”
– Dark Matter (properties)

Which model should we focus on?

Some "recent" measurements:

– top quark mass
– Higgs boson mass
– Higgs boson "couplings"
– Dark Matter (properties)

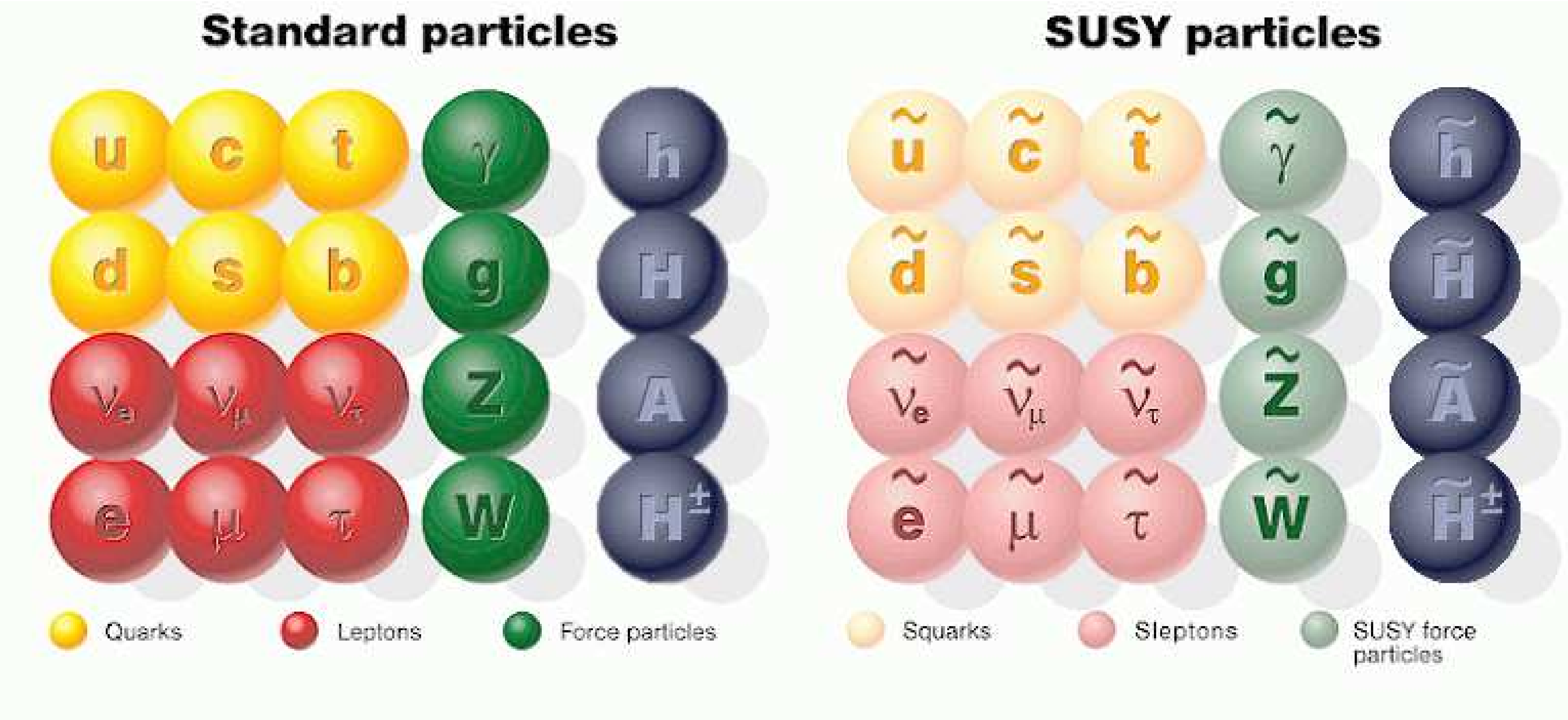
Simple SUSY models predicted correctly:

– top quark mass
– Higgs boson mass
– Higgs boson "couplings"
– Dark Matter (properties)

$\Rightarrow$ **good motivation to look at SUSY! :-)**

The Minimal Supersymmetric Standard Model (MSSM)

Superpartners for Standard Model particles



Problem in the MSSM: more than 100 free parameters

Nobody(?) believes that a model describing nature
has so many free parameters!

A. Unconstrained models (MSSM):

agnostic about how SUSY breaking is achieved
no particular SUSY breaking mechanism assumed, parameterization of possible soft SUSY-breaking terms

most general case: 105 new parameters: masses, mixing angles, phases

(⇒ many (close to) zero according to experimental data)

⇒ no model missed (within the MSSM)

⇒ $\mathcal{O}(100)$ parameters difficult to handle

B. Constrained models: → T

CMSSM, NUHM1, NUHM2, SU(5), mAMSB, sub-GUT, FUTs, . . . :

assumption on the scenario that achieves spontaneous SUSY breaking
⇒ prediction for soft SUSY-breaking terms
in terms of small set of parameters

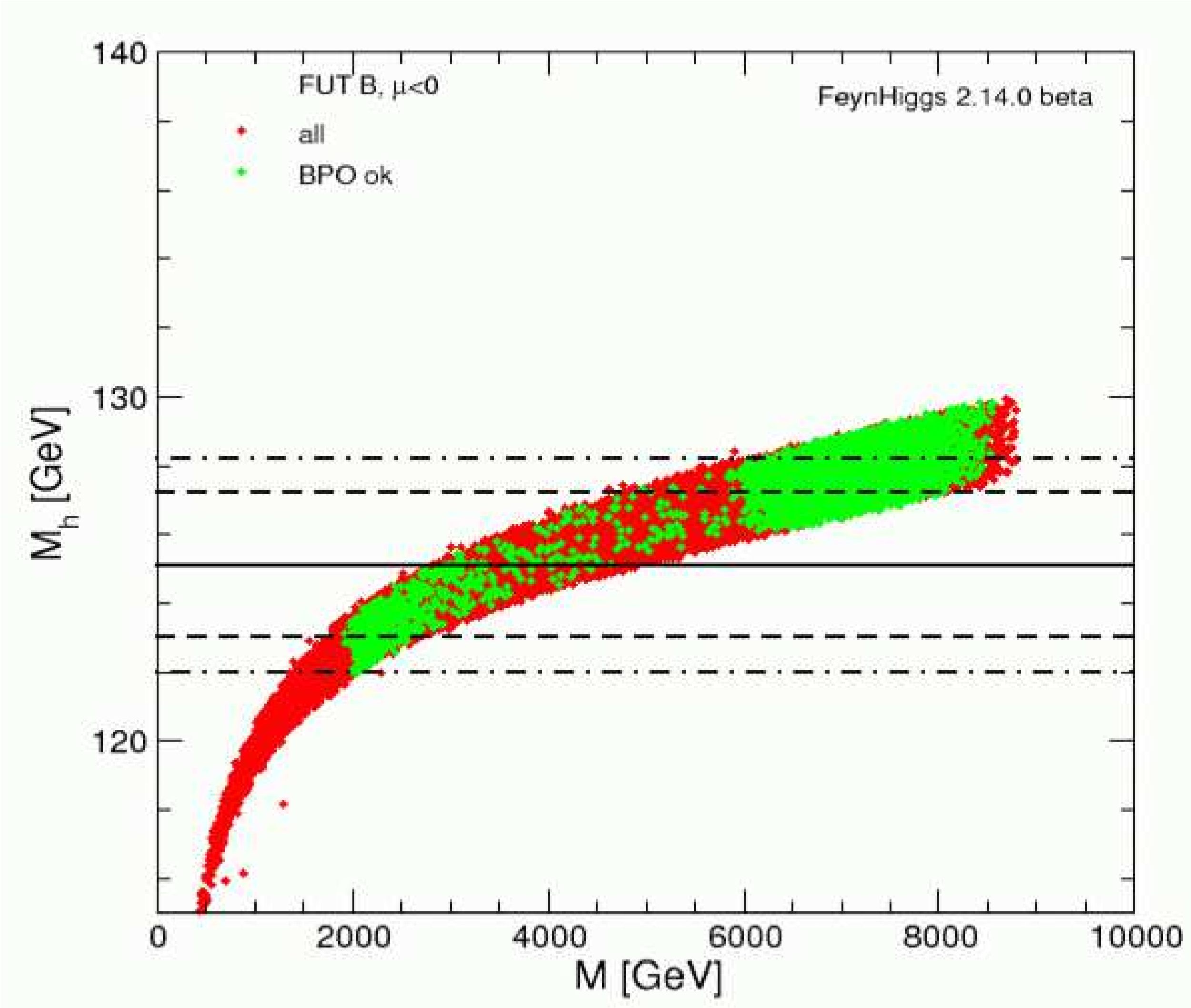
⇒ easy to handle, but not all relevant phenomenology captured

C. Benchmark scenrios:

fix all-2 MSSM parameters in a smart way, explore benchmark planes
⇒ easy to handle, interesting phenomenology captured!

B. Constrained models: Other "(dis)advantages":

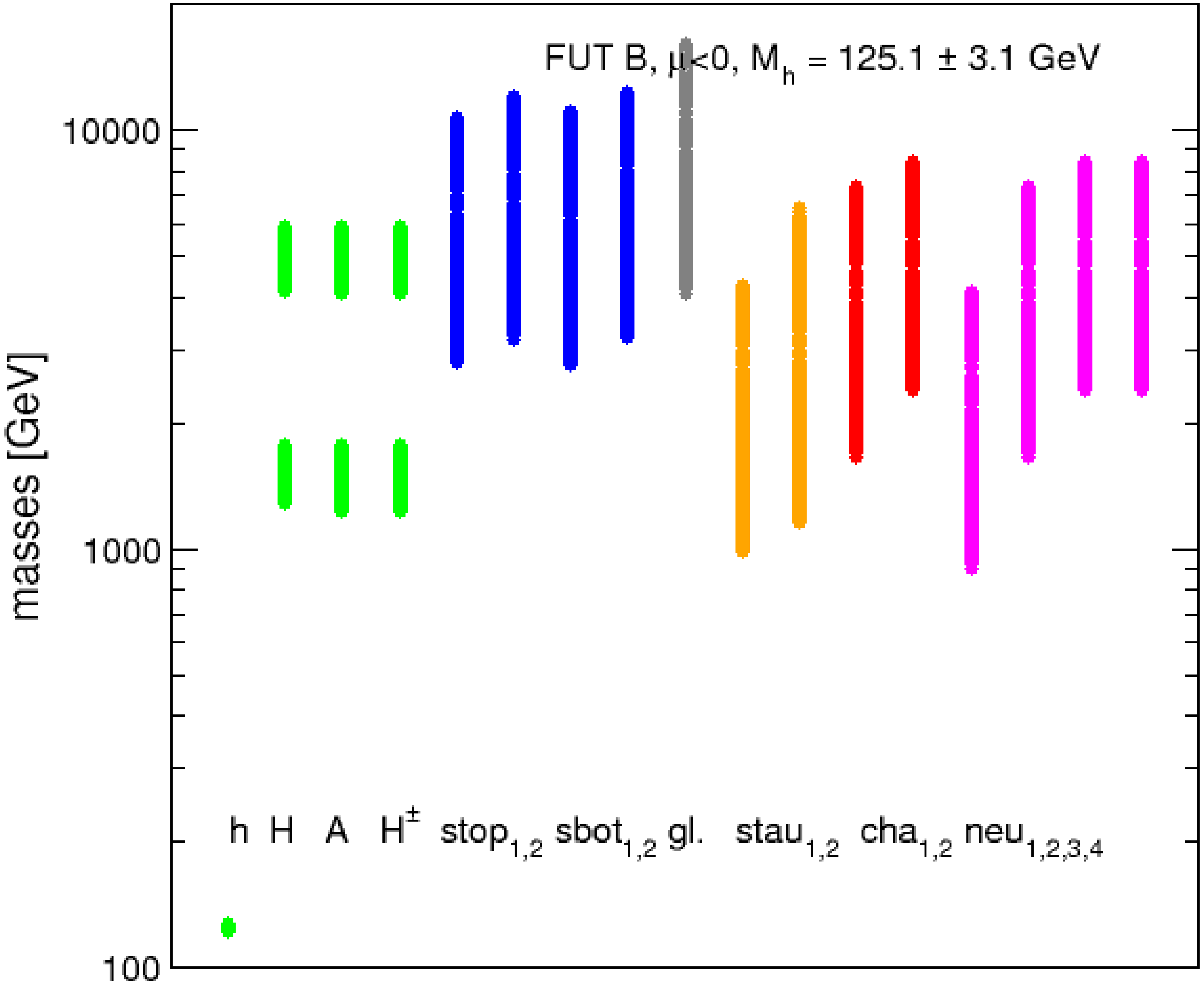
[*S.H., M. Mondragon, N. Tracas, G. Zoupanos*]



⇒ Higgs mass correct . . .

B. Constrained models: Other "(dis)advantages":

[*S.H., M. Mondragon, N. Tracas, G. Zoupanos*]



⇒ . . . but with a very (too) heavy mass spectrum

The MSSM Higgs sector:

Enlarged Higgs sector: Two Higgs doublets

$$H_1 = \begin{pmatrix} H_1^1 \\ H_1^2 \end{pmatrix} = \begin{pmatrix} v_1 + (\phi_1 + i\chi_1)/\sqrt{2} \\ \phi_1^- \end{pmatrix}$$

$$H_2 = \begin{pmatrix} H_2^1 \\ H_2^2 \end{pmatrix} = \begin{pmatrix} \phi_2^+ \\ v_2 + (\phi_2 + i\chi_2)/\sqrt{2} \end{pmatrix}$$

$$V = m_1^2 H_1 \bar{H}_1 + m_2^2 H_2 \bar{H}_2 - m_{12}^2 (\epsilon_{ab} H_1^a H_2^b + \text{h.c.})$$

$$+ \underbrace{\frac{g'^2 + g^2}{8}}(H_1 \bar{H}_1 - H_2 \bar{H}_2)^2 + \underbrace{\frac{g^2}{2}} |H_1 \bar{H}_2|^2$$

gauge couplings, in contrast to SM

physical states: $h^0, H^0, A^0, H^\pm$ Goldstone bosons: $G^0, G^\pm$

Input parameters: (to be determined experimentally)

$$\tan\beta = \frac{v_2}{v_1}, \qquad M_A^2 = -m_{12}^2 (\tan\beta + \cot\beta)$$

The MSSM Higgs sector: with $\mathcal{CP}$ violation

Enlarged Higgs sector: Two Higgs doublets

$$H_1 = \begin{pmatrix} H_1^1 \\ H_1^2 \end{pmatrix} = \begin{pmatrix} v_1 + (\phi_1 + i\chi_1)/\sqrt{2} \\ \phi_1^- \end{pmatrix}$$

$$H_2 = \begin{pmatrix} H_2^1 \\ H_2^2 \end{pmatrix} = e^{i\xi} \begin{pmatrix} \phi_2^+ \\ v_2 + (\phi_2 + i\chi_2)/\sqrt{2} \end{pmatrix}$$

$$V = m_1^2 H_1 \bar{H}_1 + m_2^2 H_2 \bar{H}_2 - m_{12}^2 (\epsilon_{ab} H_1^a H_2^b + \text{h.c.}) + \underbrace{\frac{g'^2 + g^2}{8}}(H_1 \bar{H}_1 - H_2 \bar{H}_2)^2 + \underbrace{\frac{g^2}{2}} |H_1 \bar{H}_2|^2$$

gauge couplings, in contrast to SM

physical states: $h^0, H^0, A^0, H^\pm$ Goldstone bosons: $G^0, G^\pm$

Input parameters: (to be determined experimentally)

$$\tan\beta = \frac{v_2}{v_1}, \qquad M_{H^\pm}^2$$

2 $\mathcal{CP}$-violating phases: ξ, $\arg(m_{12})$ $\Rightarrow$ can be set/rotated to zero

The Higgs sector of the cMSSM at the loop-level:

Complex parameters enter via loop corrections:

- μ : Higgsino mass parameter
- $A_{t,b,\tau}$: trilinear couplings $\Rightarrow X_{t,b,\tau} = A_{t,b,\tau} - \mu^* \{\cot\beta, \tan\beta\}$ complex
- $M_{1,2}$: gaugino mass parameter (one phase can be eliminated)
- M_3 : gluino mass parameter

$\Rightarrow$ can induce $\mathcal{CP}$-violating effects

Result:

$$(A, H, h) \to (h_3, h_2, h_1)$$

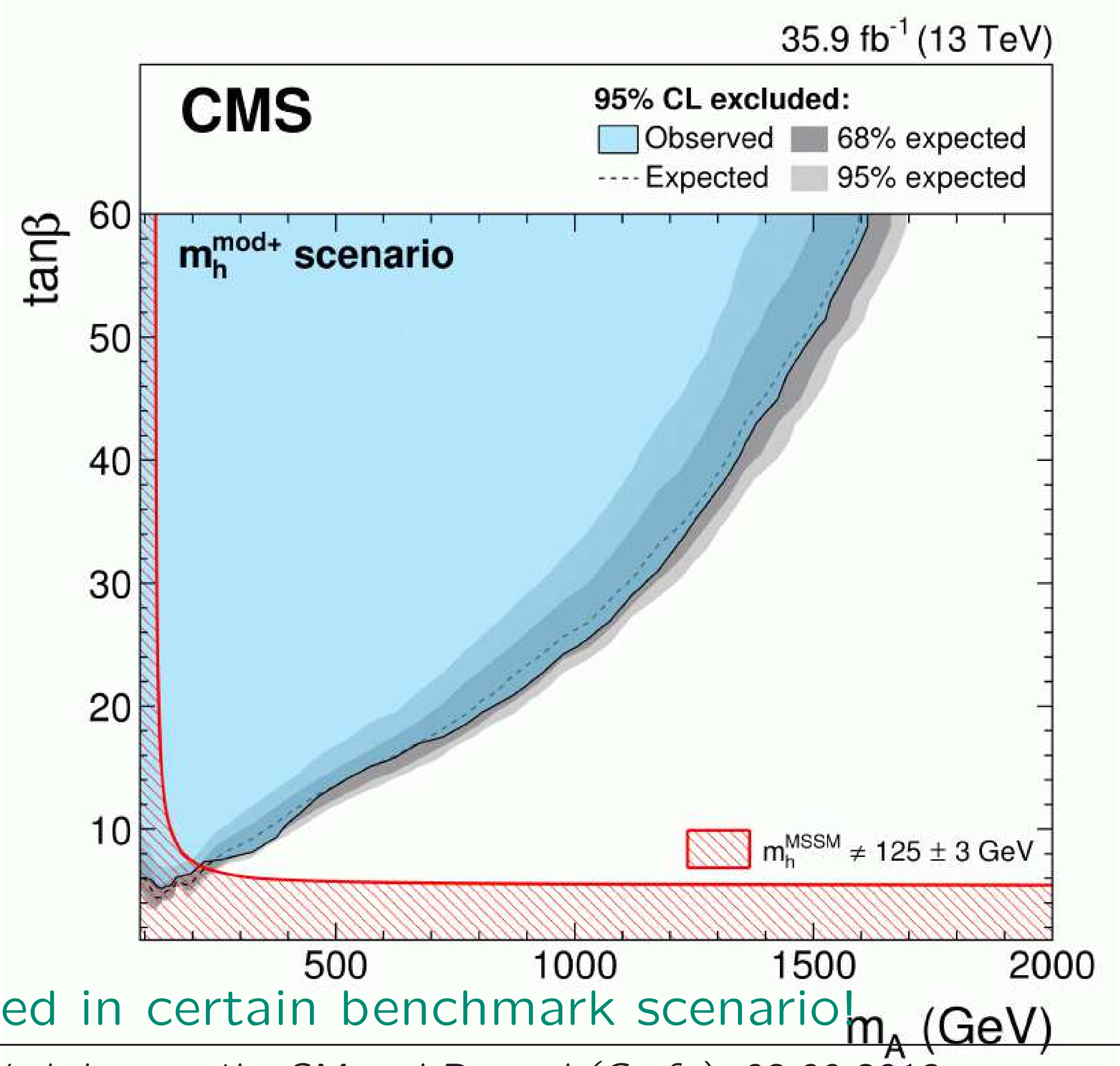
with

$$m_{h_3} > m_{h_2} > m_{h_1}$$

$\Rightarrow$ strong changes in Higgs couplings to SM gauge bosons and fermions

Latest results for neutral heavy Higgs bosons: [*CMS '18*]

MSSM Higgs exclusion contours in M_A–$\tan\beta$ plane: $b\bar{b}, gg \to h, H, A \to \tau^+\tau^-$



⇒ limits obtained in certain benchmark scenario!

We have a $\sim 125\ \mathrm{GeV}$ SM-like Higgs boson

$\Rightarrow$ What are the options?

1. Decoupling limit:
   $M_A \gg M_Z \Rightarrow$ the light Higgs becomes SM-like

2. Alignment without decoupling:
   $\Rightarrow$ a $\mathcal{CP}$-even Higgs becomes SM-like due to an "accidental" cancellation

3. Heavy Higgs SM-like: (in the "alignment w/o decoupling" scen.)
   $\Rightarrow$ is the case with the heavy $\mathcal{CP}$-even Higgs being SM-like (still) a viable solution?

Obtaining a light Higgs with SM-like couplings

[*J. Gunion, H. Haber, hep-ph/0207010*]

$\to$ $\mathcal{CP}$ conserving 2HDM in the Higgs basis ($\langle H_1 \rangle = v/\sqrt{2}$, $\langle H_2 \rangle = 0$)

$$\mathcal{V} = \ldots + \tfrac{1}{2} Z_1 (H_1^\dagger H_1)^2 + \ldots + \left[\tfrac{1}{2} Z_5 (H_1^\dagger H_2)^2 + Z_6 (H_1^\dagger H_1)(H_1^\dagger H_2) + \text{h.c.} \right] + \ldots$$

$\Rightarrow$ $\mathcal{CP}$-even mass matrix:

$$\mathcal{M}^2 = \begin{pmatrix} Z_1 v^2 & Z_6 v^2 \\ Z_6 v^2 & M_A^2 + Z_5 v^2 \end{pmatrix}$$

with mixing angle $\cos(\beta - \alpha) \equiv c_{\beta-\alpha}$

Decoupling limit: $M_A^2 \gg Z_i v^2$
$\Rightarrow m_h^2 \sim Z_1 v^2$, $|c_{\beta-\alpha} \ll 1|$, h is SM-like

Alignment limit: $Z_6 = 0$ and $Z_1 < Z_5 + M_A^2/v^2$
$\Rightarrow$ h is identical to the SM Higgs, $c_{\beta-\alpha} = 0$
$Z_6 = 0$ and $Z_1 > Z_5 + M_A^2/v^2$
$\Rightarrow$ H is identical to the SM Higgs, $c_{\beta-\alpha} = 1$

Alignment limit: see e.g.

[M. Carena, I. Low, N. Shah, C. Wagner '13][M. Carena, H. Haber, I. Low, N. Shah, C. Wagner '14]

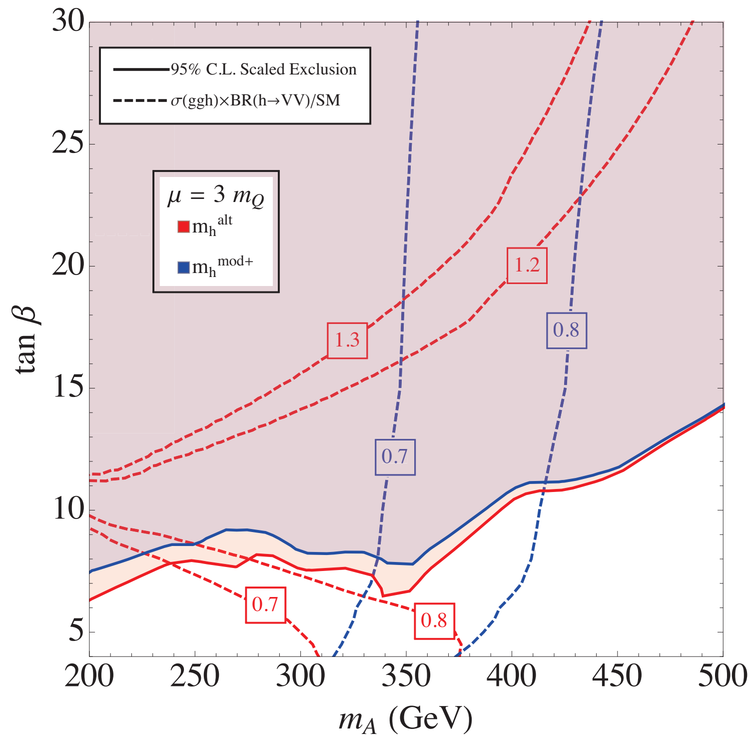
In the MSSM $Z_6 = 0$ can be obtained through an "accidental" cancellation between tree-level and loop contribution, roughly at:

$$\tan\beta \sim \left[M_h^2 + M_Z^2 + \frac{3m_t^2\mu^2}{4\pi^2 v^2 M_S^2}\left(\frac{A_t^2}{2M_S^2} - 1\right)\right] \Big/ \left[\frac{3m_t^2}{4\pi^2 v^2}\frac{\mu A_t}{M_S^2}\left(\frac{A_t^2}{6M_S^2} - 1\right)\right]$$

Compare: $m_h^{\text{mod+}}$ and m_h^{alt} :
$A_t/M_S = 2.45$, $A_t = A_f$,
$M_S = m_{\tilde f} \geq 1$ TeV, $m_{\tilde g} = 1.5$ TeV,
$M_2 = 2\,M_1 = 200$ GeV, μ adjustable

(low M_A and $\tan\beta$: tune $M_S \geq 1$ TeV to obtain $M_h \geq 122$ GeV)

$\Rightarrow$ SM-like Higgs for all M_A



Alignment limit: see e.g.

[M. Carena, I. Low, N. Shah, C. Wagner '13][M. Carena, H. Haber, I. Low, N. Shah, C. Wagner '14]

In the MSSM $Z_6 = 0$ can be obtained through an "accidental" cancellation between tree-level and loop contribution, roughly at:

$$\tan\beta \sim \left[M_h^2 + M_Z^2 + \frac{3m_t^2\mu^2}{4\pi^2 v^2 M_S^2}\left(\frac{A_t^2}{2M_S^2} - 1\right)\right] \Big/ \left[\frac{3m_t^2}{4\pi^2 v^2}\frac{\mu A_t}{M_S^2}\left(\frac{A_t^2}{6M_S^2} - 1\right)\right]$$

$m_h^{\rm alt}$: HiggsSignals [P. Bechtle et al. '15]

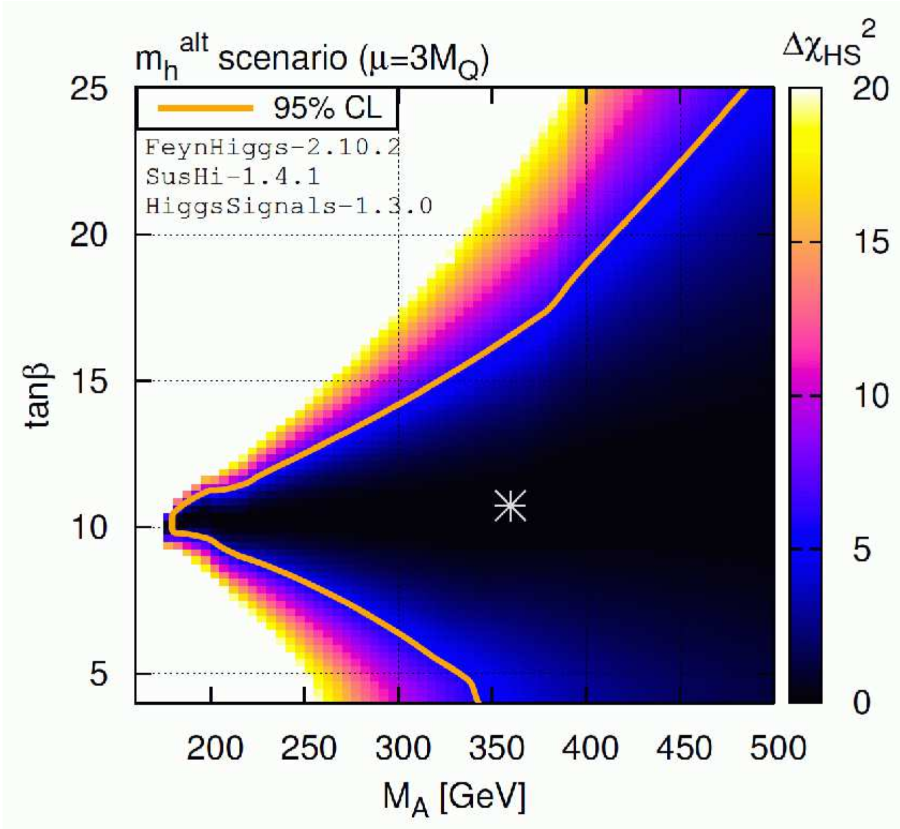
$A_t/M_S = 2.45$, $A_t = A_f$,

$M_S = m_{\tilde{f}} \geq 1$ TeV, $m_{\tilde{g}} = 1.5$ TeV,

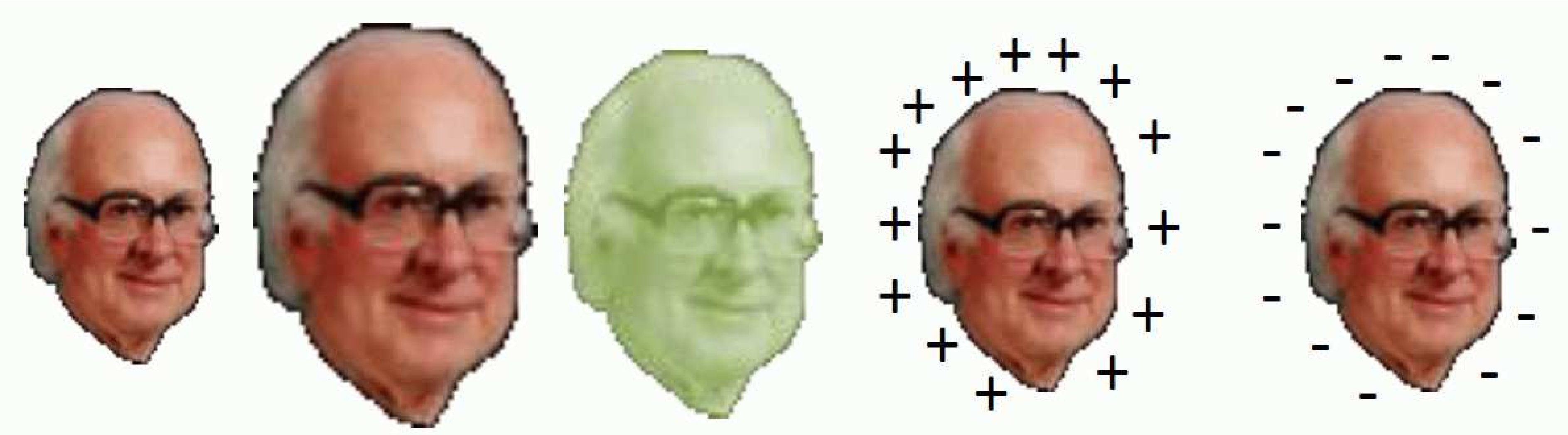
$M_2 = 2\,M_1 = 200$ GeV, μ adjustable

(low M_A and $\tan\beta$: tune $M_S \geq 1$ TeV to obtain $M_h \geq 122$ GeV)

$\Rightarrow$ SM-like Higgs for all M_A



3. Where are the SUSY Higgs bosons



Search for the MSSM Higgs bosons:

Smart choice of MSSM parameters?

$\to$ investigate benchmark scenarios:

$\to$ Vary only M_A and $\tan\beta$
$\to$ Keep all other SUSY parameters fixed

[*H. Bahl, E. Fuchs, T. Hahn, S.H., S. Liebler, S. Patel, P. Slavich, T. Stefaniak, C. Wagner, G. Weiglein '18*]

1. M_h^{125} scenario: 2HDM-like model
2. $M_h^{125}(\tilde{\tau})$ scenario: light staus: $h \to \gamma\gamma$, $H/A \to \tilde{\tau}\tilde{\tau}$
3. $M_h^{125}(\tilde{\chi})$ scenario: light EW-inos: $H/A \to \tilde{\chi}_i^0\tilde{\chi}_j^0, \tilde{\chi}_k^\pm\tilde{\chi}_l^\mp$
4. M_h^{125} (alignment) scenario: h SM-like for very low M_A
5. M_H^{125} scenario: $M_H \sim 125$ GeV, all Higgses light
6. $M_{h_1}^{125}$ (CPV) scenario: complex phases, h_2-h_3 interference

Data to be taken into account:

– Higgs boson mass (LHC) $\Rightarrow$ FeynHiggs

Data to be taken into account:

- Higgs boson mass (LHC) $\Rightarrow$ FeynHiggs
- Higgs boson signal strengths (LHC) $\Rightarrow$ HiggsSignals/SusHi

Data to be taken into account:

- Higgs boson mass (LHC) $\Rightarrow$ FeynHiggs

- Higgs boson signal strengths (LHC) $\Rightarrow$ HiggsSignals/SusHi

- Higgs boson exclusion bounds (LHC, Tevatron, LEP) $\Rightarrow$ HiggsBounds

Data to be taken into account:

- Higgs boson mass (LHC) $\Rightarrow$ FeynHiggs
- Higgs boson signal strengths (LHC) $\Rightarrow$ HiggsSignals/SusHi
- Higgs boson exclusion bounds (LHC, Tevatron, LEP) $\Rightarrow$ HiggsBounds
- SUSY searches (LHC)

Data to be taken into account:

– Higgs boson mass (LHC) ⇒ FeynHiggs

– Higgs boson signal strengths (LHC) ⇒ HiggsSignals/SusHi

– Higgs boson exclusion bounds (LHC, Tevatron, LEP) ⇒ HiggsBounds

– SUSY searches (LHC)

Data not necessarily to be taken into account:

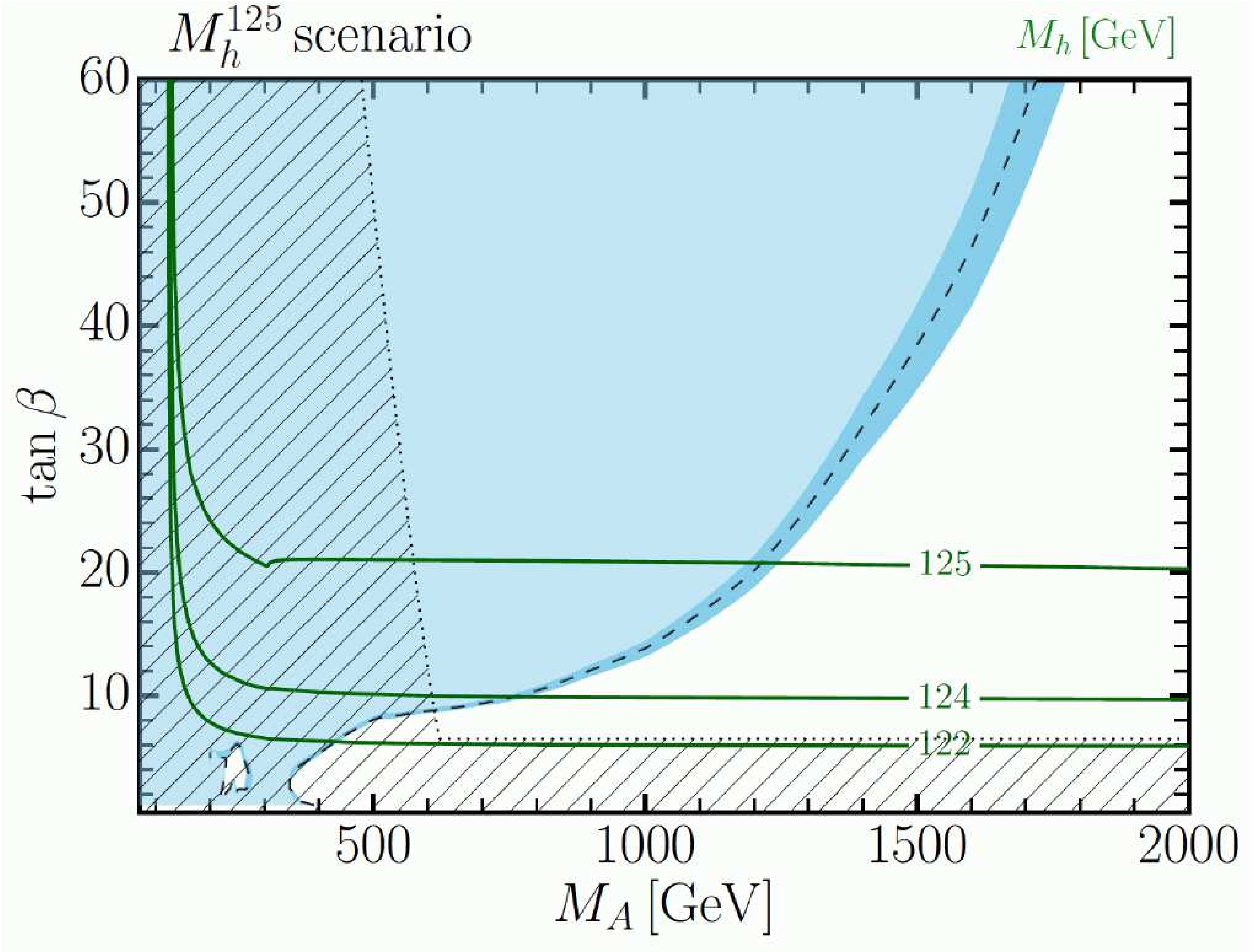
– electroweak precision data

– flavor data

– astrophysical data (DM properties)

New benchmark: M_h^{125}

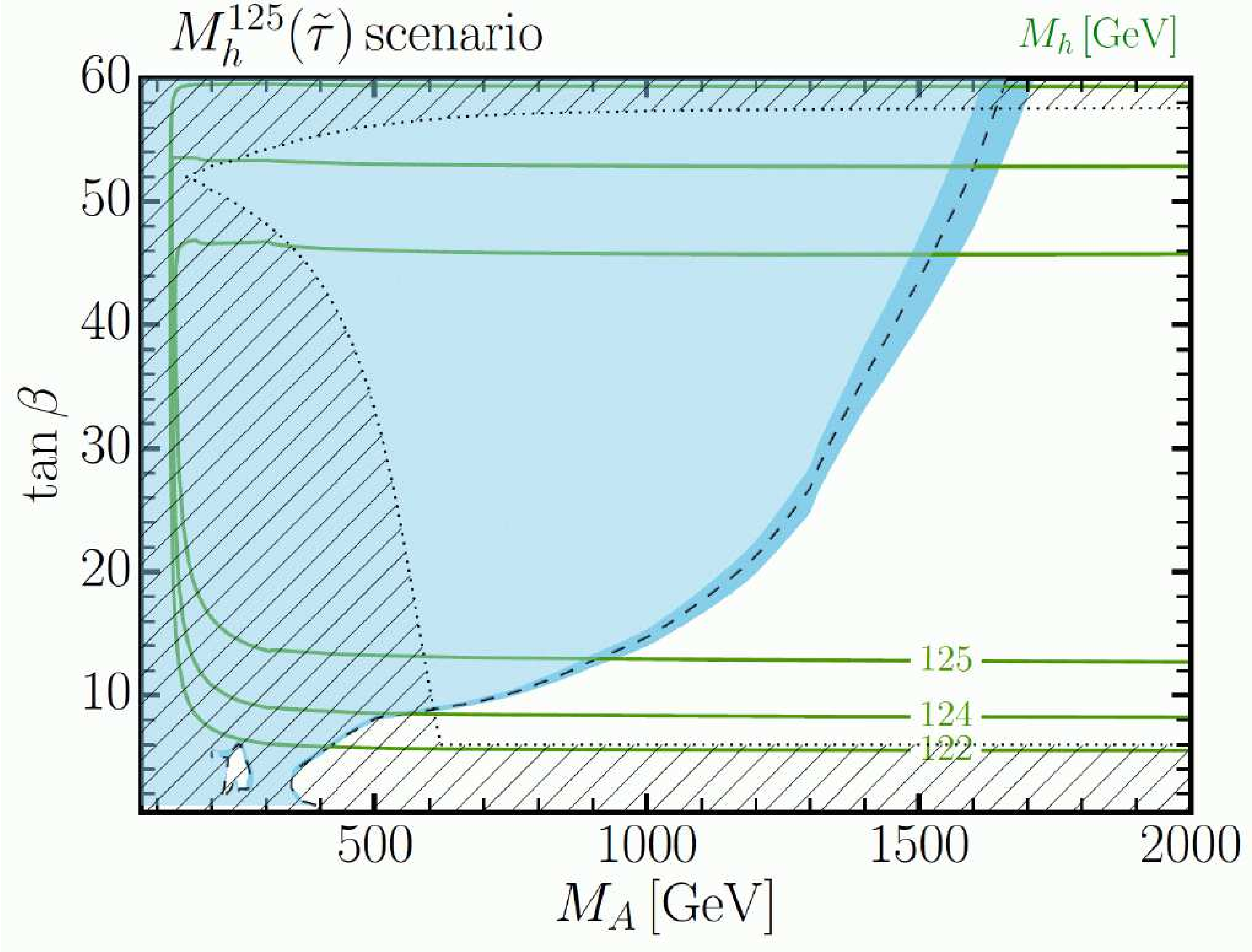
[*H. Bahl et al., '18*]



$\Rightarrow$ new vanilla benchmark model

New benchmark: $M_h^{125}(\tilde{\tau})$

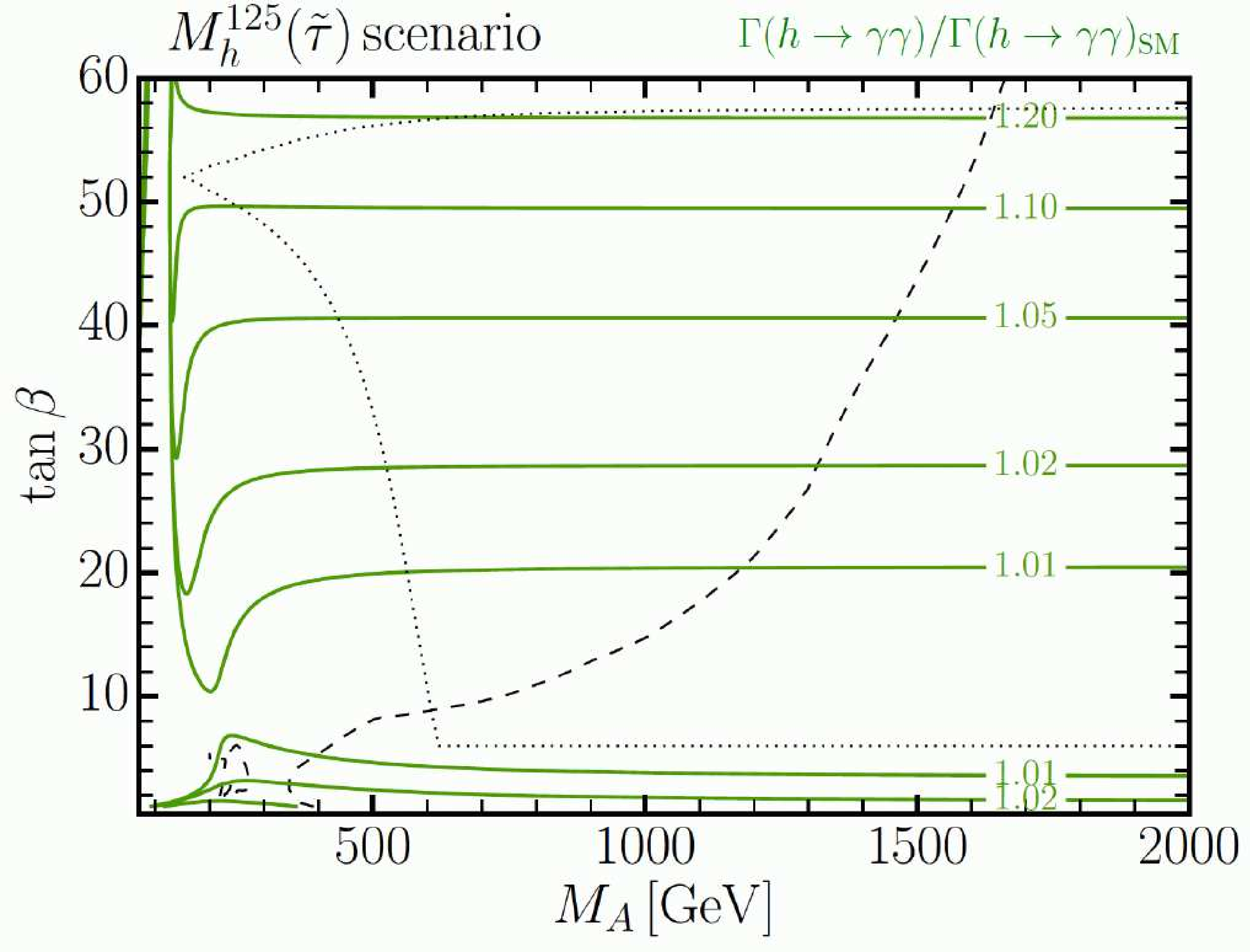
[*H. Bahl et al., '18*]



⇒ slightly reduced heavy Higgs coverage

New benchmark: $M_h^{125}(\tilde{\tau})$

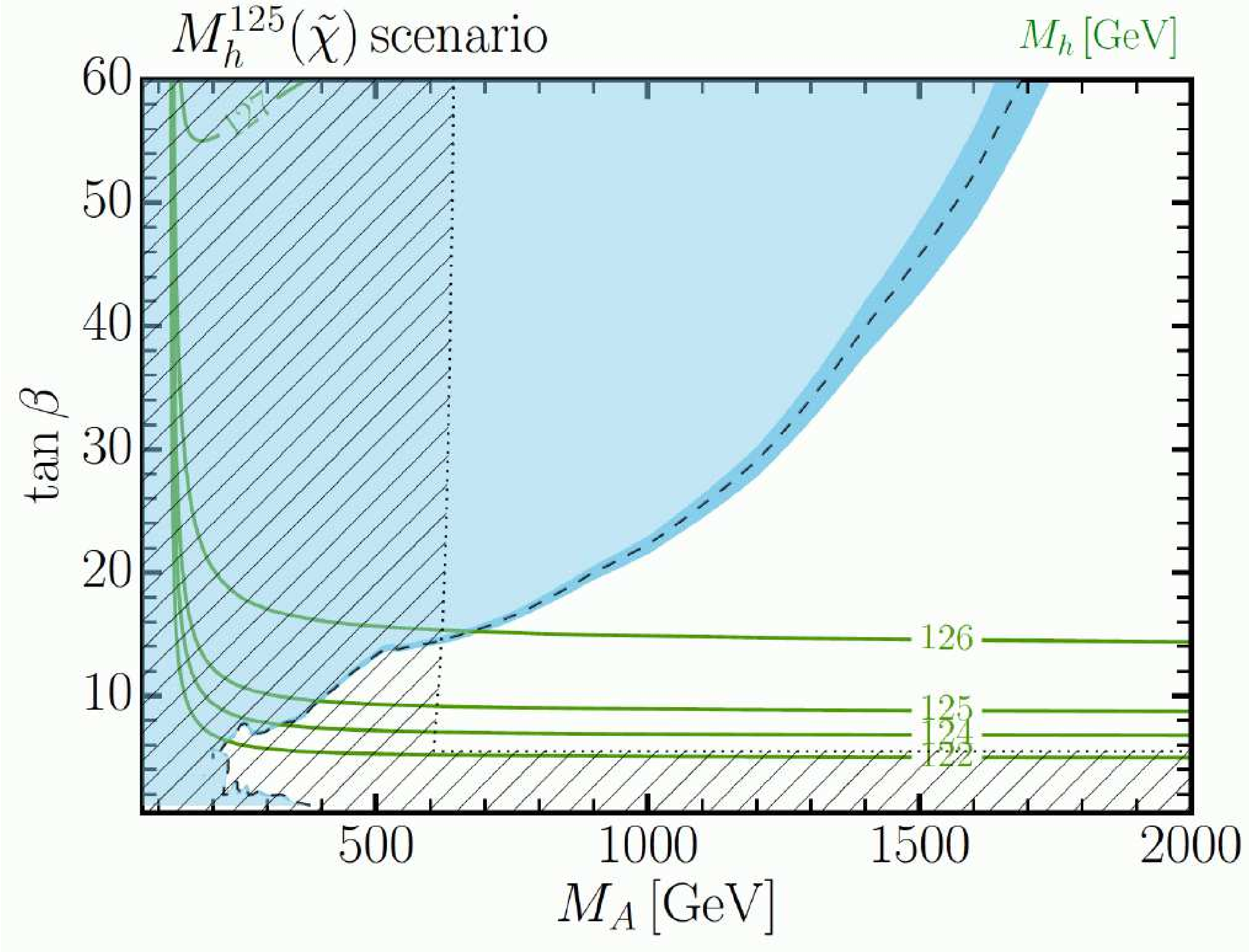
[*H. Bahl et al., '18*]



$\Rightarrow$ strong impact on $\Gamma(h \to \gamma\gamma)$

New benchmark: $M_h^{125}(\tilde{\chi})$

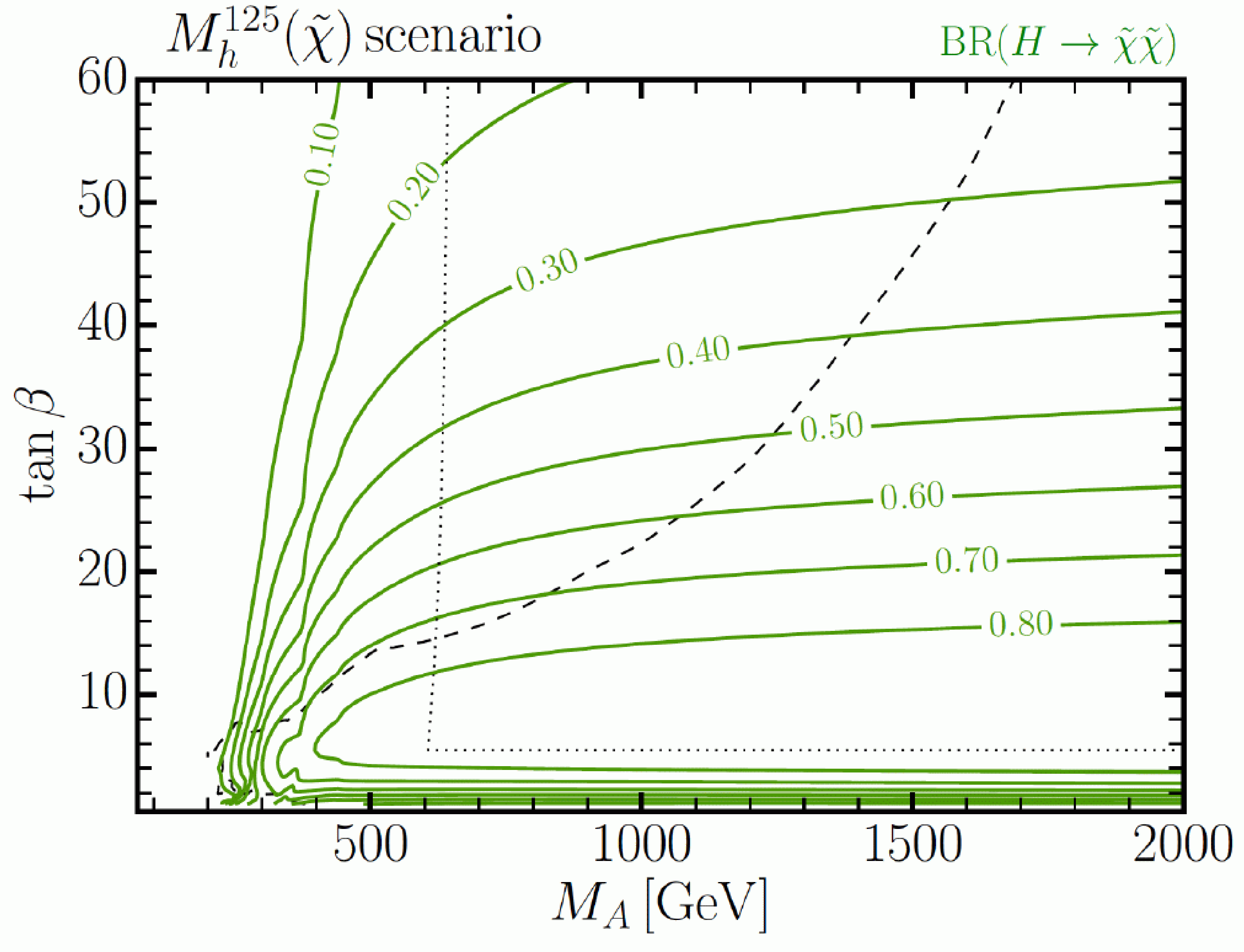
[*H. Bahl et al., '18*]



⇒ strongly reduced heavy Higgs coverage

New benchmark: $M_h^{125}(\tilde{\chi})$

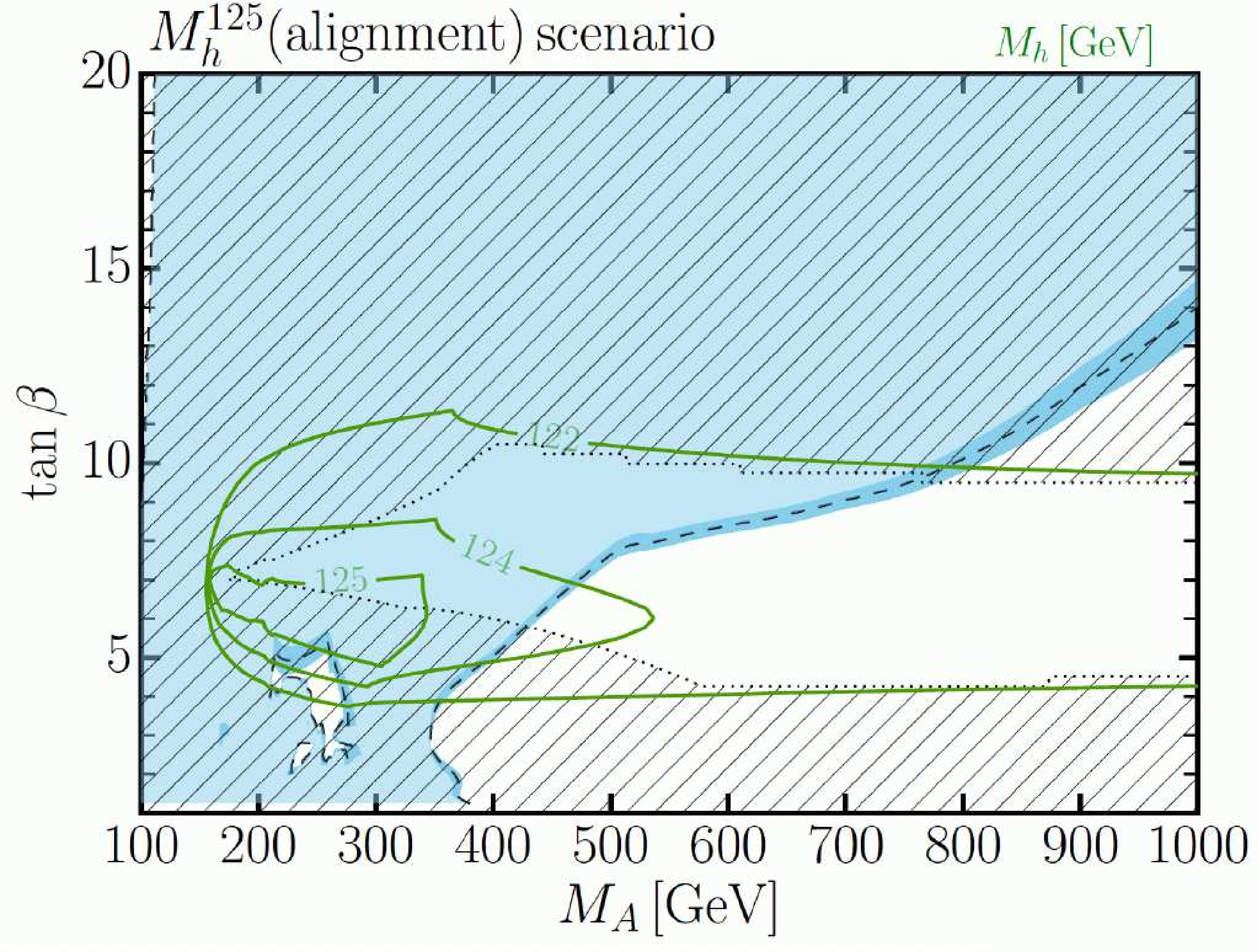
[H. Bahl et al., '18]



⇒ Huge BR of heavy Higgses to EW-inos

New benchmark: M_h^{125}(align)

[*H. Bahl et al., '18*]

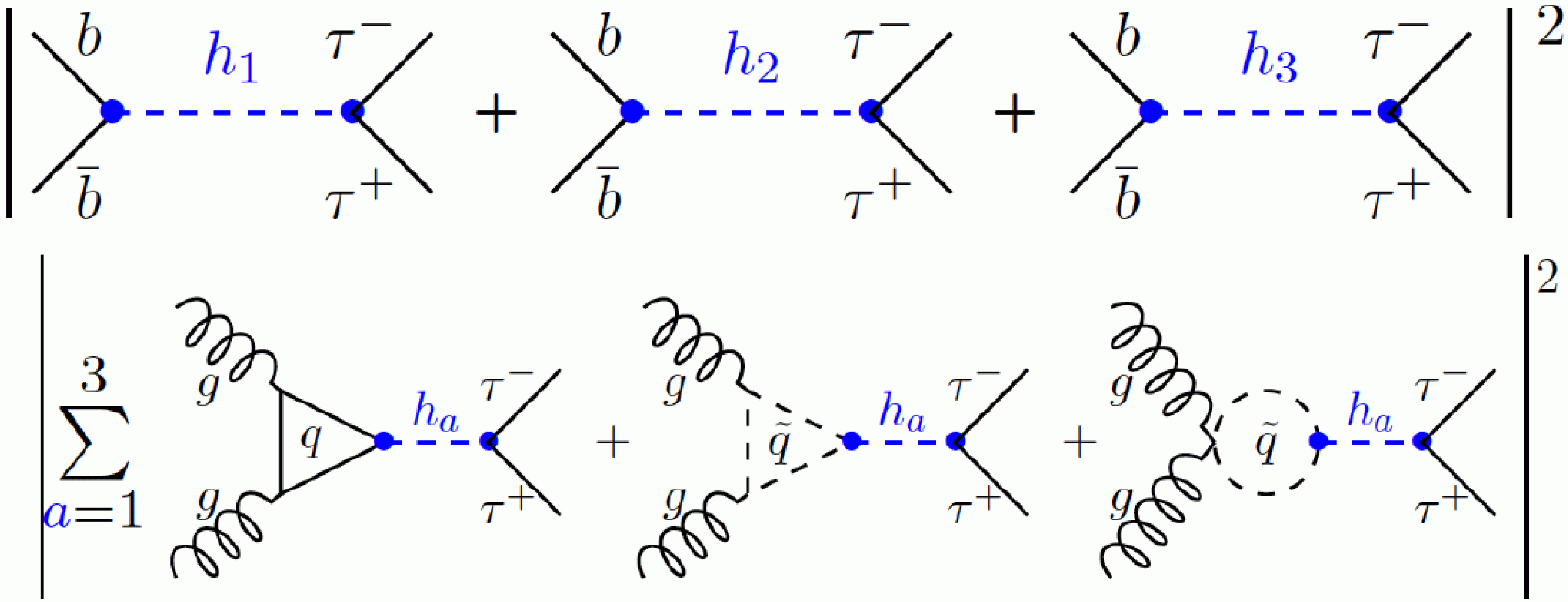


$\Rightarrow$ h SM-like for very low M_A

LHC Higgs searches for complex parameters:

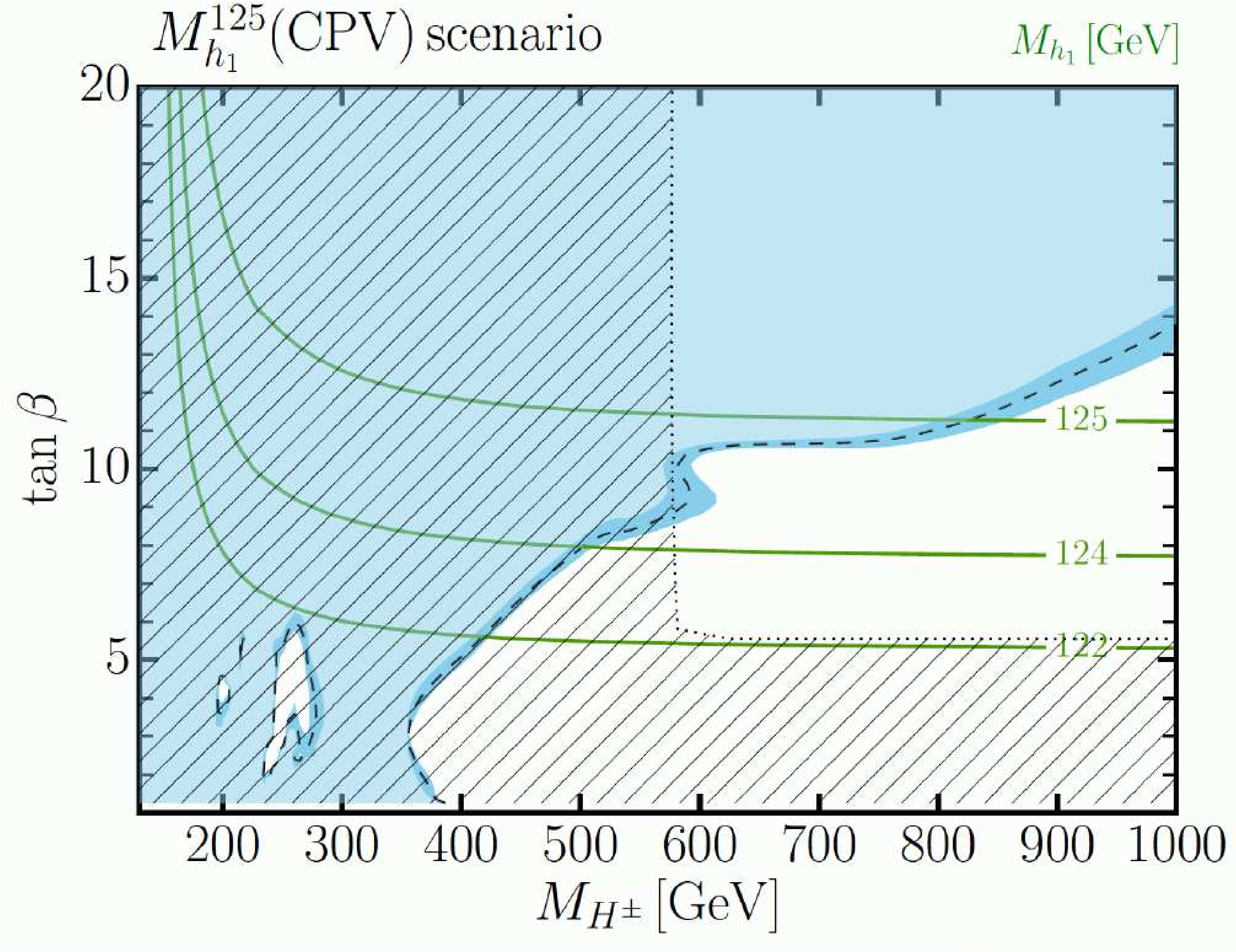
$h_1 \sim H_{125}$, $M_{h_2} \approx M_{h_3}$, CPV: large h_2-h_3 mixing possible:

Higgs bosons as intermediate states in $\{b\bar{b}, gg\} \to h_a \to \tau\tau$



New benchmark: $M_{h_1}^{125}$(CPV)

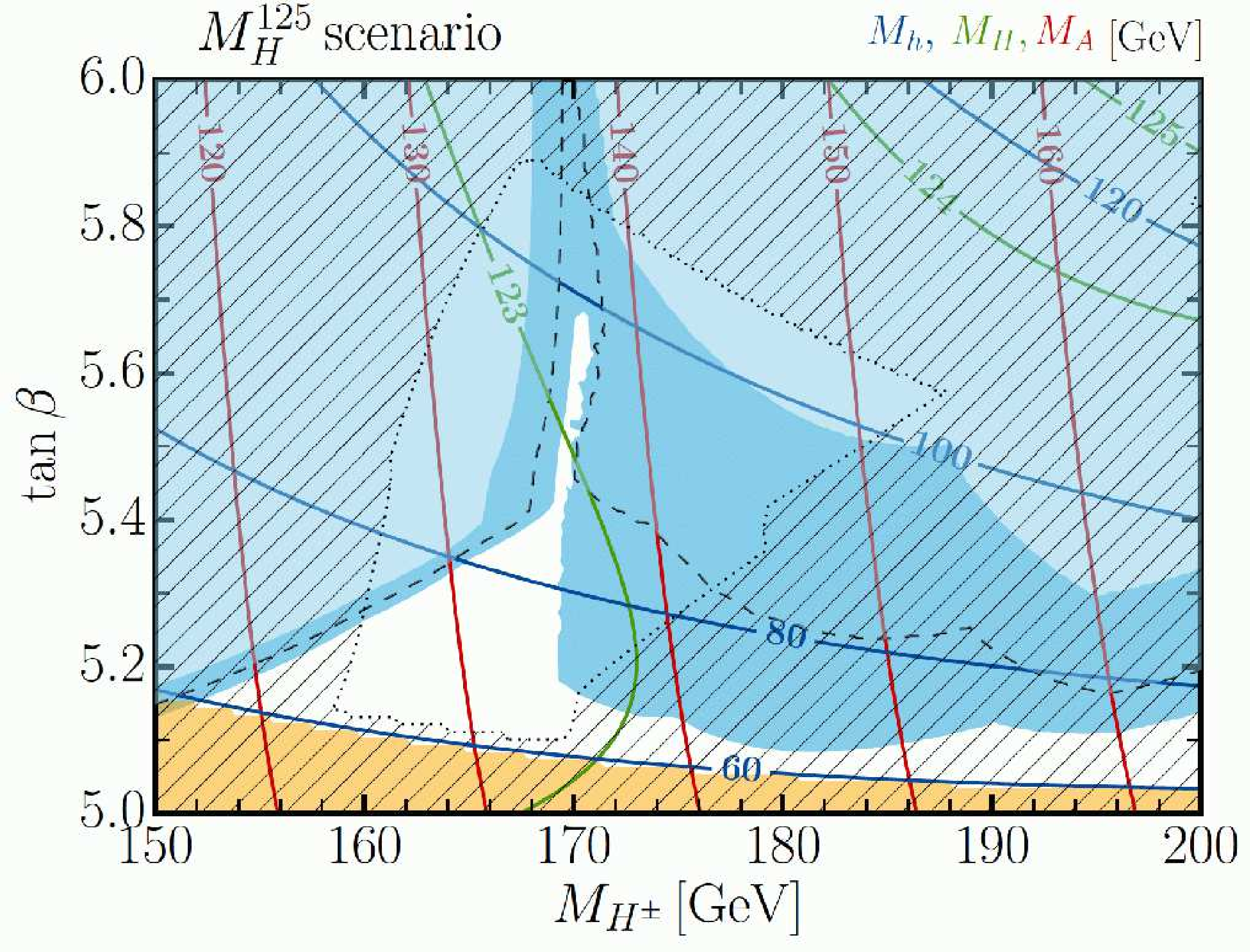
[*H. Bahl et al., '18*]



⇒ reduced coverage due to h_2-h_3 interference

New benchmark: M_H^{125}

[*H. Bahl et al., '18*]



⇒ exotic solution still viable!

4. A Higgs Boson at 96 GeV?!

– What was seen in Run I?

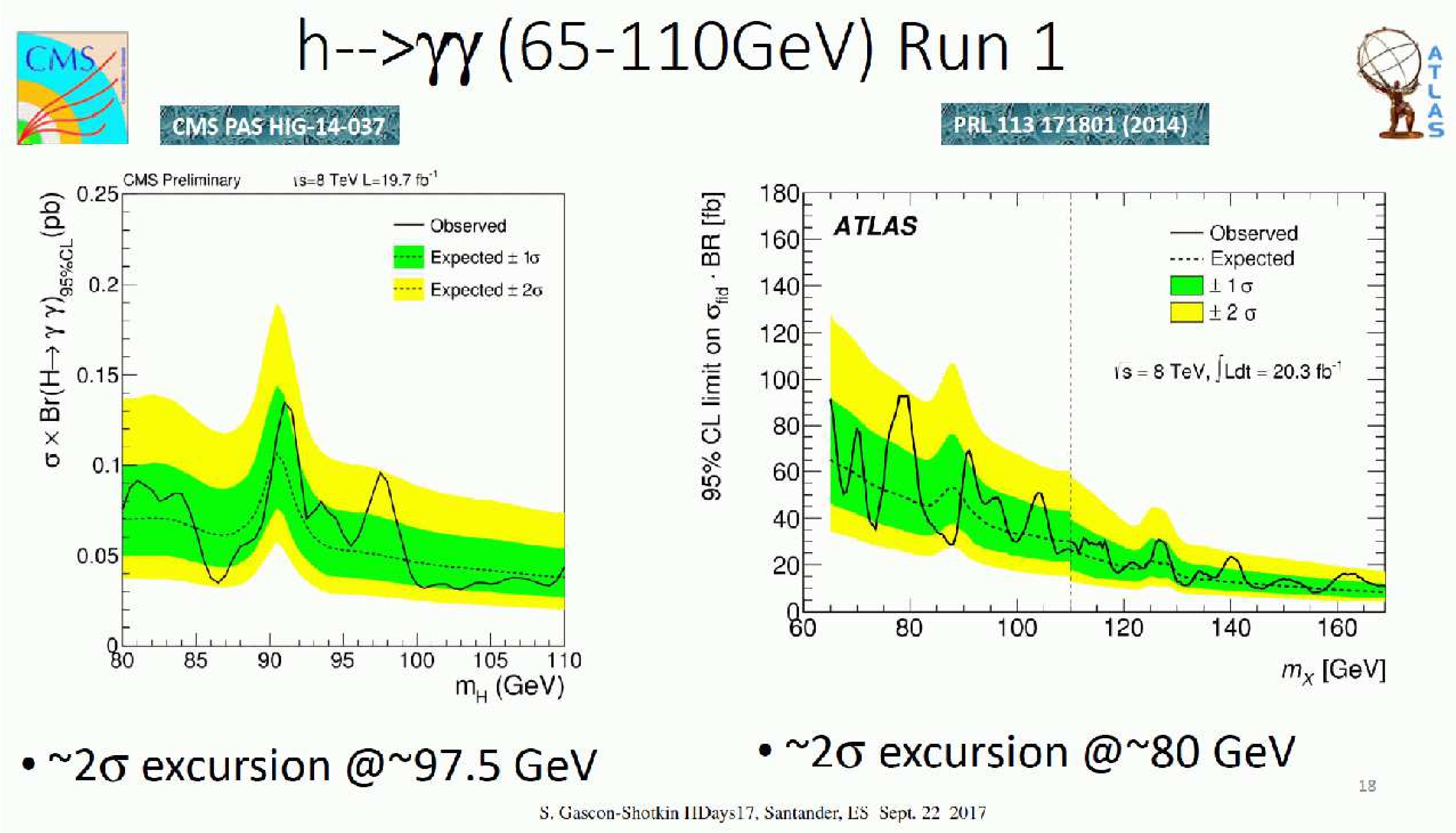
– What was seen in Run II?

– What was seen at LEP?

– Should we get excited?

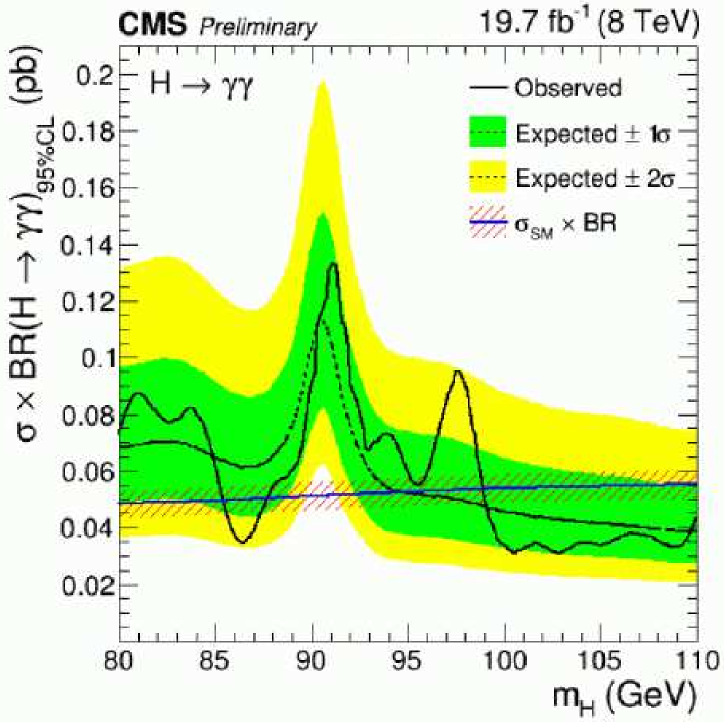
– Which model fits?

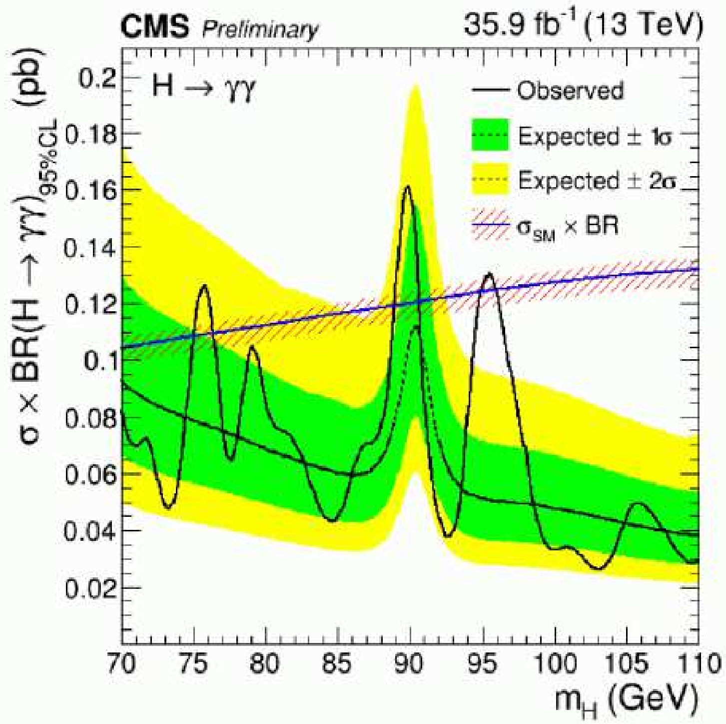
 [*S. Shotkin, talk at HDays17*]



h-->γγ (70-110 GeV) Runs 1+2

New!





CMS PAS HIG-17-013

8 TeV: minimum(maximum) limit on σ X Br : 31(133) fb at m=102.8(91.1)GeV

13 TeV: minimum(maximum) limit on σ X Br : 26(161) fb at m=103.0(89.9)GeV

- 8 TeV limits on σ X Br redone with 0.1 GeV step. Production processes assumed in SM proportions. No significant excess with respect to expected limits observed.

26

S. Gascon-Shotkin HDays17, Santander, ES Sept. 22 2017

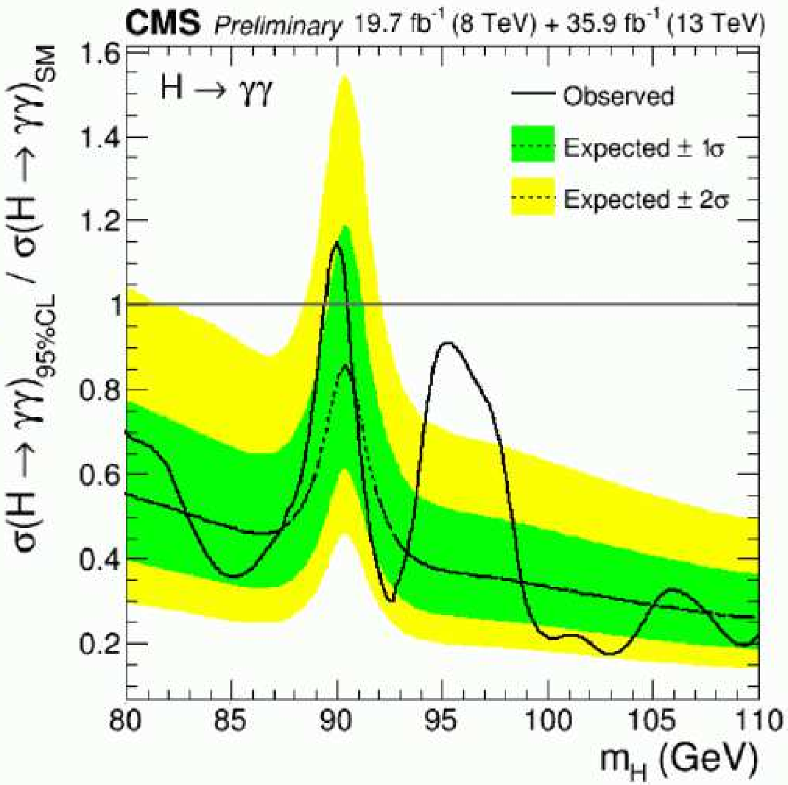
 [*S. Shotkin, talk at HDays17*]

h-->γγ (70-110 GeV) Runs 1+ 2

New!

CMS PAS HIG-17-013

All experimental + theoretical systematic uncertainties assumed uncorrelated except for those on signal acceptance due to scale variations + those on production cross sections (assumed 100% correlated).



8 TeV+13 TeV: minimum(maximum) limit on (σ X Br)/ (σ X Br)$_{SM}$: 0.17(1.15) at m=103.0(90.0)GeV

- Combined 8 TeV+13 TeV σ X BR limit normalized to SM expectation (production processes assumed in SM proportions). No significant excess with respect to expected limits observed.

29

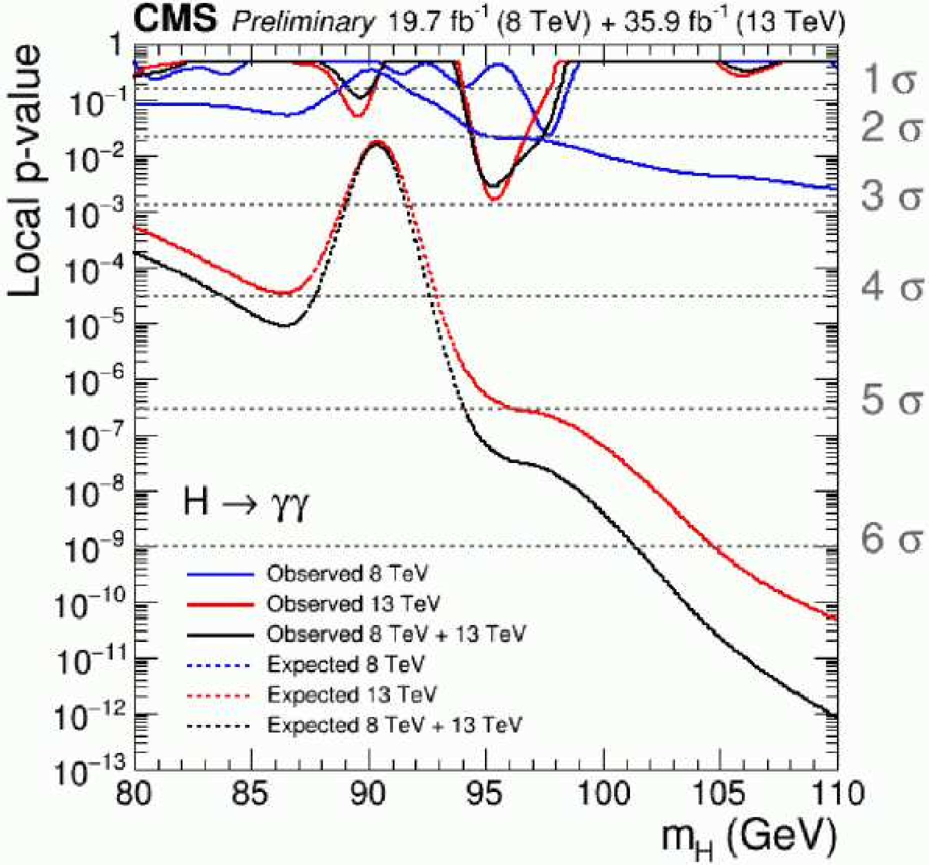
S. Gascon-Shotkin HDays17, Santander, ES Sept. 22 2017

 [S. Shotkin, talk at HDays17]

h-->γγ (70-110 GeV) Runs 1+ 2

New!

CMS PAS HIG-17-013



8 TeV: Excess with ~2.0 σ local significance at m=97.6 GeV

13 TeV: Excess with ~2.9 σ local (1.47 σ global) significance at m=95.3 GeV

8TeV+13 TeV: Excess with ~2.8 σ local (1.3 σ global) significance at m=95.3 GeV

More data are required to ascertain the origin of this excess

- Expected and observed local p-values for 8 TeV, 13 TeV and their combination

S. Gascon-Shotkin HDays17, Santander, ES Sept. 22 2017 30

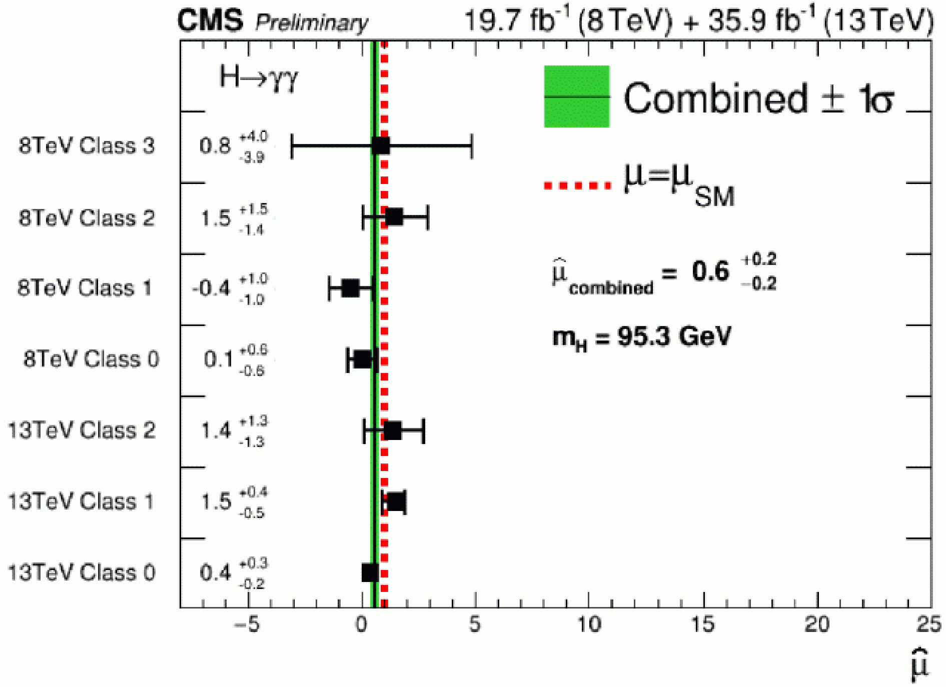
What was seen at Run II?

[S. Shotkin, talk at HDays17]

h-->γγ (70-110 GeV) Runs 1+2

New!

CMS PAS HIG-17-013



Excess here mostly driven by class 1 (&2) at 13 TeV

χ^2 probability for the seven individual values to be compatible with a single signal hypothesis: 41%

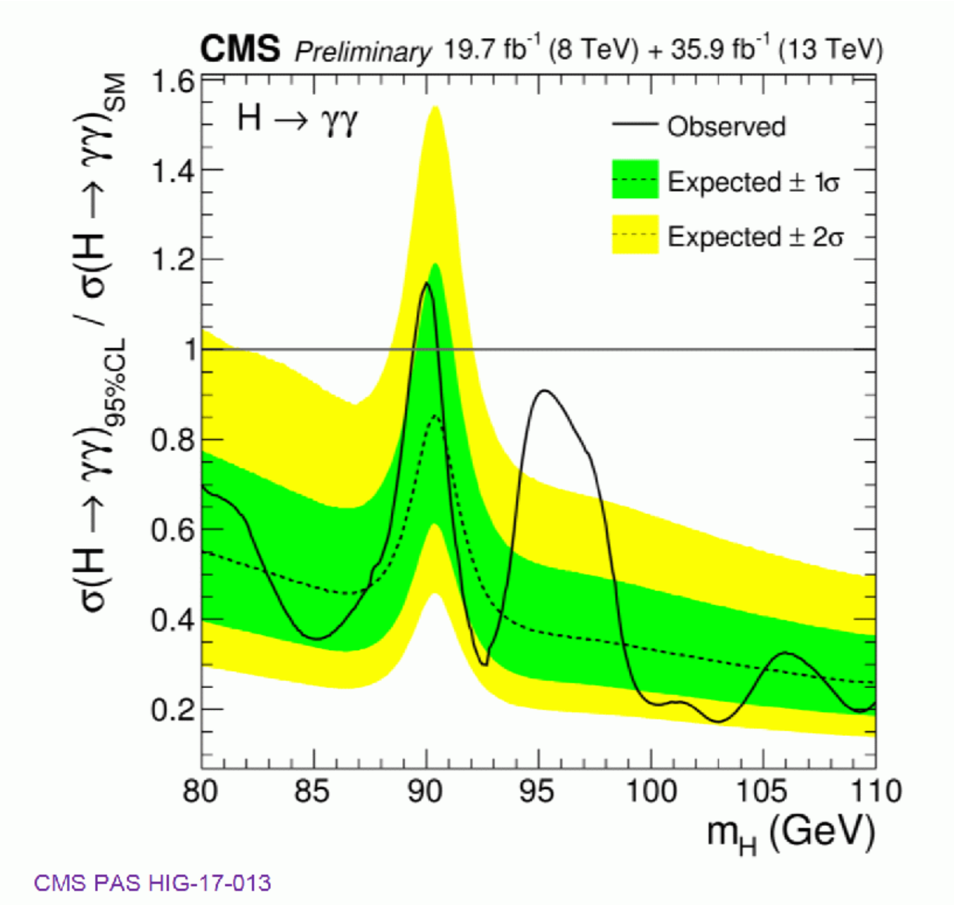
- 'Signal' strengths for the 7 event classes and overall, in the 8 TeV+13TeV combination, fixing m_H=95.3 GeV
- More data are required to ascertain the origin of this excess

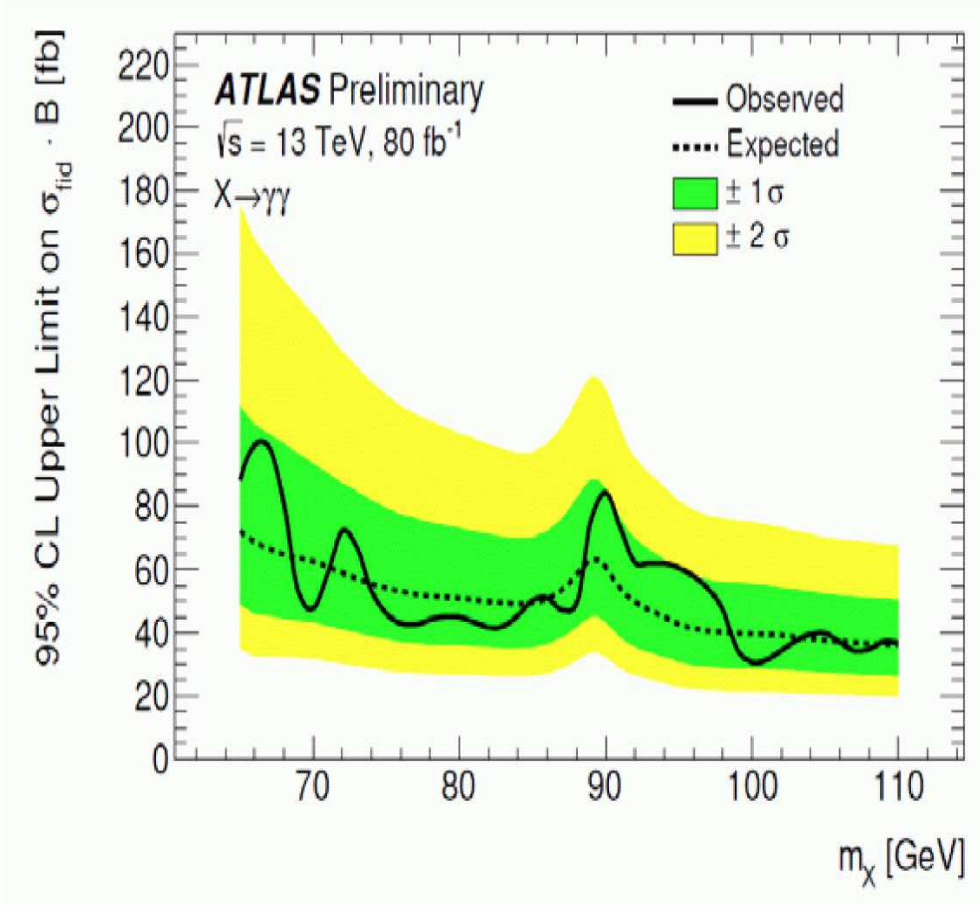
S. Gascon-Shotkin HDays17, Santander, ES Sept. 22 2017

55

$$\mu_{\text{CMS}}(96\text{ GeV}) = [\sigma(pp \to h_1) \times \text{BR}(h_1 \to \gamma\gamma)]_{\text{exp/SM}} = 0.6 \pm 0.2$$

What about ATLAS?



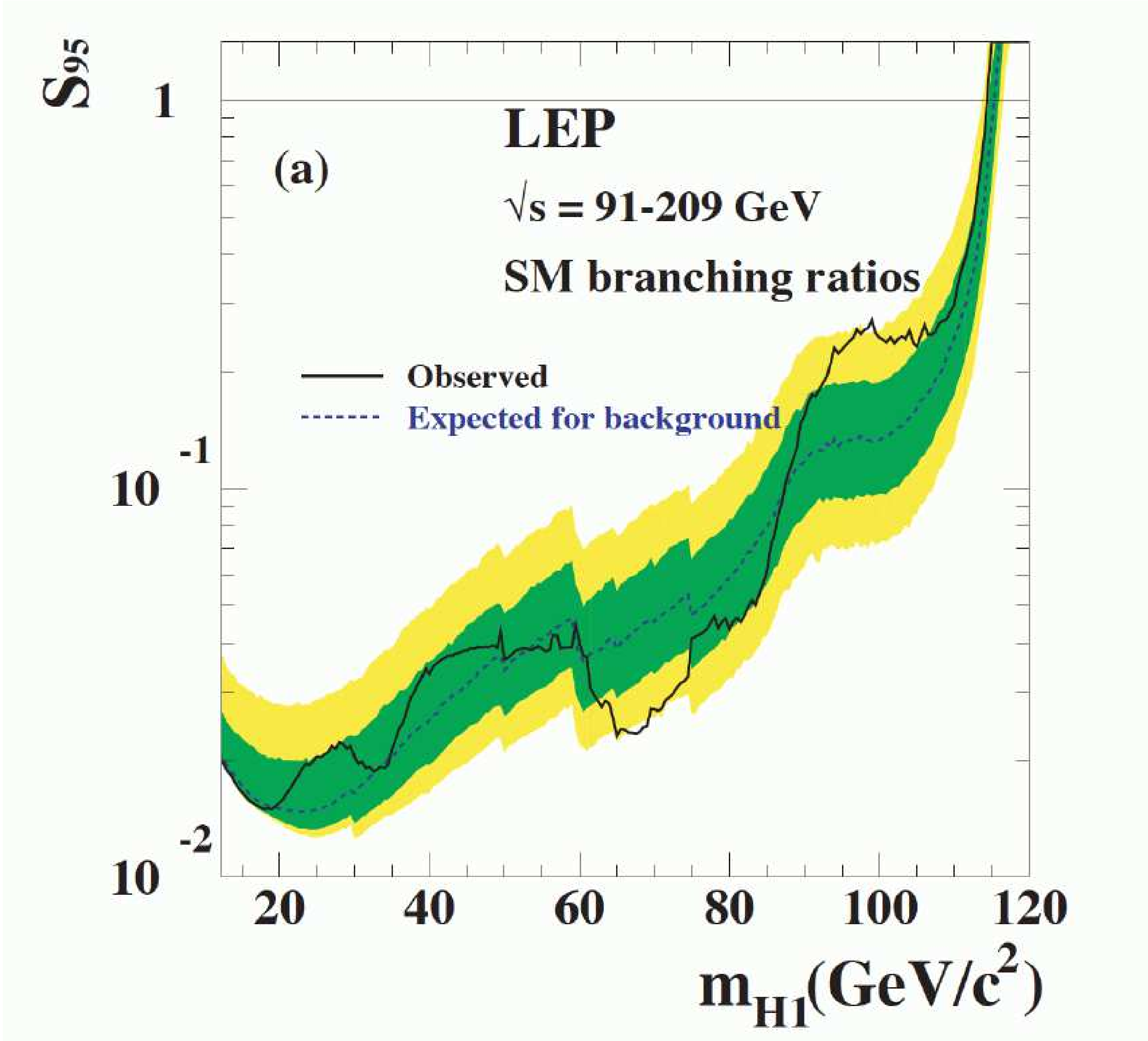


Note: ATLAS gives fiducial cross section! Conversion factor: 1/0.45

⇒ ATLAS and CMS exclusion limit **identical!** (120 fb)

Q: why does ATLAS has same sensitivity with twice amount of data?

What was seen at LEP?

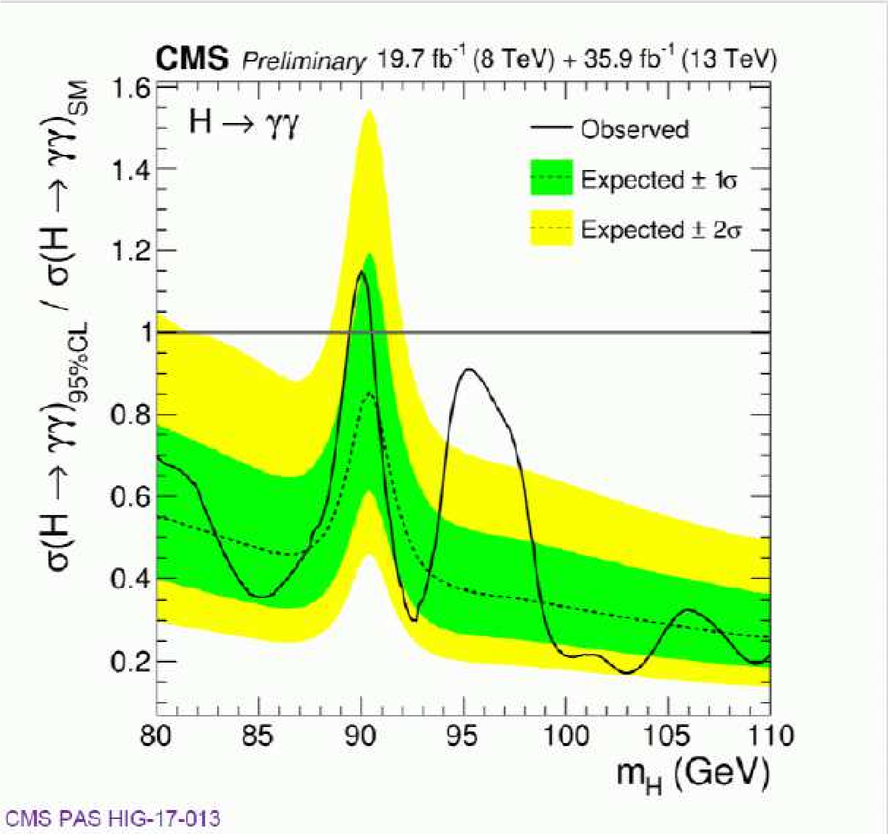


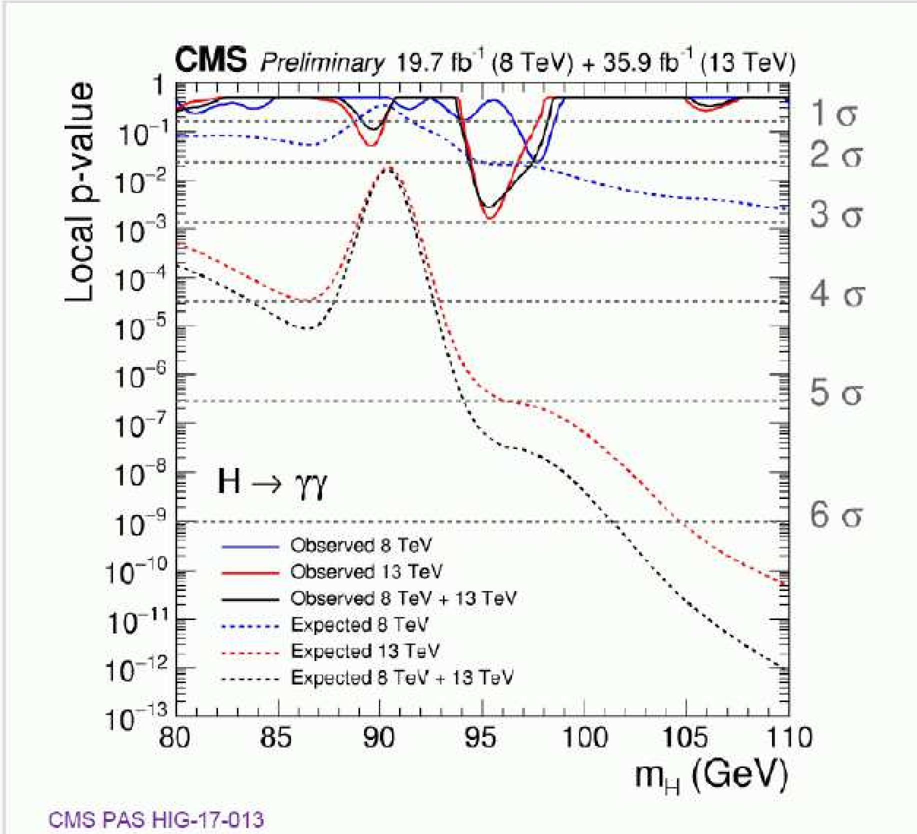
$$\mu_{\text{LEP}}(98\ \text{GeV}) = \left[\sigma(e^+e^- \to Zh_1) \times \text{BR}(h_1 \to b\bar{b})\right]_{\text{exp/SM}} = 0.117 \pm 0.057$$

Should we get excited?

[talk by L. Finco, HiggsHunting 18]

- **Combined 8 TeV + 13 TeV** $\sigma\times$BR limit normalized to SM expectation:
  - Production processes assumed in SM proportions
  - **No significant excess** with respect to background expectations
- Expected and observed local p-values for **8 TeV**, **13 TeV** and their **combination**

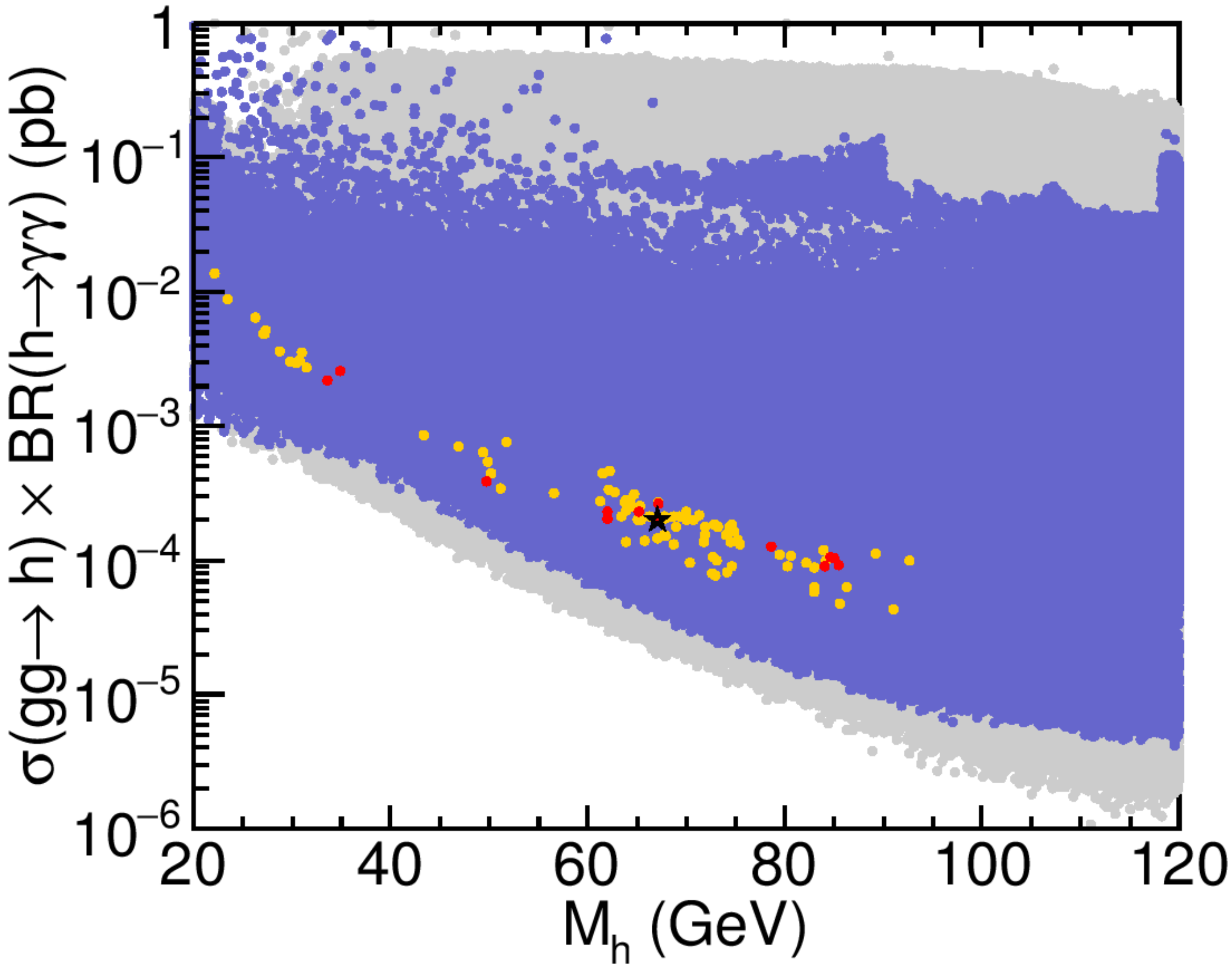




Q: When do you dare to something “significant”?

What about the MSSM?

[*P. Bechtle, H. Haber, S.H., O. Stål, T. Stefaniak, G. Weiglein, L. Zeune '16*]



⇒ too small rates!

What about the NMSSM?

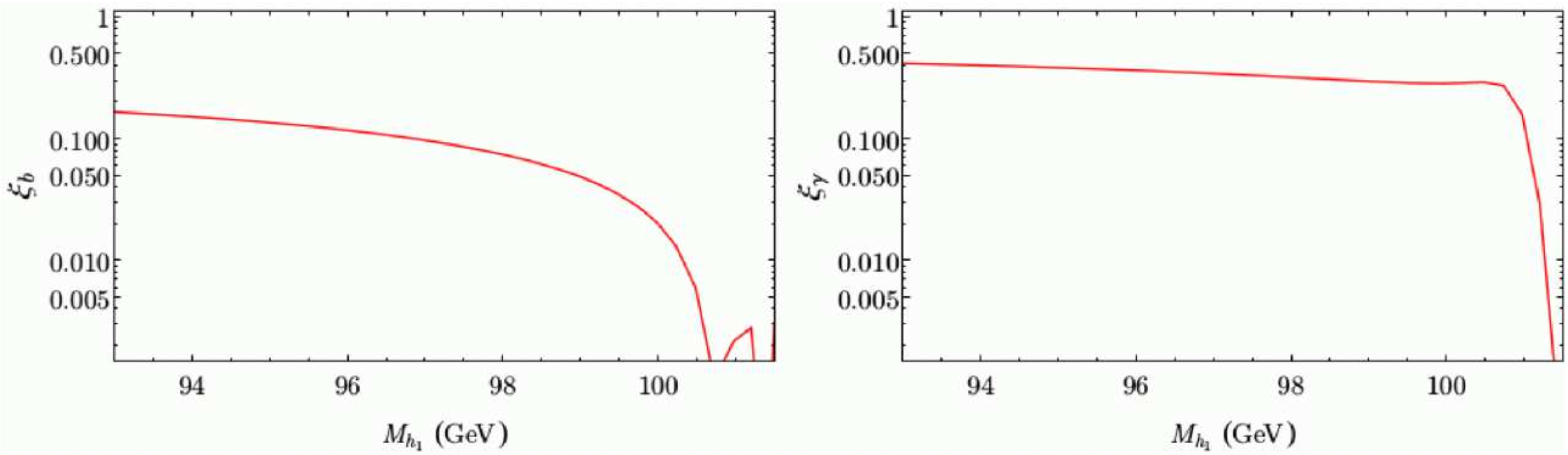
[F. Domingo, S.H., S. Passehr, G. Weiglein '18]

Parameters:

$\lambda = 0.6,\ \kappa = 0.035,\ \tan\beta = 2,\ \mu_{\text{eff}} = (397 + 15x)$ GeV, $M_{H^\pm} = 1$ TeV, $A_\kappa = -325$ GeV, $M_{\text{SUSY}} = 1$ TeV, $A_t = A_b = 0$

$$\xi_b \equiv \frac{\Gamma[h_1 \to ZZ] \cdot \text{BR}[h_1 \to b\bar{b}]}{\Gamma[H_{\text{SM}}(M_{h_1}) \to ZZ] \cdot \text{BR}[H_{\text{SM}}(M_{h_1}) \to b\bar{b}]} \sim \frac{\sigma[e^+e^- \to Z(h_1 \to b\bar{b})]}{\sigma[e^+e^- \to Z(H_{\text{SM}}(M_{h_1}) \to b\bar{b})]}$$

$$\xi_\gamma \equiv \frac{\Gamma[h_1 \to gg] \cdot \text{BR}[h_1 \to \gamma\gamma]}{\Gamma[H_{\text{SM}}(M_{h_1}) \to gg] \cdot \text{BR}[H_{\text{SM}}(M_{h_1}) \to \gamma\gamma]} \sim \frac{\sigma[gg \to h_1 \to \gamma\gamma]}{\sigma[gg \to H_{\text{SM}}(M_{h_1}) \to \gamma\gamma]}\ .$$



$\Rightarrow$ both "excesses" can be fitted simultaneously!

What about the $\mu\nu$SSM?

$\mu\nu$SSM: [*D. Lopez-Fogliani, C. Muñoz '06*]

$\mu\nu$SSM: NMSSM + well motivated RPV (in simple terms)

$\Rightarrow$ EW scale seesaw to reproduce the neutrino data

What about the $\mu\nu$SSM?

$\mu\nu$SSM: [*D. Lopez-Fogliani, C. Muñoz '06*]

$\mu\nu$SSM: NMSSM + well motivated RPV (in simple terms)

$\Rightarrow$ EW scale seesaw to reproduce the neutrino data

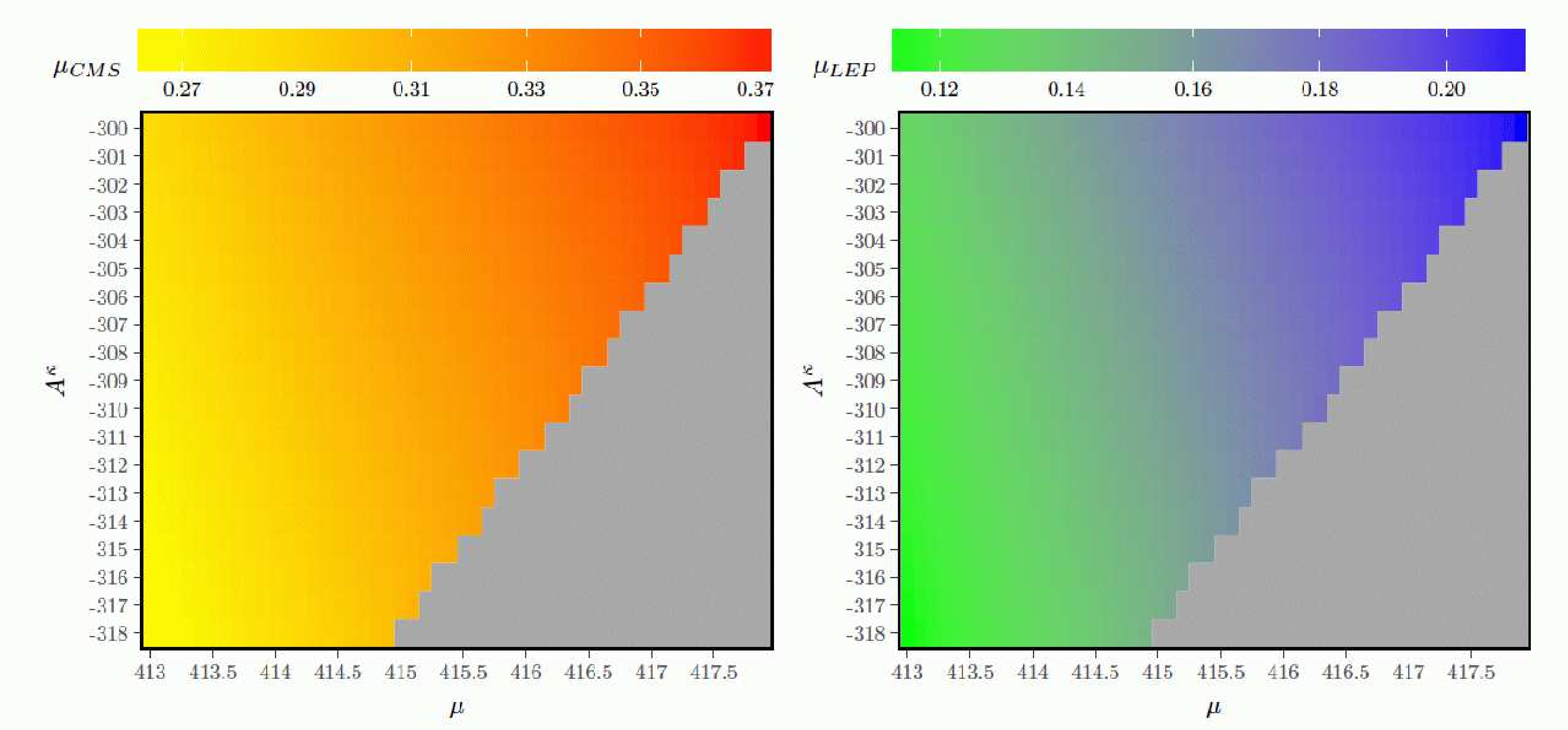
Can the $\mu\nu$SSM explain the two "excesses"?

[*T. Biekötter, S.H., C. Muñoz, arXiv:1712.07475*]

v_{iL}	Y_i^ν	A_i^ν	$\tan\beta$	μ	λ	A^λ	κ	A^κ	M_1
$\sqrt{2}\cdot 10^{-5}$	10^{-7}	-1000	2	$[413; 418]$	0.6	956.035	0.035	$[-300; -318]$	100
M_2	M_3	$m^2_{\tilde{Q}_{iL}}$	$m^2_{\tilde{u}_{iR}}$	$m^2_{\tilde{d}_{iR}}$	A_1^u	$A_{2,3}^{u,d}$	$(m^2_{\tilde{e}})_{ii}$	A_{33}^e	$A_{11,22}^e$
200	1500	800^2	800^2	800^2	0	0	800^2	0	0

Can the $\mu\nu$SSM explain the two "excesses"?

[*T. Biekötter, S.H., C. Muñoz, arXiv:1712.07475*]



$\Rightarrow$ **YES, WE CAN! :-)**

(at the $1 - 1.5\,\sigma$ level)

5. Conclusinos

- SUSY is (still) the best-motivated BSM scenario
  - unconstrained MSSM: 105 new parametes
  - constrained: CMSSM, NUHM, SU(5), mAMSB, sub-GUT, FUT, . . .
  - benchmark models: parameter planes
- Data taken into account: Higgs/SUSY
  Data not necessarily taken into account: EW/Flavor/DM
- New benchmark proposal:
  - M_h^{125} scenario: 2HDM-like model
  - $M_h^{125}(\tilde{\tau})$ scenario: light staus: $h \to \gamma\gamma$, $H/A \to \tilde{\tau}\tilde{\tau}$
  - $M_h^{125}(\tilde{\chi})$ scenario: light EW-inos: $H/A \to \tilde{\chi}_i^0\tilde{\chi}_j^0, \tilde{\chi}_k^\pm\tilde{\chi}_l^\mp$
  - M_h^{125} (alignment) scenario: h SM-like for very low M_A
  - M_H^{125} scenario: $M_H \sim 125$ GeV, all Higgses light
  - $M_{h_1}^{125}$ (CPV) scenario: complex phases, h_2-h_3 interference
- A light Higgs at 96 GeV?
  new CMS/ATLAS result (and old LEP result) possibly interesting!
  - NMSSM can explain CMS(/ATLAS) and LEP "excesses"
  - $\mu\nu$SSM can explain CMS(/ATLAS) and LEP "excesses"


Further Questions?