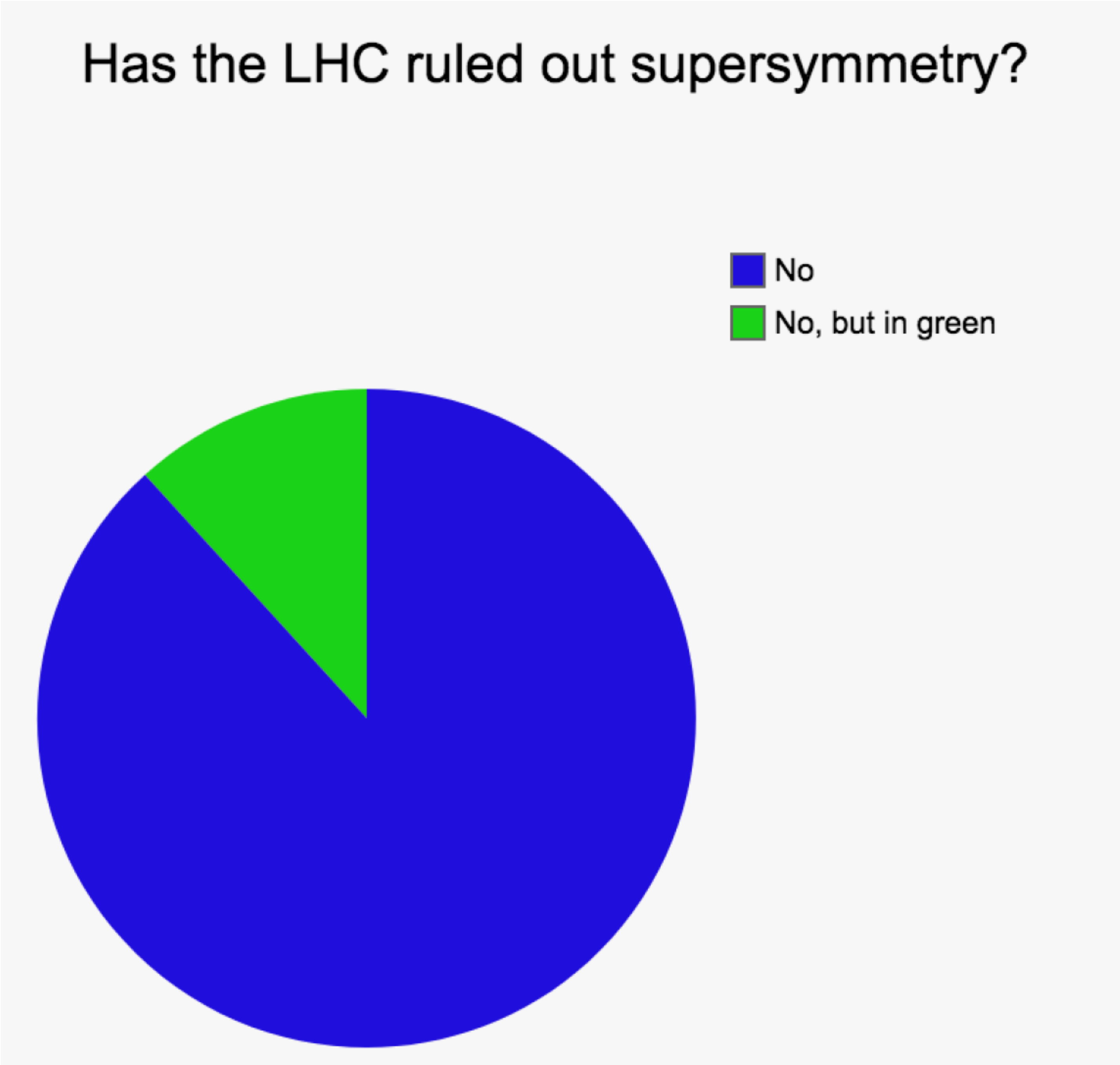

Has the LHC ruled out supersymmetry?
No
No, but in green

SUSY Dark Matter Production at the LHC?!

Sven Heinemeyer, IFT/MultiDark (CSIC, Madrid)

Zaragoza, 06/2026

In collaboration with:
Emanuele Bagnaschi, Manimala Chakraborti, Ipsita Saha

1. The main idea

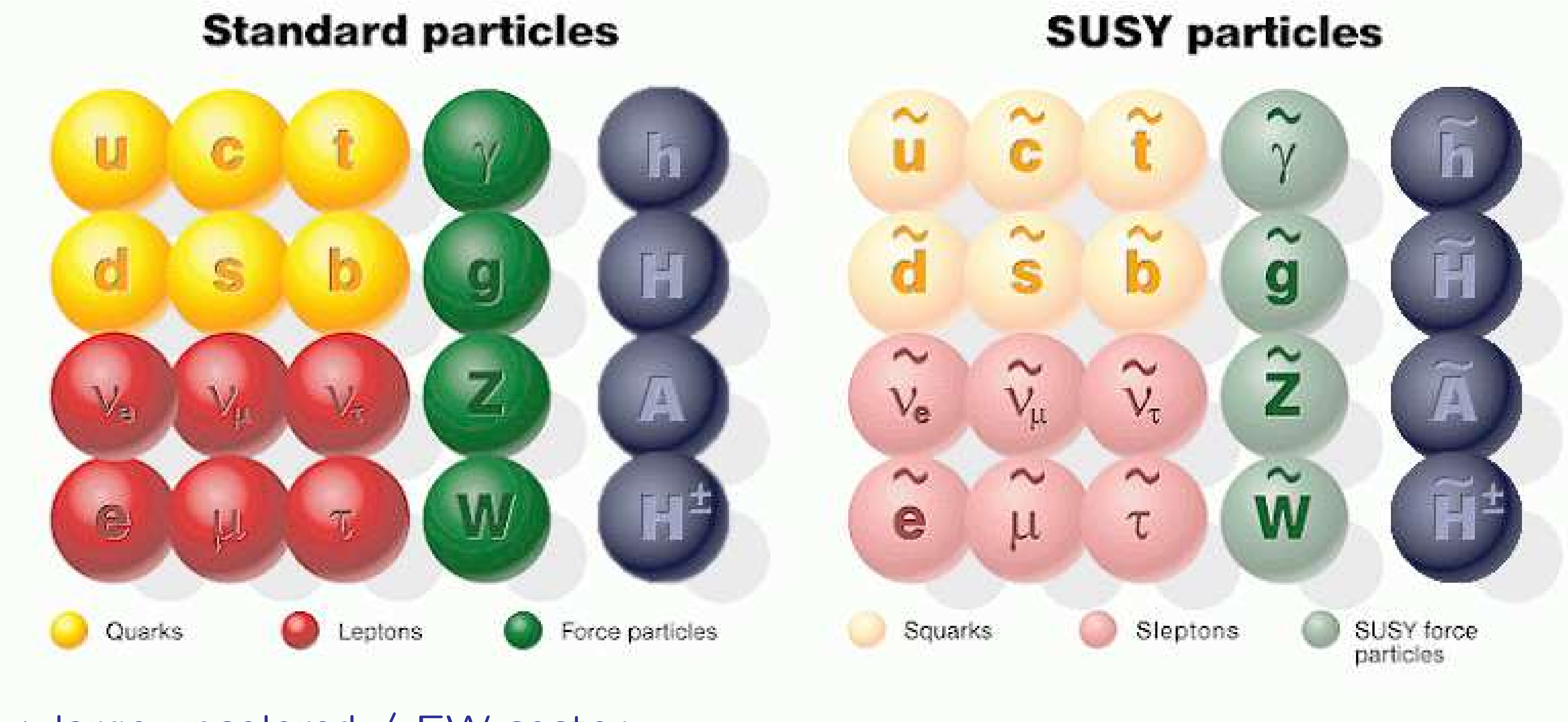
2. Evidence for low-energy SUSY?!

3. Solutions for GUT-based Scenarios

4. Conclusions

1. Motivation

The MSSM

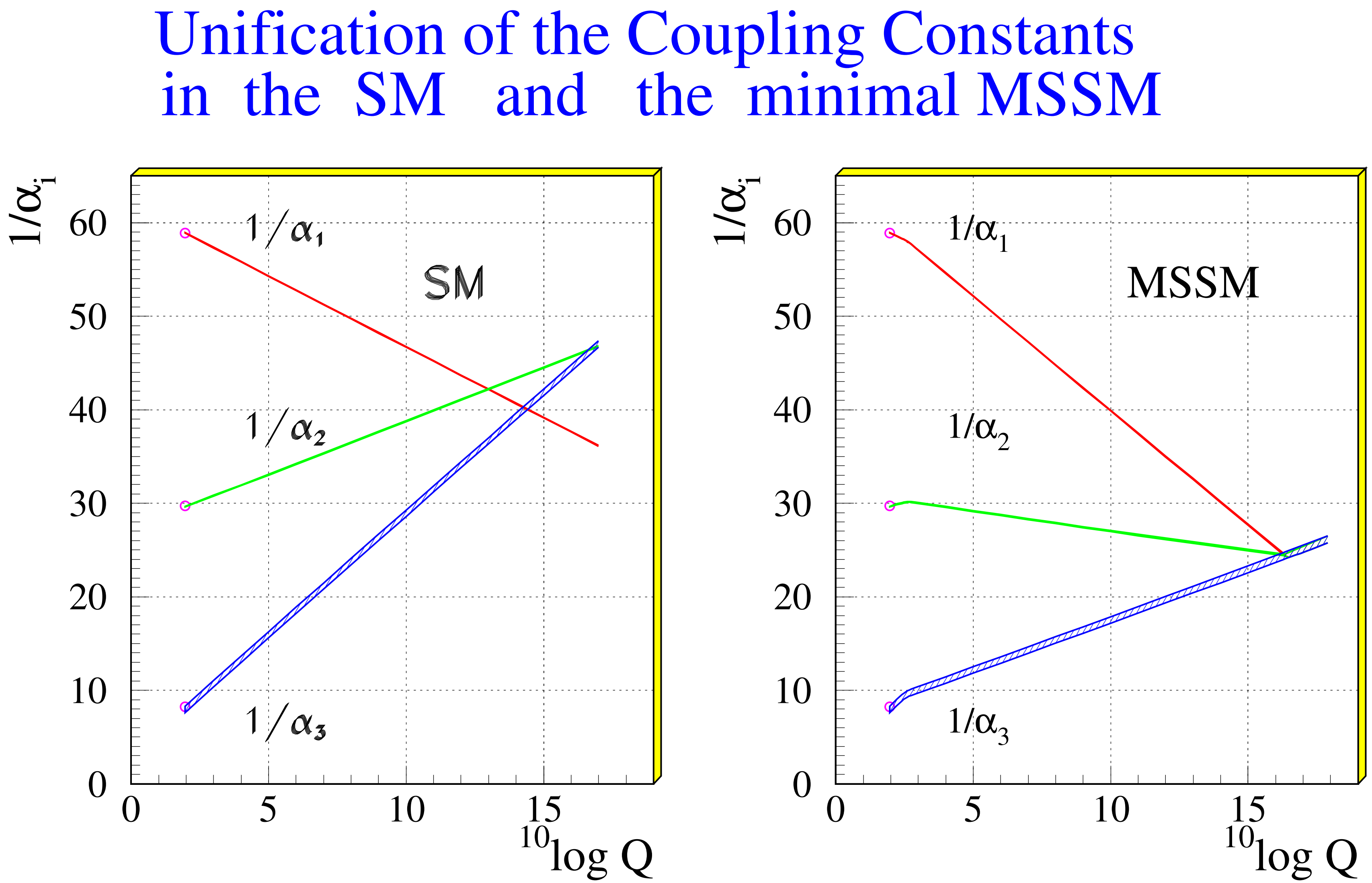


$\Rightarrow$ large uncolored / EW sector

charginos/neutralinos: M_1, M_2, μ, $\tan\beta$ $\Rightarrow$ Dark Matter candidate: $\tilde{\chi}_1^0$

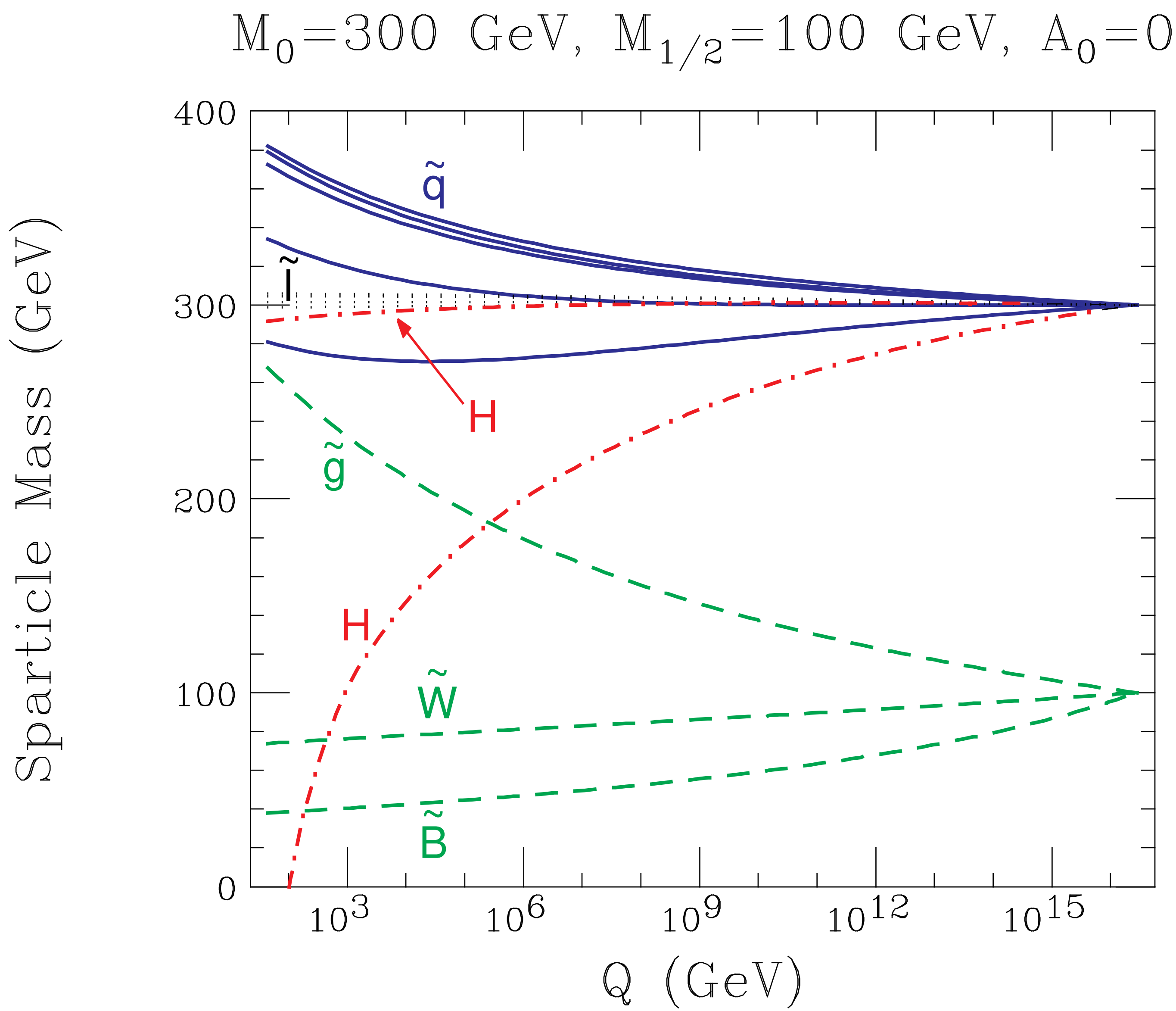
Sleptons: $M_{\tilde{l}_L}$, $M_{\tilde{l}_R}$ (equal for all 3 generations, or different 1.2. vs. 3.)

Amazing feature of the MSSM: [*Amaldi, de Boer, Fürstenau '92*]



$\Rightarrow$ SUSY is naturally imbedded in a Grand Unified Theory (GUT)

Unification at the GUT scale:



⇒ ("usual") GUT prediction: $M_1 \sim M_2/2 \sim M_3/6$ with $M_3 = m_{\tilde g} \gtrsim 2$ TeV

Many options for the correct relic density:

A) wino/bino DM with chargino co-annihilation ($M_1 \sim M_2 \lesssim \mu$)
relic DM density 100% fulfilled

B/C) bino DM with slepton co-annihilation ($M_1 \lesssim M_2, \mu$)
relic DM density 100% fulfilled
$\Rightarrow$ two cases: all 3 generations degenerate vs. 3rd generation independent

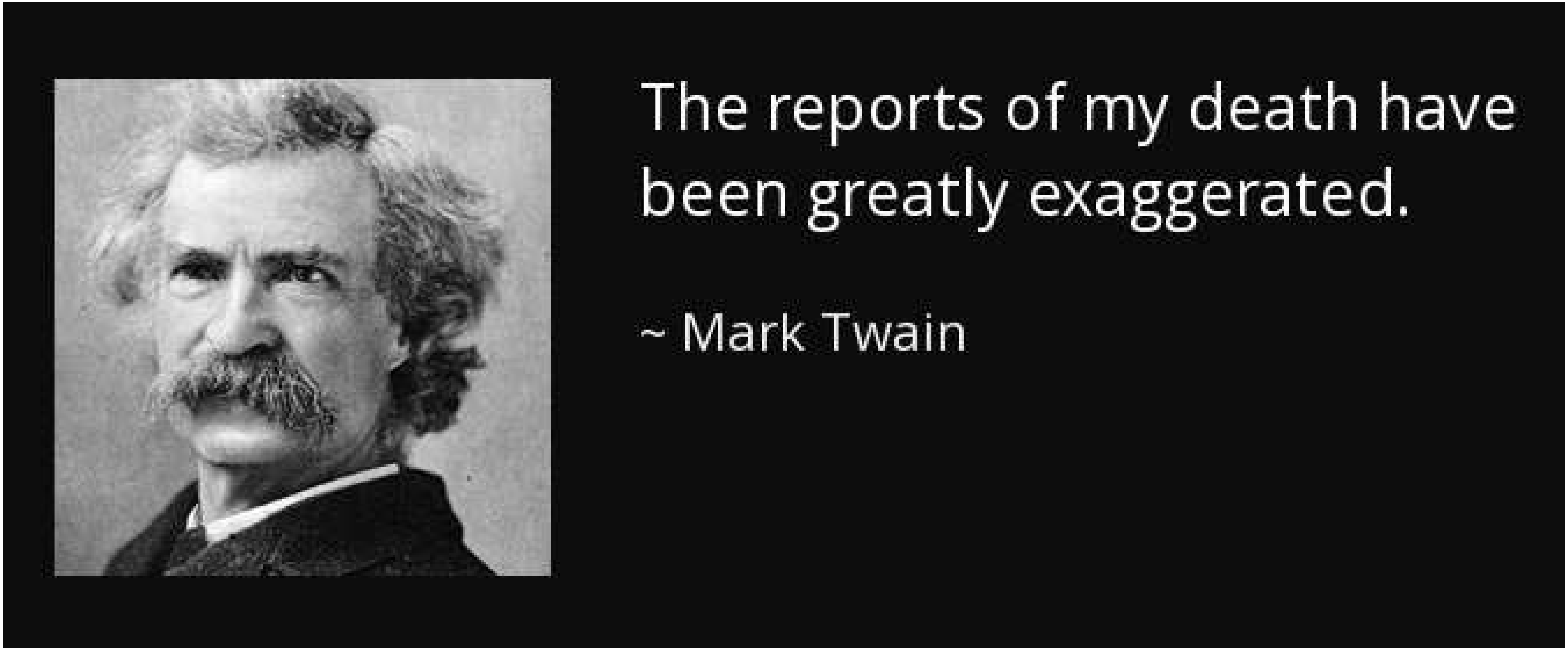
D) higgsino DM: $m_{\tilde{\chi}_1^0} \sim m_{\tilde{\chi}_2^0} \sim m_{\tilde{\chi}_1^\pm} \sim \mu$ ($\mu \lesssim M_1, M_2$)
relic DM density as upper limit (full relic density: $m_{\tilde{\chi}_1^0} \sim 1$ TeV)

E) wino DM: $m_{\tilde{\chi}_1^0} \sim m_{\tilde{\chi}_1^\pm} \sim M_2$ ($M_2 \lesssim M_1, \mu$)
relic DM density as upper limit (full relic density: $m_{\tilde{\chi}_1^0} \sim 3$ TeV)

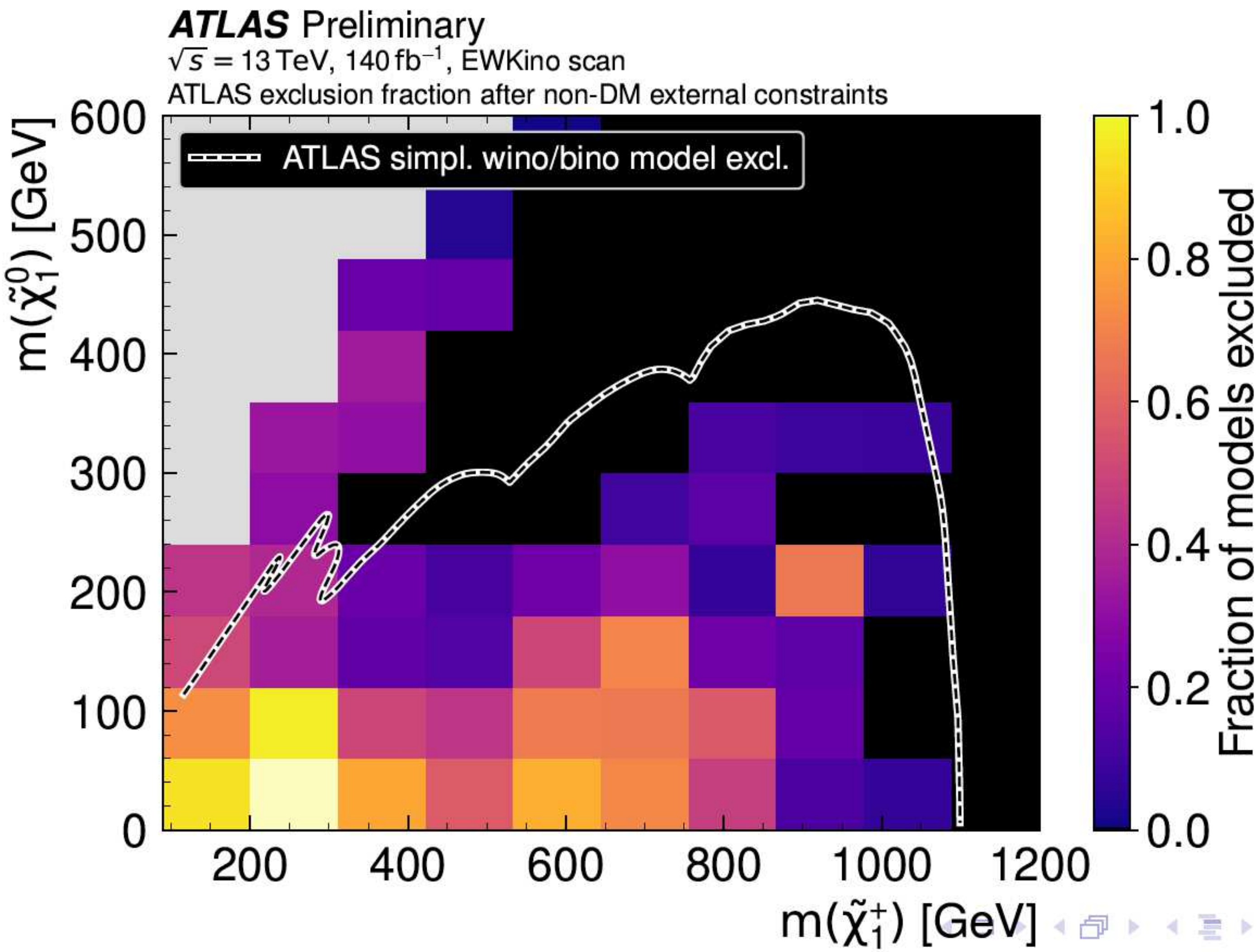
GUT-based scenarios: $M_1 \sim M_2/2 \sim M_3/6$
$\Rightarrow$ only possible for B/C and D

$m_{\tilde{g}} \gtrsim 2$ TeV $\Rightarrow M_1 \sim M_2/2 \gtrsim 350$ GeV

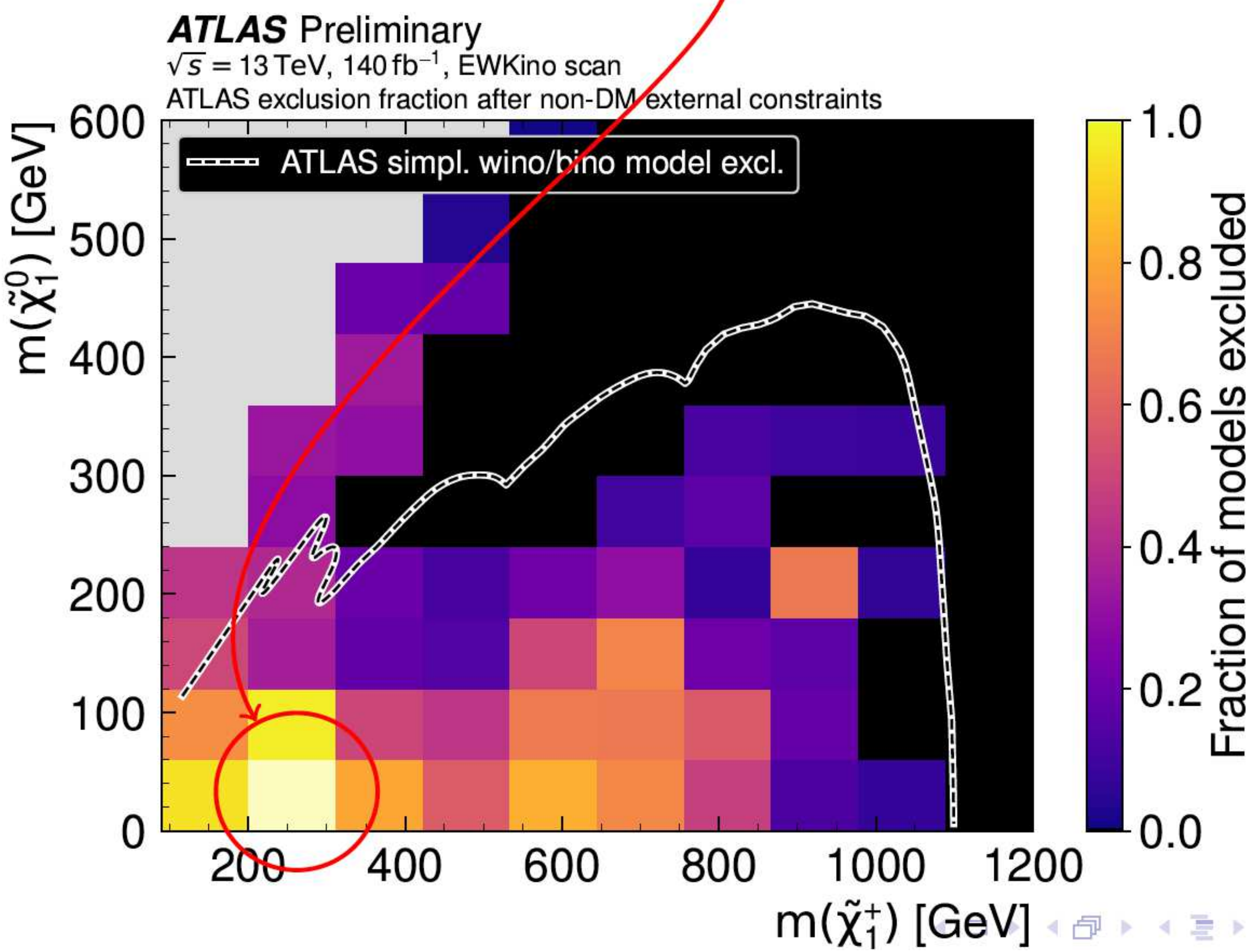
2. Evidence for low-energy SUSY?!



EW SUSY searches at the LHC: what is excluded? [*taken from M. Berggren '23*]



Only this one is actually excluded !



$\Rightarrow$ Our "models" predict low chargino/neutralino masses

Possible search channels:

- $pp \to \tilde{\chi}_1^0 \tilde{\chi}_1^0 + X$
- $pp \to \tilde{\chi}_1^0 \tilde{\chi}_2^0 \to \tilde{\chi}_1^0 \tilde{\chi}_1^0 + H/Z$
- $pp \to \tilde{\chi}_2^0 \tilde{\chi}_1^\pm \to \tilde{\chi}_1^0 H/Z \; \tilde{\chi}_1^0 W^\pm$
- $pp \to \tilde{\chi}_1^+ \tilde{\chi}_1^- \to \tilde{\chi}_1^0 W^+ \; \tilde{\chi}_1^0 W^-$
- ...

Possible kinematic situations:

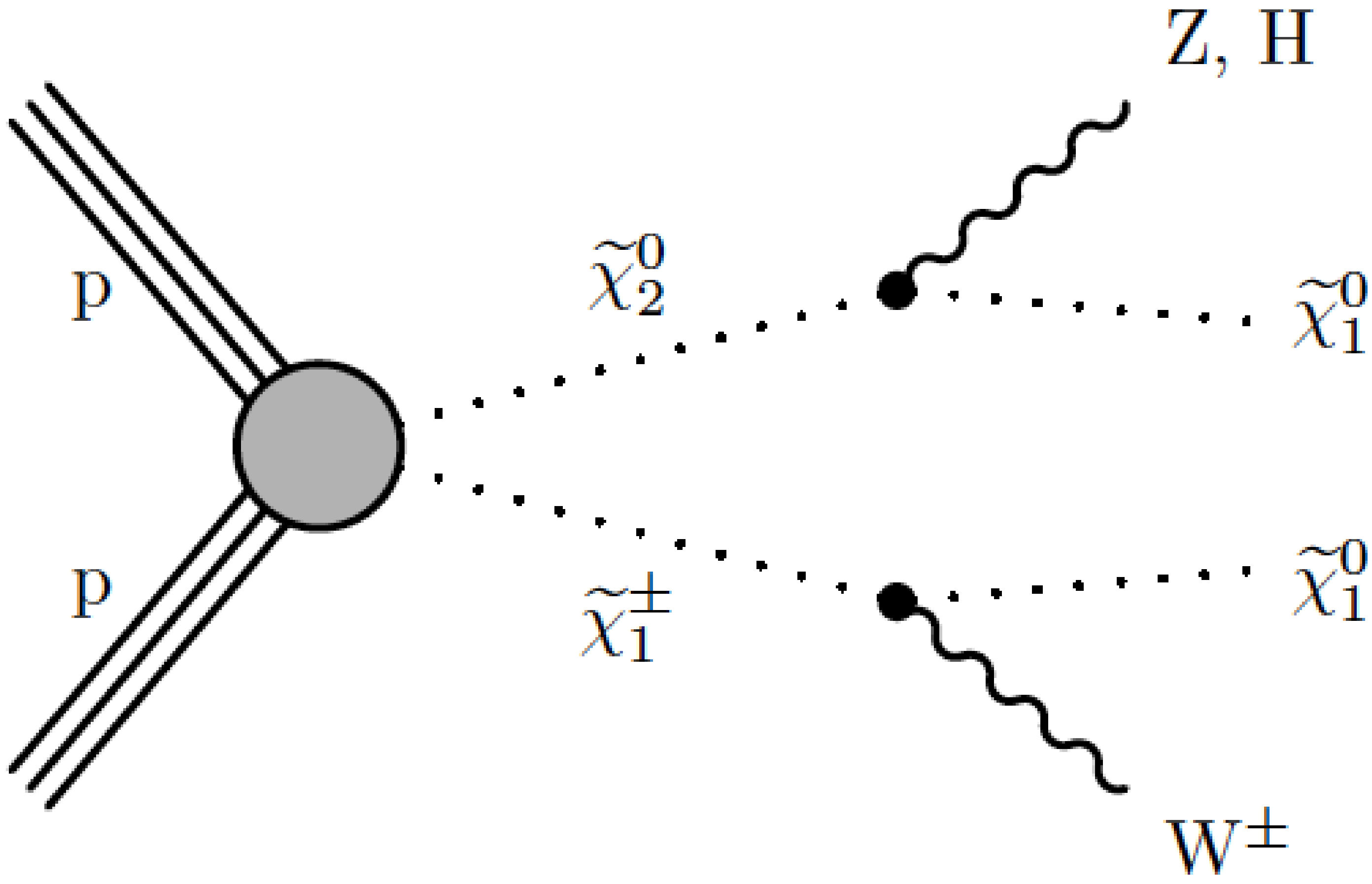
- non-compressed spectra: on-shell decays to $H/Z, W^\pm$
- compressed spectra: off-shell decays to $Z, W^\pm$
- light sleptons that appear in the decay chains
- heavy sleptons that are absent from the decay chains
- ...

$\Rightarrow$ only one of these kinematic situations can be realized

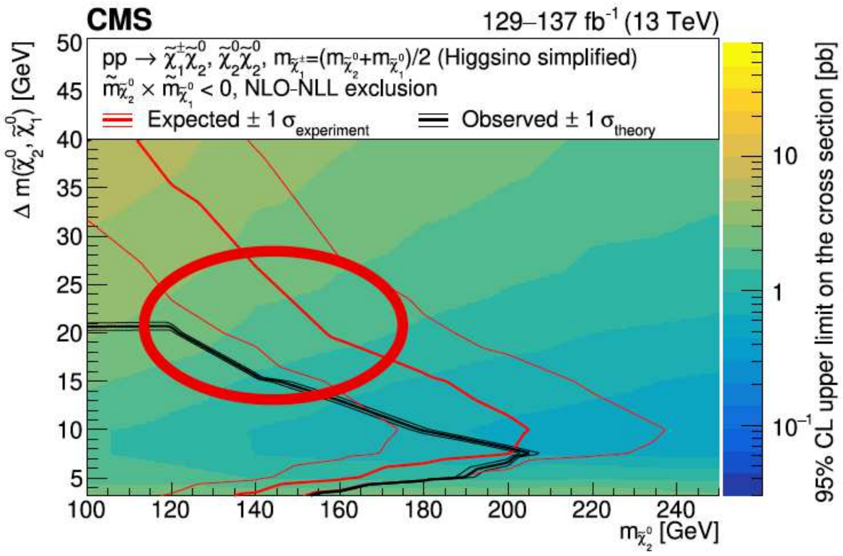
$\Rightarrow$ only one of them should show up in the LHC searches

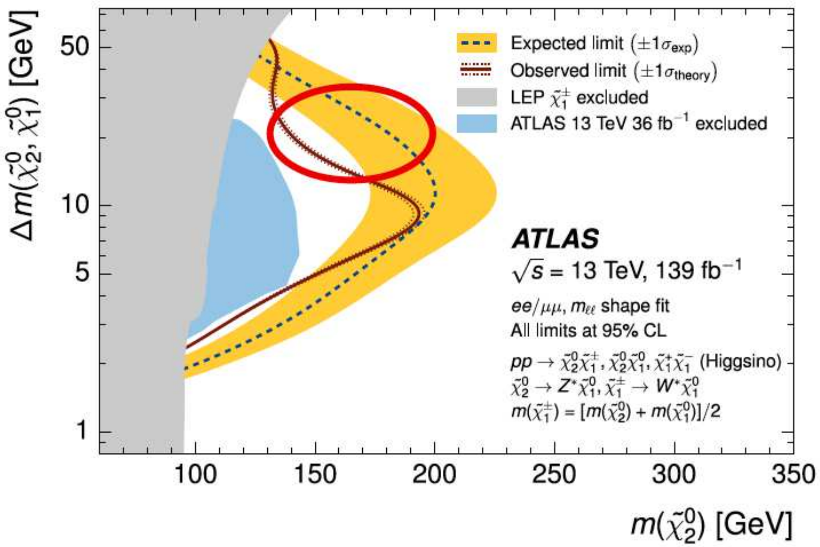
$\Rightarrow$ Our “models” predict low chargino/neutralino masses

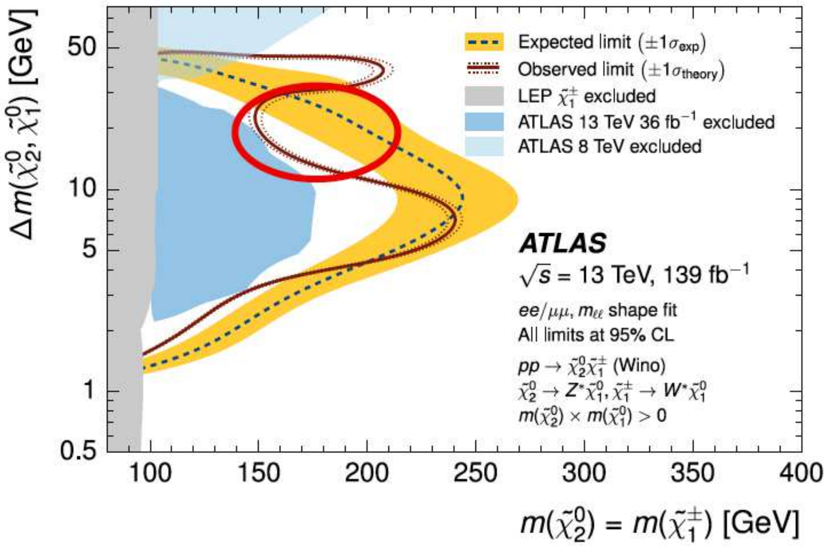
Golden mode at the LHC:

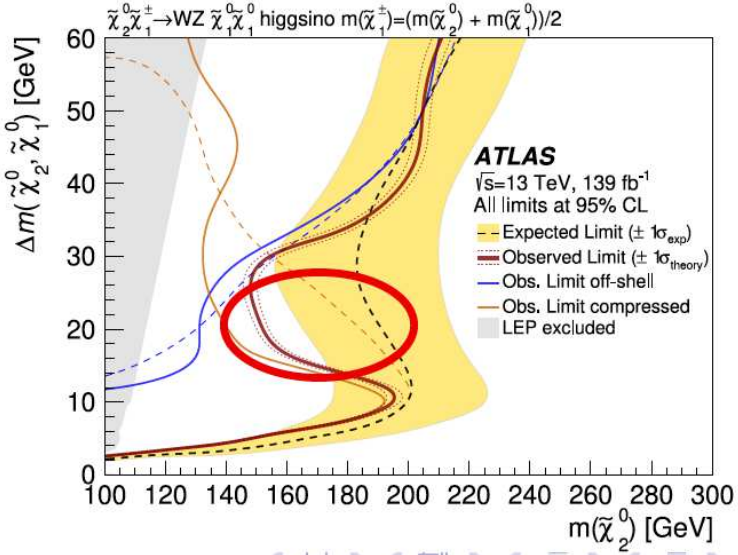


$\Rightarrow$ experimental results?

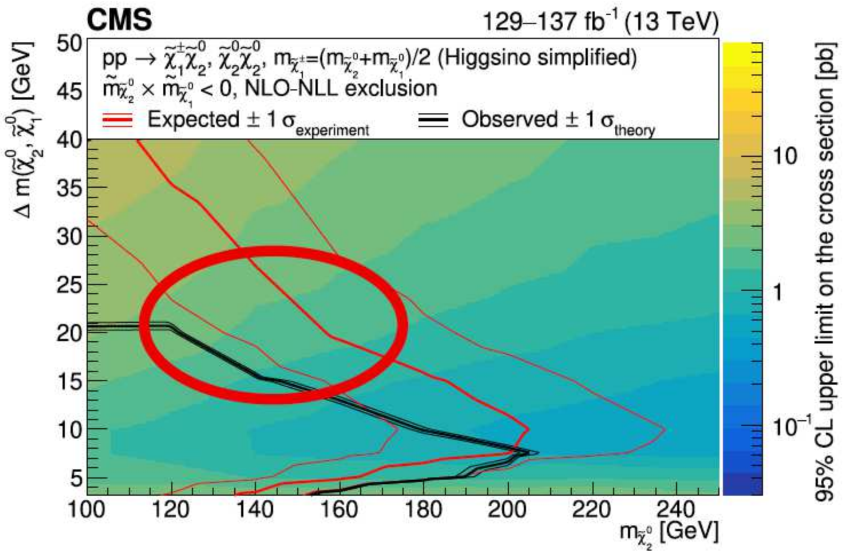

CMS
129–137 fb^{-1} (13 TeV)
pp → $\tilde\chi_1^\pm\tilde\chi_2^0$, $\tilde\chi_2^0\tilde\chi_2^0$, $m_{\tilde\chi_1^\pm}=(m_{\tilde\chi_2^0}+m_{\tilde\chi_1^0})/2$ (Higgsino simplified)
$\tilde m_{\tilde\chi_2^0} \times \tilde m_{\tilde\chi_1^0} < 0$, NLO-NLL exclusion
Expected ± 1 $\sigma_{experiment}$
Observed ± 1 σ_{theory}
$\Delta m(\tilde\chi_2^0, \tilde\chi_1^0)$ [GeV]
$m_{\tilde\chi_2^0}$ [GeV]
95% CL upper limit on the cross section [pb]

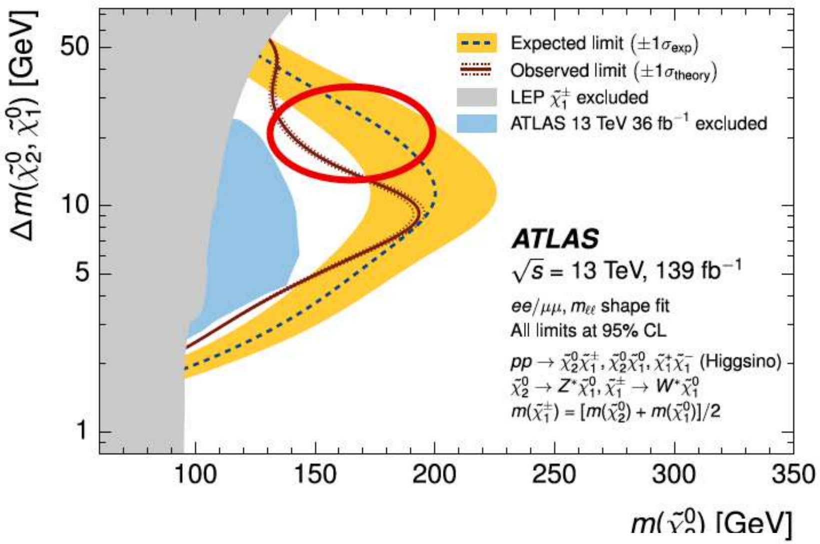

Expected limit ($\pm1\sigma_{exp}$)
Observed limit ($\pm1\sigma_{theory}$)
LEP $\tilde\chi_1^\pm$ excluded
ATLAS 13 TeV 36 fb^{-1} excluded
ATLAS
$\sqrt{s}$ = 13 TeV, 139 fb^{-1}
$ee/\mu\mu$, $m_{\ell\ell}$ shape fit
All limits at 95% CL
$pp \to \tilde\chi_2^0\tilde\chi_1^\pm, \tilde\chi_2^0\tilde\chi_1^0, \tilde\chi_1^+\tilde\chi_1^-$ (Higgsino)
$\tilde\chi_2^0 \to Z^*\tilde\chi_1^0, \tilde\chi_1^\pm \to W^*\tilde\chi_1^0$
$m(\tilde\chi_1^\pm) = [m(\tilde\chi_2^0) + m(\tilde\chi_1^0)]/2$
$\Delta m(\tilde\chi_2^0, \tilde\chi_1^0)$ [GeV]
$m(\tilde\chi_2^0)$ [GeV]

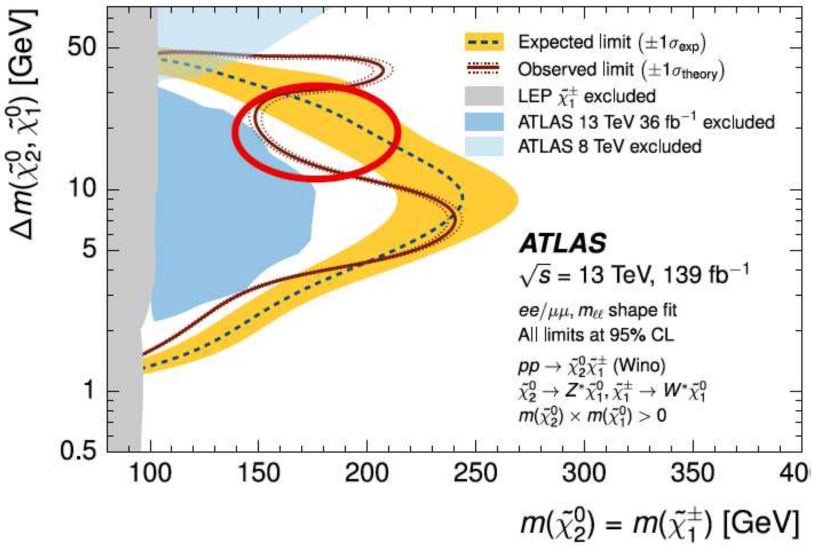

Expected limit ($\pm1\sigma_{exp}$)
Observed limit ($\pm1\sigma_{theory}$)
LEP $\tilde\chi_1^\pm$ excluded
ATLAS 13 TeV 36 fb^{-1} excluded
ATLAS 8 TeV excluded
ATLAS
$\sqrt{s}$ = 13 TeV, 139 fb^{-1}
$ee/\mu\mu$, $m_{\ell\ell}$ shape fit
All limits at 95% CL
$pp \to \tilde\chi_2^0\tilde\chi_1^\pm$ (Wino)
$\tilde\chi_2^0 \to Z^*\tilde\chi_1^0, \tilde\chi_1^\pm \to W^*\tilde\chi_1^0$
$m(\tilde\chi_2^0) \times m(\tilde\chi_1^0) > 0$
$\Delta m(\tilde\chi_2^0, \tilde\chi_1^0)$ [GeV]
$m(\tilde\chi_2^0) = m(\tilde\chi_1^\pm)$ [GeV]

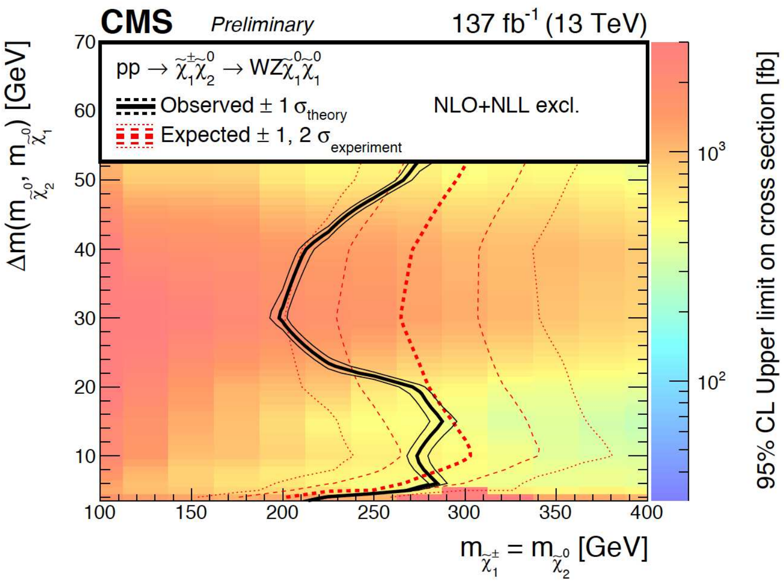

$\tilde\chi_2^0\tilde\chi_1^\pm \to WZ\ \tilde\chi_1^0\tilde\chi_1^0$ higgsino $m(\tilde\chi_1^\pm)=(m(\tilde\chi_2^0) + m(\tilde\chi_1^0))/2$
ATLAS
$\sqrt{s}$=13 TeV, 139 fb^{-1}
All limits at 95% CL
Expected Limit (± 1σ_{exp})
Observed Limit (± 1σ_{theory})
Obs. Limit off-shell
Obs. Limit compressed
LEP excluded
$\Delta m(\tilde\chi_2^0, \tilde\chi_1^0)$ [GeV]
$m(\tilde\chi_2^0)$ [GeV]

Results: “compressed” spectra w/ heavy sleptons: one more CMS analysis:



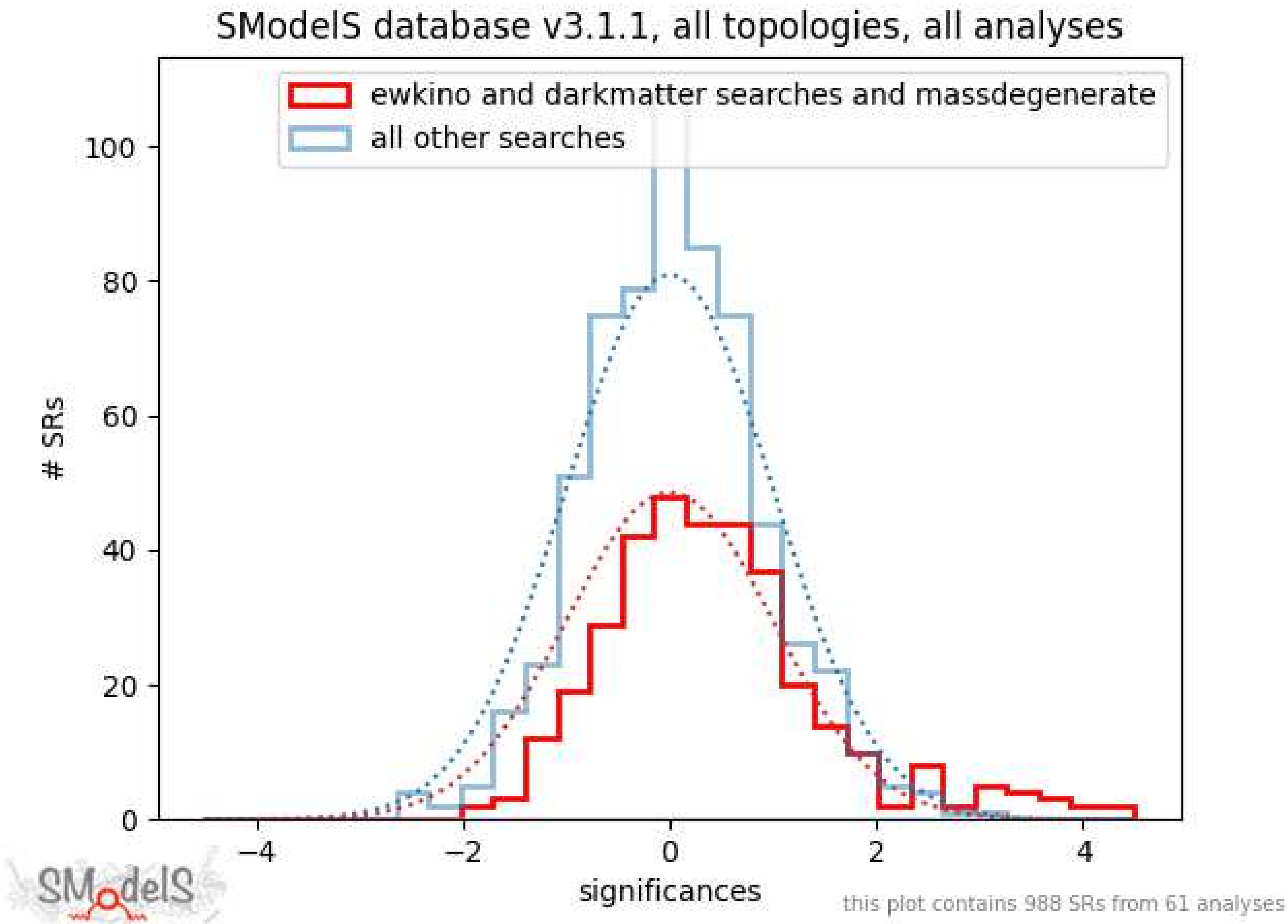






Emergence of a discovery:

[*W. Waltenberger '26*]



Consistent excesses point towards:

- $m_{\tilde{\chi}_2^0} \sim m_{\tilde{\chi}_1^\pm} \gtrsim 200$ GeV
- $\Delta m := m_{\tilde{\chi}_2^0} - m_{\tilde{\chi}_1^0} \sim \mathcal{O}\,(20$ GeV$)$

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A) wino/bino DM with chargino co-annihilation ($|M_1| \sim M_2 \lesssim \mu$)

relic DM density 100% fulfilled

Never: $M_1 \sim M_2\,/2$ $\boxed{\Rightarrow \text{not GUT-based}}$

D) higgsino DM: $m_{\tilde{\chi}_1^0} \sim m_{\tilde{\chi}_2^0} \sim m_{\tilde{\chi}_1^\pm} \sim \mu$ ($\mu \lesssim |M_1|, M_2$)

relic DM density as upper limit (full relic density: $m_{\tilde{\chi}_1^0} \sim 1$ TeV)

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$\Rightarrow$ can they fit the excesses?

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$\Rightarrow$ can they fit the excesses? $\Rightarrow$ Analysis: [*M. Chakraborti, S.H., I. Saha '24*]

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relic DM density as upper limit (full relic density: $m_{\tilde{\chi}_1^0} \sim 1$ TeV)
Possible: $M_1 \sim M_2\,/2$ $\boxed{\Rightarrow \text{can be GUT-based}}$ **Excess fit: No**

$\Rightarrow$ can they fit the excesses? $\Rightarrow$ Analysis: [*M. Chakraborti, S.H., I. Saha '24*]

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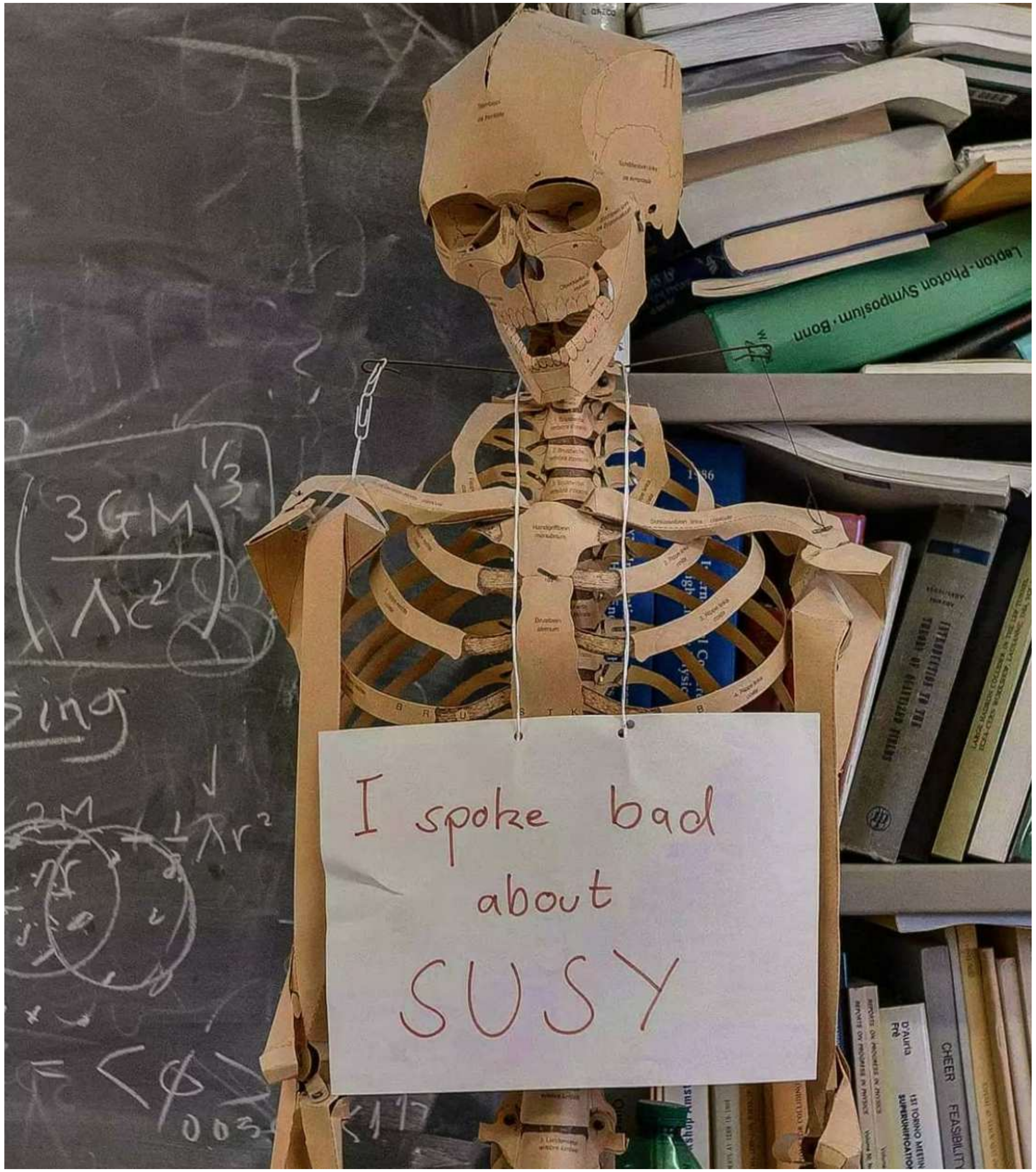
Possible: $M_1 \sim M_2\,/2$ $\boxed{\Rightarrow \text{ can be GUT-based}}$ **Excess fit: No**

$\Rightarrow$ can they fit the excesses? $\Rightarrow$ Analysis: [*M. Chakraborti, S.H., I. Saha '24*]

Solution?
$\Rightarrow$ go beyond the MSSM: add a singlet: NMSSM

3. Solution for GUT-based scenarios



Our model: **NMSSM** (Z_3 invariant NMSSM)

MSSM Higgs sector: Two Higgs doublets

$$
\begin{aligned}
H_1 &= \begin{pmatrix} H_1^1 \\ H_1^2 \end{pmatrix} = \begin{pmatrix} v_1 + (\phi_1 + i\chi_1)/\sqrt{2} \\ \phi_1^- \end{pmatrix} \\
H_2 &= \begin{pmatrix} H_2^1 \\ H_2^2 \end{pmatrix} = \begin{pmatrix} \phi_2^+ \\ v_2 + (\phi_2 + i\chi_2)/\sqrt{2} \end{pmatrix}
\end{aligned}
$$

$$
\begin{aligned}
V = {} & (\tilde{m}_1^2 + |\mu \quad|^2) H_1 \bar{H}_1 + (\tilde{m}_2^2 + |\mu \quad|^2) H_2 \bar{H}_2 - m_{12}^2 (\epsilon_{ab} H_1^a H_2^b + \text{h.c.}) \\
& + \frac{g'^2 + g^2}{8} (H_1 \bar{H}_1 - H_2 \bar{H}_2)^2 + \frac{g^2}{2} |H_1 \bar{H}_2|^2
\end{aligned}
$$

Our model: **NMSSM** (Z_3 invariant NMSSM)

NMSSM Higgs sector: Two Higgs doublets + one Higgs singlet

$$
\begin{aligned}
H_1 &= \begin{pmatrix} H_1^1 \\ H_1^2 \end{pmatrix} = \begin{pmatrix} v_1 + (\phi_1 + i\chi_1)/\sqrt{2} \\ \phi_1^- \end{pmatrix} \\
H_2 &= \begin{pmatrix} H_2^1 \\ H_2^2 \end{pmatrix} = \begin{pmatrix} \phi_2^+ \\ v_2 + (\phi_2 + i\chi_2)/\sqrt{2} \end{pmatrix} \\
S &= v_s + S_R + I S_I
\end{aligned}
$$

$$
\begin{aligned}
V = & (\tilde{m}_1^2 + |\cancel{\mu}\lambda S|^2) H_1 \bar{H}_1 + (\tilde{m}_2^2 + |\cancel{\mu}\lambda S|^2) H_2 \bar{H}_2 - m_{12}^2 (\epsilon_{ab} H_1^a H_2^b + \text{h.c.}) \\
& + \frac{g'^2 + g^2}{8} (H_1 \bar{H}_1 - H_2 \bar{H}_2)^2 + \frac{g^2}{2} |H_1 \bar{H}_2|^2 \\
& + |\lambda(\epsilon_{ab} H_1^a H_2^b) + \kappa S^2|^2 + m_S^2 |S|^2 + (\lambda A_\lambda (\epsilon_{ab} H_1^a H_2^b) S + \frac{\kappa}{3} A_\kappa S^3 + \text{h.c.})
\end{aligned}
$$

Free parameters:

$$\lambda,\ \kappa,\ A_\kappa,\ M_{H^\pm},\ \tan\beta,\ \mu_{\text{eff}} = \lambda v_s$$

Higgs spectrum:

$$\begin{aligned} \mathcal{CP}\text{-even} &: h_1, h_2, h_3 \\ \mathcal{CP}\text{-odd} &: a_1, a_2 \\ \text{charged} &: H^+, H^- \\ \text{Goldstones} &: G^0, G^+, G^- \end{aligned}$$

Neutralinos:

$$\mu \to \mu_{\text{eff}}$$

compared to the MSSM: one singlino more

$$\to \tilde{\chi}_1^0, \tilde{\chi}_2^0, \tilde{\chi}_3^0, \tilde{\chi}_4^0, \tilde{\chi}_5^0$$

$\Rightarrow$ make the LSP singlino-like $\Rightarrow$ avoid DD bounds

$$\Rightarrow \mu \lesssim M_1 \sim M_2/2 \sim M_3/6 \quad (M_3 = m_{\tilde{g}} \gtrsim 2\ \text{TeV})$$

NMSSM parameter scan:

singlino/higgsino: singlino DM with higgsino dominated $\tilde{\chi}^0_{2,3}$, $\tilde{\chi}^\pm_1$:

$$
\begin{aligned}
1000\ \text{GeV} \le 2 \times M_1 = M_2 = M_3/3 \le 2000\ \text{GeV}\,, \quad 150\ \text{GeV} < |\mu| < 300\ \text{GeV}\,,\\
1000\ \text{GeV} = m_{\tilde{l}_L} = m_{\tilde{l}_R}\,, \quad A_e = A_\mu = A_\tau = 0\,,\\
5000\ \text{GeV} = M_{\tilde{Q}_{1,2}} = M_{\tilde{u}_R,\tilde{d}_R,\tilde{c}_R,\tilde{s}_R}\,, \quad A_{u,d,c,s} = 0\,,\\
3000\ \text{GeV} = M_{\tilde{Q}_3} = M_{\tilde{t}_R,\tilde{b}_R}\,, \quad A_b = 0\,, \quad 5000\ \text{GeV} < A_t < 8000\ \text{GeV}\,,\\
-0.7 \le \kappa < 0.7\,, \quad 0 < \lambda < 5\,, \quad 0.5 \le \tan\beta \le 50\,,\\
5\ \text{GeV} \le |A_\lambda| \le 5000\ \text{GeV}\,, \quad -1000\ \text{GeV} \le A_\kappa \le 1000\ \text{GeV}\,.
\end{aligned}
$$

$$M_1 = 1/2\, M_2 = 1/6\, M_3 \ge 500\ \text{GeV}$$

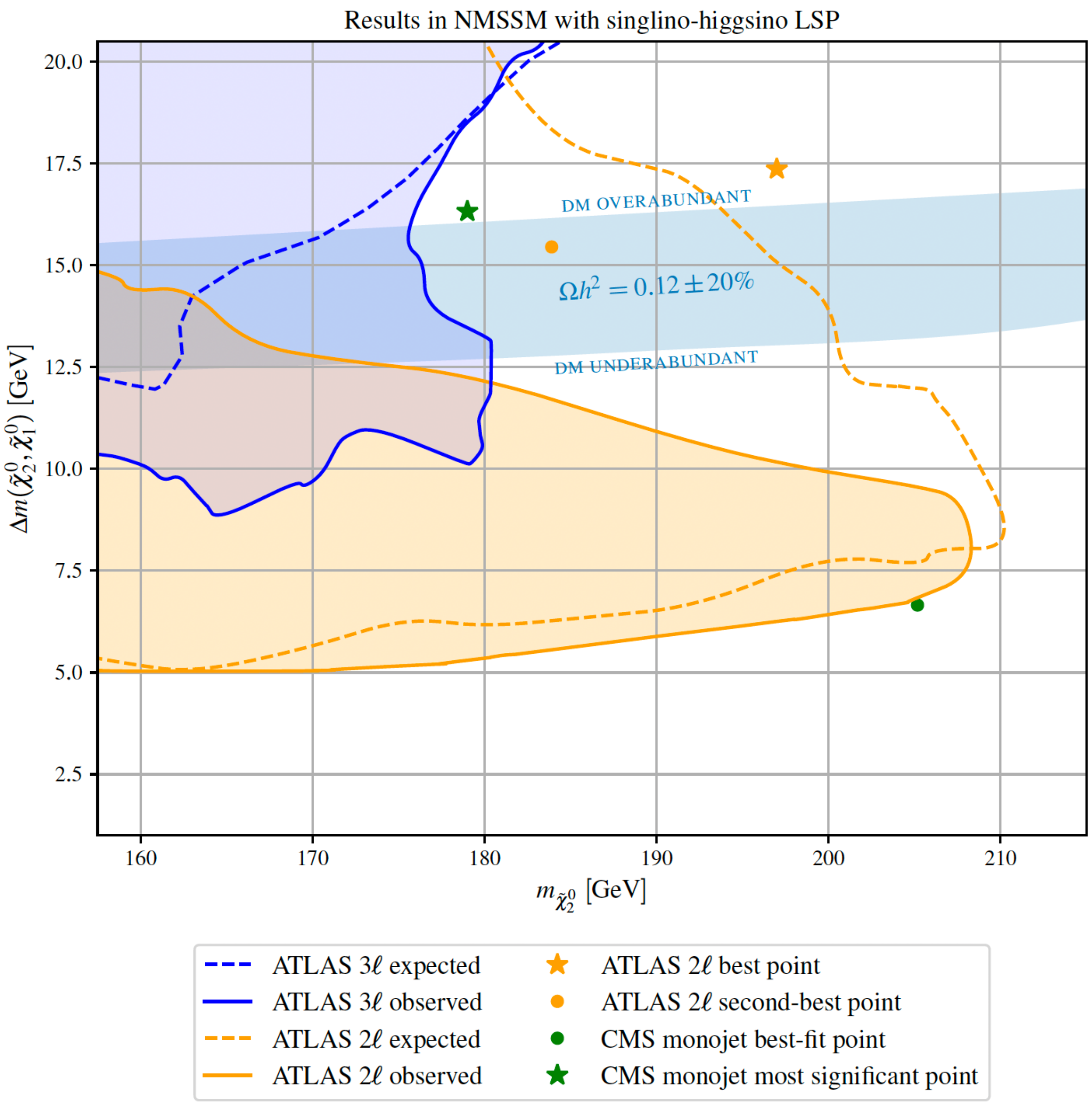
$\Rightarrow m_{\tilde{g}} \ge 3$ TeV - safe from LHC limits

Constraints:

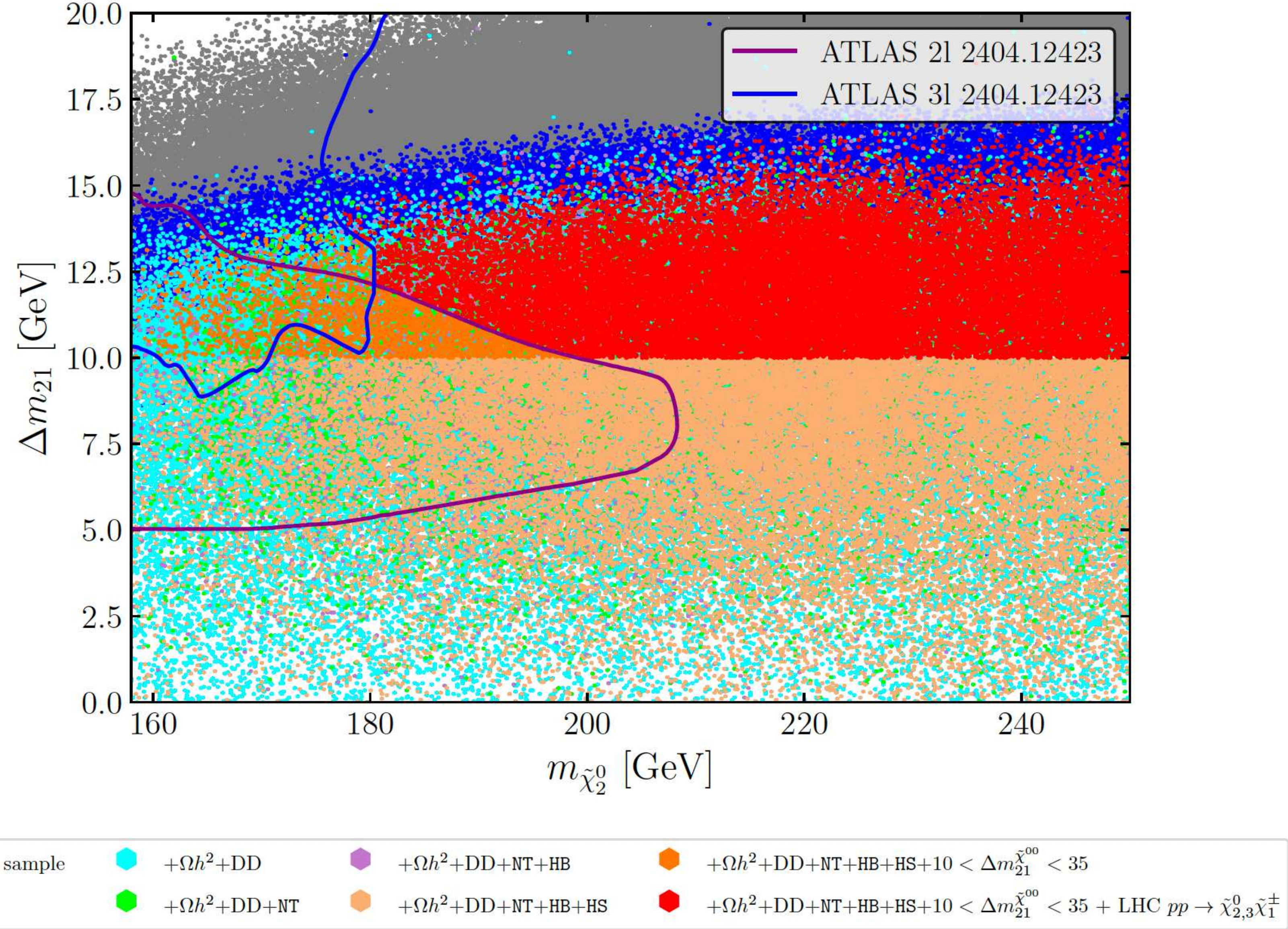
- LSP singlino component $\geq 90\%$
- DM relic density (MicrOmegas)
- DM direct detection limits (MicrOmegas)
- BSM Higgs search bounds (HiggsBounds)
- LHC Higgs boson rate measurements (HiggsSignals)
- flavor constraints (naturally fulfilled)
- LHC SUSY search limits

$\Rightarrow$ red points are in agrement with all constraints and the excesses

Take bounds from: [D. Agin, B. Fuks, M. Goodsell, T. Murphy '24]

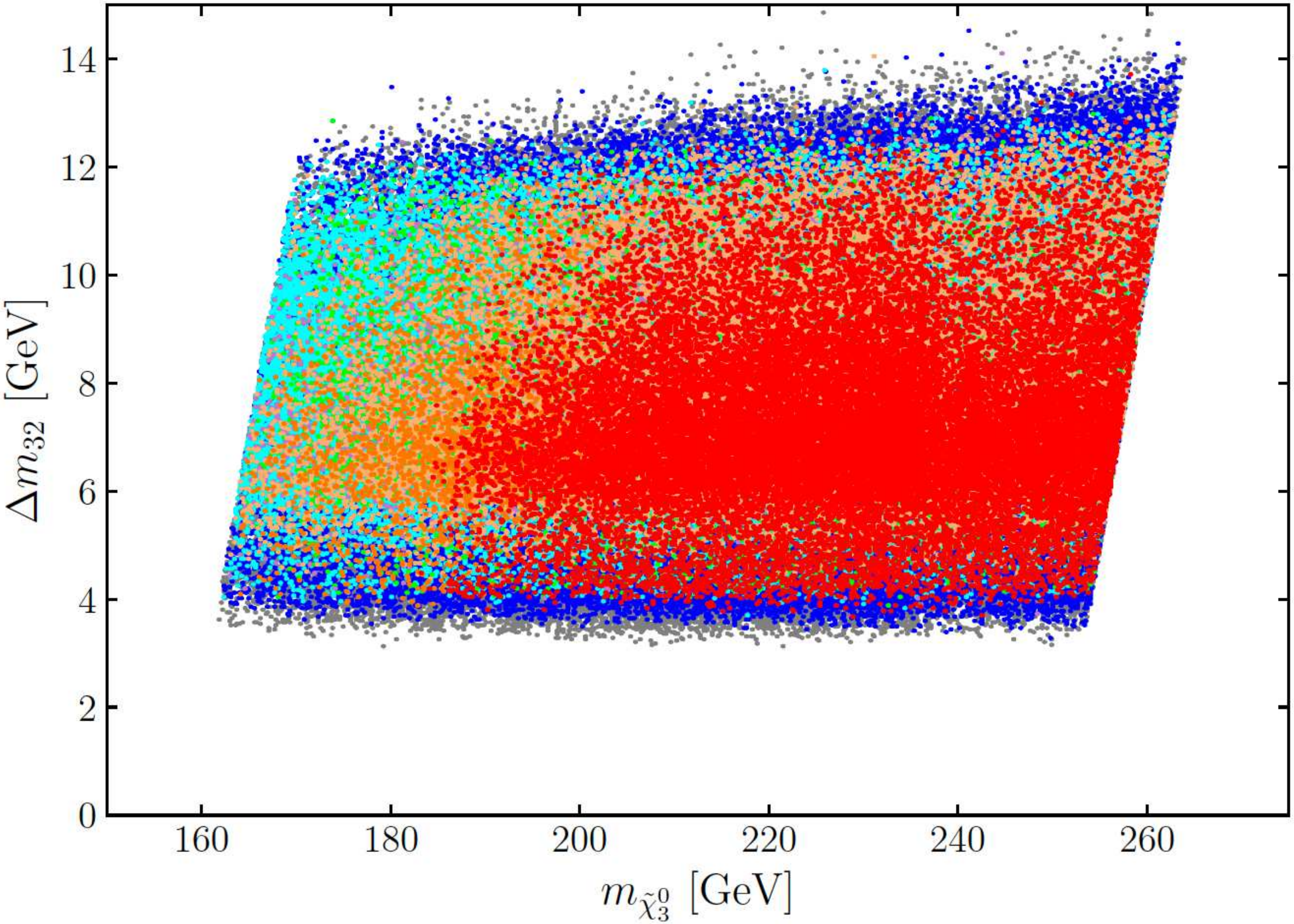


higgsino(−): $m_{\tilde{\chi}_2^0}$-Δm plane with LHC bounds included:



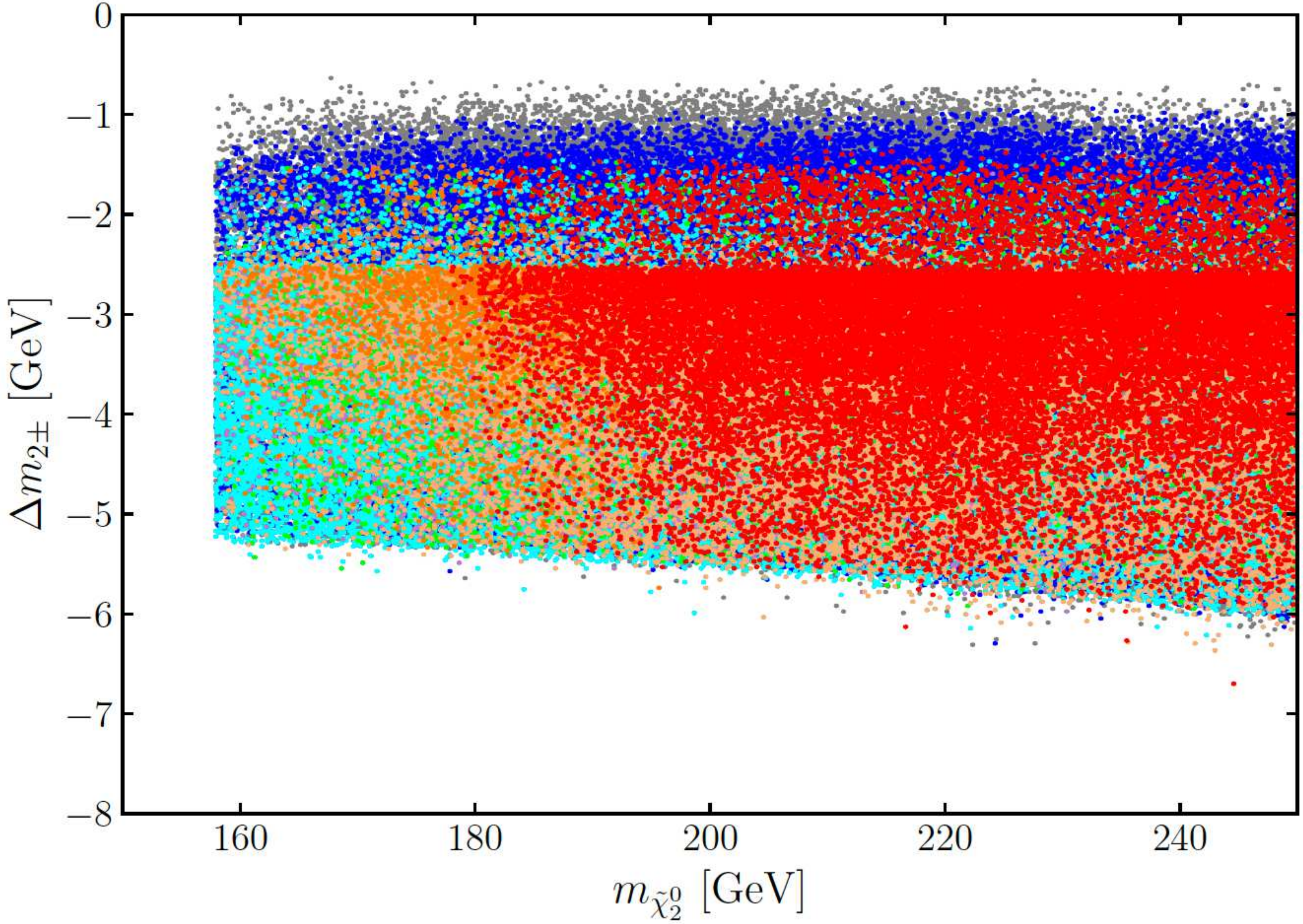
$\Delta m_{21} := m_{\tilde{\chi}_2^0} - m_{\tilde{\chi}_1^0} \Rightarrow$ correct mass region to fit the excesses, Δm perfect!

higgsino(−): more than one Δm:



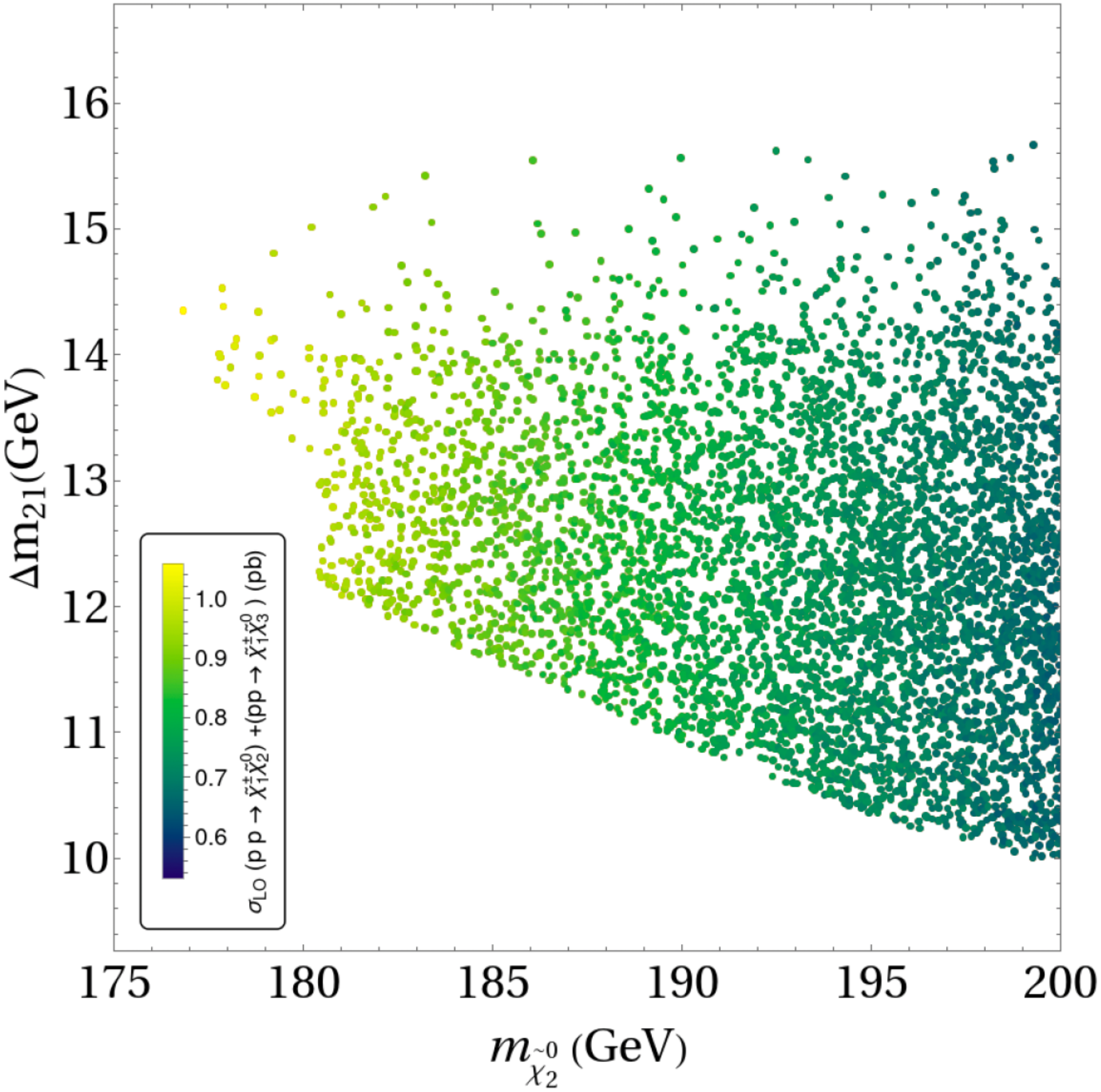
$\Delta m_{32} := m_{\tilde{\chi}_3^0} - m_{\tilde{\chi}_2^0}$ $\Rightarrow$ large mass gap, better for the excesses

higgsino(−): more than one Δm:



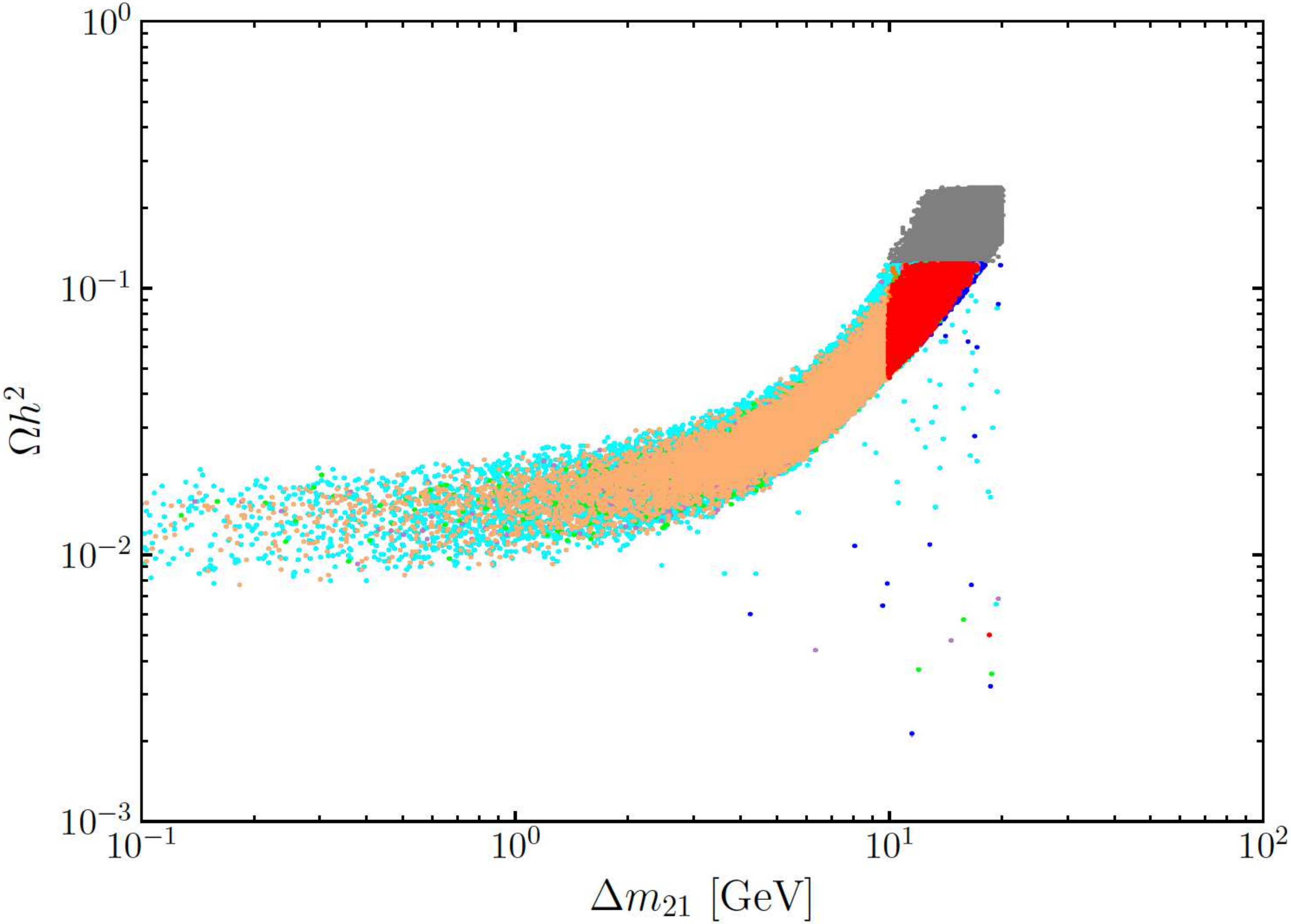
$\Delta m_{2\pm} := m_{\tilde{\chi}_2^0} - m_{\tilde{\chi}_1^\pm}$ ⇒ large mass gap, better for the excesses

higgsino(−):production cross section at the LHC:



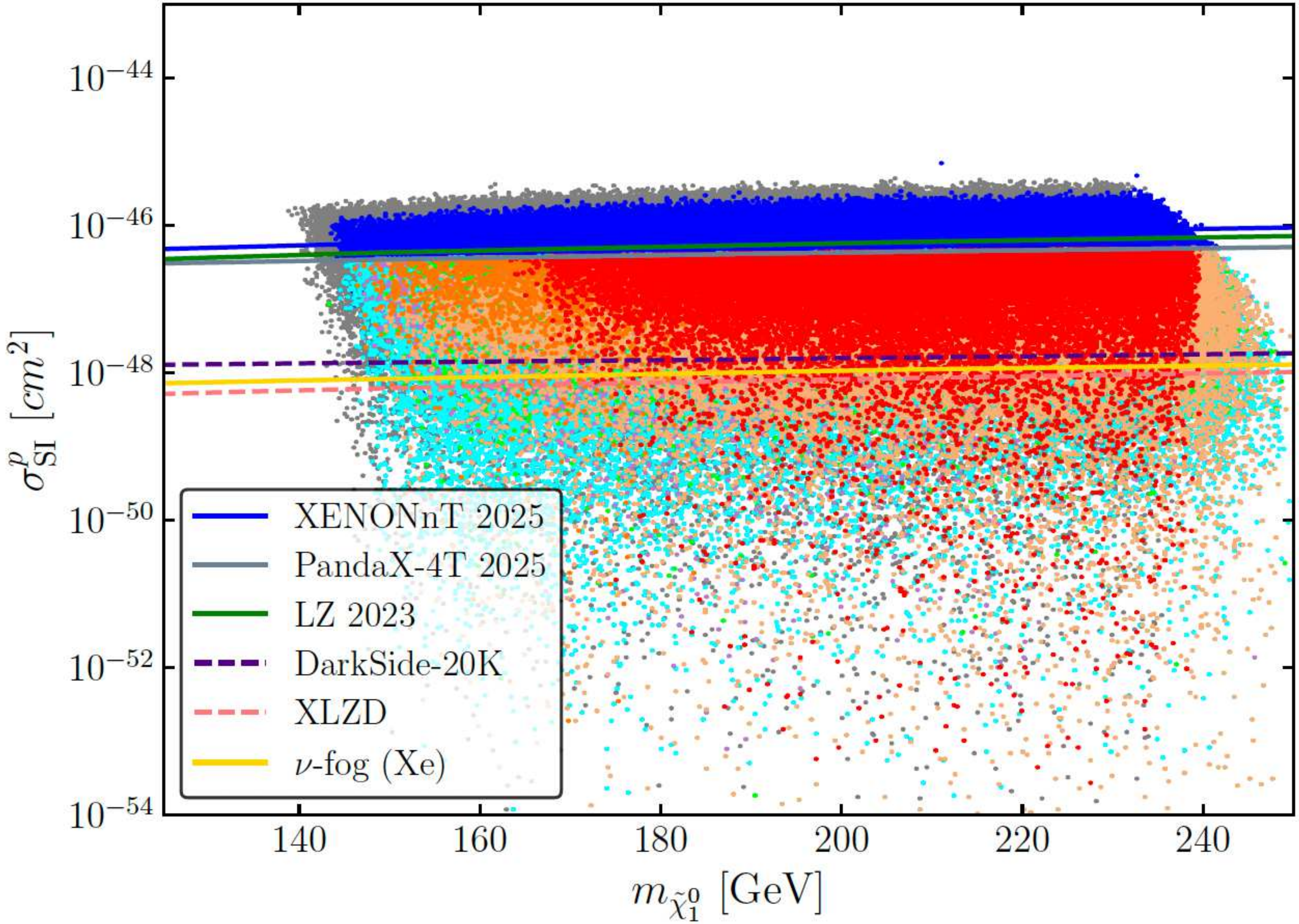
$\Delta m_{21} := m_{\tilde{\chi}_2^0} - m_{\tilde{\chi}_1^0}1$ ⇒ lower masses fit well the expected cross section

higgsino(−): DM relic density:



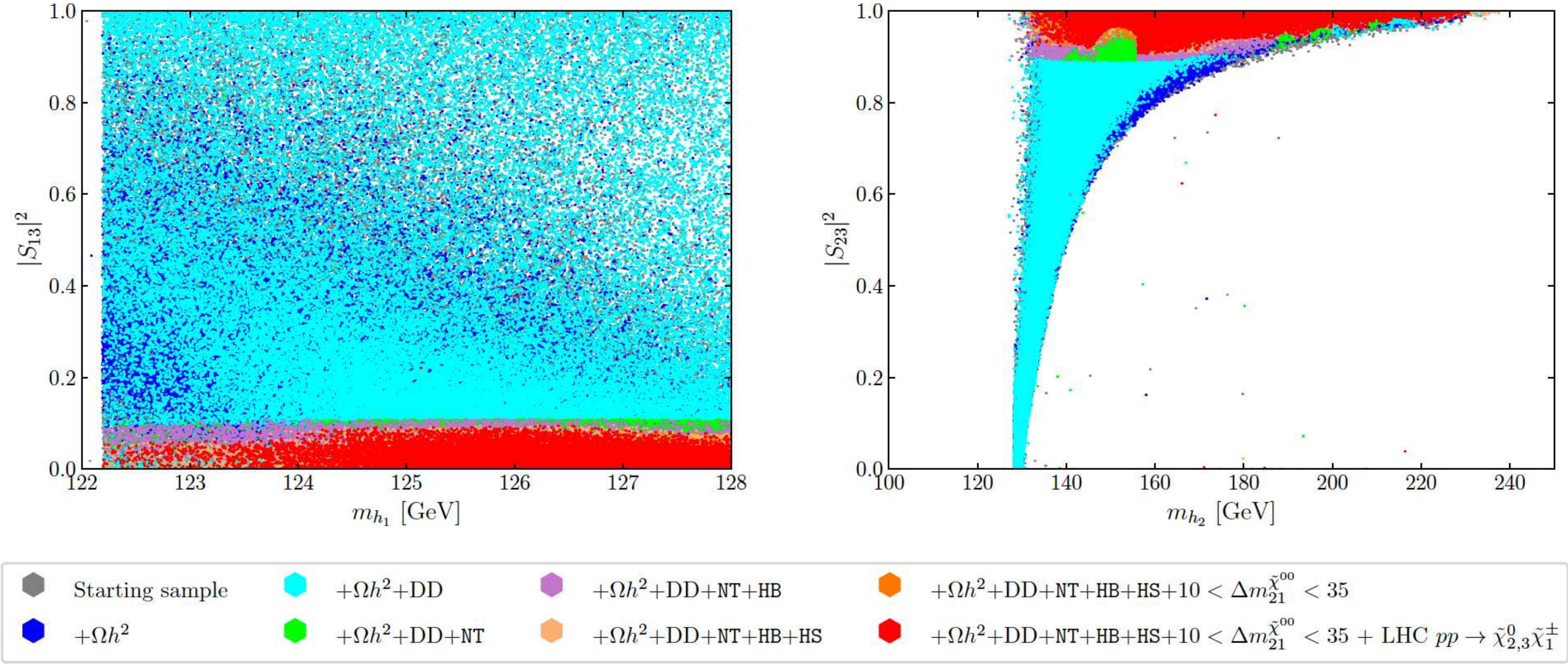
$\Delta m_{21} := m_{\tilde{\chi}_2^0} - m_{\tilde{\chi}_1^0}$ ⇒ larger mass gap favors full relic density

higgsino(−): predictions for DD experiments



⇒ good prospects for next round of DD experiments

higgsino(−): Singlet components of light Higgses:



⇒ interesting prospects for light second Higgs?

⇒ so far in agreement with all bounds!

4. Conclusinos

- For the first time consistent excesses in ATLAS and CMS in SUSY searches have been observed.

- $pp \to \tilde{\chi}_2^0 \tilde{\chi}_1^\pm \to \tilde{\chi}_1^0 Z^* \, \tilde{\chi}_1^0 W^*$
  with $m_{\tilde{\chi}_2^0} \approx m_{\tilde{\chi}_1^\pm} \gtrsim 200$ GeV, $\Delta m := m_{\tilde{\chi}_2^0} - m_{\tilde{\chi}_1^0} \approx 20 - 25$ GeV

- MSSM wino/bino DM with chargino co-annihilation ($|M_1| \sim M_2 \lesssim \mu$)
  Never: $M_1 \sim M_2/2$ $\boxed{\Rightarrow \text{not GUT-based}}$ **Excess fit: YES**
  MSSM higgsino DM: $m_{\tilde{\chi}_1^0} \sim m_{\tilde{\chi}_2^0} \sim m_{\tilde{\chi}_1^\pm} \sim \mu$ ($\mu \lesssim |M_1|, M_2$)
  Possible: $M_1 \sim M_2/2$ $\boxed{\Rightarrow \text{can be GUT-based}}$ **Excess fit: No**

- Solution: NMSSM $\Rightarrow$ LSP singlino like $\Rightarrow$ avoid DD bounds

  $\Rightarrow \mu \lesssim M_1 \sim M_2/2 \sim M_3/6$ $\quad (M_3 = m_{\tilde{g}} \gtrsim 2$ TeV) $\boxed{\Rightarrow \text{GUT based}}$

  – mass gap(s) well described **Excess fit: YES**
  – interesting prospects for next round of DD experiments


Further Questions?

A) Wino/bino DM with chargino co-annihilation

Parameter scan:

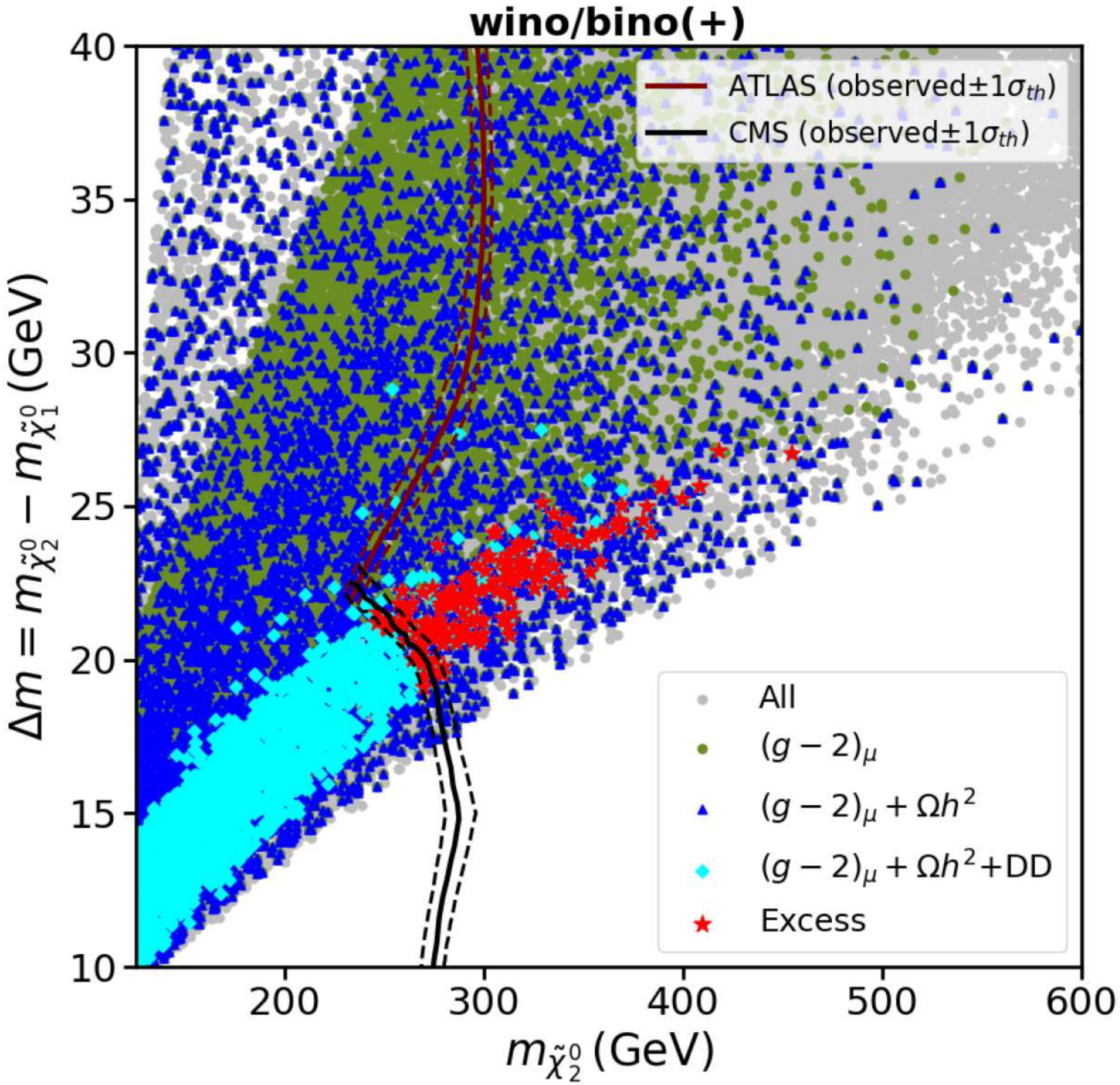
$$
\begin{aligned}
100 \text{ GeV} \le |M_1| &\le 400 \text{ GeV}\ , \\
|M_1| \le M_2 &\le 1.1 |M_1|\ , \\
1.1|M_1| \le \mu &\le 10|M_1|, \\
2 \le \tan\beta &\le 60, \\
100 \text{ GeV} \le m_{\tilde{L}} &\le 1.5 \text{ TeV}, \\
m_{\tilde{R}} &= m_{\tilde{L}}\ .
\end{aligned}
$$

(latter condition only to make the analysis simpler, no relevant effect)

wino/bino(+): $M_1 \times \mu > 0$
wino/bino(−): $M_1 \times \mu < 0$

relic DM density can be 100% fulfilled
$\Rightarrow m_{\text{(N)LSP}} \lesssim 600(650)$ GeV
(original scan assuming a $5\,\sigma$ deviation in $(g-2)_\mu$)

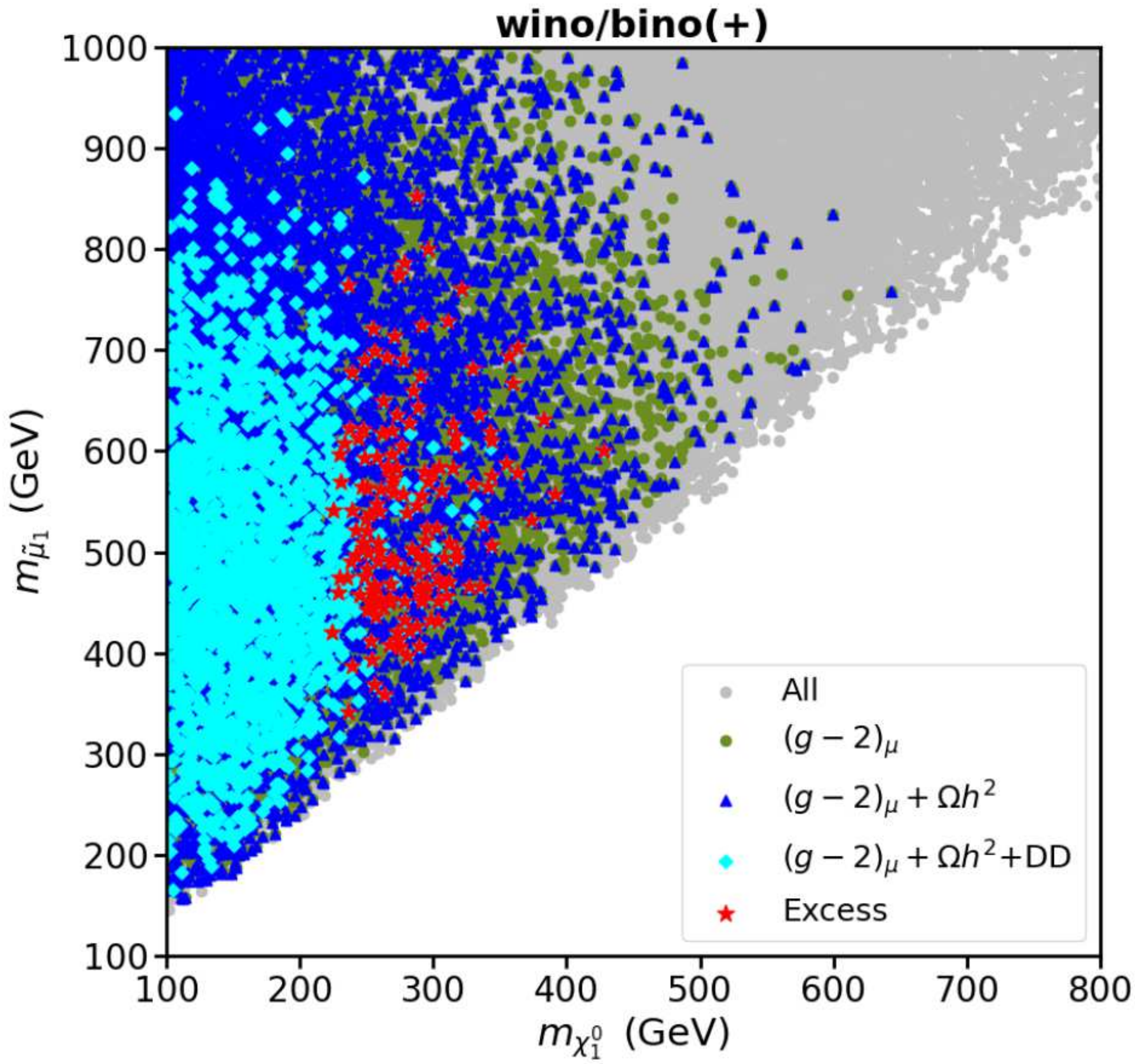
wino/bino(+): results in the $m_{\tilde{\chi}_2^0}$-Δm plane:



$\Rightarrow$ excesses not fully at the same Δm . . .

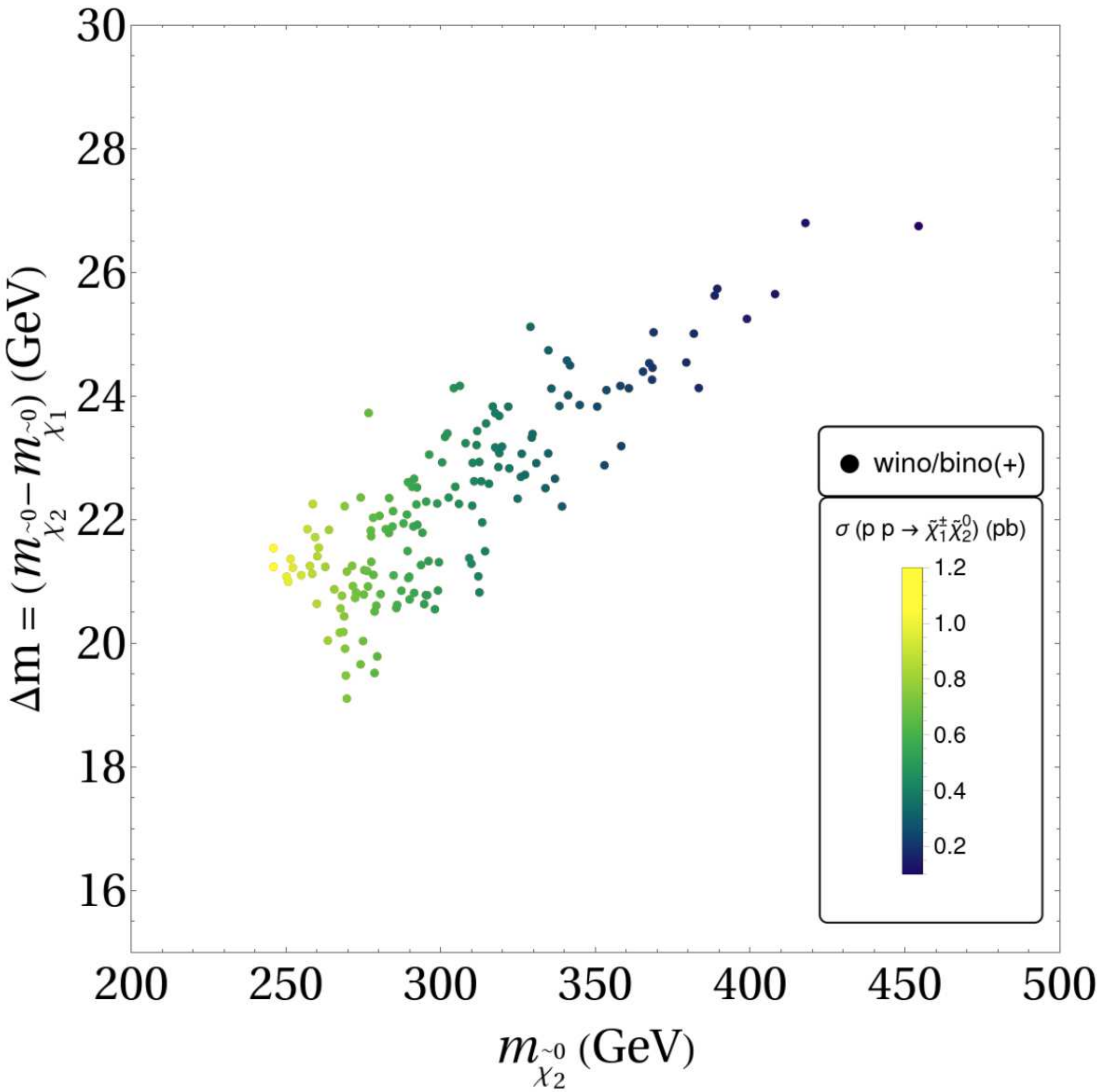
$\Rightarrow$ but many "good points" at $\Delta m \sim 20$ GeV

wino/bino(+): limits on slepton masses:



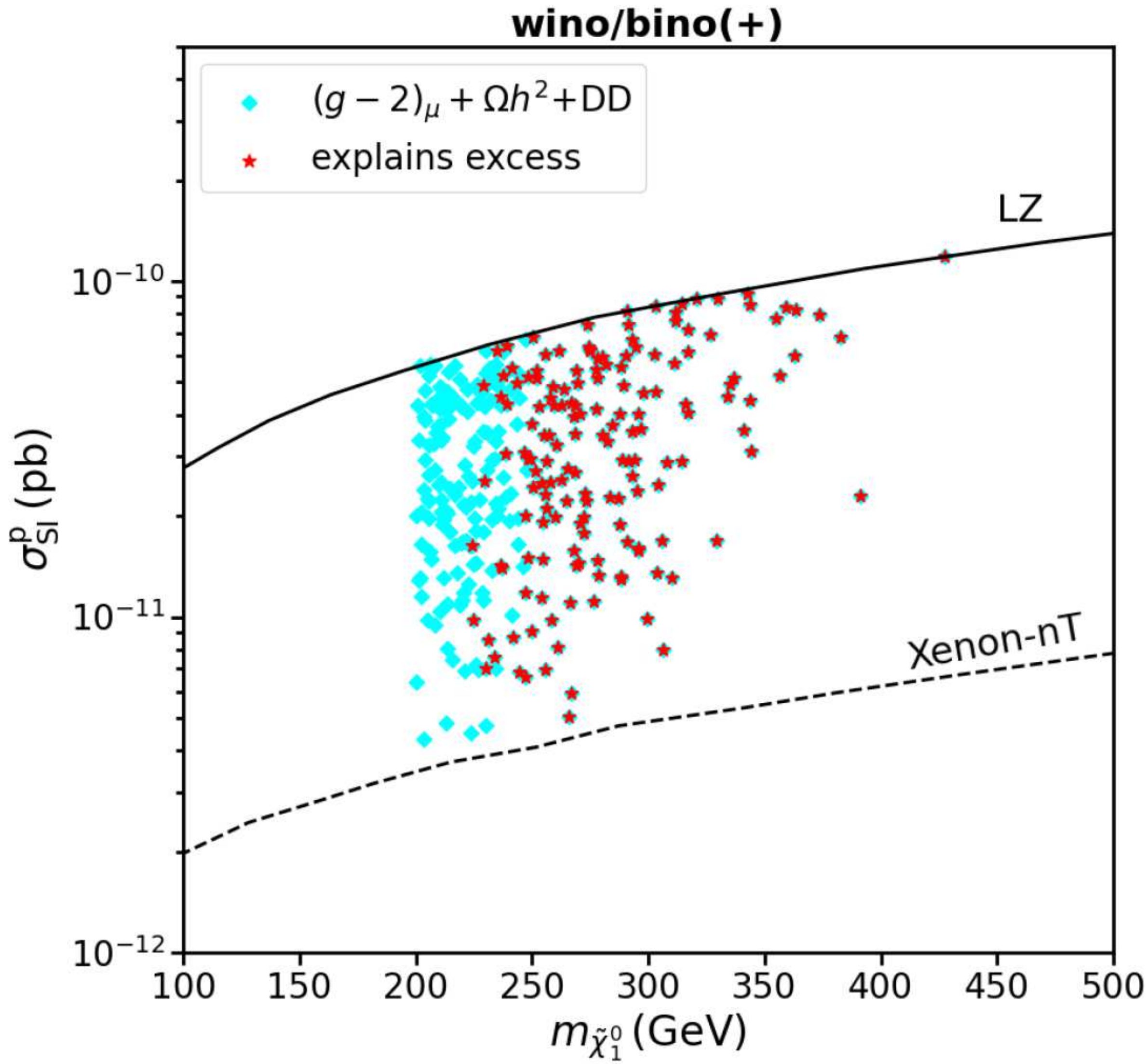
$\Rightarrow$ no limits on slepton masses (as expected)

wino/bino(+): LHC cross sections:



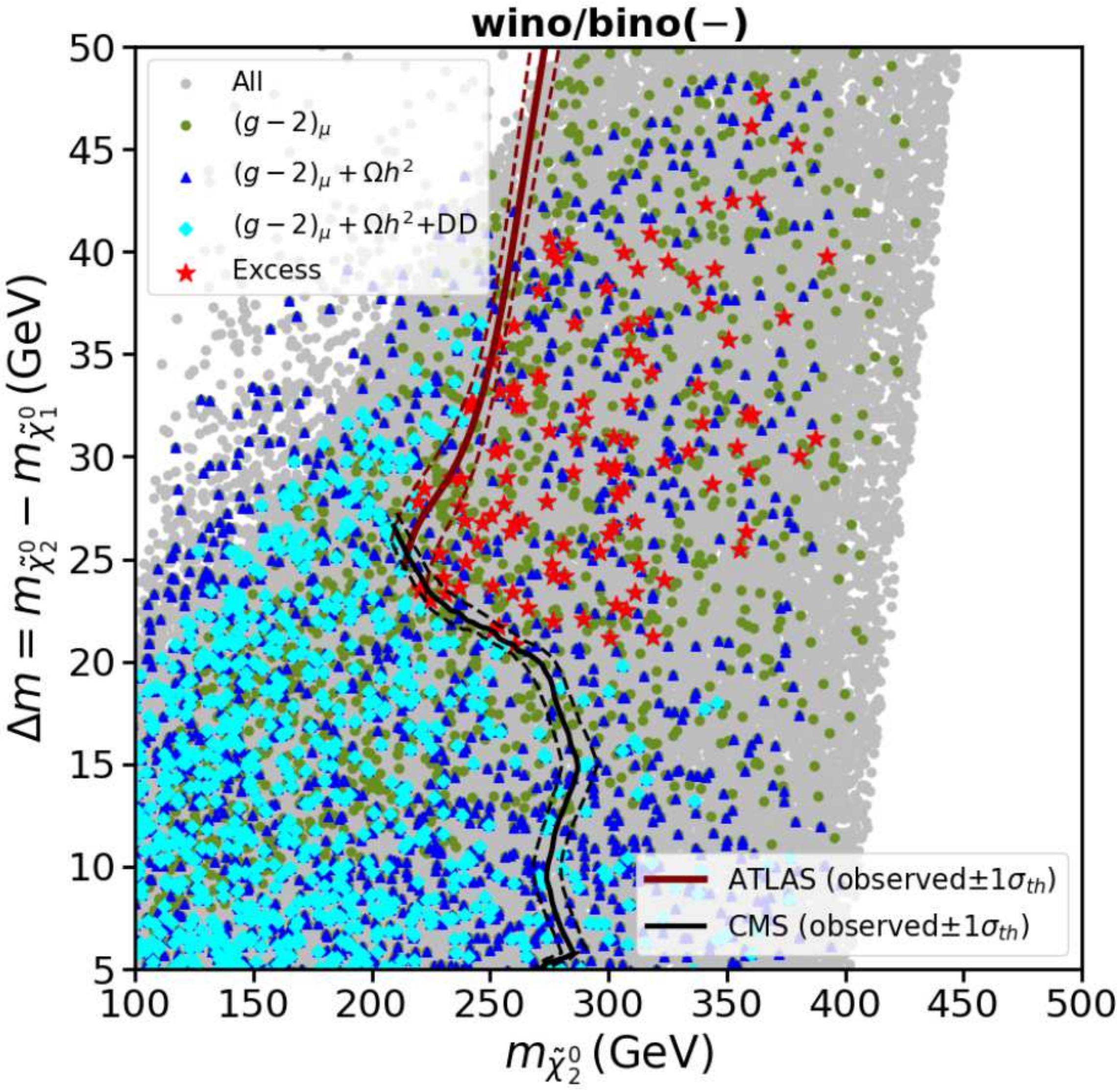
⇒ for lower massess XS have roughly the size required by excesses

wino/bino(+): direct detection prospects:



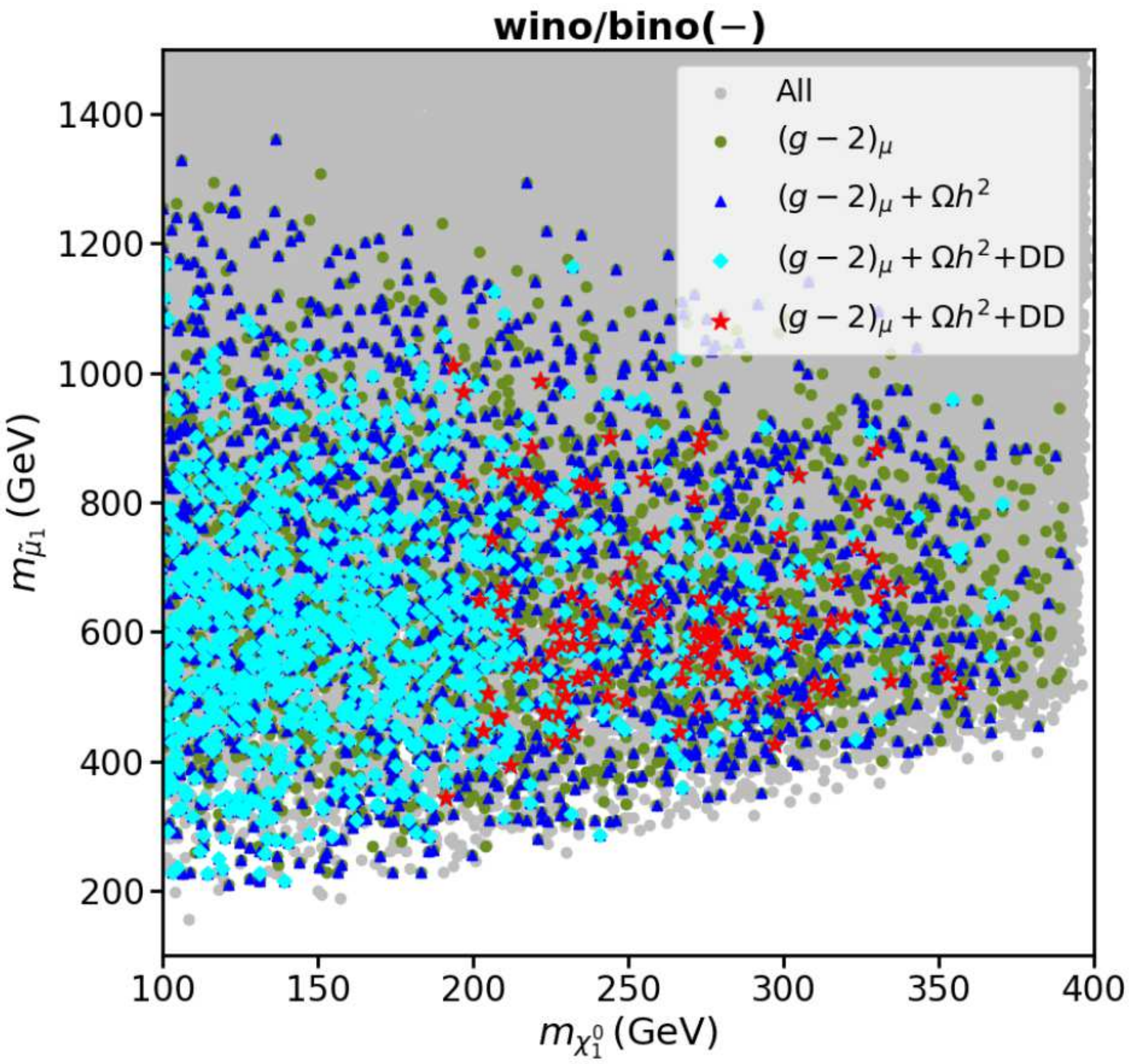
$\Rightarrow$ wino/bino(+)/$\tilde{\chi}_1^\pm$ co-annihiliation will be covered by XENON-nT/LZ

wino/bino($-$): results in the $m_{\tilde{\chi}_2^0}$-Δm plane:



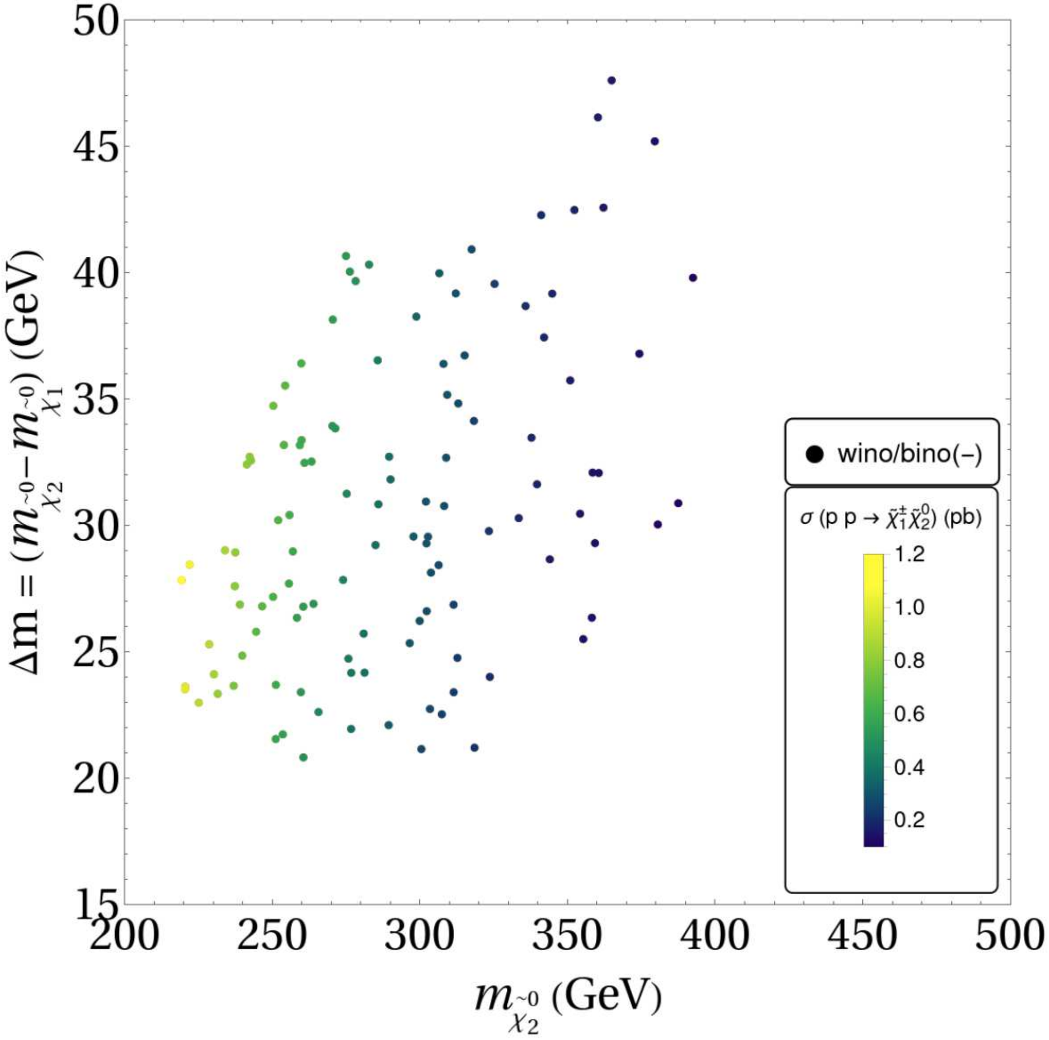
$\Rightarrow$ ATLAS/CMS excesses agree better in Δm than for wino/bino($+$)
$\Rightarrow$ but many "good points" at $\Delta m \sim 25$ GeV

wino/bino(−): limits on slepton masses:



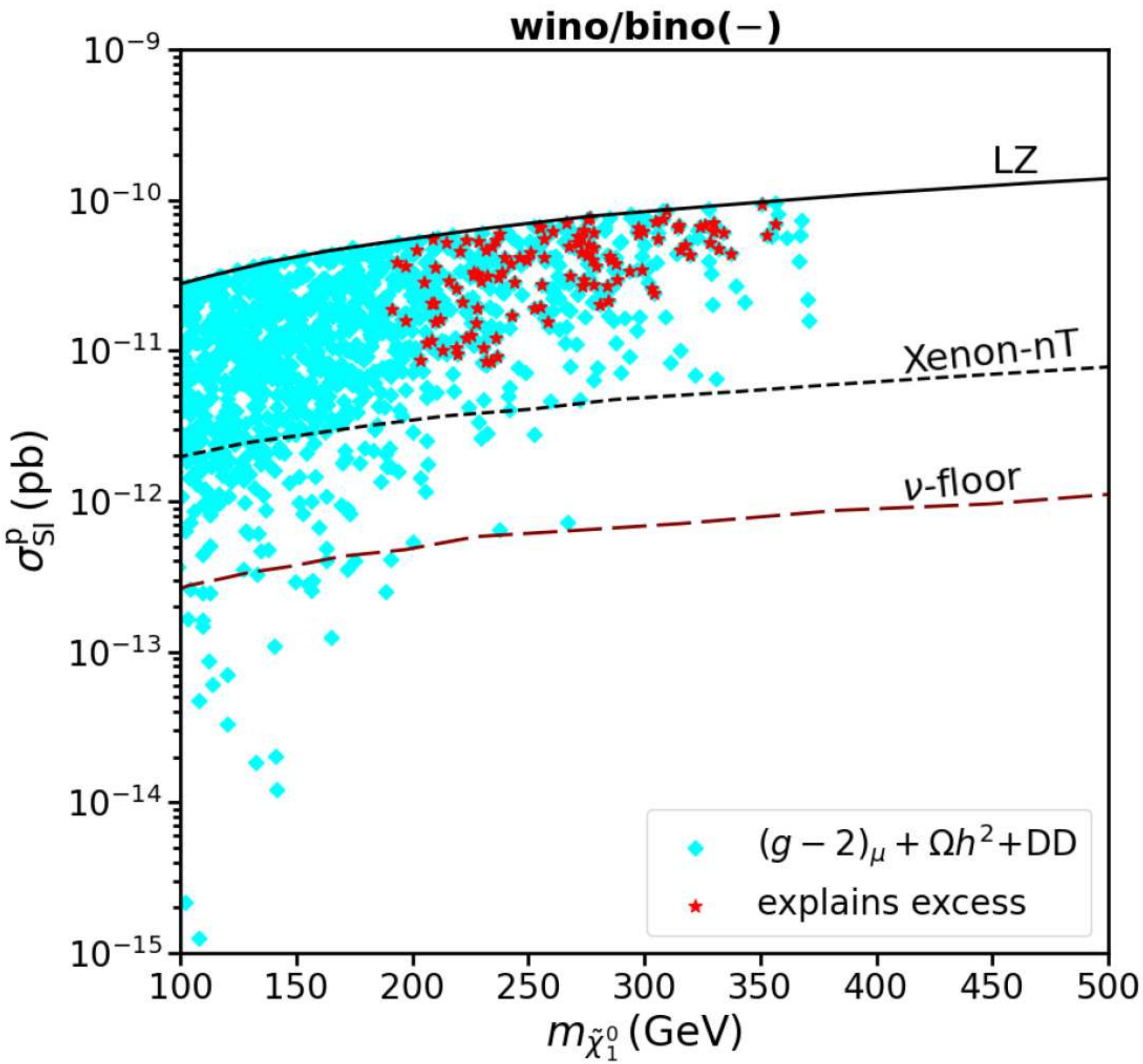
⇒ no limits on slepton masses (as expected)

wino/bino(−): LHC cross sections:



⇒ for lower masses XS have roughly the size required by excesses

wino/bino(−): direct detection prospects:



⇒ wino/bino(−)/$\tilde\chi_1^\pm$ co-annihiliation will be covered by XENON-nT/LZ

⇒ low mass points now excluded ⇒ would have been a problem for DD

D) Higgsino DM

Original parameter scan: $(M_1 \times \mu > 0)$

$$100\ \text{GeV} \le \mu \le 1.2\ \text{TeV}\ ,$$

$$1.1\mu \le M_1 \le 10\mu\ ,$$

$$1.1 M_2 \le \mu \le 10\mu\ ,$$

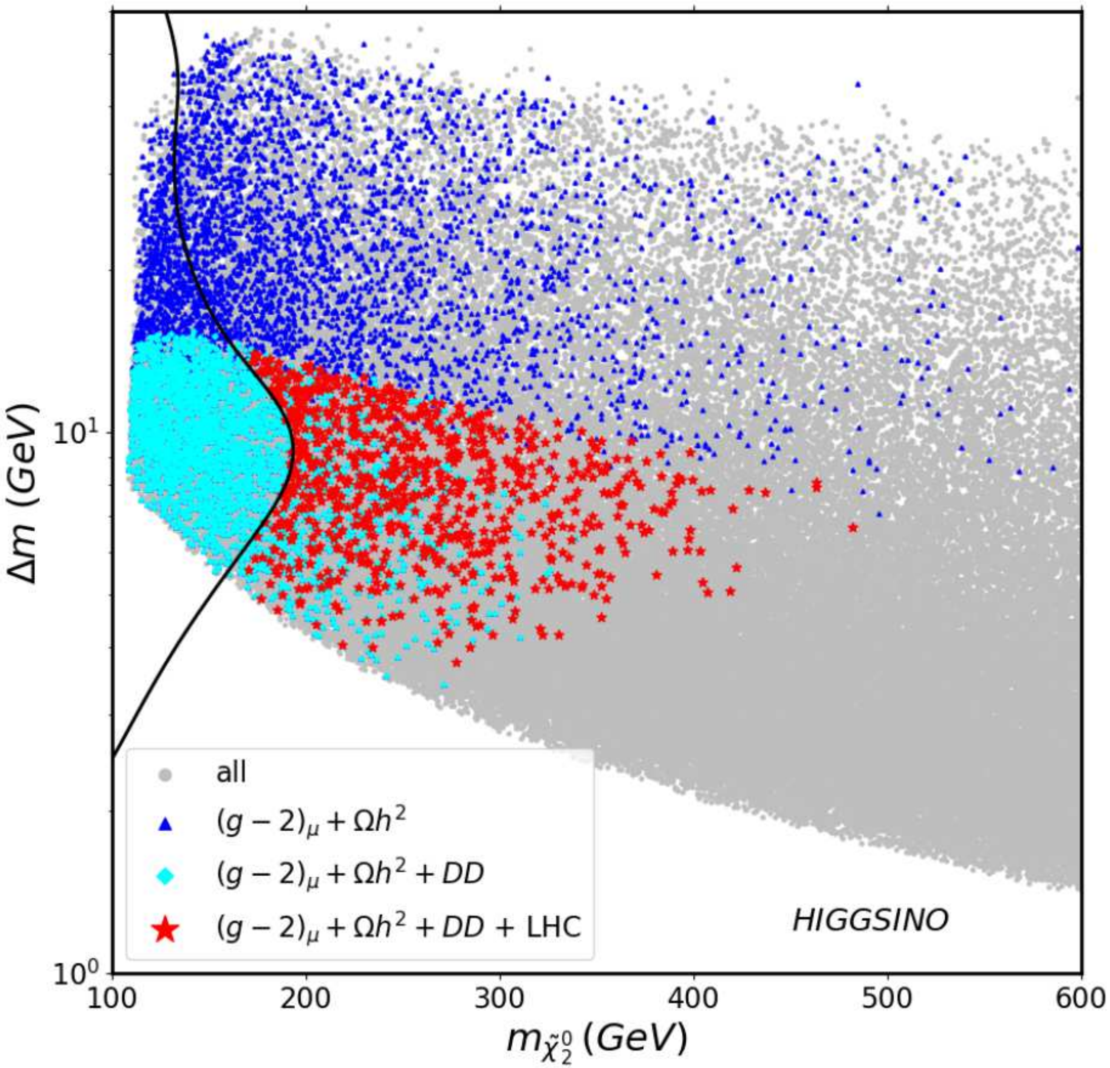
$$5 \le \tan\beta \le 60,$$

$$100\ \text{GeV} \le m_{\tilde{L}}, m_{\tilde{R}} \le 2\ \text{TeV},$$

$\Rightarrow m_{\tilde{\chi}_1^0} \sim m_{\tilde{\chi}_2^0} \sim m_{\tilde{\chi}_1^\pm} \sim \mu$

Full DM relic density reached only for $m_{\tilde{\chi}_1^0} \sim 1$ TeV
$\Rightarrow$ incompatible with a $5\,\sigma$ deviation in $(g-2)_\mu$
$\Rightarrow m_{\text{(N)LSP}} \lesssim 500$ GeV

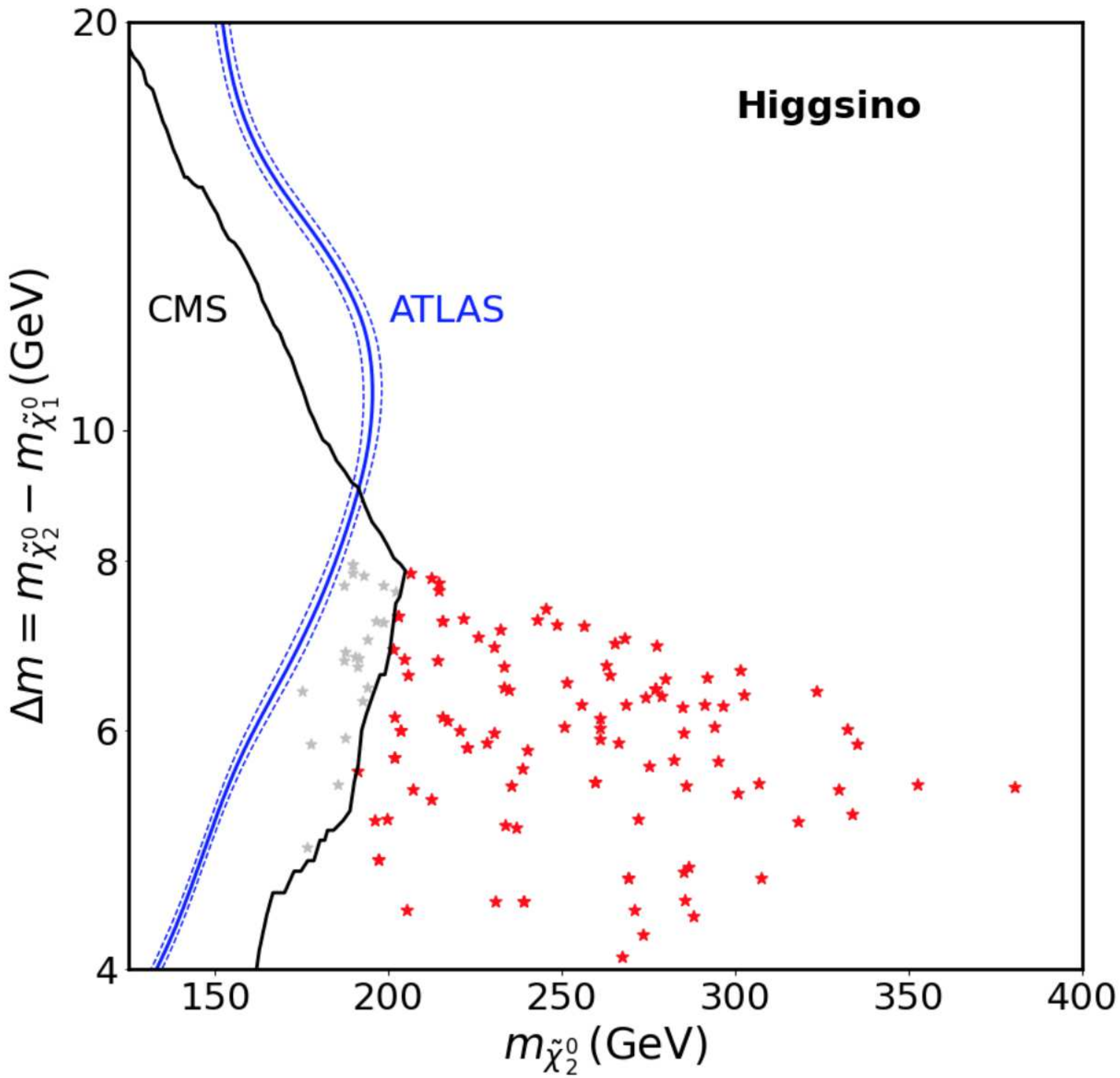
Results in the $m_{\tilde{\chi}_2^0}$-Δm plane with old DD bound: [2021]



$\Rightarrow$ direct detection is the limiting factor on Δm

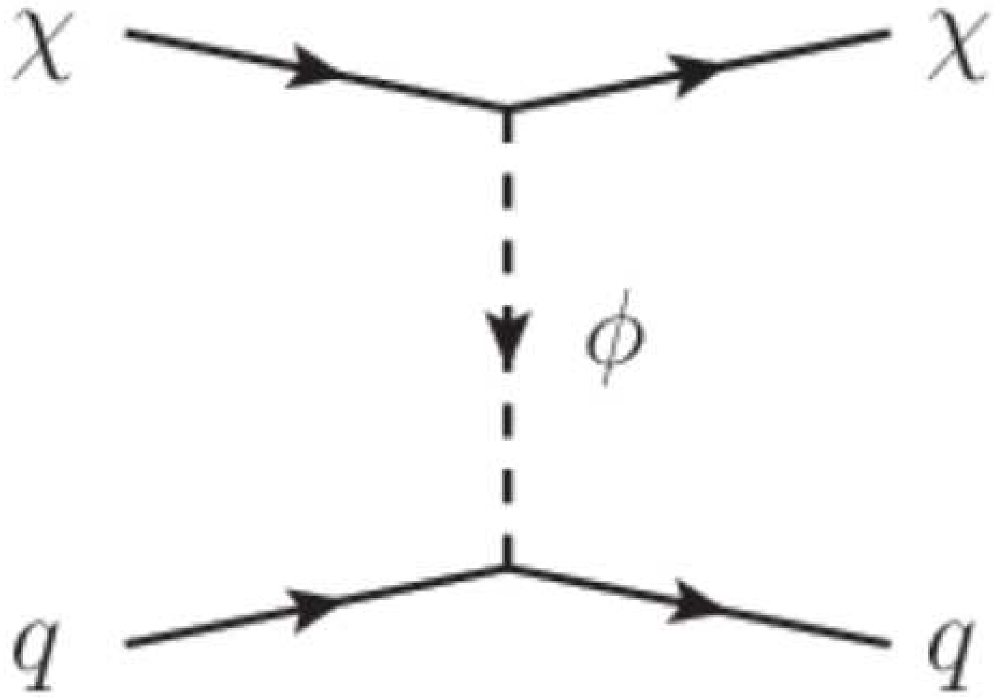
Results in the $m_{\tilde{\chi}_2^0}$-Δm plane

[PRELIMINARY]



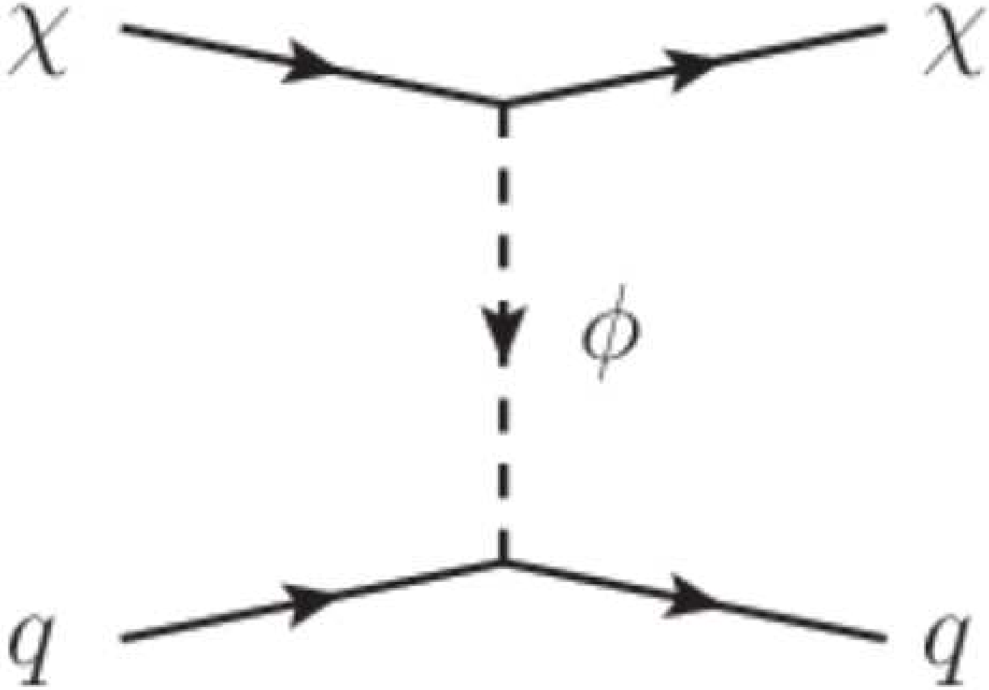
⇒ excess not fitted :-(⇒ DD cuts away the "good points"

Problematic diagram for higgsino DM DD:



$\phi = h, H$

Problematic diagram for higgsino DM DD:



$\phi = h, H$

$\Rightarrow$ cancellation possible for $\mu \times M_1 < 0$ ("blind spots")

$\Rightarrow$ new scan with $M_1 < 0$

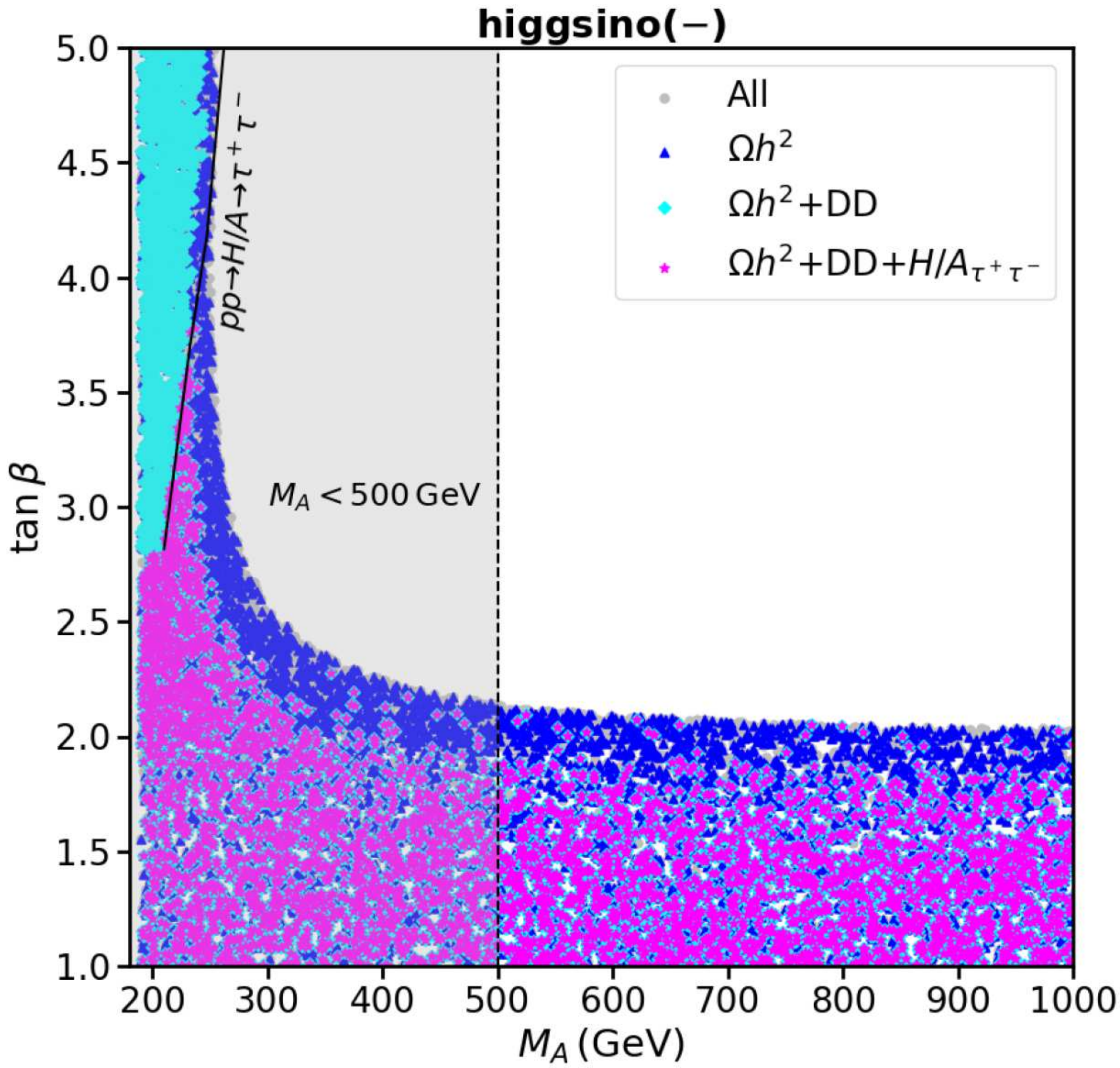
New scan with $M_1 \times \mu < 0$

$$
\begin{aligned}
-190\ \text{GeV} \leq M_1 \leq -1500\ \text{GeV}\ , \\
M_2 = 2\ \text{TeV}\ , \\
\mu = \frac{-2M_1 \tan\beta}{4 + x_1 \tan^2\beta}, \quad x_1 = \frac{m_h^2}{m_H^2}\ , \\
5 \leq \tan\beta \leq 50\ , \\
190 \leq M_A \leq 1200\ , \\
2M_1 \leq m_{\tilde{l}_L}, m_{\tilde{l}_R} \leq 1500\ \text{GeV}\ ,
\end{aligned}
$$

Condition on μ and M_1: exact blind spot conditions

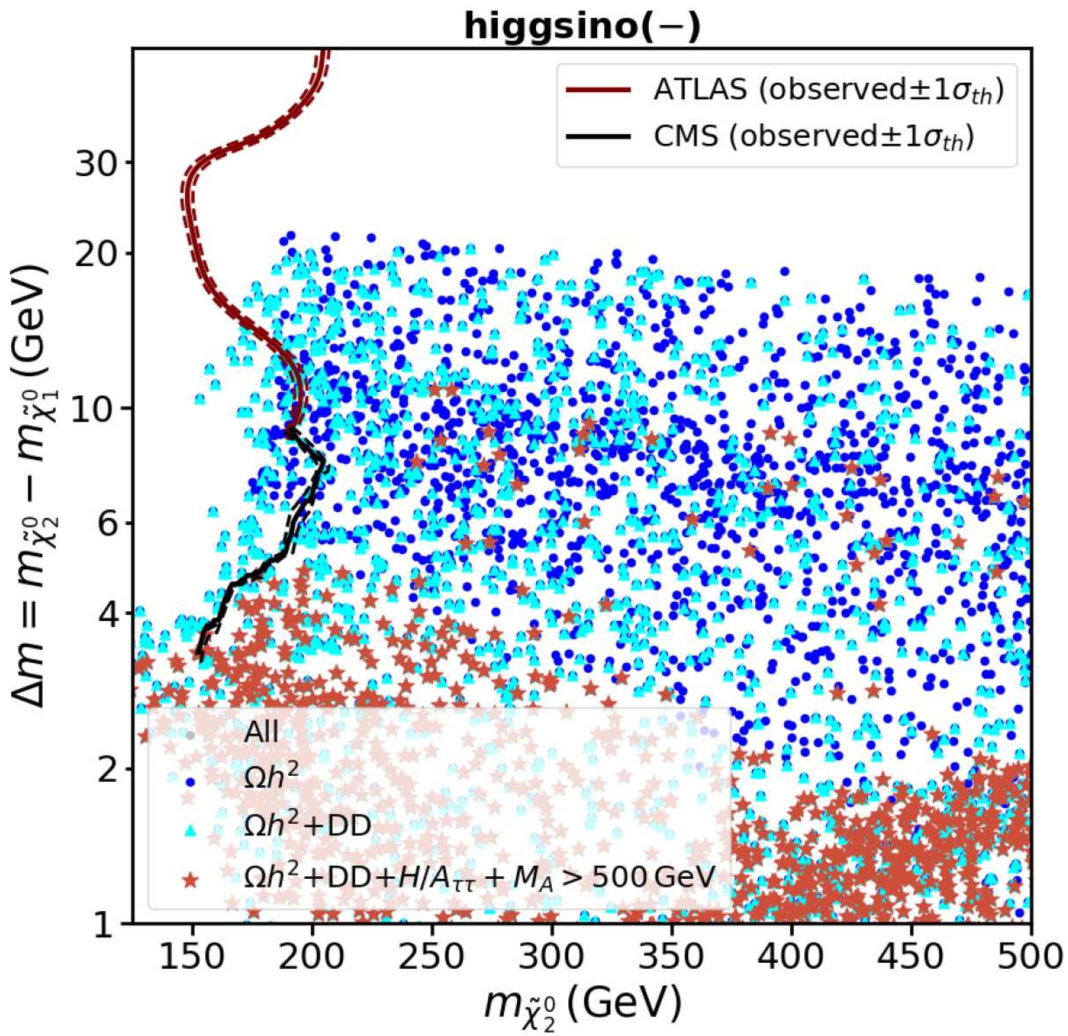
relaxed blind spot condition: scan up to $\mu/|M_1| < 1$

New scan with $M_1 \times \mu < 0$



$\Rightarrow M_A \gtrsim 500$ GeV and $\tan\beta \lesssim 2$ allowed

New scan with $M_1 \times \mu < 0$



$\Rightarrow$ restrictions still cut away the "good parameter space"

$\Rightarrow$ higgsino(−) does not work (in the MSSM)