A to Z

of the

Muon Anomalous Magnetic Moment

in the MSSM

with Pati-Salam

at the GUT scale

A. S. Belyaev, J. E. Camargo-Molina, S. F. King, D. J. Miller, A. P. Morais, P. B. Schaefers

arXiv:1605.02072 [hep-ph]
JHEP 1606 (2016) 142

Outline

The Model

The Anomalous Magnetic Moment of the Muon a_μ

Experimental Constraints

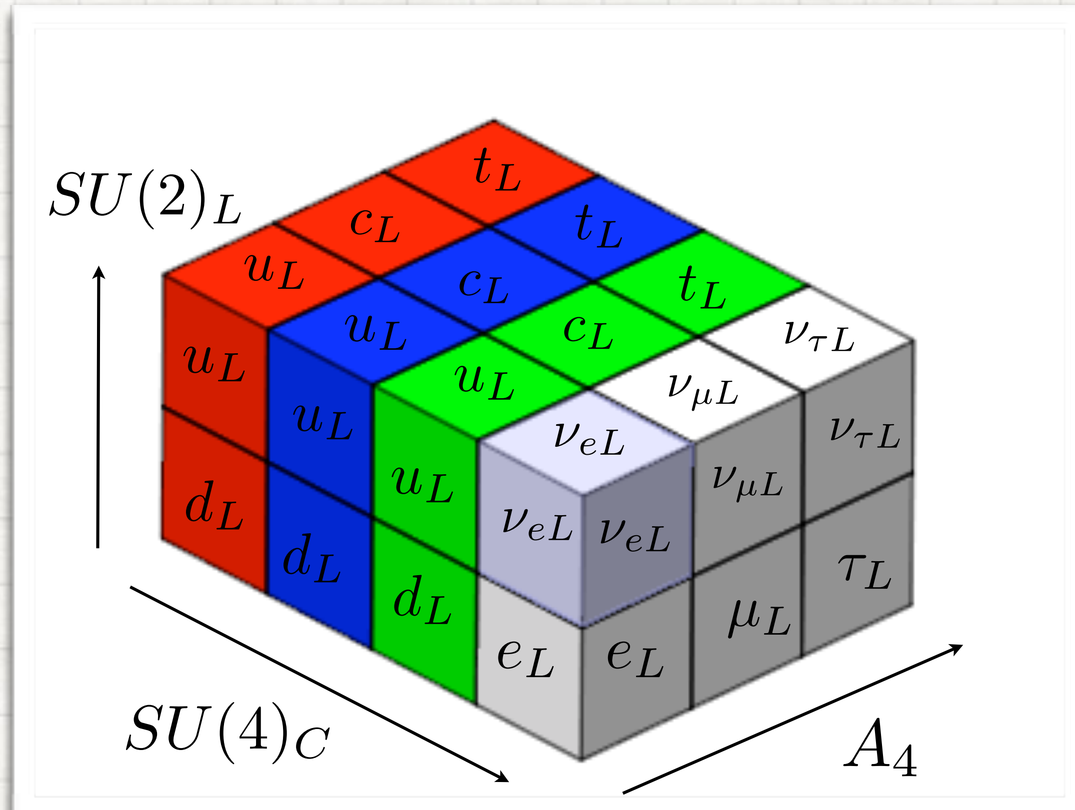
Results

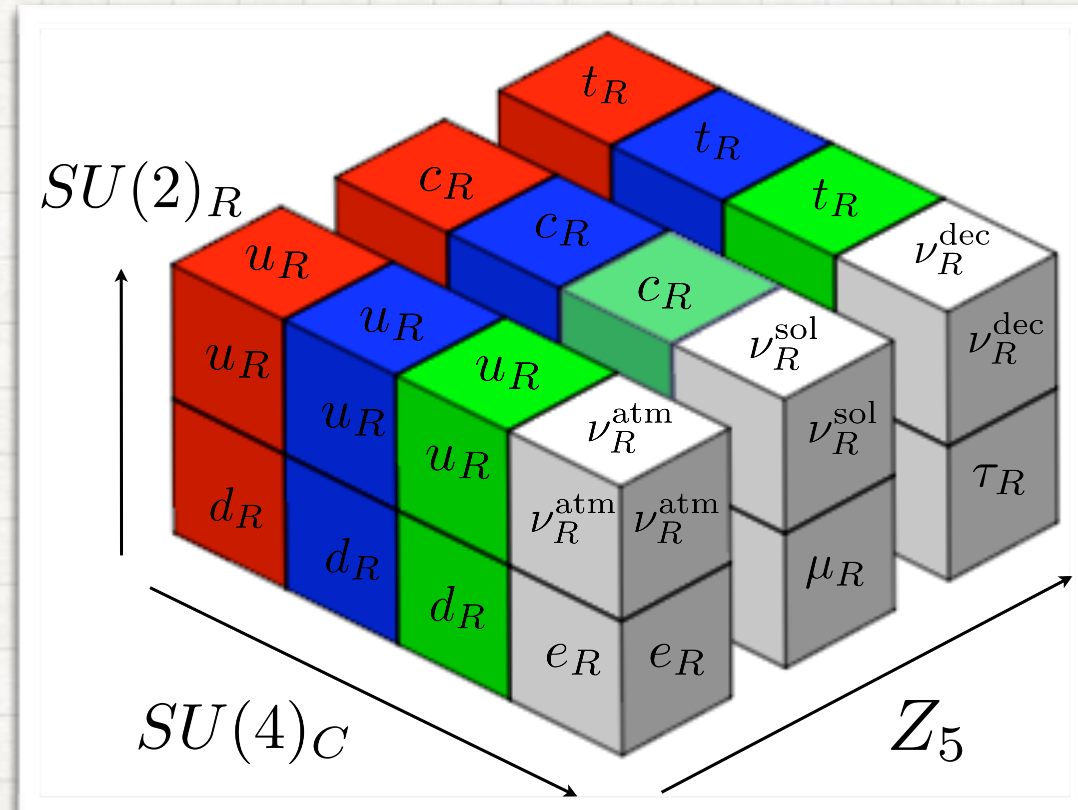
Vacuum Stability

Conclusion & Outlook

The Model

$$SU(4)_C \times SU(2)_L \times SU(2)_R \times A_4 \times Z_5$$





S. F. King JHEP 08 (2014) 130

triplet under A_4

$$F = (4,2,1)_i = \begin{pmatrix} u & u & u & \nu \\ d & d & d & e \end{pmatrix}_i \to (Q_i, L_i),$$

$$F_i^c = (\bar{4},1,2)_i = \begin{pmatrix} u^c & u^c & u^c & \nu^c \\ d^c & d^c & d^c & e^c \end{pmatrix}_i \to (u_i^c, d_i^c, \nu_i^c, e_i^c),$$

singlets under A_4, distinguished by Z_5 charges α, α^3, 1

The Model

- Pati-Salam breaks at GUT scale to SM by PS Higgs

$$H^c = (\bar{4}, 1, 2) = (u^c_H, d^c_H, \nu^c_H, e^c_H),$$
$$\overline{H^c} = (4, 1, 2) = (\bar{u}^c_H, \bar{d}^c_H, \bar{\nu}^c_H, \bar{e}^c_H)$$

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- VEV's close to GUT scale to keep gauge coupling unification

$$\langle H^c \rangle = \langle \nu^c_H \rangle = \langle \overline{H^c} \rangle = \langle \bar{\nu}^c_H \rangle \sim 2 \times 10^{16}\ \mathrm{GeV}$$

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- model reduces to MSSM below GUT scale
- novel boundary conditions at GUT scale (more constrained than MSSM, less than CMSSM)

THE MODEL

Model parameters

- m_0 → left-handed squark and slepton masses for all three generations
- $m_i \, (i = 1, 2, 3)$ → right-handed squark and slepton masses for each generation *i*
- $M_j \, (j = 1, 2, 3)$ → Bino, Wino and Gluino mass parameters
- $m_{H_k} \, (k = u, d)$ → light Higgs doublet masses
- A_{tri}
- $\tan\beta$
- $\text{sgn}(\mu)$

The Anomalous Magnetic Moment of the Muon

- Dirac equation predicts $\vec{M} = g_\mu \frac{e}{2\,m_\mu} \vec{S}$

  gyromagnetic ratio

- classically, $g_\mu = 2$

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- exp. value a^{exp}_μ = (11,659,209.1 ± 6.4) 10^{-10}
- theo. value a^{SM}_μ = (11,659,180.3 ± 4.9) 10^{-10}

Muon *g-2* Collaboration, Phys. Rev. D**73** (2006) 072003, [hep-ex/0602035]

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- theo. value a^{SM}_μ = (11,659,180.3 ± 4.9) 10^{-10}
- 3-4σ difference, denoted by Δa_μ

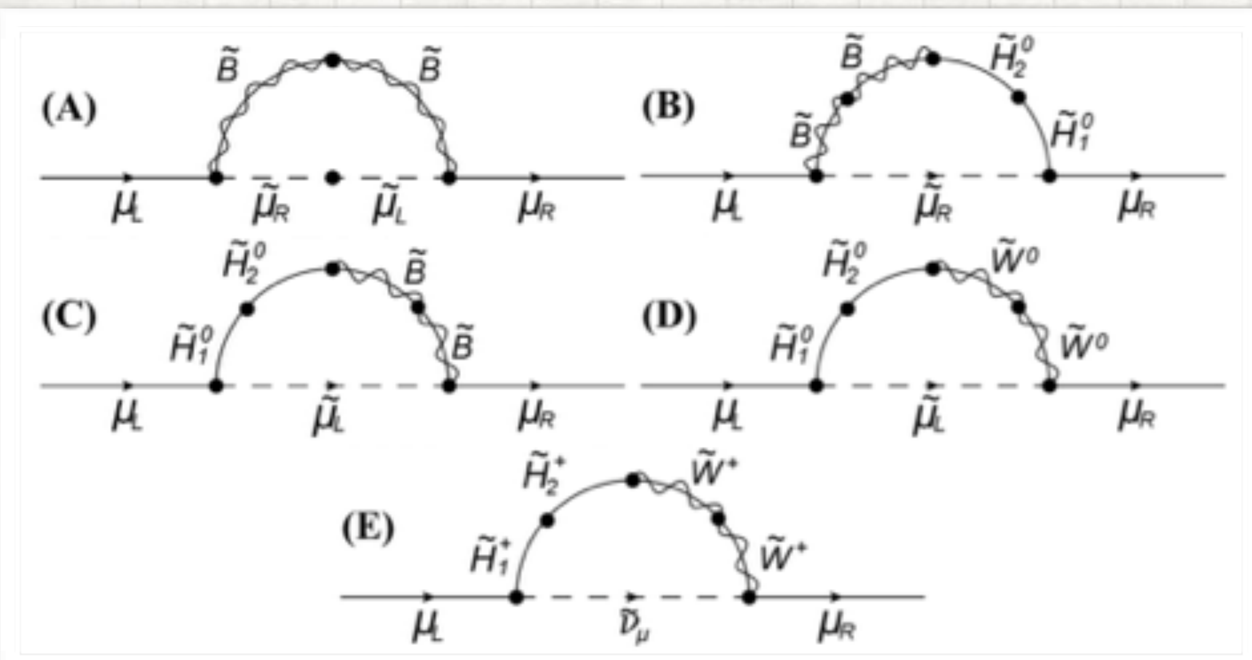
$$\Delta a_\mu = a_\mu^{\mathrm{exp}} - a_\mu^{\mathrm{SM}} = (28.8 \pm 8.0) \times 10^{-10}$$

PDG, Chin. Phys. C38 (2014) 090001

- SUSY has potential to resolve this

The Anomalous Magnetic Moment of the Muon

- One loop MSSM contributions



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$$\Delta a_\mu^{(A)} = \left(\frac{M_1\mu}{m_{\tilde{\mu}_L}^2 m_{\tilde{\mu}_R}^2}\right)\frac{\alpha_1}{4\pi}m_\mu^2 \tan\beta \cdot f_{\mathrm{neutral}}\left(\frac{m_{\tilde{\mu}_L}^2}{M_1^2}, \frac{m_{\tilde{\mu}_R}^2}{M_1^2}\right),$$

$$\Delta a_\mu^{(B)} = -\left(\frac{1}{M_1\mu}\right)\frac{\alpha_1}{4\pi}m_\mu^2 \tan\beta \cdot f_{\mathrm{neutral}}\left(\frac{M_1^2}{m_{\tilde{\mu}_R}^2}, \frac{\mu^2}{m_{\tilde{\mu}_R}^2}\right),$$

$$\Delta a_\mu^{(C)} = \left(\frac{1}{M_1\mu}\right)\frac{\alpha_1}{8\pi}m_\mu^2 \tan\beta \cdot f_{\mathrm{neutral}}\left(\frac{M_1^2}{m_{\tilde{\mu}_L}^2}, \frac{\mu^2}{m_{\tilde{\mu}_L}^2}\right),$$

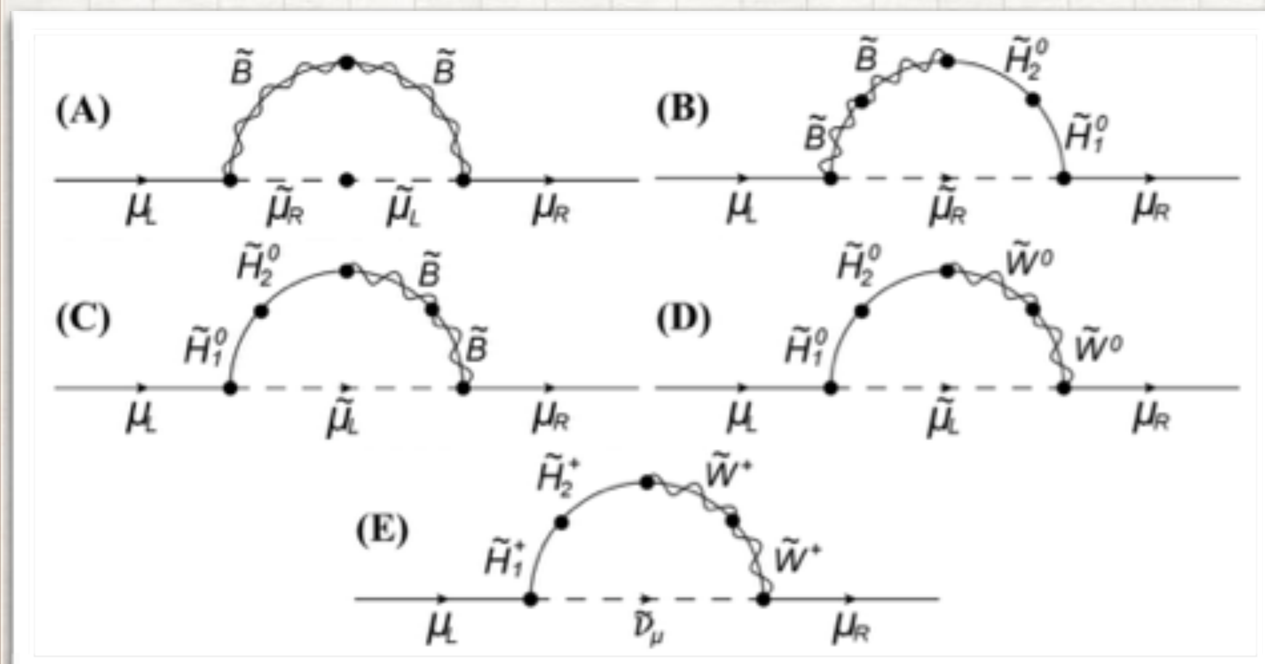
$$\Delta a_\mu^{(D)} = -\left(\frac{1}{M_2\mu}\right)\frac{\alpha_2}{8\pi}m_\mu^2 \tan\beta \cdot f_{\mathrm{neutral}}\left(\frac{M_2^2}{m_{\tilde{\mu}_L}^2}, \frac{\mu^2}{m_{\tilde{\mu}_L}^2}\right),$$

$$\Delta a_\mu^{(E)} = \left(\frac{1}{M_2\mu}\right)\frac{\alpha_2}{4\pi}m_\mu^2 \tan\beta \cdot f_{\mathrm{charged}}\left(\frac{M_2^2}{m_{\tilde{\nu}_\mu}^2}, \frac{\mu^2}{m_{\tilde{\nu}_\mu}^2}\right),$$

D. Stöckinger, hep-ph/0609168v1

The Anomalous Magnetic Moment of the Muon

- One loop MSSM contributions
- $\Delta a_\mu(A)$ benefits from large μ and small smuon masses



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$$\Delta a_\mu^{(A)} = \left(\frac{M_1\mu}{m_{\tilde\mu_L}^2 m_{\tilde\mu_R}^2}\right)\frac{\alpha_1}{4\pi}m_\mu^2\tan\beta\cdot f_{\text{neutral}}\left(\frac{m_{\tilde\mu_L}^2}{M_1^2},\frac{m_{\tilde\mu_R}^2}{M_1^2}\right),$$

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$$\Delta a_\mu^{(C)} = \left(\frac{1}{M_1\mu}\right)\frac{\alpha_1}{8\pi}m_\mu^2\tan\beta\cdot f_{\text{neutral}}\left(\frac{M_1^2}{m_{\tilde\mu_L}^2},\frac{\mu^2}{m_{\tilde\mu_L}^2}\right),$$

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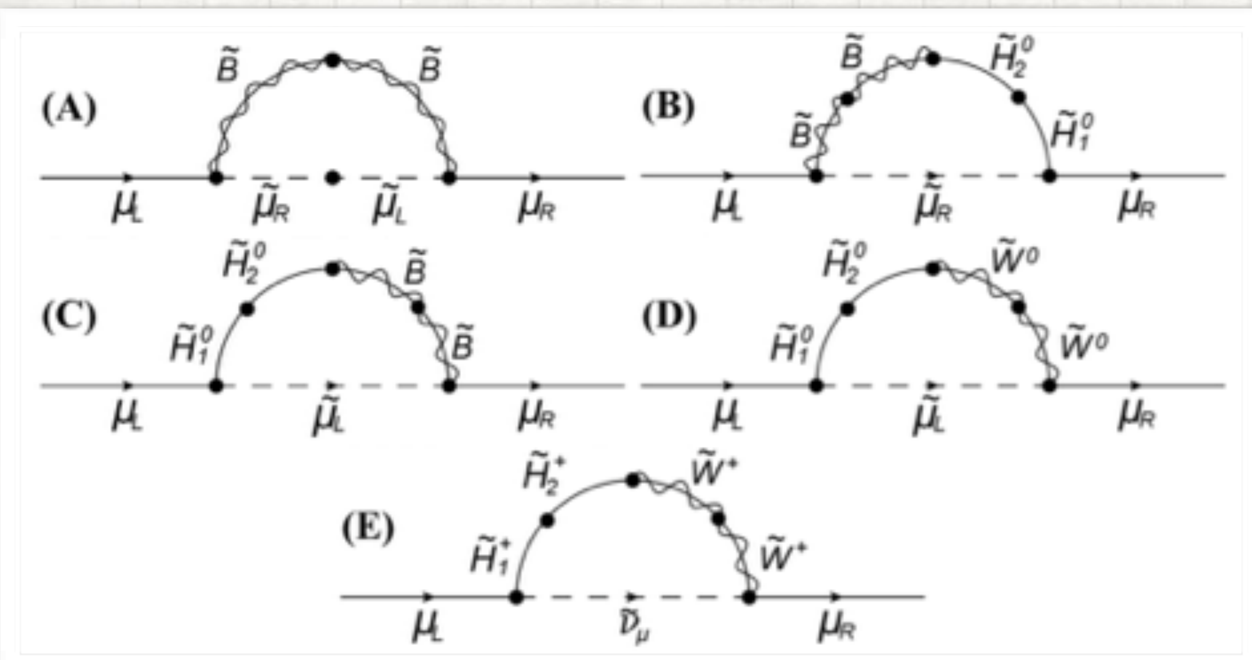
- One loop MSSM contributions
- $\Delta a_\mu(A)$ benefits from large μ and small smuon masses
- $\Delta a_\mu(B,E)$ benefit from $sgn(M_1) = - sgn(M_2)$, $M_1 < 0$
- $\Delta a_\mu(C,D)$ benefit from $sgn(M_1) = - sgn(M_2)$, $M_1 > 0$
- $0 \leq f(x,y) \leq 1$



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$$\Delta a_\mu^{(A)} = \left(\frac{M_1\mu}{m^2_{\tilde{\mu}_L} m^2_{\tilde{\mu}_R}}\right) \frac{\alpha_1}{4\pi} m_\mu^2 \tan\beta \cdot f_{\text{neutral}}\left(\frac{m^2_{\tilde{\mu}_L}}{M_1^2}, \frac{m^2_{\tilde{\mu}_R}}{M_1^2}\right),$$

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D. Stöckinger, hep-ph/0609168v1

Experimental Constraints

- model should successfully describe

1. Δa_μ
2. Dark Matter
   - Relic Density Ωh^2, Dark Matter direct detection cross sections
3. Collider Constraints
   - *Higgs mass, BR(b > s γ), BR(B_s > $\mu^+ \mu^-$)*

RESULTS

- Workflow

1. Choose input parameters
2. generate spectra with SOFTSUSY
3. check constraints with MICROMEGAS
4. redo, if necessary

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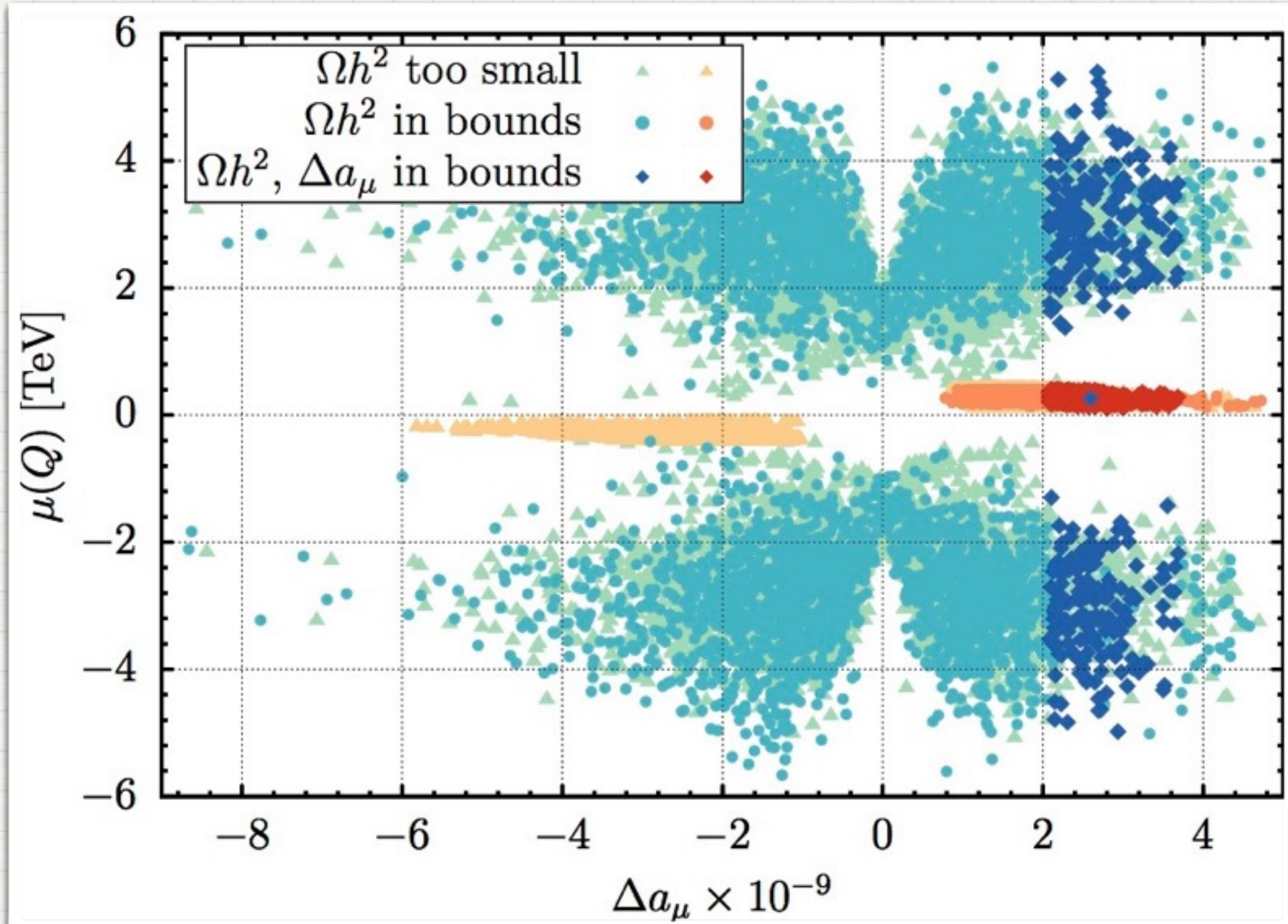
- A first inclusive scan

Parameter	range
$\lvert A_{\text{tri}} \rvert$	1 – 3000
m_0, m_1, m_2	1 – 500
m_3	1 – 3000
m_{H_1}, m_{H_2}	1 – 3000

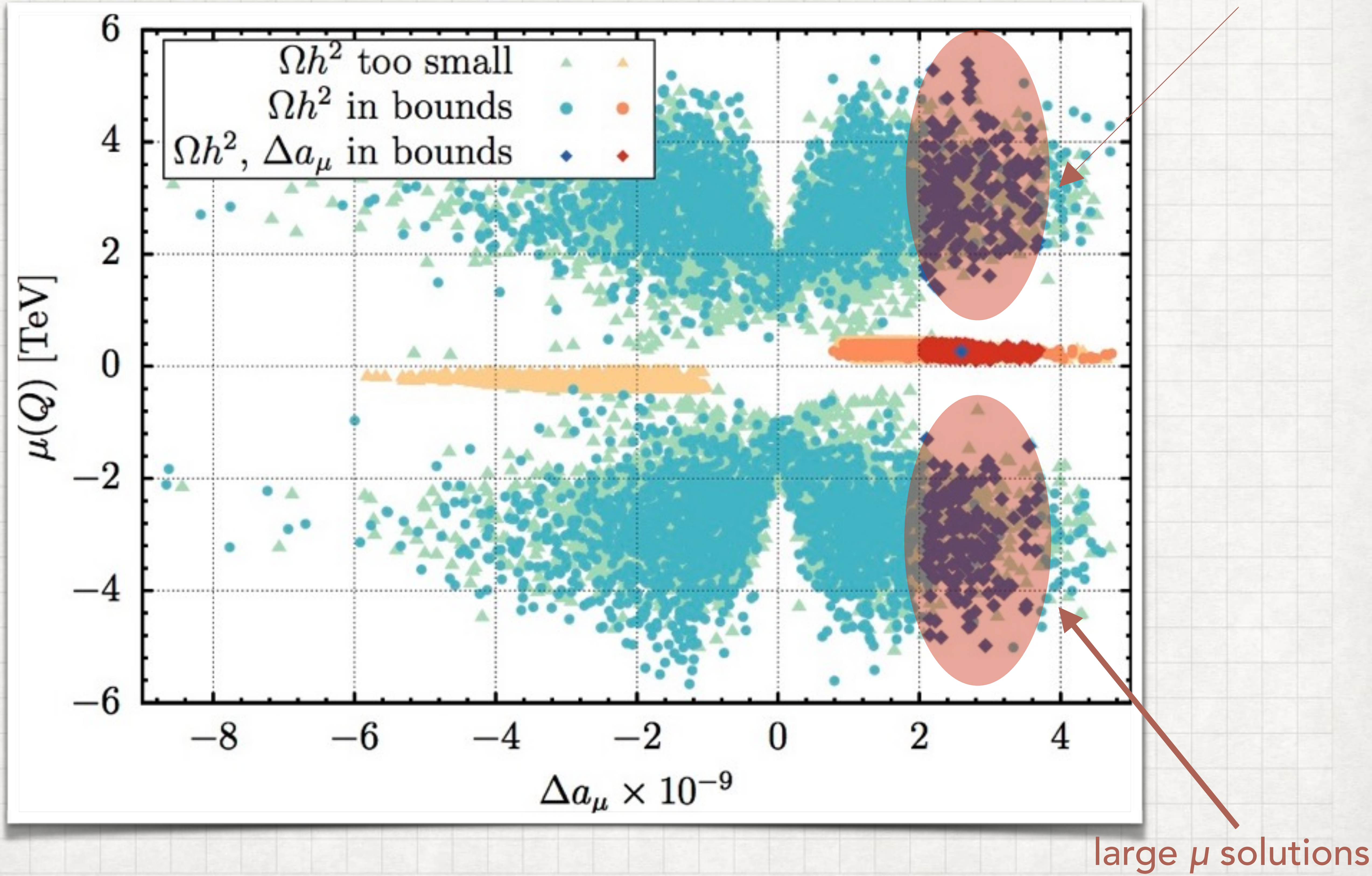
Parameter	range
$\lvert M_1 \rvert, \lvert M_2 \rvert$	1 – 600
$\lvert M_3 \rvert$	1 – 6000
$\tan\beta$	5 – 50
$\text{sgn}(\mu)$	± 1

RESULTS



Ωh^2 too small
Ωh^2 in bounds
Ωh^2, Δa_μ in bounds
$\mu(Q)$ [TeV]
6
4
2
0
−2
−4
−6
−8
−6
−4
−2
0
2
4
$\Delta a_\mu \times 10^{-9}$

RESULTS



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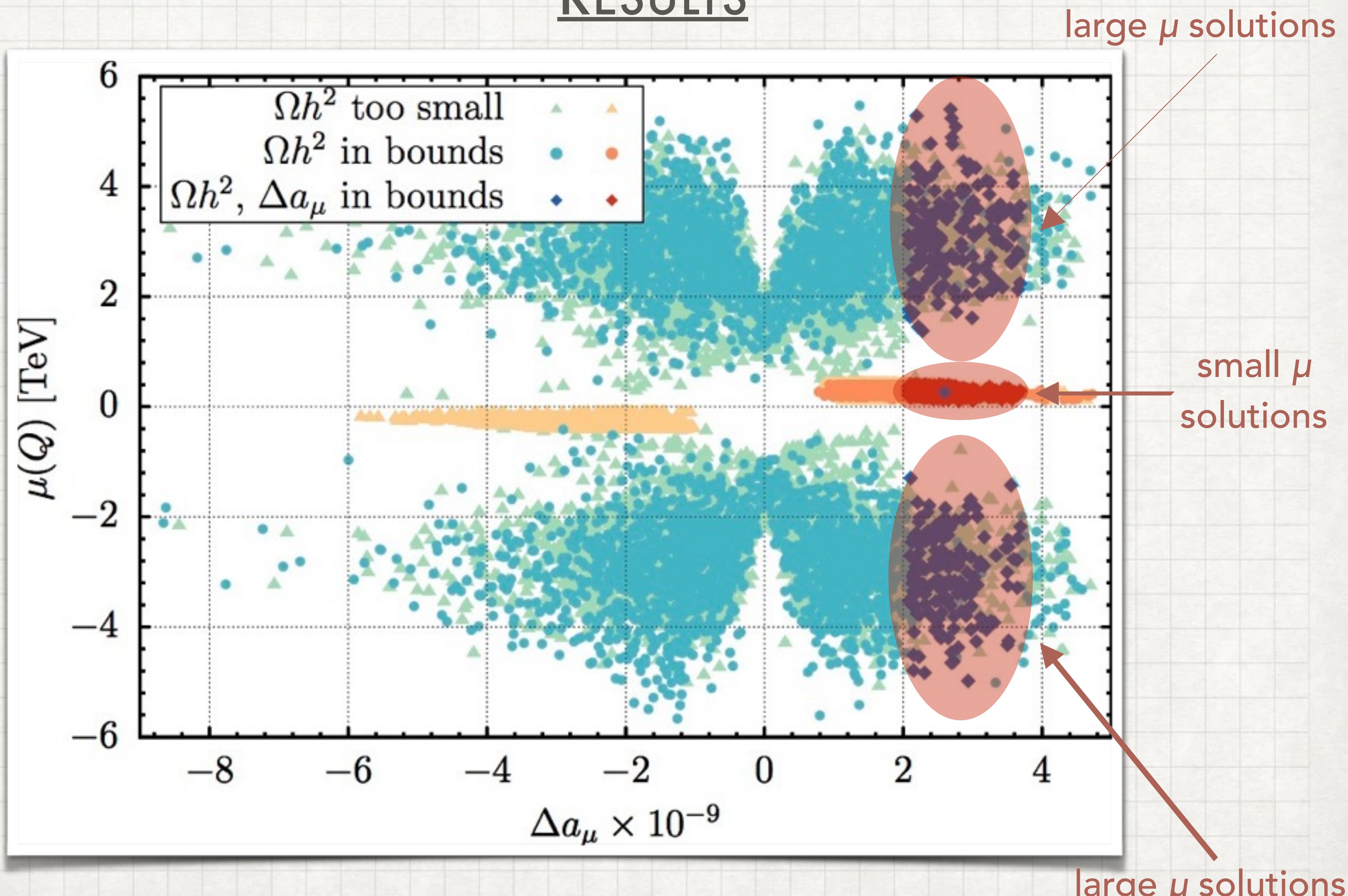
large μ solutions
large μ solutions

Results



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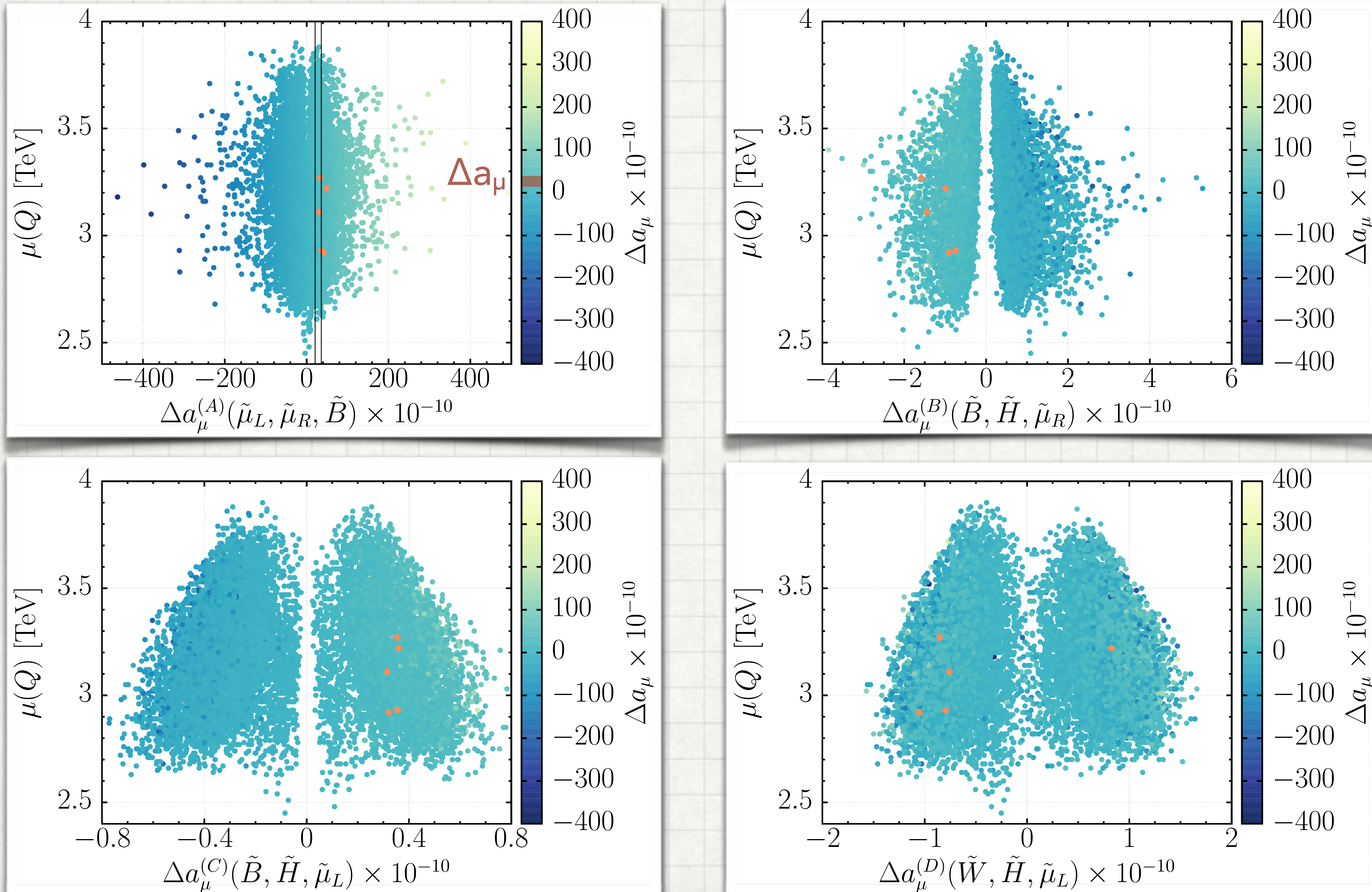
$\Delta a_\mu \times 10^{-9}$
large μ solutions
small μ solutions
large μ solutions

Results

Parameter	range			Parameter	range		
A_{tri}	-3000	–	0	M_1	-1000	–	1000
m_0	100	–	300	M_2	-2000	–	2000
m_1	500	–	1500	M_3	2000	–	3000
m_2	100	–	400	$\tan\beta$	5	–	50
m_3	1000	–	2000	$\text{sgn}(\mu)$		± 1	
m_{H_1}, m_{H_2}	100	–	3000				

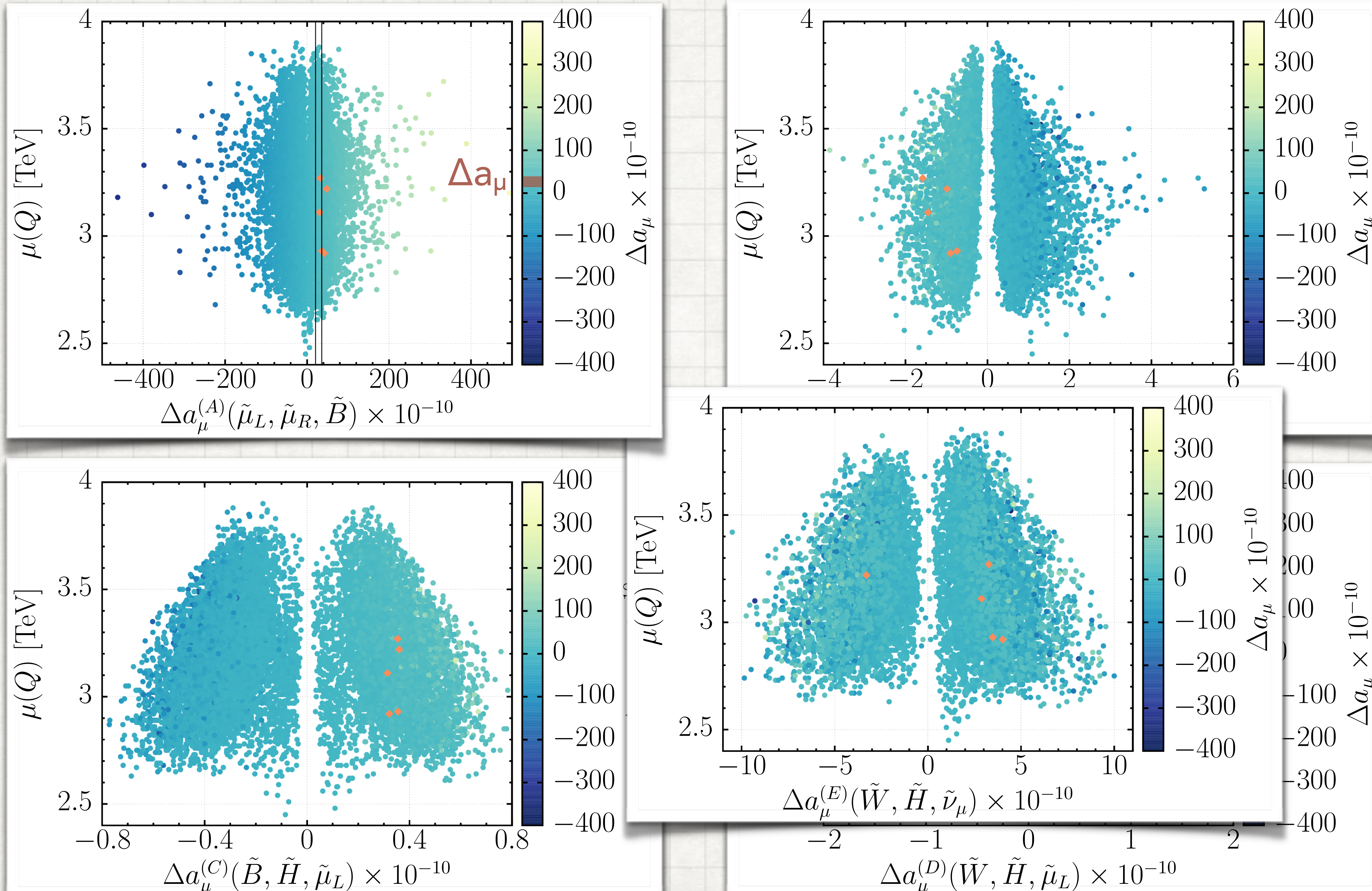
- Large μ scenario
  - small m_0, m_2 keep smuons light
  - large m_3, M_3 keep squarks and gluino heavy
  - *negative A_{tri} consequence of previous scans*

RESULTS



Δa_μ
$\mu(Q)$ [TeV]
$\Delta a_\mu^{(A)}(\tilde{\mu}_L, \tilde{\mu}_R, \tilde{B}) \times 10^{-10}$
$\Delta a_\mu^{(B)}(\tilde{B}, \tilde{H}, \tilde{\mu}_R) \times 10^{-10}$
$\Delta a_\mu^{(C)}(\tilde{B}, \tilde{H}, \tilde{\mu}_L) \times 10^{-10}$
$\Delta a_\mu^{(D)}(\tilde{W}, \tilde{H}, \tilde{\mu}_L) \times 10^{-10}$
$\Delta a_\mu \times 10^{-10}$

Results



Δa_μ
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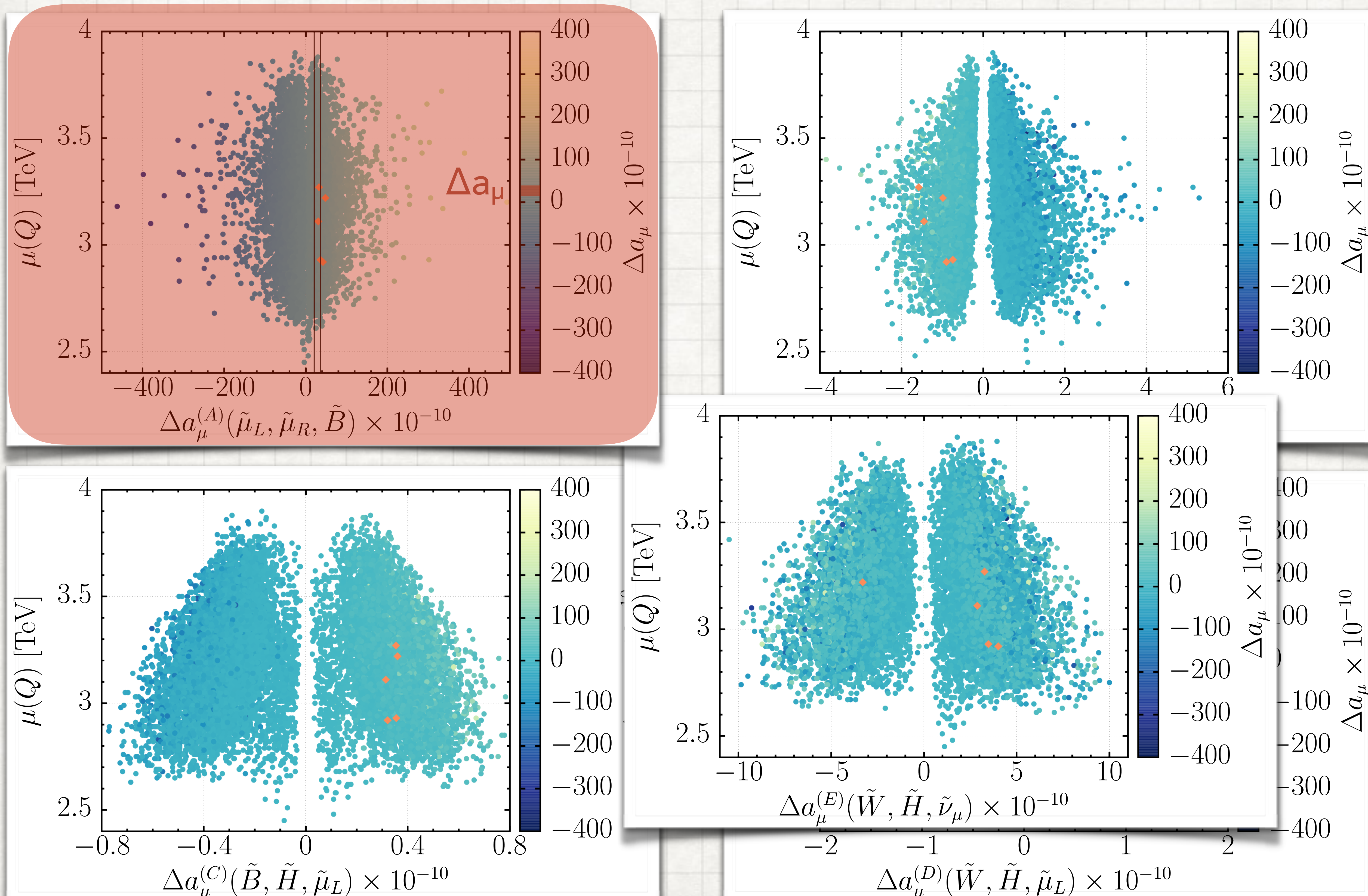
$\Delta a_\mu^{(D)}(\tilde{W}, \tilde{H}, \tilde{\mu}_L) \times 10^{-10}$
$\Delta a_\mu^{(E)}(\tilde{W}, \tilde{H}, \tilde{\nu}_\mu) \times 10^{-10}$

dominant contribution

RESULTS



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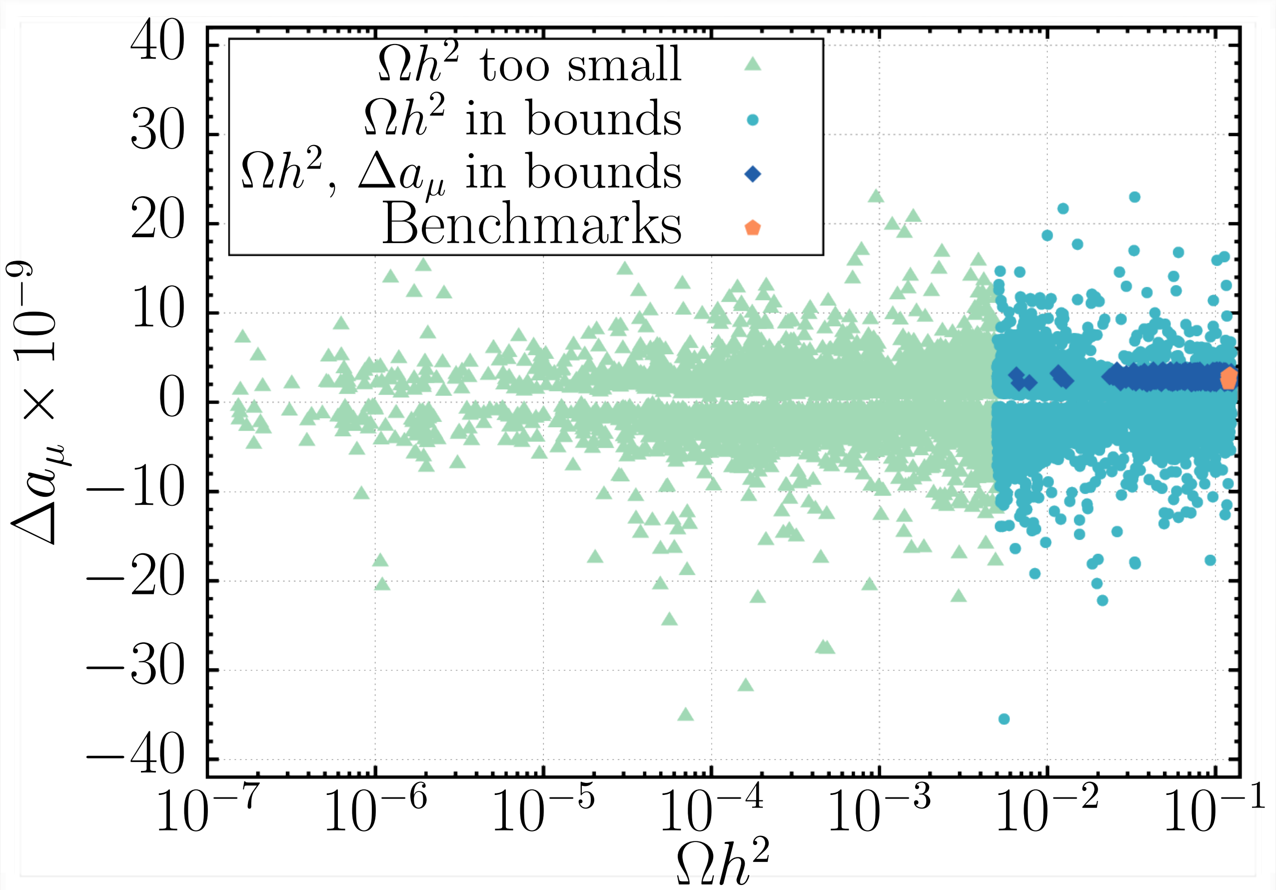
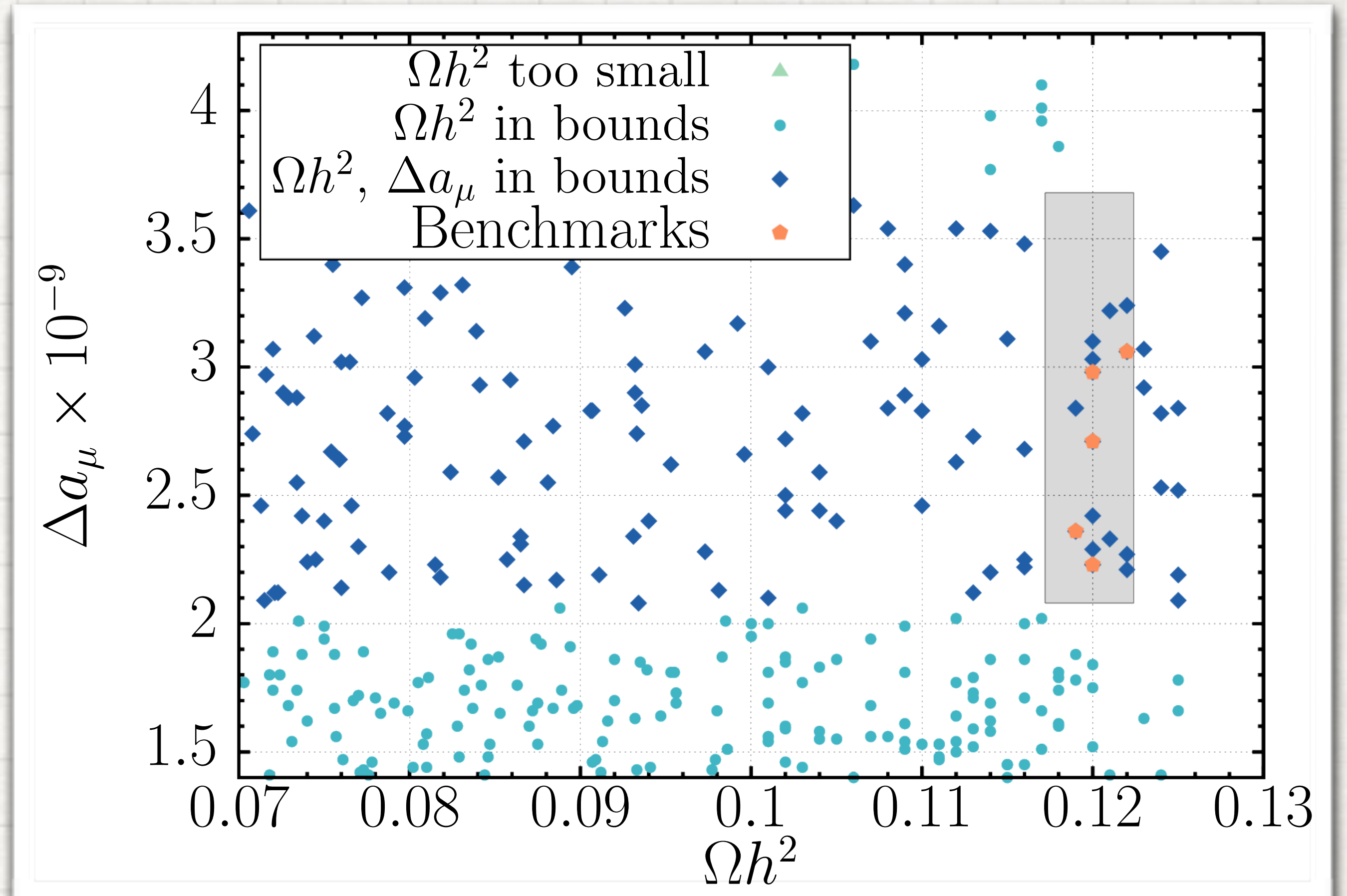




- several points fulfil Ωh^2 and Δa_μ perfectly in exp. 1σ bound (grey rectangle)
- $\mu \approx 3$ TeV for large μ benchmark points

Results

- keep best points as benchmarks

	Benchmark:	BP6	BP7	BP8	BP9	BP10	
Input at GUT scale	$\tan\beta$	16.96	26.88	32.15	22.21	40.22	
	$\text{sgn}(\mu)$	+	+	+	+	+	
	m_0	238.8	149.6	106.5	271.5	137.5	[GeV]
	m_1	1426.7	1131.1	626.5	508.9	1470.7	[GeV]
	m_2	239.2	302.7	125.3	193.5	178.4	[GeV]
	m_3	1458.7	1631.9	1076.3	1434.2	1847.8	[GeV]
	M_1	577.9	292.3	711.6	579.8	760.7	[GeV]
	M_2	412.8	612.4	948.8	-436.4	982.8	[GeV]
	M_3	2195.7	2055.2	2680.5	2456.0	2524.6	[GeV]
	M_{h_1}	670.6	2924.4	577.0	1512.8	1577.3	[GeV]
	M_{h_2}	814.9	925.9	918.8	1306.2	1362.7	[GeV]
	A_{tri}	-2244.8	-2776.6	-1113.2	-2896.2	-2370.1	[GeV]
	Q	3409.7	3163.2	4072.1	3742.4	3845.1	[GeV]
	$\mu(Q)$	2932.7	2917.6	3105.9	3217.7	3271.1	[GeV]
Constraints	$\Delta\rho$	7.01×10^{-6}	1.01×10^{-5}	1.91×10^{-5}	2.36×10^{-6}	3.57×10^{-5}	
	$\text{Br}(b \to s\gamma)$	3.32×10^{-4}	3.29×10^{-4}	3.30×10^{-4}	3.32×10^{-4}	3.28×10^{-4}	
	$\text{Br}(B_s \to \mu^+\mu^-)$	3.07×10^{-9}	3.13×10^{-9}	3.14×10^{-9}	3.08×10^{-9}	3.32×10^{-9}	
	$\sigma^{\text{DD SI}}$	9.69×10^{-13}	4.44×10^{-13}	6.65×10^{-13}	5.50×10^{-13}	6.31×10^{-13}	[pb]
	Ωh^2	1.20×10^{-1}	1.22×10^{-1}	1.20×10^{-1}	1.20×10^{-1}	1.19×10^{-1}	
	Δa_μ	2.71×10^{-9}	3.06×10^{-9}	2.23×10^{-9}	2.98×10^{-9}	2.36×10^{-9}	

Planck Collaboration, Astron. Astrophys. 571 (2014) A16

LUX Collaboration, Phys. Rev. Lett. 112 (2014) 091303

BaBar Collaboration, Phys. Rev. D86 (2012) 052012

CMS Collaboration, Phys. Rev. Lett. 111 (2013) 101804

- $\Omega h^2 = 0.1198 \pm 0.0026$, $\sigma^{DD\text{-}SI} \leq 7.6 \cdot 10^{-10}$ pb, BR(b > s γ) = $(3.29 + 0.19 + 0.48) \cdot 10^{-4}$, BR($B_s > \mu^+ \mu^-$) = $3.0^{+1.0}_{-0.9} \cdot 10^{-9}$

Vacuum Stability

- SoftSUSY uses two-loop tadpole contrib. to ensure EWSB by Higgs VEV's, but …
  - CCB minima ignored
  - other solutions might exist

VACUUM STABILITY

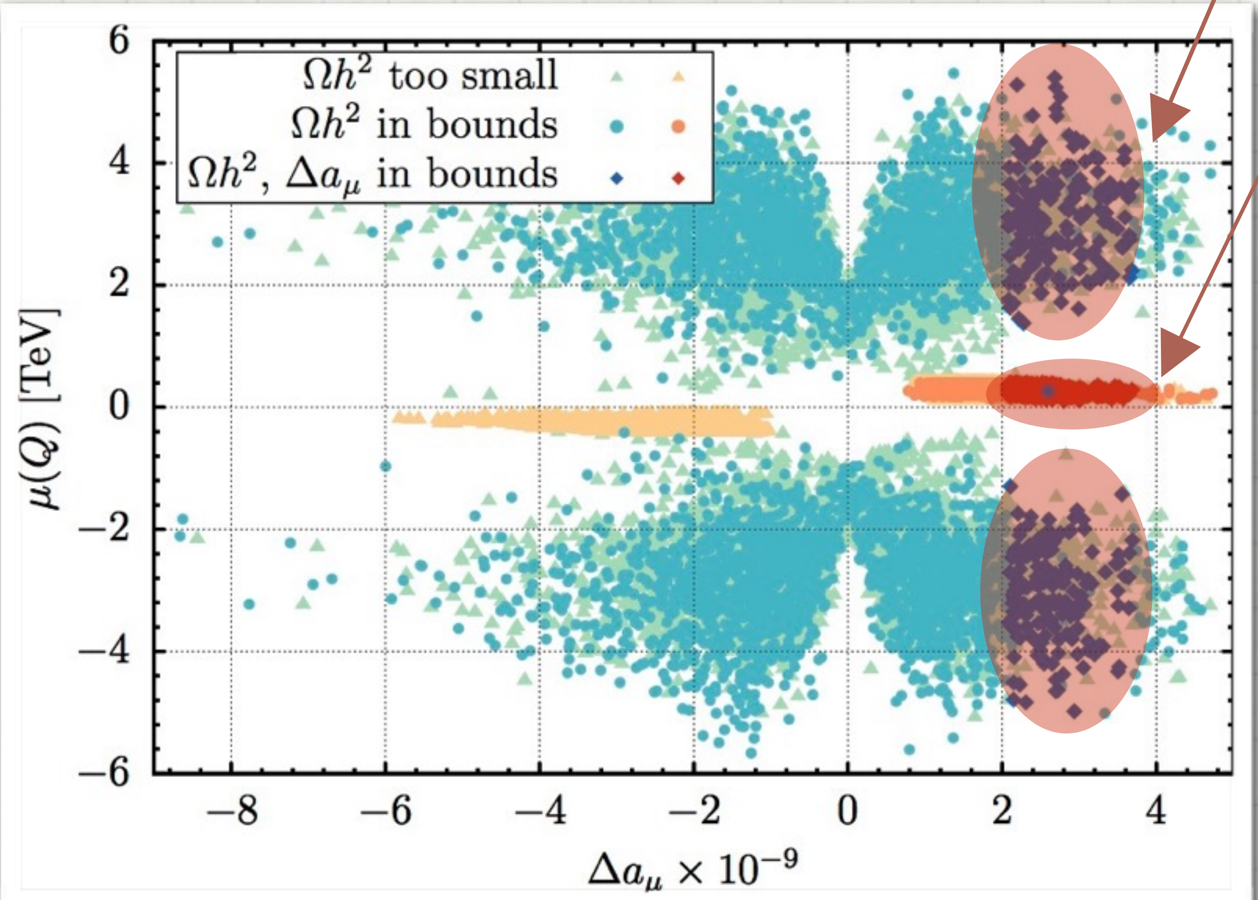
- SOFTSUSY uses two-loop tadpole contrib. to ensure EWSB by Higgs VEV's, but …
    - CCB minima ignored
    - other solutions might exist
- might lie lower than desired vacua
- need to check that SOFTSUSY's EWSB vacua are safe
- VEVACIOUS used to study all tree-level and one-loop desired vacua

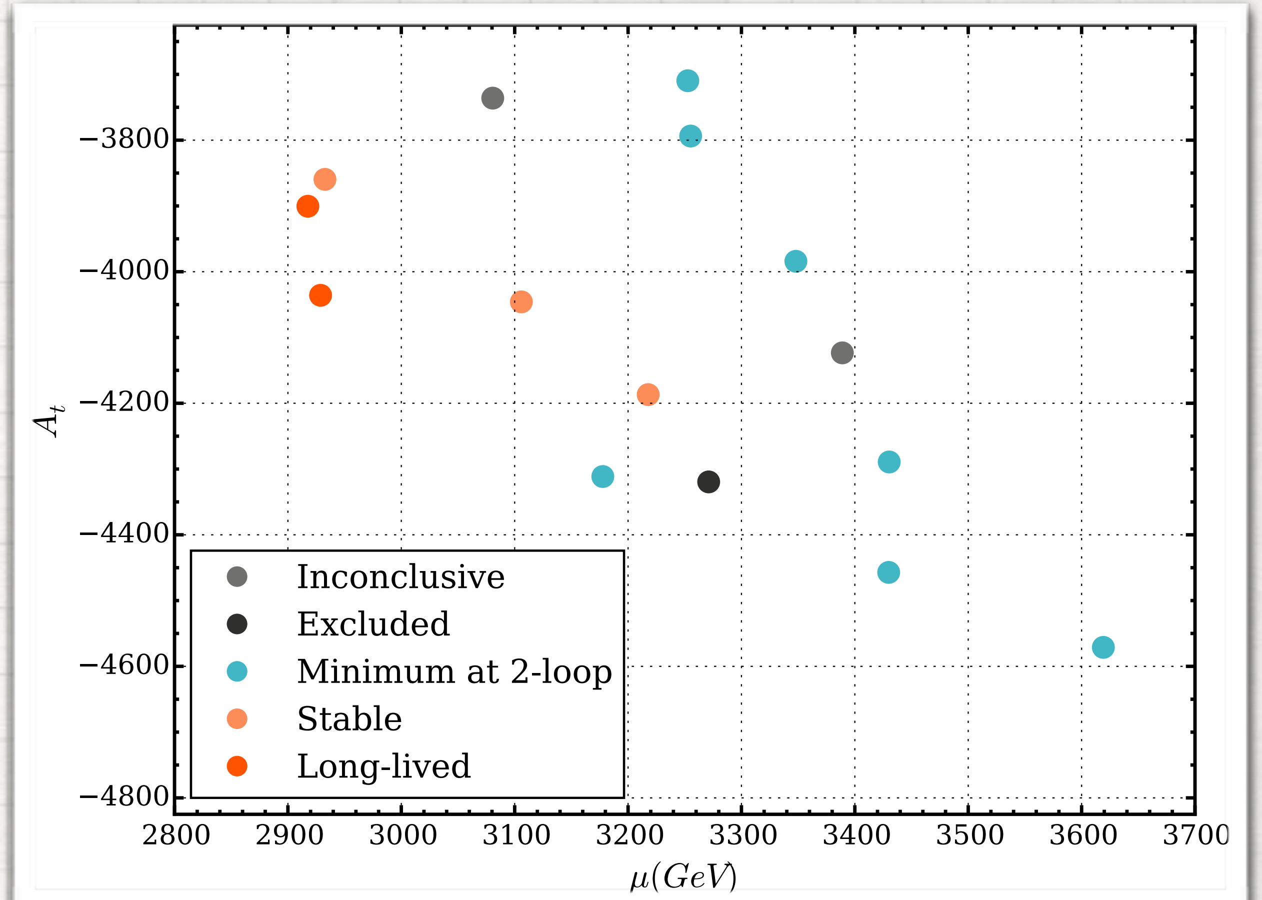
Vacuum Stability

- small μ vacua always global minima of one-loop eff. potential
- large μ vacua not as conclusive since desired vacua often arise at two-loop only
  - technically unfeasible for now

large μ solutions

small μ solutions





Conclusion & Outlook

- Pati-Salam model able to explain phenomena beyond ν-physics
  - Dark Matter, Relic density
  - exp. constraints (Higgs mass, BR($b > s\gamma$), BR($B_s > \mu^+ \mu^-$))
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- found two viable regions in parameter space (small μ, large μ)
- vacuum stable for all points in small μ region
- vacuum sometimes stable for points in large μ region (for technical reasons)
- light smuons and large $\Delta m = m_{\tilde{\mu}_L} - m_{\tilde{\chi}_1^0}$ give rise to explore collider physics

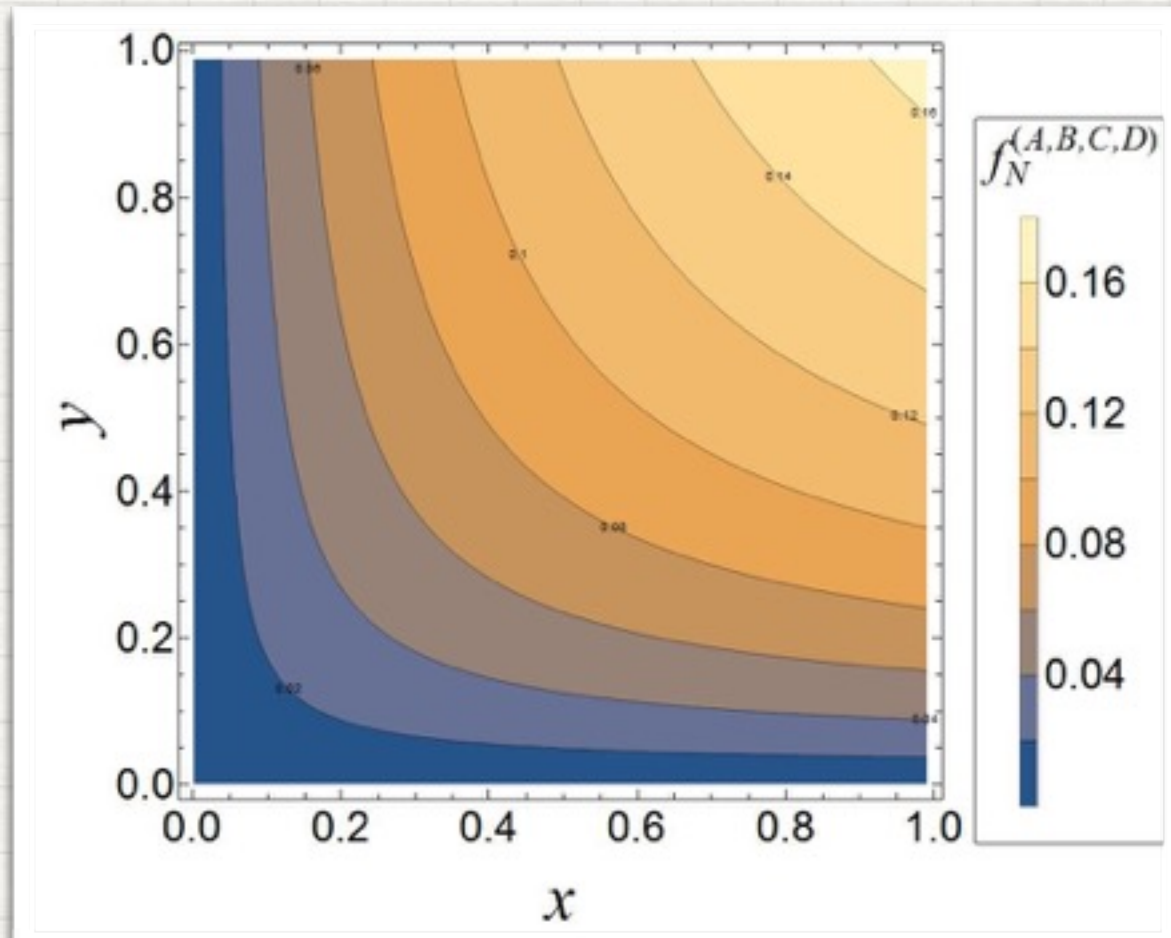
Thank you!

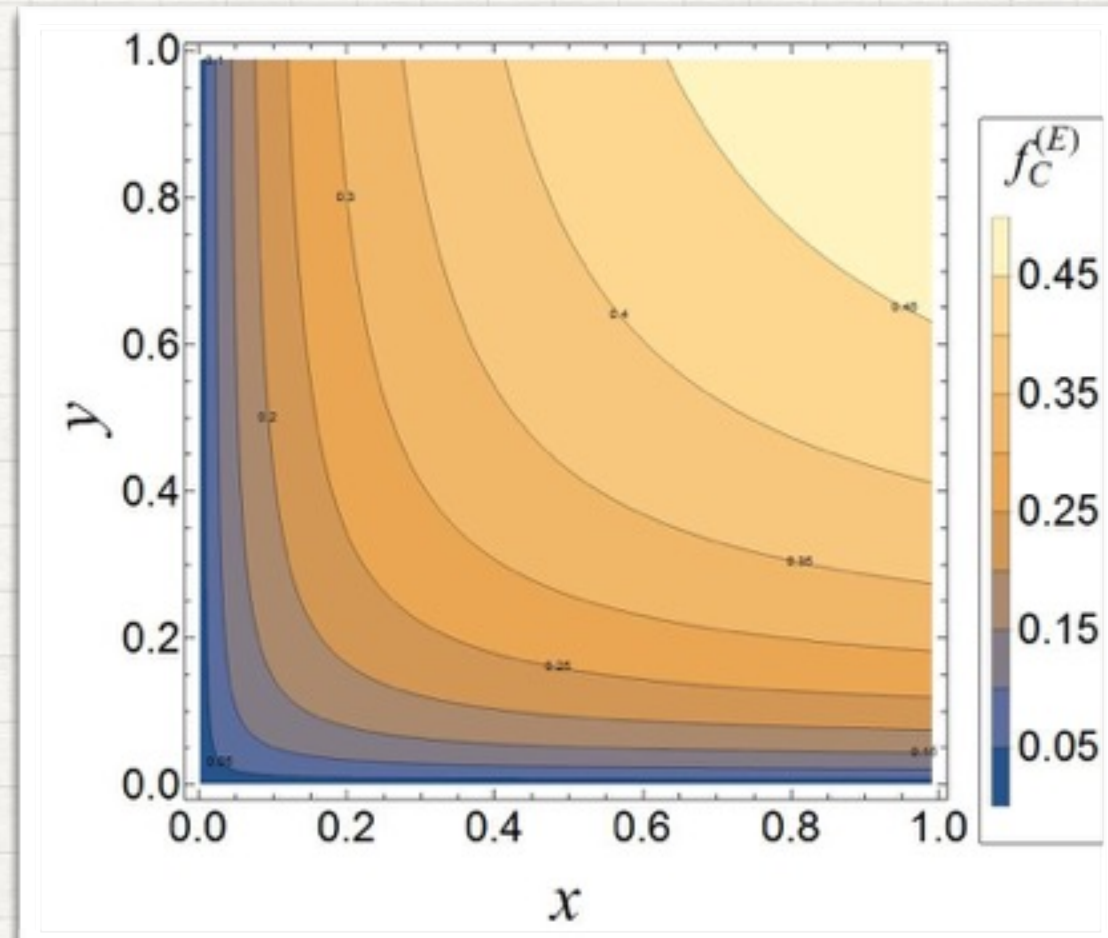
Backup Slides

The f-Functions

$$f_{\mathrm{N}}^{(A,B,C,D)}(x,y) = xy\left[\frac{-3+x+y+xy}{(x-1)^2(y-1)^2} + \frac{2x\log x}{(x-y)(x-1)^3} - \frac{2y\log y}{(x-y)(y-1)^3}\right],$$

$$f_{\mathrm{C}}^{(E)}(x,y) = xy\left[\frac{5-3(x+y)+xy}{(x-1)^2(y-1)^2} - \frac{2\log x}{(x-y)(x-1)^3} + \frac{2\log y}{(x-y)(y-1)^3}\right]$$





for fixed (x,y), $f_C^{(E)}$ ~10 times larger than $f_N^{(A,B,C,D)}$

Results

Parameter	Range			Parameter	Range		
A_{tri}	-4000	–	-2300	M_1	-500	–	-100
m_0	400	–	700	M_2	100	–	600
m_1	300	–	500	M_3	750	–	1200
m_2	200	–	400	$\tan\beta$	15	–	35
m_3	200	–	2000	$\text{sgn}(\mu)$		$+1$	
m_{H_1}, m_{H_2}	1500	–	2500				

- Small μ scenario
  - small m_0, m_2 keep smuons light
  - large A_{tri} compensates for smallish m_3, M_3
  - $sgn(M_1) = - sgn(M_2)$ with $M_1 < 0$ to enhance diagrams (B) and (E)

Results

Parameter	Range	Parameter	Range
A_{tri}	-4000 – -2300	M_1	-500 – -100
m_0	400 – 700	M_2	100 – 600
m_1	300 – 500	M_3	750 – 1200
m_2	200 – 400	$\tan\beta$	15 – 35
m_3	200 – 2000	$\text{sgn}(\mu)$	$+1$
m_{H_1}, m_{H_2}	1500 – 2500		

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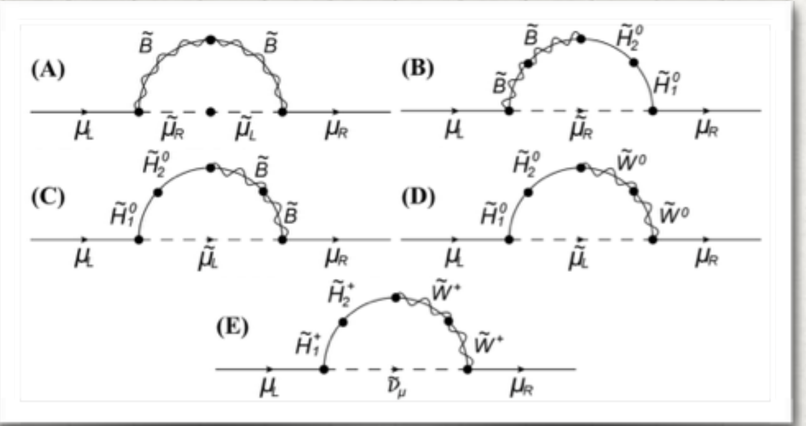
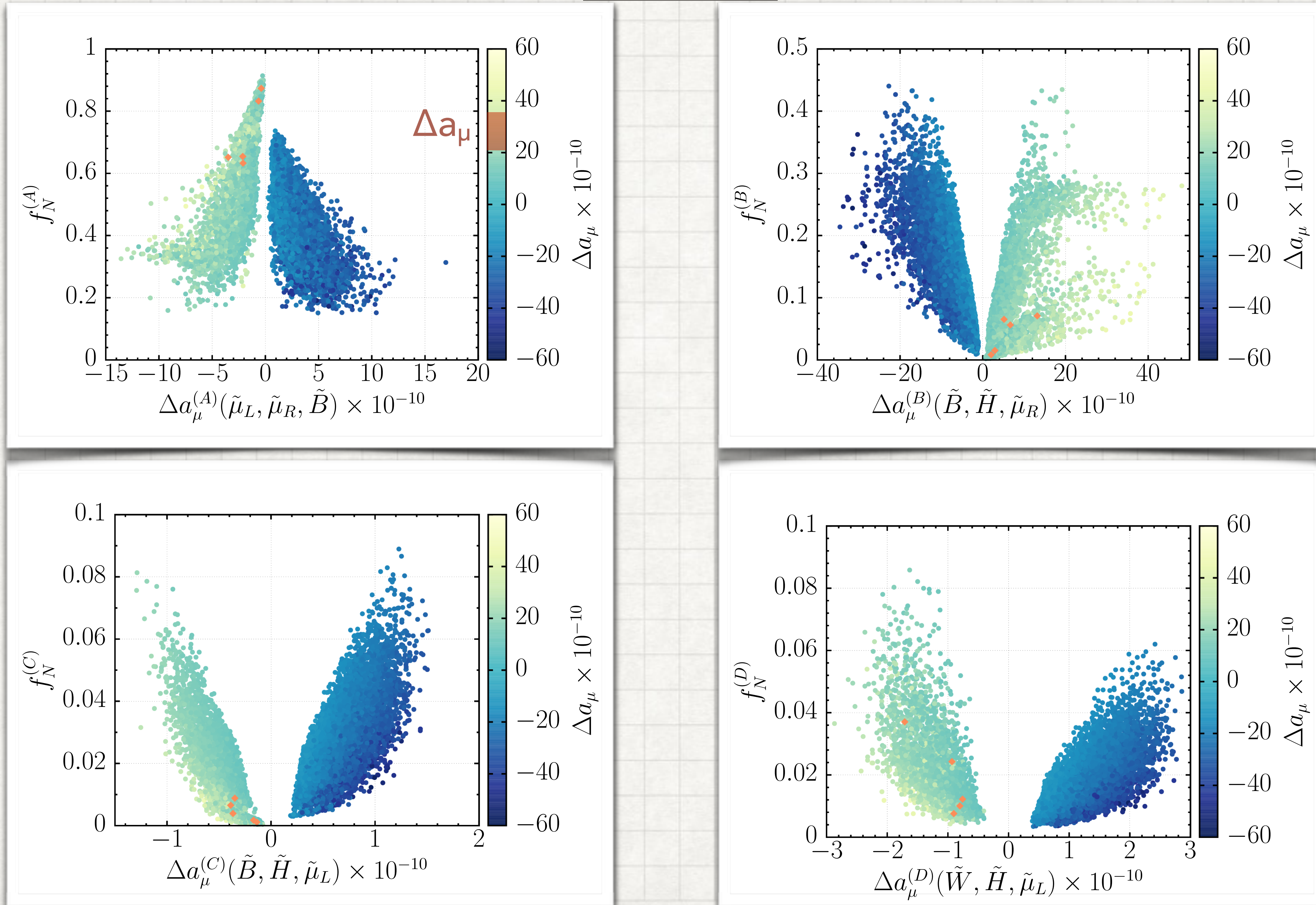
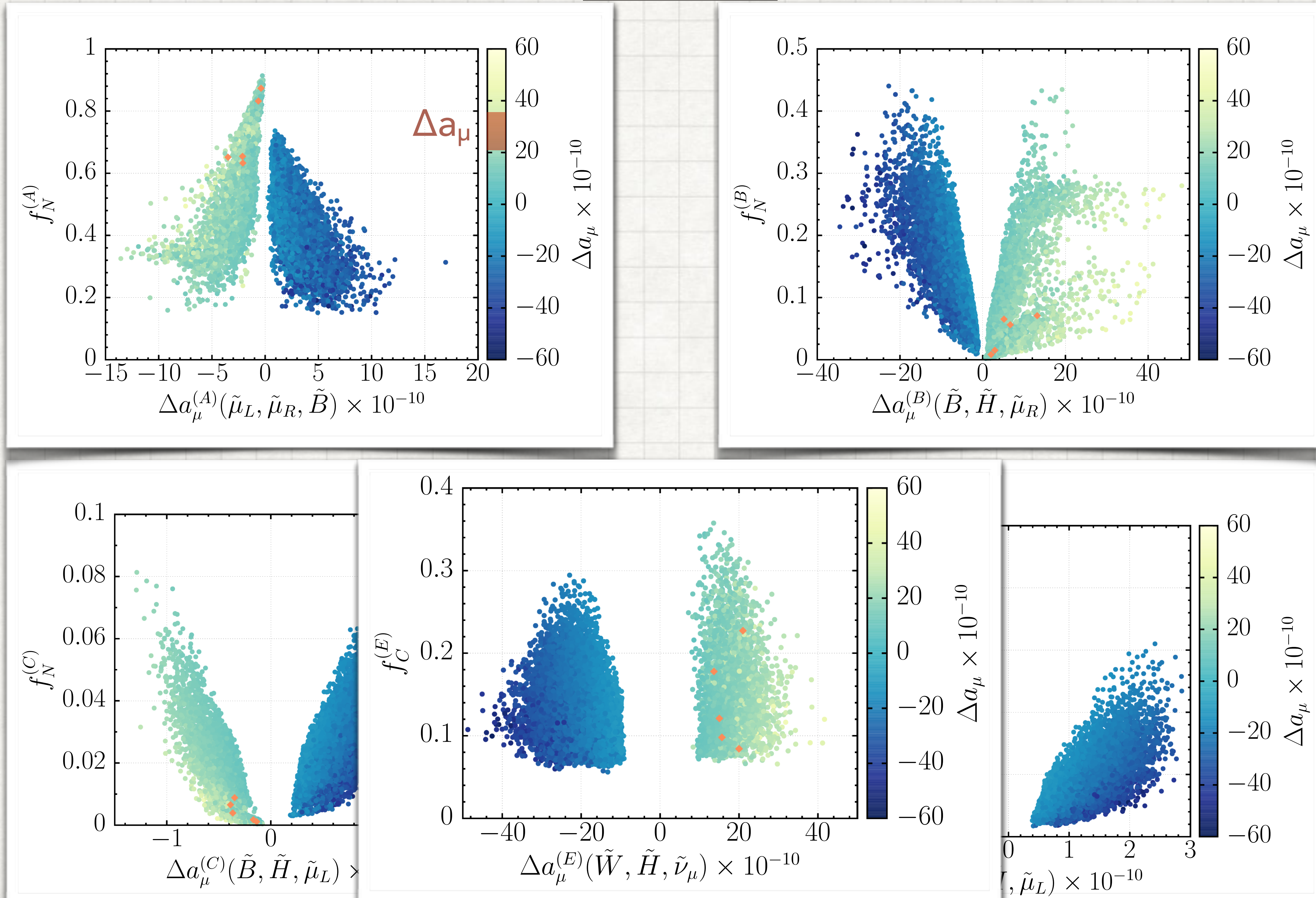


RESULTS

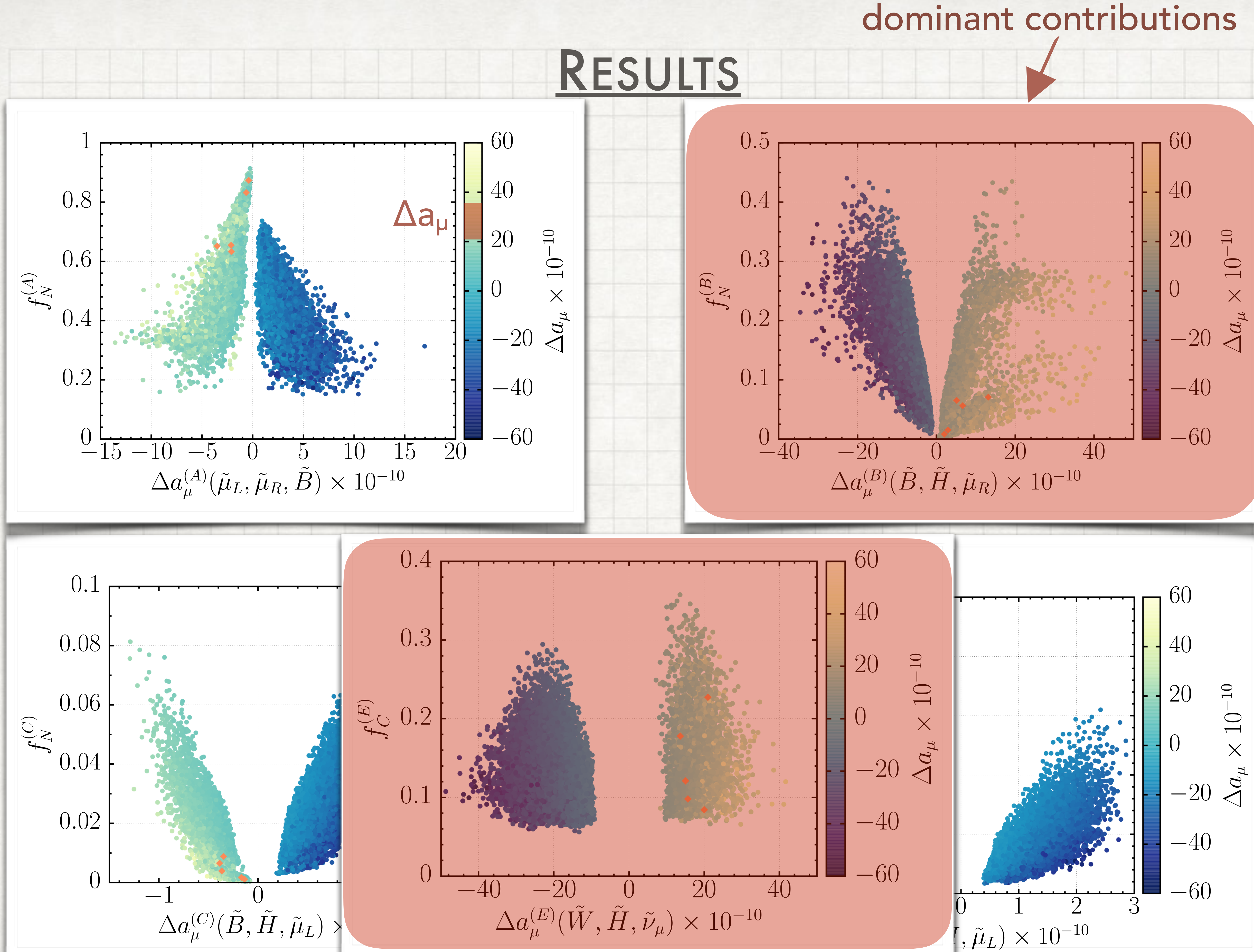

Δa_μ
$f_N^{(A)}$
$\Delta a_\mu^{(A)}(\tilde{\mu}_L, \tilde{\mu}_R, \tilde{B}) \times 10^{-10}$
$\Delta a_\mu \times 10^{-10}$
$f_N^{(B)}$
$\Delta a_\mu^{(B)}(\tilde{B}, \tilde{H}, \tilde{\mu}_R) \times 10^{-10}$
$f_N^{(C)}$
$\Delta a_\mu^{(C)}(\tilde{B}, \tilde{H}, \tilde{\mu}_L) \times 10^{-10}$
$f_N^{(D)}$
$\Delta a_\mu^{(D)}(\tilde{W}, \tilde{H}, \tilde{\mu}_L) \times 10^{-10}$

RESULTS

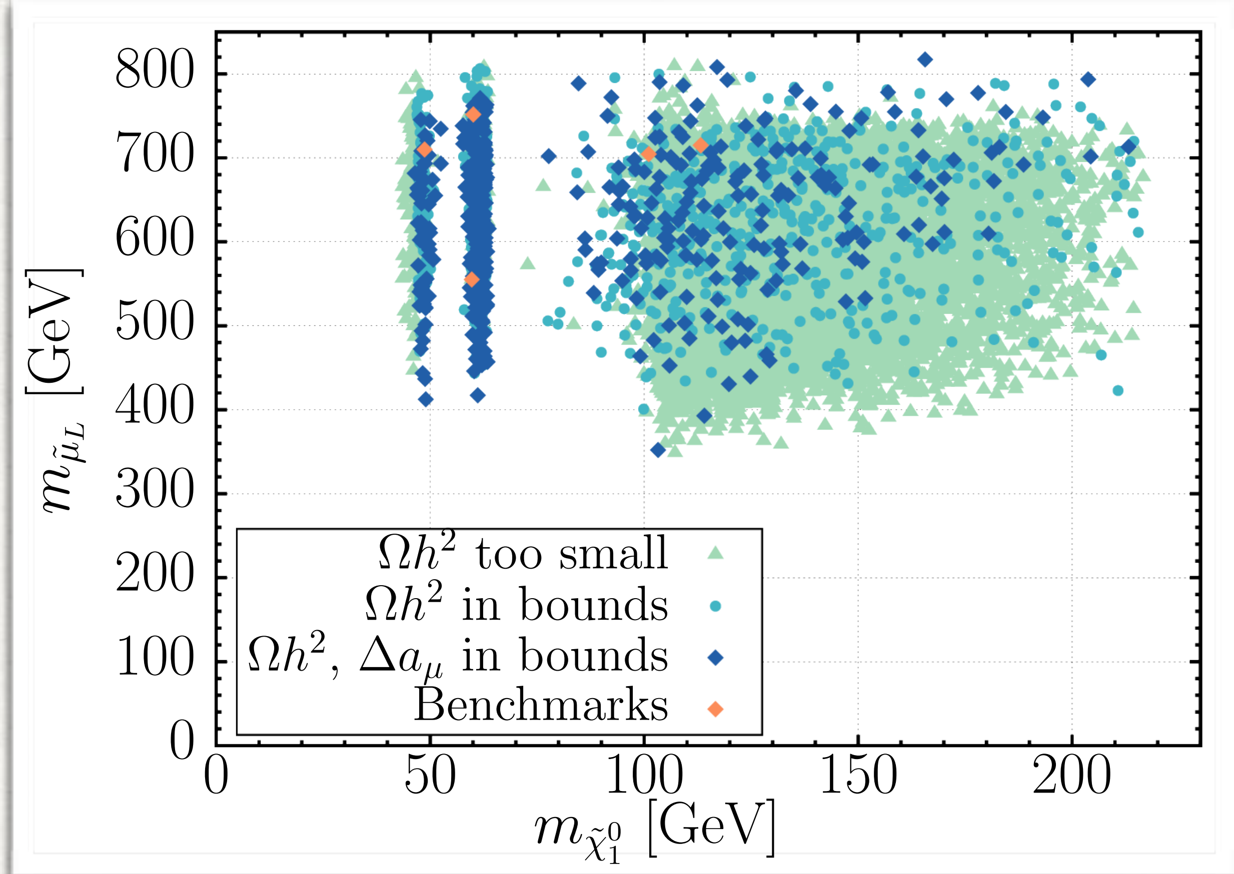


Δa_μ
$f_N^{(A)}$
$\Delta a_\mu^{(A)}(\tilde{\mu}_L, \tilde{\mu}_R, \tilde{B}) \times 10^{-10}$
$\Delta a_\mu \times 10^{-10}$
$f_N^{(B)}$
$\Delta a_\mu^{(B)}(\tilde{B}, \tilde{H}, \tilde{\mu}_R) \times 10^{-10}$
$\Delta a_\mu \times 10^{-10}$
$f_N^{(C)}$
$\Delta a_\mu^{(C)}(\tilde{B}, \tilde{H}, \tilde{\mu}_L) \times$
$f_C^{(E)}$
$\Delta a_\mu^{(E)}(\tilde{W}, \tilde{H}, \tilde{\nu}_\mu) \times 10^{-10}$
$\Delta a_\mu \times 10^{-10}$
$, \tilde{\mu}_L) \times 10^{-10}$
$\Delta a_\mu \times 10^{-10}$

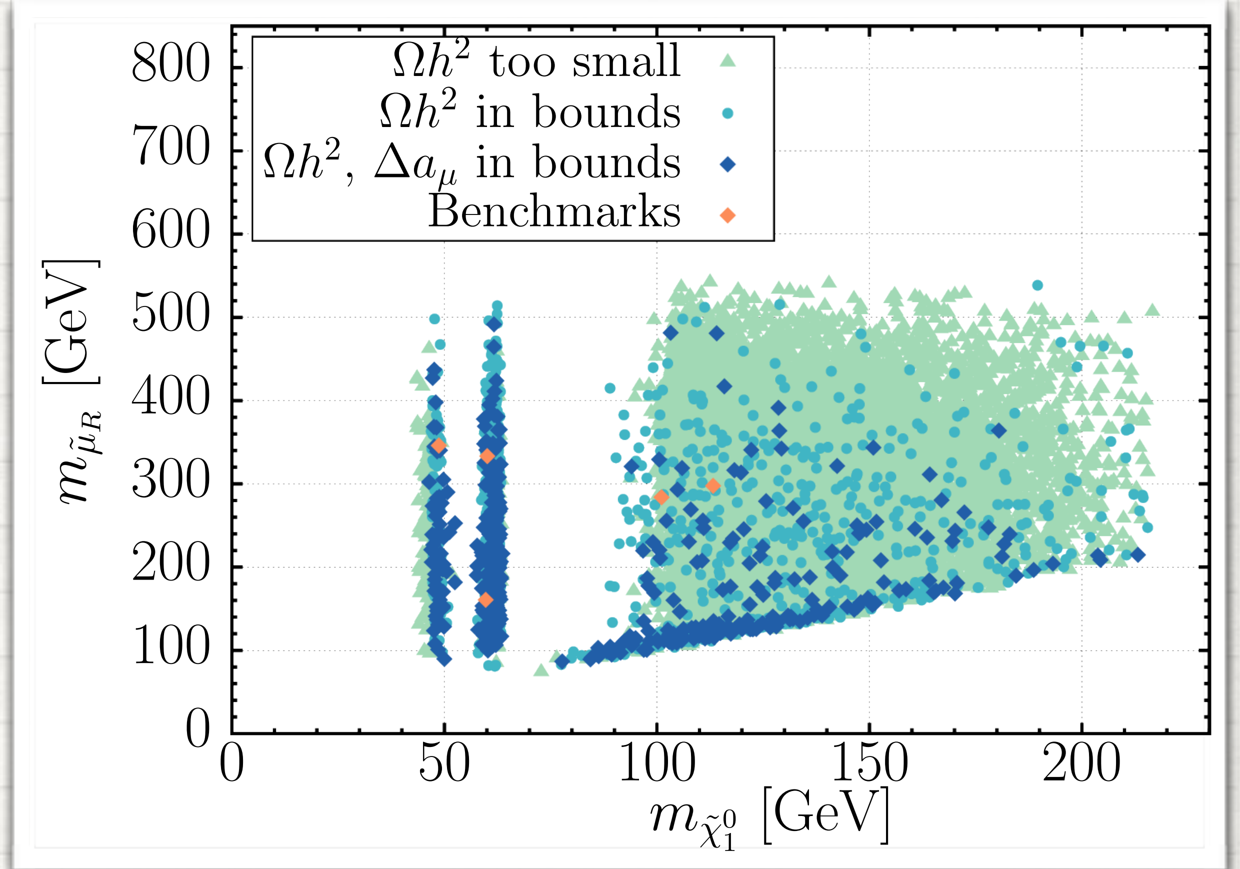
Results


dominant contributions
Δaμ
$f_N^{(A)}$
$\Delta a_\mu^{(A)}(\tilde{\mu}_L, \tilde{\mu}_R, \tilde{B}) \times 10^{-10}$
$\Delta a_\mu \times 10^{-10}$
$f_N^{(B)}$
$\Delta a_\mu^{(B)}(\tilde{B}, \tilde{H}, \tilde{\mu}_R) \times 10^{-10}$
$\Delta a_\mu \times 10^{-10}$
$f_N^{(C)}$
$\Delta a_\mu^{(C)}(\tilde{B}, \tilde{H}, \tilde{\mu}_L) \times$
$f_C^{(E)}$
$\Delta a_\mu^{(E)}(\tilde{W}, \tilde{H}, \tilde{\nu}_\mu) \times 10^{-10}$
$\Delta a_\mu \times 10^{-10}$
$, \tilde{\mu}_L) \times 10^{-10}$
$\Delta a_\mu \times 10^{-10}$

Results

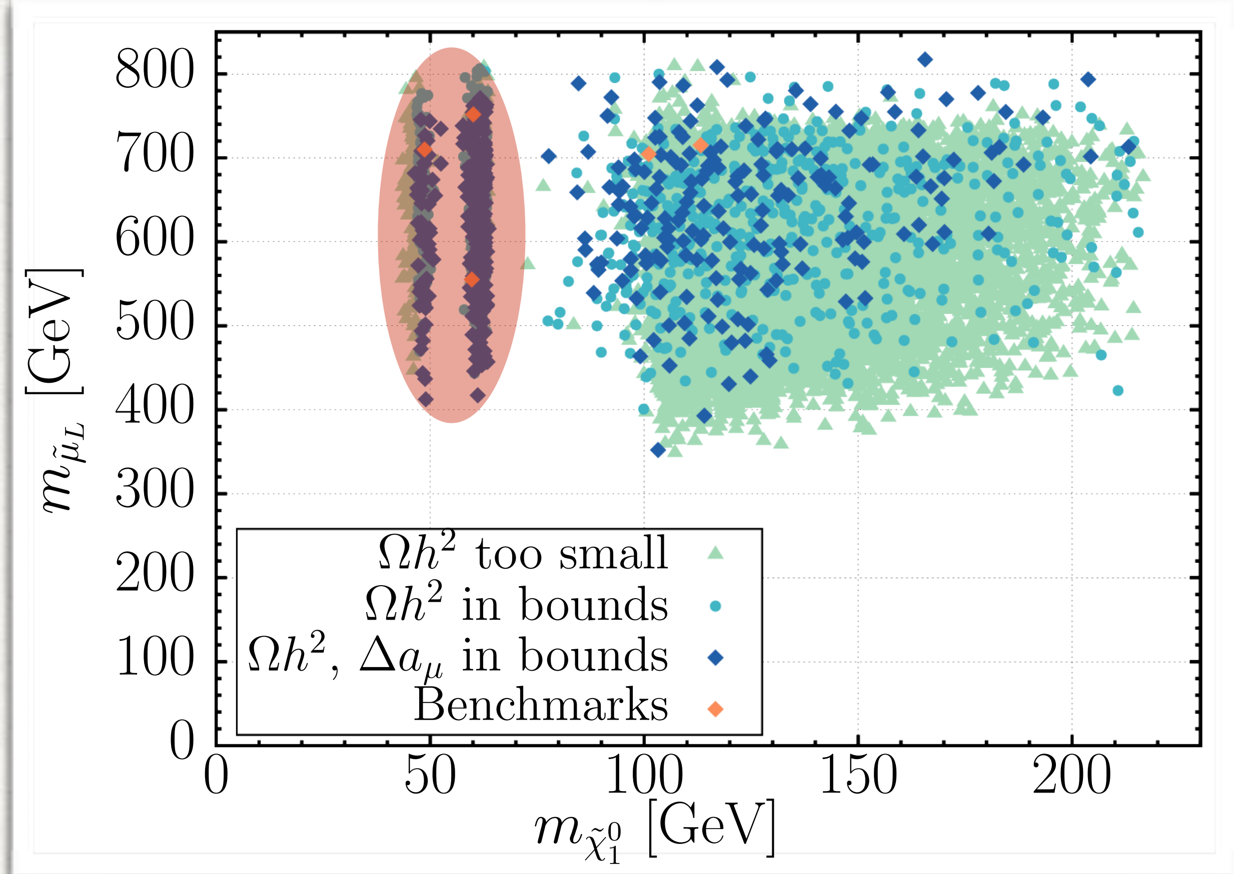


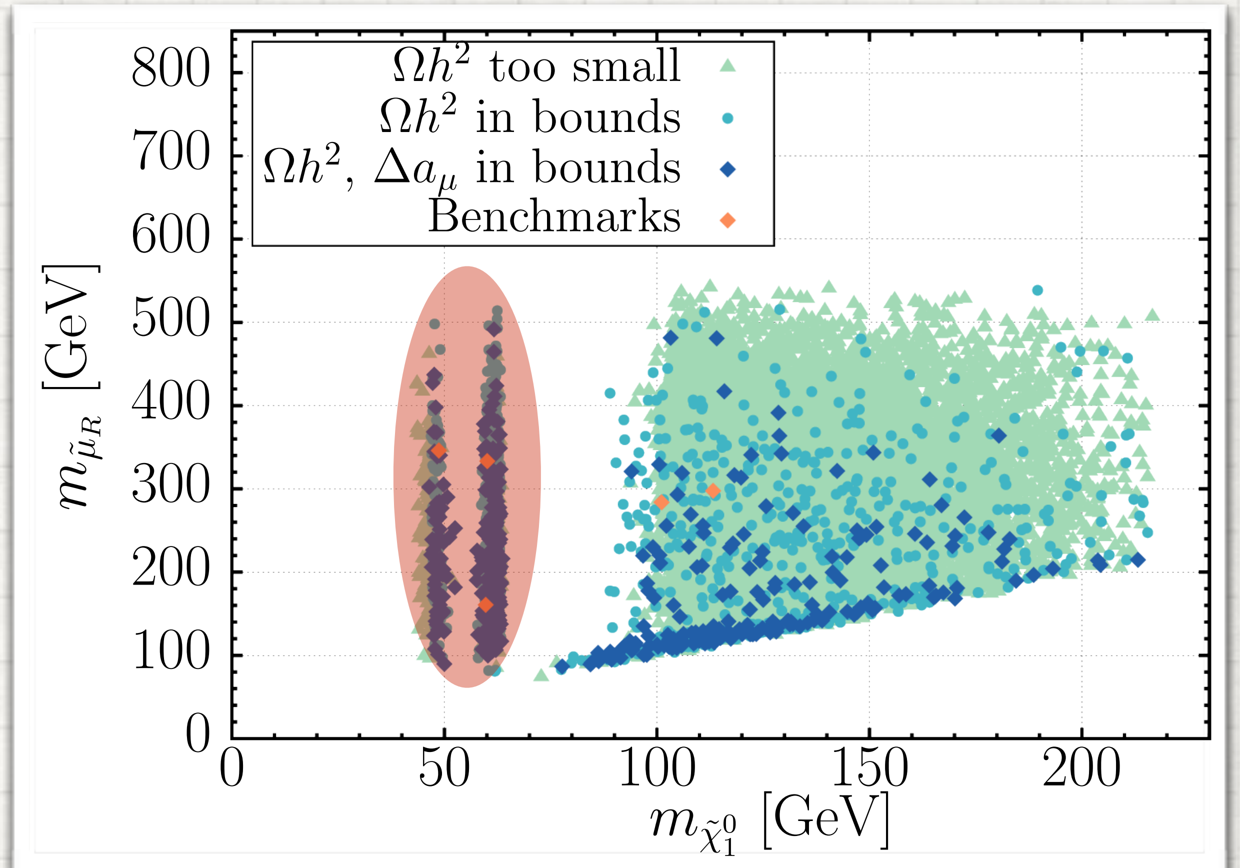
800
700
600
500
400
300
200
100
0
0
50
100
150
200
$m_{\tilde{\mu}_L}$ [GeV]
$m_{\tilde{\chi}_1^0}$ [GeV]
Ωh^2 too small
Ωh^2 in bounds
Ωh^2, Δa_μ in bounds
Benchmarks



800
700
600
500
400
300
200
100
0
0
50
100
150
200
$m_{\tilde{\mu}_R}$ [GeV]
$m_{\tilde{\chi}_1^0}$ [GeV]
Ωh^2 too small
Ωh^2 in bounds
Ωh^2, Δa_μ in bounds
Benchmarks

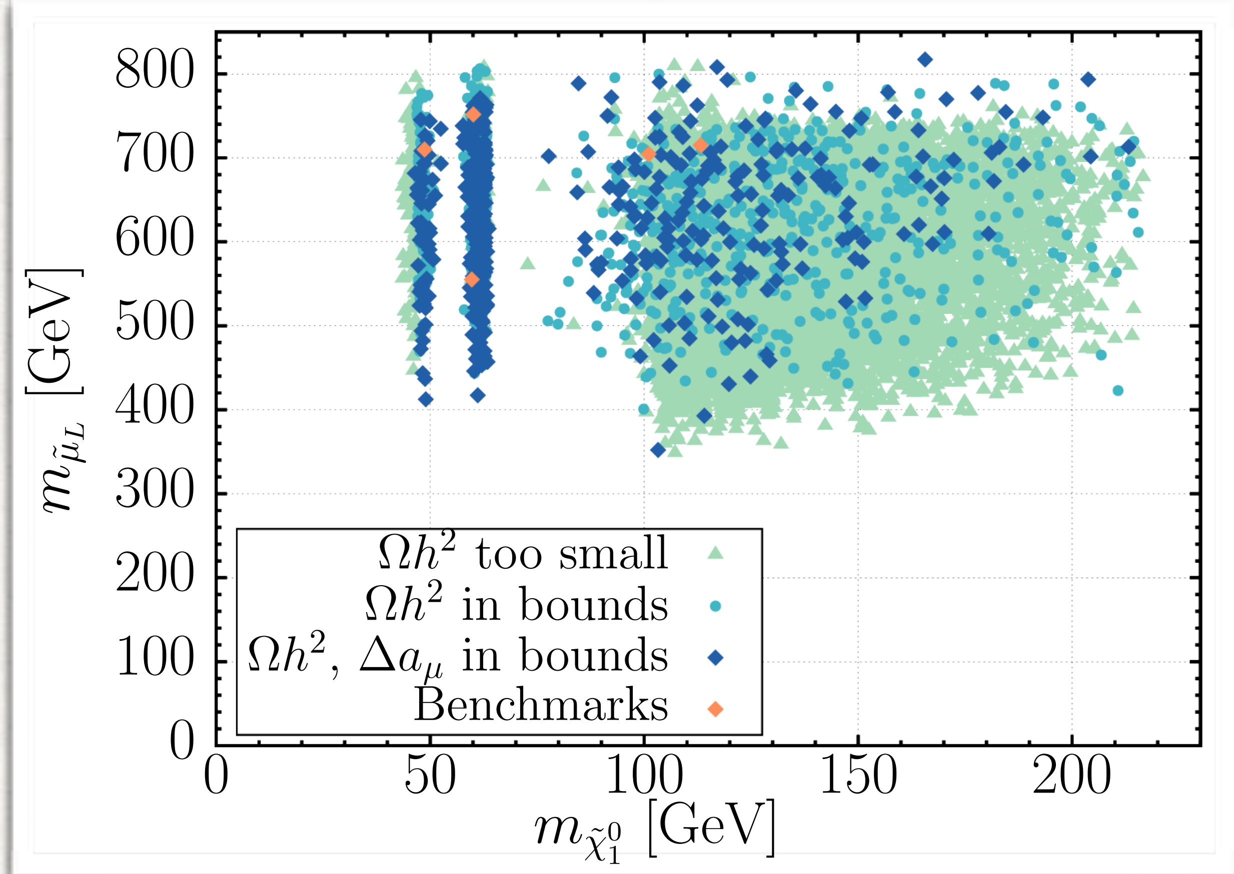
RESULTS

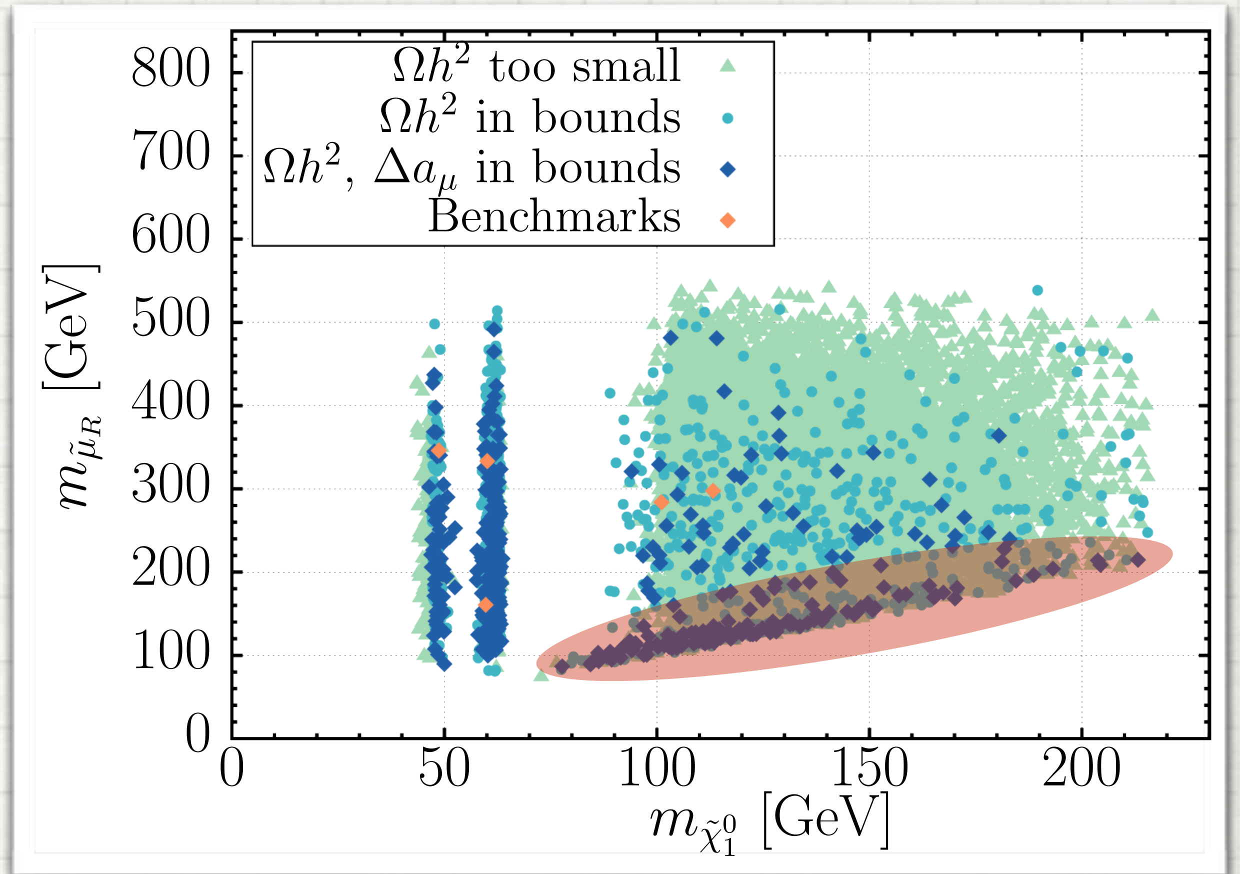




- two bands due to DM annihilation ($\tilde{\chi}_1^0 \tilde{\chi}_1^0 \to Z, H$)

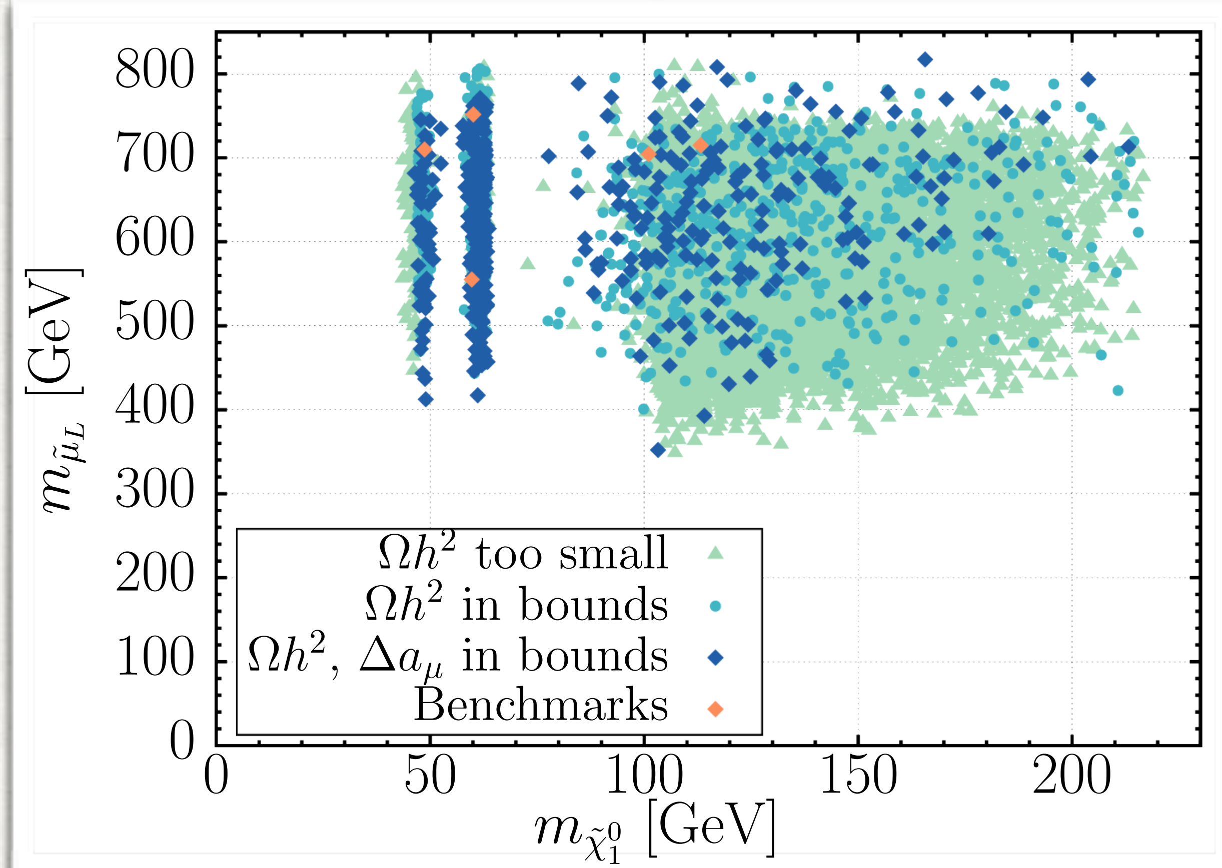
RESULTS

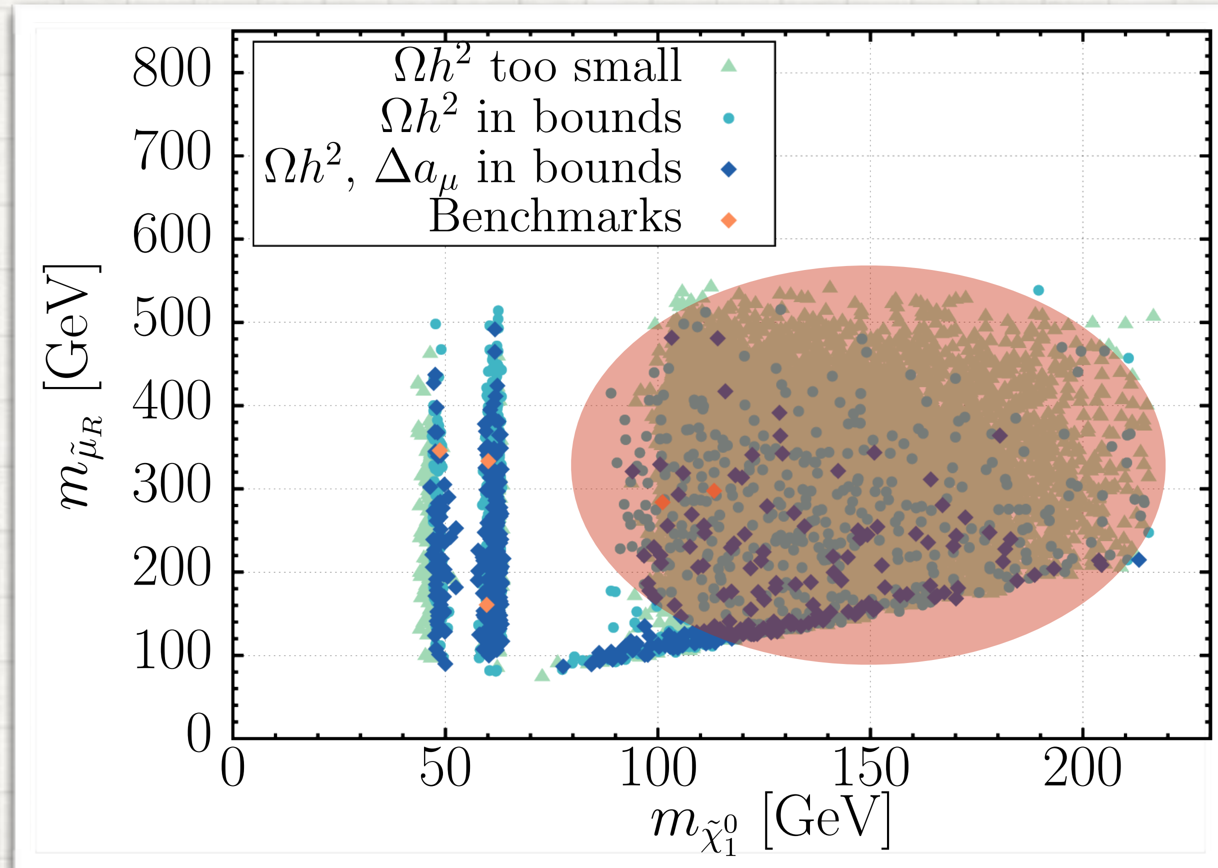




- two bands due to DM annihilation ($\tilde{\chi}_1^0\,\tilde{\chi}_1^0 \to Z, H$)
- lower diagonal corresponds to $\tilde{\chi}_1^0 - \tilde{\mu}_R$ co-annihilation

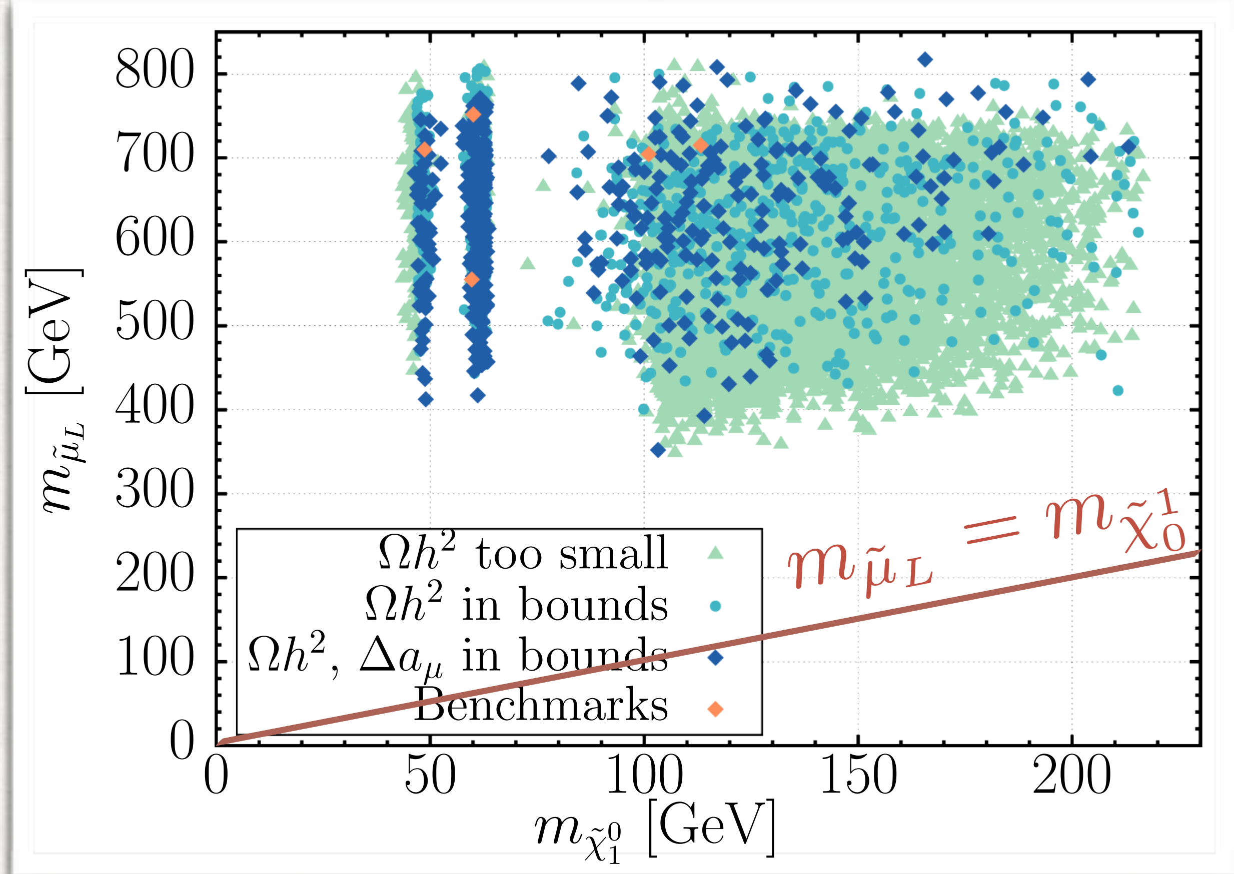
RESULTS

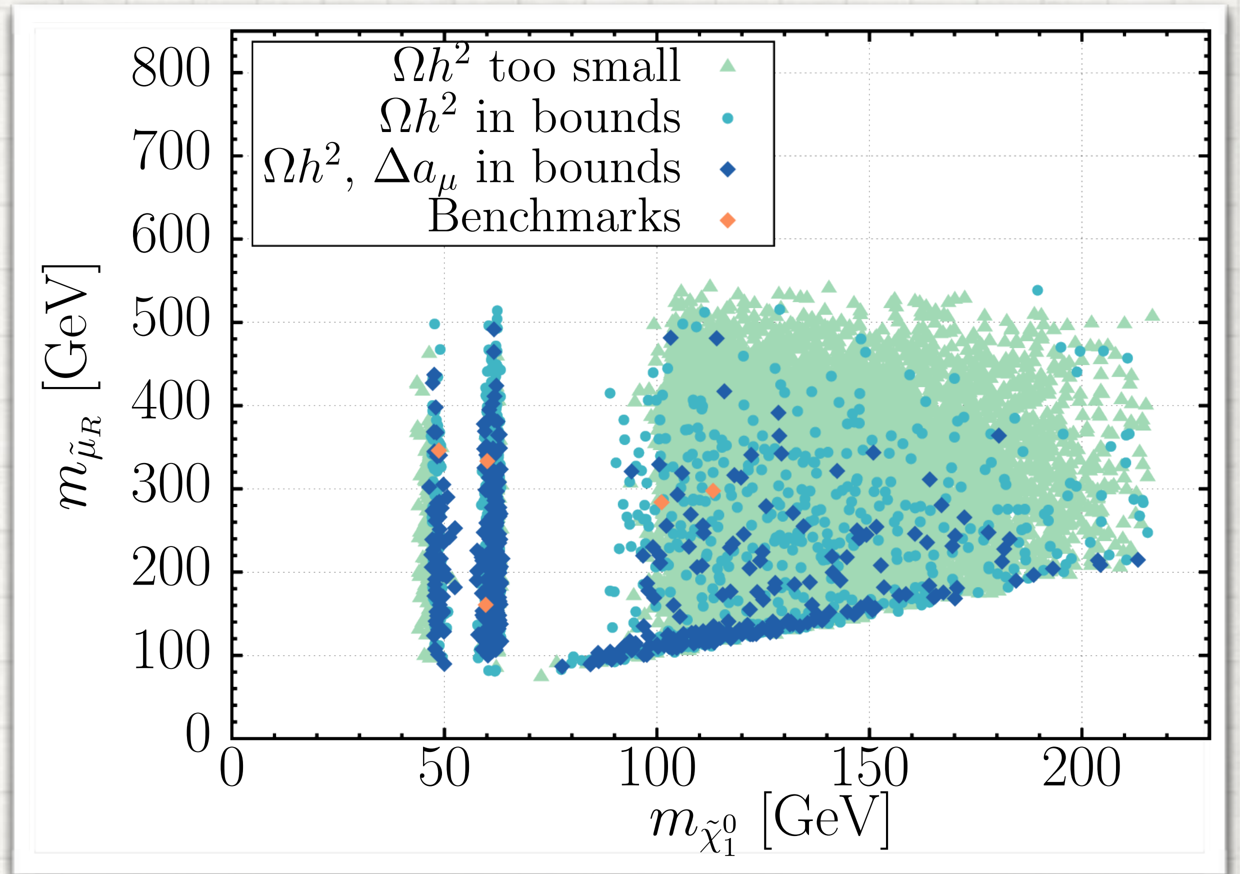




- two bands due to DM annihilation ($\tilde{\chi}_1^0\,\tilde{\chi}_1^0 \to Z, H$)
- lower diagonal corresponds to $\tilde{\chi}_1^0 - \tilde{\mu}_R$ co-annihilation
- bulk corresponds to co-annihilation of $\tilde{\chi}_1^0$ with non-$\tilde{\mu}$ NLSP

Results





- two bands due to DM annihilation ($\tilde{\chi}_1^0 \tilde{\chi}_1^0 \to Z, H$)
- lower diagonal corresponds to $\tilde{\chi}_1^0 - \tilde{\mu}_R$ co-annihilation
- bulk corresponds to co-annihilation of $\tilde{\chi}_1^0$ with non-$\tilde{\mu}$ NLSP
- mass gaps always large for $\tilde{\mu}_L$

Results

- keep best points as benchmarks

	Benchmark:	BP1	BP2	BP3	BP4	BP5	
Input at GUT scale	$\tan\beta$	26.48	21.20	22.89	29.52	25.88	
	$\mathrm{sgn}(\mu)$	+	+	+	+	+	
	m_0	681.1	490.4	689.0	691.4	688.4	[GeV]
	m_1	402.0	327.5	447.0	364.4	417.9	[GeV]
	m_2	397.4	273.0	394.2	342.2	390.7	[GeV]
	m_3	1204.7	871.8	1085.4	987.4	1192.3	[GeV]
	M_1	-100.1	-124.1	-123.8	-224.9	-255.1	[GeV]
	M_2	294.9	367.5	449.9	168.6	177.9	[GeV]
	M_3	1004.6	1085.7	1109.8	1066.5	947.6	[GeV]
	M_{h_1}	2204.8	2108.4	2246.6	2127.3	2007.2	[GeV]
	M_{h_2}	2385.7	2350.9	2455.7	2330.2	2344.7	[GeV]
	A_{tri}	-2839.1	-2762.5	-2838.5	-2764.0	-3090.0	[GeV]
	Q	1293.4	1337.0	1409.0	1360.4	1143.6	[GeV]
	$\mu(Q)$	212.3	250.5	263.2	335.2	397.9	[GeV]
Constraints	$\Delta\rho$	1.04×10^{-5}	1.60×10^{-5}	8.96×10^{-6}	1.25×10^{-5}	1.66×10^{-5}	
	$\mathrm{Br}(b\to s\gamma)$	2.89×10^{-4}	2.91×10^{-4}	2.91×10^{-4}	3.25×10^{-4}	3.25×10^{-4}	
	$\mathrm{Br}(B_s\to\mu^+\mu^-)$	2.69×10^{-9}	2.97×10^{-9}	2.97×10^{-9}	3.06×10^{-9}	3.11×10^{-9}	
	$\sigma^{\mathrm{DD\ SI}}$	1.31×10^{-11}	1.28×10^{-11}	1.18×10^{-11}	2.42×10^{-11}	1.06×10^{-11}	[pb]
	Ωh^2	1.05×10^{-1}	1.25×10^{-1}	1.23×10^{-1}	8.32×10^{-2}	8.47×10^{-2}	
	Δa_μ	1.37×10^{-9}	2.28×10^{-9}	1.30×10^{-9}	1.99×10^{-9}	1.52×10^{-9}	

Planck Collaboration, Astron. Astrophys. 571 (2014) A16

LUX Collaboration, Phys. Rev. Lett. 112 (2014) 091303

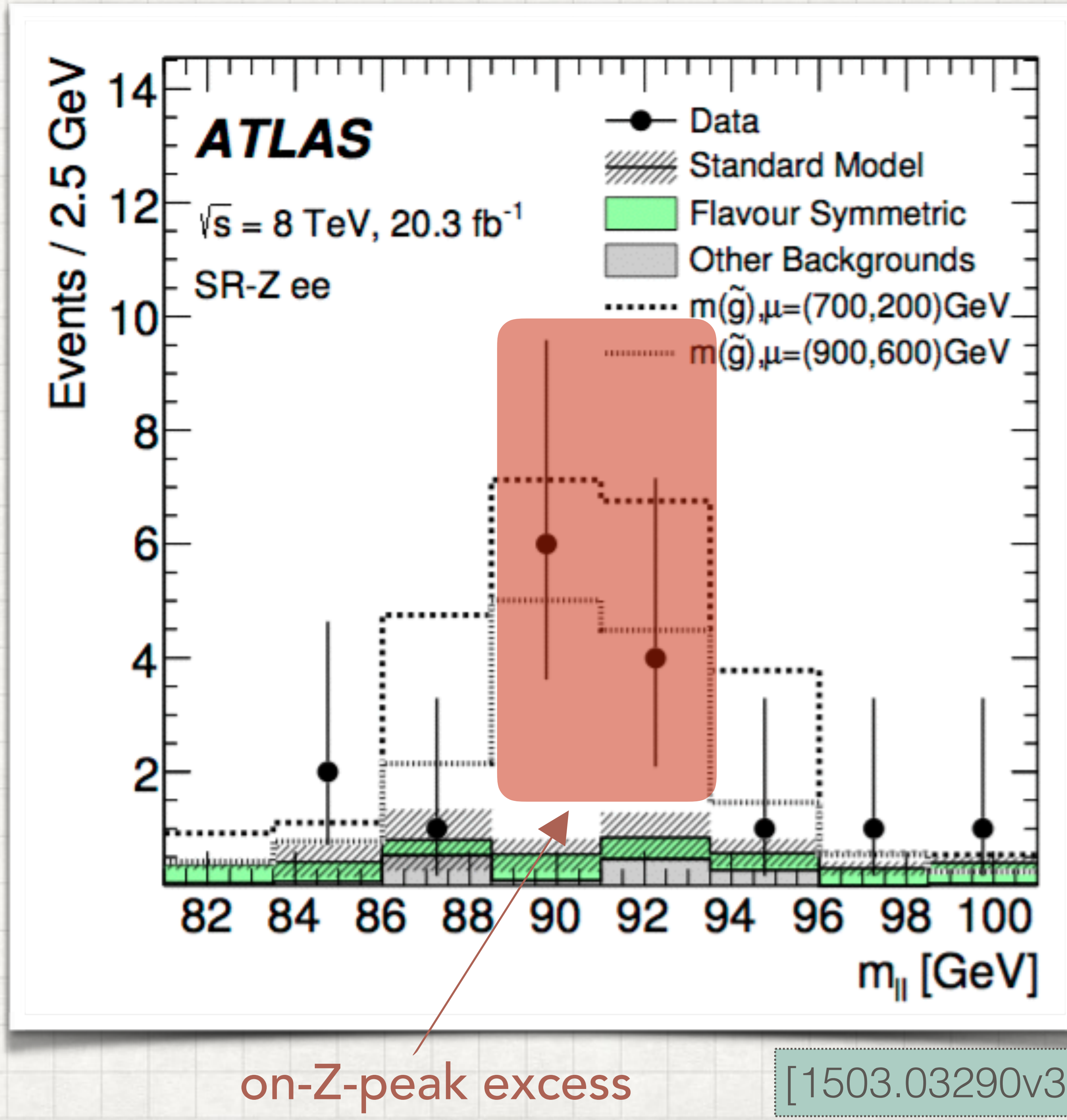
BaBar Collaboration, Phys. Rev. D86 (2012) 052012

CMS Collaboration, Phys. Rev. Lett. 111 (2013) 101804

- $\Omega h^2 = 0.1198 \pm 0.0026$, $\sigma^{DD\text{-}SI} \leq 7.6 \cdot 10^{-10}$ pb, $BR(b > s\,\gamma) = (3.29 + 0.19 + 0.48) \cdot 10^{-4}$, $BR(B_s > \mu^+ \mu^-) = 3.0^{+1.0}_{-0.9} \cdot 10^{-9}$

ATLAS and CMS Di-Lepton Excesses

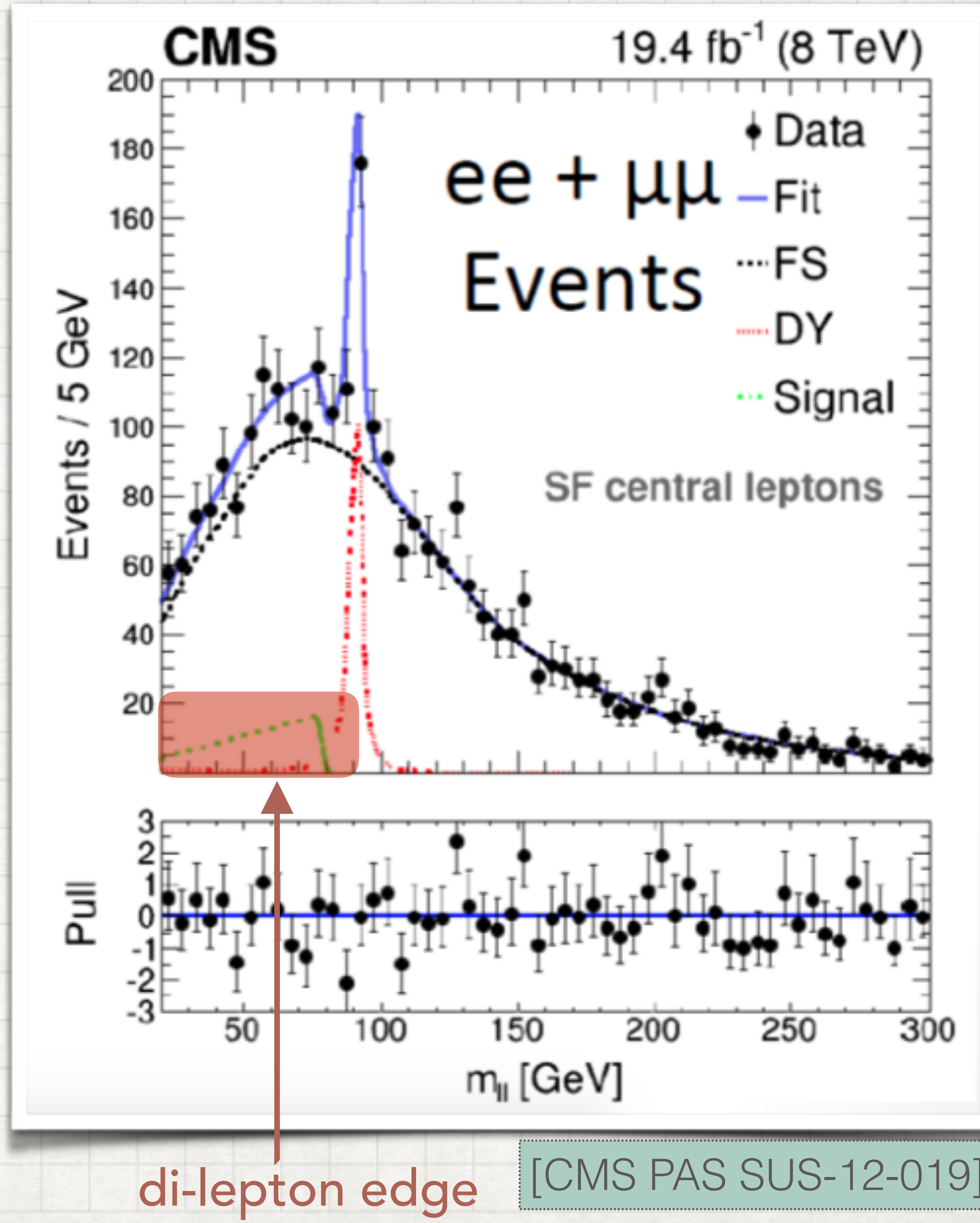
- ATLAS search for 2 OSSF leptons, jets and MET @ LHC8 (20.3 fb^{-1})
- CMS observed nothing on-peak



[1503.03290v3]

ATLAS and CMS Di-Lepton Excesses

- CMS search for 2 OSSF leptons, jets and MET @ LHC8 (19.4 fb^{-1})
- ATLAS observed nothing off-peak



[CMS PAS SUS-12-019]