



*Lepton flavor enrichment and the muon  $g - 2$   
contribution through susy loops.*

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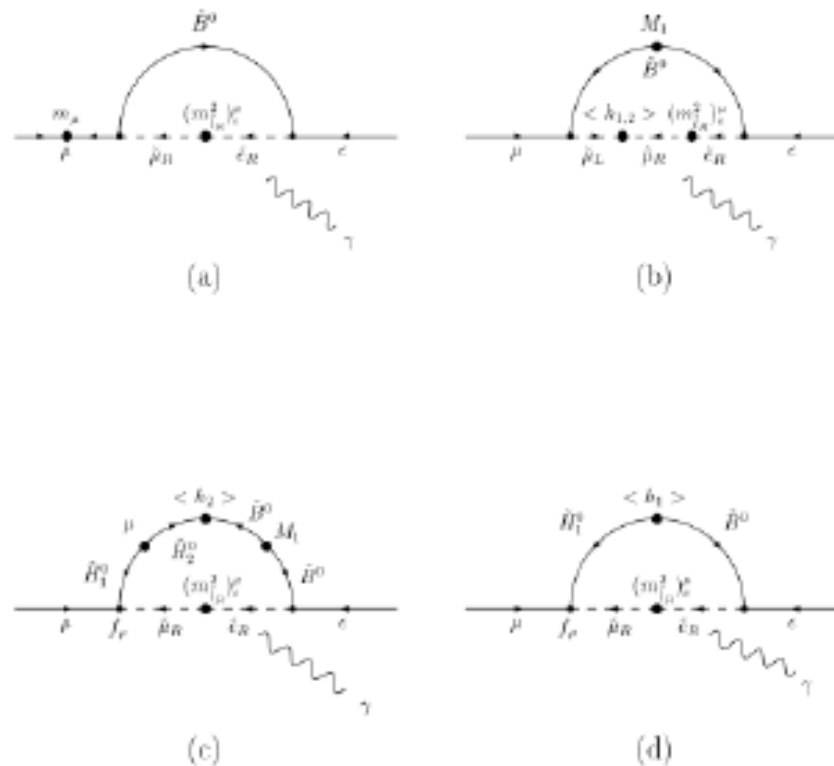
## Outline

- LFV susy loop and MIA.  
Discussion of two methods.
- Muon  $g-2$  status review.  
Experimental & Theoretical.
- **Non-universal sfermion masses and mixing angles**  
↪ flavor mixing within 2nd and 3rd families.
- Phenomenological consequences on charged lepton sector.  
 $BR(\tau \rightarrow \mu\gamma)$ .  
 $BR(h^0 \rightarrow \mu\tau)$   
 $EV$  contributions to  $(g - 2)$ .

## Pioneers on Lepton Flavor Violations in MSSM using MIA

Using a qualitative approximation in the flavor basis, known as *Mass Insertion Approximation (MIA)*,

J. Hisano, T. Moroi, K. Tobe and M. Yamaguchi, Phys. Lett. B 391, 341 (1997)



## *Supersymmetry LFV with MIA.*

### *Lepton Flavor Violations in MSSM using MIA*

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The MIA takes the diagonal part of the flavour mass matrix is absorbed into a definition on an unphysical massive propagator and the non-diagonal parts commonly refered to as mass insertions is treated perturbatively, as part of the interaction Lagrangian.

Dedes, Paraskevas, Rosiek, Suxho, Tamvakis 2015

"The MIA is a Taylor expansion only with respect ...(to) the mass-squared difference. A small off-diagonal element does not necessarily imply a small mass difference. Instead, it may be related to small mixing angles. But then the validity of the MIA is questionable."

Guy Raz 2002

# Gauge invariance Lepton flavor Violation loops

SUSY LFV contributions to EW precision data manifest at one-loop level



① The contribution to *Lepton Flavor Violation* from susy 1-loop diagram:

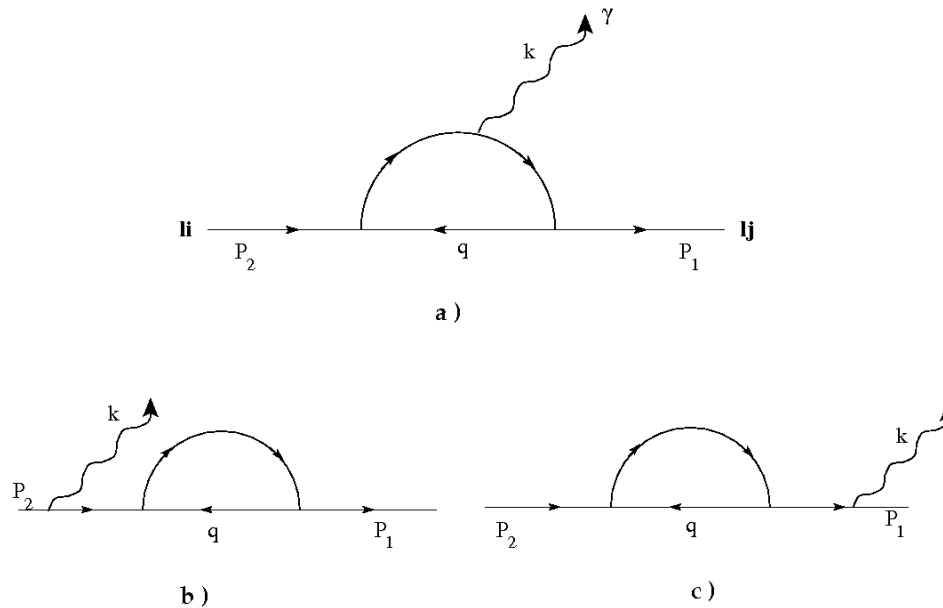


Figure 1:  $\tau \rightarrow \mu \gamma$  SUSY contribution.

## *Super potential of the MSSM*

Interactions  $\rightsquigarrow$  SUSY and Gauge invariance

The only *freedom* that one has is the choice of the *superpotential* **W**

[A .DJOUADI, The Anatomy of ElectroWeak Symmetry Breaking Tome II: The Higgs bosons in the Minimal Supersymmetric Model]

$$W_{MSSM} = \frac{1}{2}M^{ij}\phi_i\phi_j + \frac{1}{6}y^{ijk}\phi_i\phi_j\phi_k \quad (1)$$

where  $\phi$  are the quiral super fields.

By renormalization only bilinear and trilinear terms are permitted

[see for instance S.P. Martin 07]

## *SUSY* $\rightarrow$ *Soft-terms of MSSM*

*Soft SUSY Lagrangian*

Kuroda 99

$$\mathcal{L}_{\text{soft}}^{\text{MSSM}} = \mathcal{L}_{\text{gauginogluino}}^{\text{mass}} - \mathcal{L}_{\text{sfermion}}^{\text{mass}} - \mathcal{L}_{\text{Higgs}} - \mathcal{L}_{\text{trilinear}} \quad (2)$$

with

$$-\mathcal{L}_{\text{gauginogluino}}^{\text{mass}} = \frac{1}{2} \left[ M_1 \tilde{B} \tilde{B} + M_2 \sum_{a=1}^3 \tilde{W}^a \tilde{W}_a + M_3 \sum_{a=1}^8 \tilde{G}^a \tilde{G}_a + h.c. \right] \quad (3)$$

$$-\mathcal{L}_{\text{sfermion}}^{\text{mass}} = \sum_{i=\text{gen}} m_{\tilde{Q}_i}^2 \tilde{Q}_i^\dagger \tilde{Q}_i + m_{\tilde{L}_i}^2 \tilde{L}_i^\dagger \tilde{L}_i + m_{\tilde{u}_i}^2 |\tilde{u}_{Ri}| + m_{\tilde{d}_i}^2 |\tilde{d}_{Ri}|^2 + m_{\tilde{l}_i}^2 |\tilde{l}_{Ri}|^2 \quad (4)$$

$$-\mathcal{L}_{\text{Higgs}} = m_1^2 H_1^\dagger H_1 + m_2^2 H_2^\dagger H_2 + \mu B (H_2 \cdot H_1 + h.c.) \quad (5)$$

$$-\mathcal{L}_{\text{trilinear}} = \sum_{i,j=\text{gen}} \left[ A_{ij}^u \tilde{Q}_i H_2 \tilde{u}_{Rj}^* + A_{ij}^u \tilde{Q}_i H_1 \tilde{d}_{Rj}^* + A_{ij}^l \tilde{L}_i H_1 \tilde{l}_{Rj}^* \right] \quad (6)$$

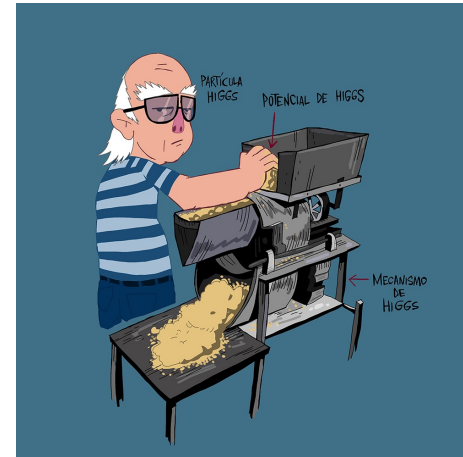


## Reducing *MSSM* parameters

phenomenological, **pMSSM**: 22 input parameters:

$$\begin{aligned} & \tan \beta; \\ & m_1^2, m_2^2; \\ & M_1, M_2, M_3; \\ & \tilde{m}_q, \tilde{m}_{uR}, \tilde{m}_{dR}, \tilde{m}_l, \tilde{m}_{eR}; \\ & \tilde{m}_{Qt}, \tilde{m}_{tR}, \tilde{m}_{bR}, \tilde{m}_{L\tau}, \tilde{m}_{\tau R}; \\ & A_{u,c}, A_{d,s}, A_{e,\mu}; \quad A_t, A_b, A_\tau \end{aligned}$$

$$m_h = 125 \text{ GeV}$$



We propose a different consideration for trilinear couplings:

$$A_u, A_d, A_e; \quad A_{c,t}, A_{s,b}, A_{\mu,\tau}$$

where the two families are mixed.

The current way to analyze a supersymmetric model is to fix the Higgs mass to the experimental value, and all of the corrections adjust from there, calling this parametrization as *hMSSM*

## *Ligth Higgs mass as a fixed parameter: hMSSM*

In order to accomplish for the previous simple relation of Higgs mass, the following choice of SUSY parameters has to be imposed:

[M. Carena (2013) ]

- (a) A decoupling regime with heavy A states:  $m_A \sim \mathcal{O}(TeV)$
- (b)  $\tan \beta \gtrsim 10$  to maximize tree-level contributions.
- (c) Heavy stops squarks, *i.e.* large SUSY mass scale  $M_S$ , to enhance logarithmic contributions.
- (d) Maximal mixing scenario for trilinear stop couplings:  $X_t = \sqrt{6}M_S$ , maximizing stop loops.

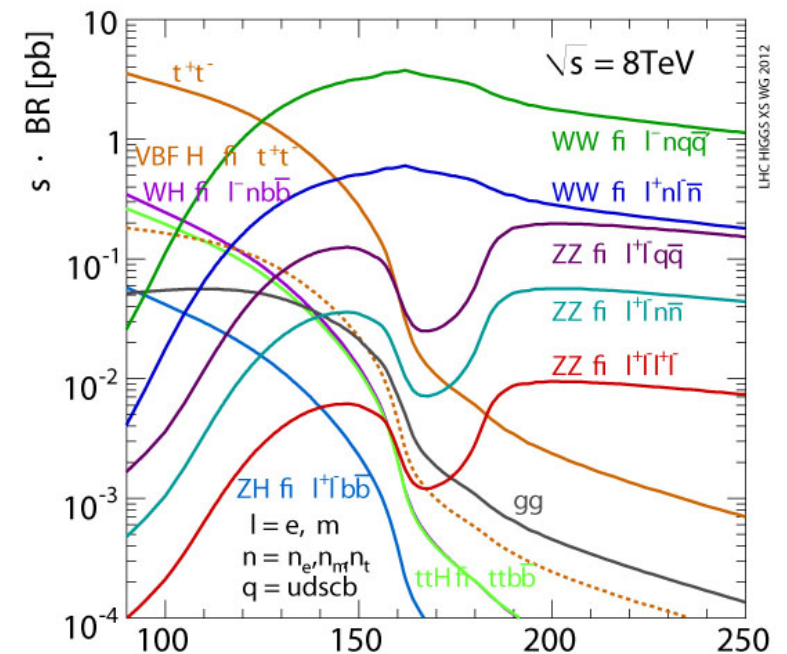
## *Higgs boson production*

Once the Higgs mass is determined, the SM Higgs properties are fixed. Any contribution from an extended Higgs sector may shift the couplings, and hence its production and decay rates.

Arbey, Battaglia, Djouadi, Mahmoudi, Muhlleitner and Spira (2021)

Bounds on Higgs production would be proved with improved precision by HL-LHC.

process	$\sqrt{s}$	$\sigma^{tot}$
$gg \rightarrow h$	14 TeV	$\sigma_{ggh}^{tot} \approx 50 pb$
$qq \rightarrow hqq$	14 TeV	$\sigma_{VBF}^{tot} \approx 4 pb$
$qq \rightarrow hV$	14 TeV	$\sigma_{hV}^{tot} \approx 2.5 pb$
$pp \rightarrow t\bar{t}h$	14 TeV	$\sigma_{t\bar{t}h}^{tot} \approx 0.6 pb$
$gg \rightarrow hh$	14 TeV	$\sigma_{gghh}^{tot} \approx 50 fb$

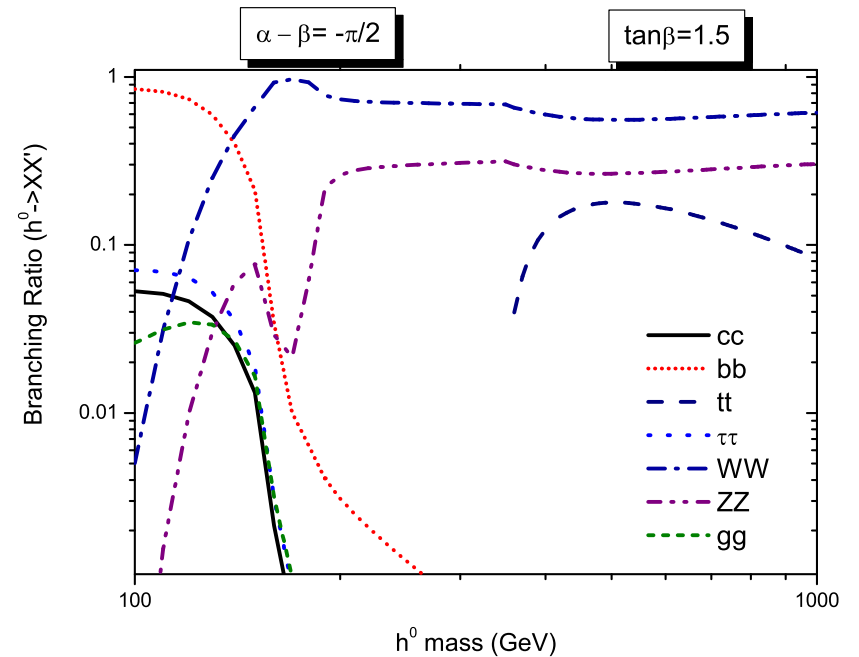


## *Higgs boson decay rates*

Analyze the production and decay rates using the defined coupling modifiers

$$\kappa_X = \frac{g_{hXX}^{MSSM}}{g_{hXX}^{SM}}$$

process	BR
$h \rightarrow bb$	over 60%
$h \rightarrow W * W \rightarrow ll\nu\nu$	20%
$h \rightarrow Z * Z \rightarrow llll$	2.5%
$h \rightarrow \tau\tau$	$\approx 5\%$
$h \rightarrow gg$	8%
$h \rightarrow c\bar{c}$	3%
$h \rightarrow \gamma\gamma$	$2 \times 10^{-3}$
$h \rightarrow \mu\bar{\mu}$	$2 \times 10^{-4}$



# Supersymmetry experimental searches.

## ATLAS SUSY Searches\* - 95% CL Lower Limits

July 2020

ATLAS Preliminary

$\sqrt{s} = 13$  TeV

Model	Signature	$\int \mathcal{L} dt$ [fb $^{-1}$ ]	Mass limit	Reference						
Inclusive Searches	$\tilde{q}\tilde{q}, \tilde{q} \rightarrow q\tilde{\chi}_1^0$	0 $e, \mu$ mono-jet	2-6 jets 1-3 jets	$E_T^{miss}$ $E_T^{miss}$	139 36.1	$\tilde{q}$ [10x Degen.] $\tilde{q}$ [1x, 8x Degen.]	0.43 0.71 1.9	$m(\tilde{\chi}_1^0) < 400$ GeV $m(\tilde{q}) - m(\tilde{\chi}_1^0) = 5$ GeV	ATLAS-CONF-2019-040 1711.03301	
	$\tilde{g}\tilde{g}, \tilde{g} \rightarrow q\tilde{q}\tilde{\chi}_1^0$	0 $e, \mu$	2-6 jets	$E_T^{miss}$	139	$\tilde{g}$ $\tilde{g}$	2.35 Forbidden 1.15-1.95	$m(\tilde{\chi}_1^0) = 0$ GeV $m(\tilde{\chi}_1^0) = 1000$ GeV	ATLAS-CONF-2019-040 ATLAS-CONF-2019-040	
	$\tilde{g}\tilde{g}, \tilde{g} \rightarrow q\tilde{q}W\tilde{\chi}_1^0$	1 $e, \mu$	2-6 jets	$E_T^{miss}$	139	$\tilde{g}$	2.2	$m(\tilde{\chi}_1^0) < 600$ GeV	ATLAS-CONF-2020-047	
	$\tilde{g}\tilde{g}, \tilde{g} \rightarrow q\tilde{q}(\ell\ell)\tilde{\chi}_1^0$	$ee, \mu\mu$	2 jets	$E_T^{miss}$	36.1	$\tilde{g}$	1.2	$m(\tilde{g}) - m(\tilde{\chi}_1^0) = 50$ GeV	1805.11381	
	$\tilde{g}\tilde{g}, \tilde{g} \rightarrow q\tilde{q}WZ\tilde{\chi}_1^0$	0 $e, \mu$ SS $e, \mu$	7-11 jets 6 jets	$E_T^{miss}$ $E_T^{miss}$	139 139	$\tilde{g}$ $\tilde{g}$	1.97 1.15	$m(\tilde{\chi}_1^0) < 600$ GeV $m(\tilde{g}) - m(\tilde{\chi}_1^0) = 200$ GeV	ATLAS-CONF-2020-002 1909.08457	
	$\tilde{g}\tilde{g}, \tilde{g} \rightarrow \tilde{t}\tilde{t}\tilde{\chi}_1^0$	0-1 $e, \mu$ SS $e, \mu$	3 $b$ 6 jets	$E_T^{miss}$ $E_T^{miss}$	79.8 139	$\tilde{g}$ $\tilde{g}$	2.25 1.25	$m(\tilde{\chi}_1^0) < 200$ GeV $m(\tilde{g}) - m(\tilde{\chi}_1^0) = 300$ GeV	ATLAS-CONF-2018-041 1909.08457	
	$3^{rd}$ gen. squarks direct production	$\tilde{b}_1\tilde{b}_1, \tilde{b}_1 \rightarrow b\tilde{\chi}_1^0/\tilde{\chi}_1^\pm$	Multiple Multiple	Multiple Multiple	$E_T^{miss}$ $E_T^{miss}$	36.1 139	$\tilde{b}_1$ $\tilde{b}_1$	Forbidden 0.74 0.9 Forbidden	$m(\tilde{\chi}_1^0) = 300$ GeV, BR( $\tilde{b}_1\tilde{\chi}_1^0$ )=1 $m(\tilde{\chi}_1^\pm) = 200$ GeV, $m(\tilde{\chi}_1^\pm) = 300$ GeV, BR( $\tilde{b}_1\tilde{\chi}_1^\pm$ )=1	1708.09266, 1711.03301 1909.08457
		$\tilde{b}_1\tilde{b}_1, \tilde{b}_1 \rightarrow b\tilde{\chi}_2^0 \rightarrow bh\tilde{\chi}_1^0$	0 $e, \mu$ 2 $\tau$	6 $b$ 2 $b$	$E_T^{miss}$ $E_T^{miss}$	139 139	$\tilde{b}_1$ $\tilde{b}_1$	Forbidden 0.13-0.85 0.23-1.35	$\Delta m(\tilde{\chi}_2^0, \tilde{\chi}_1^0) = 130$ GeV, $m(\tilde{\chi}_1^0) = 100$ GeV $\Delta m(\tilde{\chi}_2^\pm, \tilde{\chi}_1^\pm) = 130$ GeV, $m(\tilde{\chi}_1^\pm) = 0$ GeV	1908.03122 ATLAS-CONF-2020-031
$\tilde{t}_1\tilde{t}_1, \tilde{t}_1 \rightarrow t\tilde{\chi}_1^0$		0-1 $e, \mu$	$\geq 1$ jet	$E_T^{miss}$	139	$\tilde{t}_1$	1.25	$m(\tilde{\chi}_1^0) = 1$ GeV	ATLAS-CONF-2020-003, 2004.14060	
$\tilde{t}_1\tilde{t}_1, \tilde{t}_1 \rightarrow Wb\tilde{\chi}_1^0$		1 $e, \mu$	3 jets/1 $b$	$E_T^{miss}$	139	$\tilde{t}_1$	0.44-0.59	$m(\tilde{\chi}_1^0) = 400$ GeV	ATLAS-CONF-2019-017	
$\tilde{t}_1\tilde{t}_1, \tilde{t}_1 \rightarrow \tilde{t}_1 b \nu, \tilde{t}_1 \rightarrow \tau\tilde{G}$		1 $\tau + 1 e, \mu, \tau$	2 jets/1 $b$	$E_T^{miss}$	36.1	$\tilde{t}_1$	1.16	$m(\tilde{t}_1) = 800$ GeV	1803.10178	
$\tilde{t}_1\tilde{t}_1, \tilde{t}_1 \rightarrow c\tilde{\chi}_1^0/\tilde{c}\tilde{c}, \tilde{c} \rightarrow c\tilde{\chi}_1^0$		0 $e, \mu$	2 $c$	$E_T^{miss}$	36.1	$\tilde{t}_1$ $\tilde{t}_1$	0.85 0.46 0.43	$m(\tilde{\chi}_1^0) = 0$ GeV $m(\tilde{t}_1, \tilde{c}) - m(\tilde{\chi}_1^0) = 50$ GeV $m(\tilde{t}_1, \tilde{c}) - m(\tilde{\chi}_1^0) = 5$ GeV	1805.01649 1805.01649 1711.03301	
$\tilde{t}_1\tilde{t}_1, \tilde{t}_1 \rightarrow t\tilde{\chi}_2^0, \tilde{\chi}_2^0 \rightarrow Z/h\tilde{\chi}_1^0$		1-2 $e, \mu$	1-4 $b$	$E_T^{miss}$	139	$\tilde{t}_1$	0.067-1.18	$m(\tilde{\chi}_2^0) = 500$ GeV	SUSY-2018-09	
$\tilde{t}_2\tilde{t}_2, \tilde{t}_2 \rightarrow \tilde{t}_1 + Z$		3 $e, \mu$	1 $b$	$E_T^{miss}$	139	$\tilde{t}_2$	Forbidden 0.86	$m(\tilde{\chi}_1^0) = 360$ GeV, $m(\tilde{t}_1) - m(\tilde{\chi}_1^0) = 40$ GeV	SUSY-2018-09	
EW direct		$\tilde{\chi}_1^+\tilde{\chi}_2^0$ via WZ	3 $e, \mu$ $ee, \mu\mu$	$\geq 1$ jet	$E_T^{miss}$ $E_T^{miss}$	139 139	$\tilde{\chi}_1^+/\tilde{\chi}_2^0$ $\tilde{\chi}_1^+/\tilde{\chi}_2^0$	0.64 0.205	$m(\tilde{\chi}_1^0) = 0$ $m(\tilde{\chi}_1^\pm) - m(\tilde{\chi}_1^0) = 5$ GeV	ATLAS-CONF-2020-015 1911.12606
		$\tilde{\chi}_1^+\tilde{\chi}_1^+$ via WW	2 $e, \mu$	$\geq 1$ jet	$E_T^{miss}$	139	$\tilde{\chi}_1^+$	0.42	$m(\tilde{\chi}_1^0) = 0$	1908.08215
	$\tilde{\chi}_1^+\tilde{\chi}_2^0$ via Wh	0-1 $e, \mu$	2 $b/2 \gamma$	$E_T^{miss}$	139	$\tilde{\chi}_1^+/\tilde{\chi}_2^0$	Forbidden 0.74	$m(\tilde{\chi}_1^0) = 70$ GeV	2004.10894, 1909.09226	
	$\tilde{\chi}_1^+\tilde{\chi}_1^+$ via $\tilde{\ell}_L/\tilde{\nu}$	2 $e, \mu$		$E_T^{miss}$	139	$\tilde{\chi}_1^+$	1.0	$m(\tilde{\ell}, \tilde{\nu}) = 0.5(m(\tilde{\chi}_1^+) + m(\tilde{\chi}_1^0))$	1908.08215	
	$\tilde{\tau}\tilde{\tau}, \tilde{\tau} \rightarrow \tau\tilde{\chi}_1^0$	2 $\tau$		$E_T^{miss}$	139	$\tilde{\tau}$	0.16-0.3 0.12-0.39	$m(\tilde{\chi}_1^0) = 0$	1911.06660	
	$\tilde{\ell}_{L,R}\tilde{\ell}_{L,R}, \tilde{\ell} \rightarrow \ell\tilde{\chi}_1^0$	2 $e, \mu$ $ee, \mu\mu$	0 jets $\geq 1$ jet	$E_T^{miss}$ $E_T^{miss}$	139 139	$\tilde{\ell}$ $\tilde{\ell}$	0.7 0.256	$m(\tilde{\chi}_1^0) = 0$ $m(\tilde{\ell}) - m(\tilde{\chi}_1^0) = 10$ GeV	1908.08215 1911.12606	
	$\tilde{H}\tilde{H}, \tilde{H} \rightarrow h\tilde{G}/Z\tilde{G}$	0 $e, \mu$ 4 $e, \mu$	$\geq 3 b$ 0 jets	$E_T^{miss}$ $E_T^{miss}$	36.1 139	$\tilde{H}$ $\tilde{H}$	0.13-0.23 0.55 0.29-0.88	BR( $\tilde{H} \rightarrow h\tilde{G}$ )=1 BR( $\tilde{H} \rightarrow Z\tilde{G}$ )=1	1806.04030 ATLAS-CONF-2020-040	
	Long-lived particles	Direct $\tilde{\chi}_1^+\tilde{\chi}_1^-$ prod., long-lived $\tilde{\chi}_1^\pm$	Disapp. trk	1 jet	$E_T^{miss}$	36.1	$\tilde{\chi}_1^\pm$ $\tilde{\chi}_1^\pm$	0.46 0.15	Pure Wino Pure higgsino	1712.02118 ATL-PHYS-PUB-2017-019
Stable $\tilde{g}$ R-hadron			Multiple		36.1	$\tilde{g}$	2.0		1902.01636, 1808.04095	
Metastable $\tilde{g}$ R-hadron, $\tilde{g} \rightarrow q\tilde{q}\tilde{\chi}_1^0$			Multiple		36.1	$\tilde{g}$	[ $\tau(\tilde{g}) = 10$ ns, 0.2 ns] 2.05 2.4	$m(\tilde{\chi}_1^0) = 100$ GeV	1710.04901, 1808.04095	
RPV	$\tilde{\chi}_1^+\tilde{\chi}_1^+/\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+ \rightarrow Z\ell \rightarrow \ell\ell\ell$	3 $e, \mu$		$E_T^{miss}$	139	$\tilde{\chi}_1^+/\tilde{\chi}_1^-$	[BR( $Z\tau$ )=1, BR( $Ze$ )=1] 0.625 1.05	Pure Wino	ATLAS-CONF-2020-009	
	LFV $pp \rightarrow \tilde{\nu}_\tau + X, \tilde{\nu}_\tau \rightarrow e\mu/\ell\tau/\mu\tau$	$e\mu, e\tau, \mu\tau$		$E_T^{miss}$	3.2	$\tilde{\nu}_\tau$	1.9	$\lambda_{511} = 0.11, \lambda_{132/133/233} = 0.07$	1607.08079	
	$\tilde{\chi}_1^+\tilde{\chi}_1^+/\tilde{\chi}_2^0 \rightarrow WW/Z\ell\ell\ell\nu\nu$	4 $e, \mu$	0 jets	$E_T^{miss}$	36.1	$\tilde{\chi}_1^+/\tilde{\chi}_2^0$	0.82 1.33	$m(\tilde{\chi}_1^0) = 100$ GeV	1804.03602	
	$\tilde{g}\tilde{g}, \tilde{g} \rightarrow q\tilde{q}\tilde{\chi}_1^0, \tilde{\chi}_1^0 \rightarrow qq\tilde{q}$	4-5 large-R jets	Multiple	$E_T^{miss}$	36.1 36.1	$\tilde{g}$ $\tilde{g}$	1.3 1.9 1.05 2.0	Large $\lambda_{112}^{\prime\prime}$	1804.03568 ATLAS-CONF-2018-003	
	$\tilde{t}_1, \tilde{t}_1 \rightarrow \tilde{t}_1\tilde{\chi}_1^0, \tilde{\chi}_1^0 \rightarrow tbs$	Multiple	$\geq 4b$	$E_T^{miss}$	36.1	$\tilde{t}_1$	0.55 1.05	$m(\tilde{\chi}_1^0) = 200$ GeV, bino-like	ATLAS-CONF-2018-003	
	$\tilde{t}_1, \tilde{t}_1 \rightarrow b\tilde{\chi}_1^+, \tilde{\chi}_1^+ \rightarrow bbs$	Multiple	$\geq 4b$	$E_T^{miss}$	139	$\tilde{t}_1$	Forbidden 0.95	$m(\tilde{\chi}_1^0) = 200$ GeV, bino-like $m(\tilde{t}_1) = 500$ GeV	ATLAS-CONF-2020-016	
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1 \rightarrow bs$	2 jets + 2 $b$		$E_T^{miss}$	36.1	$\tilde{t}_1$	0.42 0.61		1710.07171	
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1 \rightarrow q\ell$	2 $e, \mu$ 1 $\mu$	2 $b$ DV	$E_T^{miss}$ $E_T^{miss}$	36.7 136	$\tilde{t}_1$ $\tilde{t}_1$	0.4-1.45 1.0 1.6	BR( $\tilde{t}_1 \rightarrow b\ell$ ) > 20% BR( $\tilde{t}_1 \rightarrow q\mu$ ) = 100%, $\cos\theta = 1$	1710.05544 2003.11956	

\*Only a selection of the available mass limits on new states or phenomena is shown. Many of the limits are based on simplified models, c.f. refs. for the assumptions made.

10 $^{-1}$  1 Mass scale [TeV]

## *MSSM sfermion mass matrix*

The sfermion mass matrix can be written as blocks of  $3 \times 3$

$$\tilde{M}_f^2 = \begin{pmatrix} M_{LL}^2 & M_{LR}^2 \\ M_{LR}^{2\dagger} & M_{RR}^2 \end{pmatrix} \quad (7)$$

The elements of this matrix decomposed on the different terms of the MSSM Lagrangian are given by,

$$\tilde{M}_f^2 = \begin{pmatrix} m_{f,LL}^2 + F_{f,LL} + D_{f,LL} & m_{f,LR}^2 + F_{f,LR} \\ (m_{f,LR}^2 + F_{f,LR})^\dagger & m_{f,RR}^2 + F_{f,RR} + D_{f,RR} \end{pmatrix} \quad (8)$$

For charged leptons, we will have

$$\mathbf{M}_{\tilde{l}}^2 = \begin{pmatrix} m_{slL}^2 + m_l^2 + M_Z^2 \cos 2\beta (I_3^l - Q_l s_w^2) & m_l X_l \\ m_l X_l & m_{slR}^2 + m_l^2 + M_Z^2 \cos 2\beta Q_l s_w^2 \end{pmatrix}, \quad (9)$$

with  $X_l = A_l - \mu \tan \beta$ , and we assume  $m_{sfR}^2 \simeq m_{sfL}^2 \simeq \tilde{m}_0^2$

## *Flavor Ansatz for the trilinear terms*

We propose that the trilinear scalar term would mix the second and third families as follows:

$$A = \begin{pmatrix} 0 & 0 & 0 \\ 0 & w & z \\ 0 & y & 1 \end{pmatrix} \quad A_0 = \begin{pmatrix} 0 & 0 & 0 \\ 0 & A_w & A_z \\ 0 & A_y & A_0 \end{pmatrix} \quad (10)$$

Then the sfermion mass matrix is given by

$$\tilde{M}_{\tilde{l}}^2 = \left( \begin{array}{cc|cccc} \tilde{m}_L^2 & 0 & 0 & 0 & 0 & 0 \\ 0 & \tilde{m}_R^2 & 0 & 0 & 0 & 0 \\ \hline 0 & 0 & \tilde{m}_L^2 & X_2 & 0 & A_z \\ 0 & 0 & X_2 & \tilde{m}_R^2 & A_y & 0 \\ 0 & 0 & 0 & A_y & \tilde{m}_L^2 & X_3 \\ 0 & 0 & A_z & 0 & X_3 & \tilde{m}_R^2 \end{array} \right), \quad (11)$$

with

$$X_2 = (A_w - \mu \tan \beta) m_\mu$$

$$X_3 = (A_0 - \mu \tan \beta) m_\tau$$

## *New general physical masses for sfermions*

Then we will have non-degenerate sfermion masses:

$$\begin{aligned}m_{f\tilde{2}_1}^2 &= \frac{1}{2}(2\tilde{m}_0^2 + X_2 + X_3 - R) \\m_{f\tilde{2}_2}^2 &= \frac{1}{2}(2\tilde{m}_0^2 - X_2 - X_3 + R) \\m_{f\tilde{3}_1}^2 &= \frac{1}{2}(2\tilde{m}_0^2 - X_2 - X_3 - R) \\m_{f\tilde{3}_2}^2 &= \frac{1}{2}(2\tilde{m}_0^2 + X_2 + X_3 + R)\end{aligned}\tag{12}$$

where  $R = \sqrt{4A_y^2 + (X_2 - X_3)^2}$

$$A_y = A_z\tag{13}$$



## *Mass Basis: Rotation matrix for sfermions*

We write the  $4 \times 4$  rotation matrix for sleptons as a  $2 \times 2$  block matrix

$$\mathcal{O}_{\tilde{f}} = \frac{1}{\sqrt{2}} \begin{pmatrix} \Theta & -\Theta \\ \Theta\sigma_3 & \Theta\sigma_3 \end{pmatrix} \quad (14)$$

where  $\sigma_3$  is Pauli matrix and

$$\Theta = \begin{pmatrix} -\sin \frac{\varphi}{2} & -\cos \frac{\varphi}{2} \\ \cos \frac{\varphi}{2} & -\sin \frac{\varphi}{2} \end{pmatrix} \quad (15)$$

with

$$\sin \varphi \rightarrow \frac{2A_y}{\sqrt{4A_y^2 + (X_2 - X_3)^2}}, \quad (16)$$

$$\cos \varphi \rightarrow \frac{(X_2 - X_3)}{\sqrt{4A_y^2 + (X_2 - X_3)^2}} \quad (17)$$

## *1-loop BR( $\tau \rightarrow \mu\gamma$ ) no-MIA*

The Lagrangian  $\tilde{B}^0 \tilde{l} \tilde{l}$  in mass eigenstate now is given by:

$$\begin{aligned}
 \mathcal{L}_{\tilde{B}\tilde{l}} = & -\frac{g}{2\sqrt{2}} \tan \theta_W \bar{\tilde{B}} \left\{ [-P_L \tilde{e}_1 + 2P_R \tilde{e}_2] e + \right. \\
 & -\frac{s_\varphi}{\sqrt{2}} [(1 + 3\gamma_5)\tilde{\mu}_1 + (3 + \gamma_5)\tilde{\mu}_2] \mu + \\
 & +\frac{c_\varphi}{\sqrt{2}} [(1 + 3\gamma_5)\tilde{\mu}_1 + (3 + \gamma_5)\tilde{\mu}_2] \tau + \\
 & +\frac{c_\varphi}{\sqrt{2}} [(3 + \gamma_5)\tilde{\tau}_1 + (1 + 3\gamma_5)\tilde{\tau}_2] \mu + \\
 & \left. +\frac{s_\varphi}{\sqrt{2}} [(3 + \gamma_5)\tilde{\tau}_1 + (1 + 3\gamma_5)\tilde{\tau}_2] \tau \right\}
 \end{aligned} \tag{18}$$

We may write the coupling as

$$g_{l_i B \tilde{l}_r} = -\frac{g \tan \theta_W}{4} [S_{l_i, \tilde{l}_r} + P_{l_i, \tilde{l}_r} \gamma^5]$$

## 1-loop BR( $\tau \rightarrow \mu\gamma$ ) gauge invariance... a)

$$\begin{aligned} \mathcal{M}_a = & -eg_c^2 \bar{u}(p_1) \left[ (S_i S_j - P_i P_j) + (S_i P_j - S_j P_i) \gamma^5 \right] m_{\tilde{B}} \frac{1}{(2\pi)^4} \int dq^4 \frac{2(p_2 + q) \cdot \epsilon}{D_q D_1 D_2} \\ & -eg_c^2 \bar{u}(p_1) \left[ (S_i S_j + P_i P_j) + (S_i P_j + S_j P_i) \gamma^5 \right] \frac{1}{(2\pi)^4} \int dq^4 \frac{2(p_2 + q) \cdot \epsilon \not{q}}{D_q D_1 D_2}, \end{aligned}$$

where  $D_q = q^2 - m_{\tilde{B}}^2$ ,  $D_1 = (q + p_1)^2 - m_{\tilde{l}_r}^2$ ,  $D_2 = (q + p_2)^2 - m_{\tilde{l}_r}^2$ , and  $\epsilon$  is the photon polarization vector. For the  $\tau \rightarrow \mu\gamma$  decay, we have  $i = \tau$  and  $j = \mu$  and the  $S_{i,j}$ ,  $P_{i,j}$  couplings are labeled as follows:  $S_i = S_{\tilde{B}\tau\tilde{l}}$ ,  $S_j = S_{\tilde{B}\mu\tilde{l}}$ ,  $P_i = P_{\tilde{B}\tau\tilde{l}}$  and  $P_j = P_{\tilde{B}\mu\tilde{l}}$ . All the possible sleptons running inside the loop are indicated by the index  $\tilde{l} = \tilde{\mu}_1, \tilde{\mu}_2, \tilde{\tau}_1, \tilde{\tau}_2$ . The corresponding values are given in Table 1.

$\tilde{l}$	$\tilde{\mu}_1$	$\tilde{\mu}_2$	$\tilde{\tau}_1$	$\tilde{\tau}_2$
$S_{\tilde{B}\tau\tilde{l}}$	$3 \sin \frac{\varphi}{2}$	$\sin \frac{\varphi}{2}$	$\cos \frac{\varphi}{2}$	$3 \cos \frac{\varphi}{2}$
$P_{\tilde{B}\tau\tilde{l}}$	$\sin \frac{\varphi}{2}$	$3 \sin \frac{\varphi}{2}$	$3 \cos \frac{\varphi}{2}$	$\cos \frac{\varphi}{2}$
$S_{\tilde{B}\mu\tilde{l}}$	$3 \cos \frac{\varphi}{2}$	$\cos \frac{\varphi}{2}$	$-\sin \frac{\varphi}{2}$	$-3 \sin \frac{\varphi}{2}$
$P_{\tilde{B}\mu\tilde{l}}$	$\cos \frac{\varphi}{2}$	$3 \cos \frac{\varphi}{2}$	$-3 \sin \frac{\varphi}{2}$	$-\sin \frac{\varphi}{2}$

Table 1: Scalar and pseudoscalar Bino-lepton-slepton couplings with lepton flavour mixing

For the anomaly  $g - 2$  we set  $i = j = \mu$ .

## *1-loop BR( $\tau \rightarrow \mu\gamma$ ) gauge invariance*

For the diagram Fig. 1(b) we have

$$\mathcal{M}_b = -\bar{u}(p_1)e\Sigma_b \frac{[\not{p}_1 + m_i]}{m_j^2 - m_i^2} \not{\epsilon} u(p_2), \quad (19)$$

with

$$\begin{aligned} \Sigma_b = & m_{\tilde{B}}g_c^2 [(S_iS_j - P_iP_j) + (S_iP_j - S_jP_i)\gamma^5] \frac{1}{(2\pi)^4} \int \frac{dq^4}{D_q D_1} \\ & + g_c^2 [(S_iS_j + P_iP_j) + (S_iP_j + S_jP_i)\gamma^5] \frac{1}{(2\pi)^4} \int \frac{dq^4 \not{q}}{D_q D_1}. \end{aligned} \quad (20)$$

The amplitude for Fig. 1(c) reads

$$\mathcal{M}_c = -\bar{u}(p_1)e\gamma_\mu\epsilon^\mu \frac{[\not{p}_1 + \not{k} + m_j]}{m_i^2 - m_j^2} \Sigma_c u(p_2), \quad (21)$$

where

$$\begin{aligned}\Sigma_c &= m_{\tilde{B}} g_c^2 [(S_i S_j - P_i P_j) + (S_i P_j - S_j P_i) \gamma^5] \frac{1}{(2\pi)^4} \int \frac{dq^4}{D_q D_2} \\ &\quad + g_c^2 [(S_i S_j + P_i P_j) + (S_i P_j + S_j P_i) \gamma^5] \frac{1}{(2\pi)^4} \int \frac{dq^4 \not{q}}{D_q D_2}.\end{aligned}$$

The total amplitude which is the sum of Eqs.(19, 19, 21) is written as follows:

$$\begin{aligned}\mathcal{M}_T &= \bar{u}(p_1) [\imath E_{ij} \sigma^{\mu\nu} k_\nu \epsilon_\mu + \imath F_{ij} \sigma^{\mu\nu} k_\nu \epsilon_\mu \gamma^5] u(p_2) \\ &= \bar{u}(p_1) \left[ \frac{E_{ij}}{2} + \frac{F_{ij}}{2} \gamma^5 \right] [\not{k}, \not{\epsilon}] u(p_2).\end{aligned}\tag{22}$$

The Branching Ratio will be given by

$$\mathcal{BR}(\tau \rightarrow \mu\gamma) = \frac{(1-x^2)^3 m_\tau^3}{4\pi\Gamma_\tau} \left[ \left| \sum_{\tilde{l}} E_{\tilde{l}}^{\tau\mu} \right|^2 + \left| \sum_{\tilde{l}} F_{\tilde{l}}^{\tau\mu} \right|^2 \right],\tag{23}$$

with  $x = \frac{m_\mu}{m_\tau}$ .

In the case of  $i = \tau$  and  $j = \mu$  we would have the expressions for  $E_{ij}$  and  $F_{ij}$

as in Eqs.(24, 25).

$$\begin{aligned}
E_{\tau\mu\tilde{l}_r} &= \frac{is_\varphi c_\varphi e g^2 \tan^2 \theta_W}{(16\pi)^2 (m_\tau^2 - m_\mu^2) (m_\tau + m_\mu)} \{ \\
&E_{1,r} (B0[m_\tau^2, m_{\tilde{B}}^2, m_{\tilde{l}_r}^2] - B0[m_\mu^2, m_{\tilde{B}}^2, m_{\tilde{l}_r}^2]) \\
&- E_{2,r} (1 + 2m_{\tilde{l}_r}^2 C0[m_\tau^2, m_\mu^2, 0, m_{\tilde{l}_r}^2, m_{\tilde{B}}^2, m_{\tilde{l}_r}^2]) \\
&- E_{3,r} (B0[m_\tau^2, m_{\tilde{B}}^2, m_{\tilde{l}_r}^2] - B0[0, m_{\tilde{B}}^2, m_{\tilde{l}_r}^2]) \\
&+ E_{4,r} (B0[m_\mu^2, m_{\tilde{B}}^2, m_{\tilde{l}_r}^2] - B0[0, m_{\tilde{B}}^2, m_{\tilde{l}_r}^2]) \} \quad (24)
\end{aligned}$$

$$\begin{aligned}
F_{\tau\mu\tilde{l}_r} &= -\frac{is_\varphi c_\varphi e g^2 \tan^2 \theta_W}{(16\pi)^2 (m_\tau - m_\mu) (m_\tau^2 - m_\mu^2)} [ \\
&\{ F_{1,r} (B0[m_\tau^2, m_B^2, m_{\tilde{l}_r}^2] - B0[m_\mu^2, m_B^2, m_{\tilde{l}_r}^2]) \\
&+ F_{2,r} (1 + 2m_{\tilde{l}_r}^2 C0[m_\tau^2, m_\mu^2, 0, m_{\tilde{l}_r}^2, m_B^2, m_{\tilde{l}_r}^2]) \\
&- F_{3,r} (B0[m_\tau^2, m_B^2, m_{\tilde{l}_r}^2] - B0[0, m_B^2, m_{\tilde{l}_r}^2]) \\
&+ F_{4,r} (B0[m_\mu^2, m_B^2, m_{\tilde{l}_r}^2] - B0[0, m_B^2, m_{\tilde{l}_r}^2]) \} ] \quad (25)
\end{aligned}$$

## *Muon magnetic moment anomaly ( $g - 2$ )*

A discrepancy in the anomalous magnetic moment of the muon is found between SM prediction and experimental measurement, calculate the possible contribution through FV SUSY.

$$a_{\mu}^{exp} = 116592059(22) \times 10^{-11} ,$$

$$a_{\mu}^{SM} = 116591810(43) \times 10^{-11} ,$$

The Muon  $g - 2$  Collaboration, arXiv:2308.06230v2 (2023)

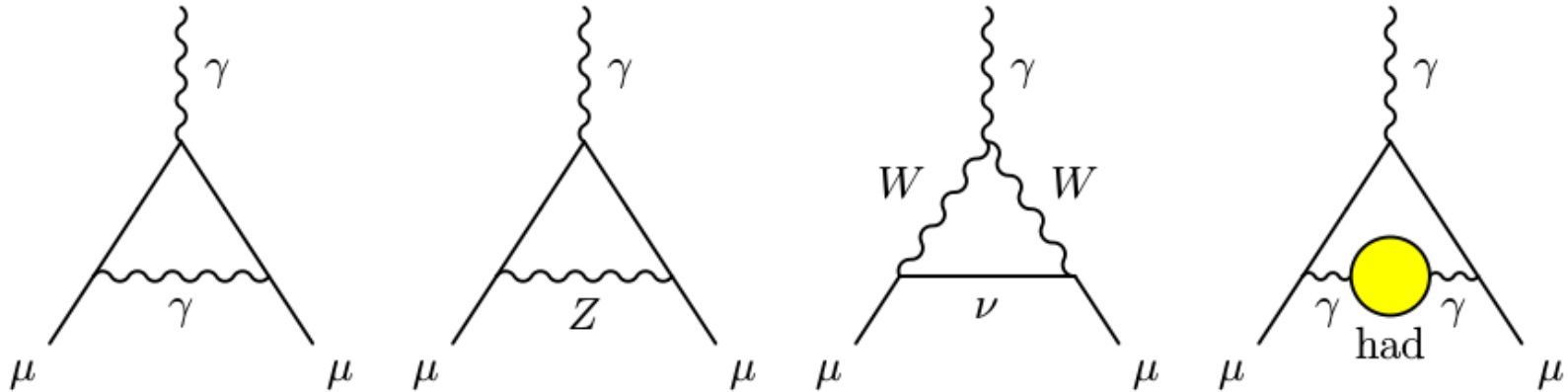
*The anomalous magnetic moment of the muon in the Standard Model* arXiv:2006.04822v2  
(2020)

$$\sigma = 48.3 \rightarrow a_{\mu}^{Exp} - a_{\mu}^{SM} = 5.15\sigma$$

New physics contribution:  $a_{\mu}^{SUSY} = 4.15\sigma \times 10^{-11} = 200.445 \times 10^{-11}$

## Muon magnetic moment anomaly $a_\mu$

$$a_\mu^{\text{SM}} = a_\mu^{\text{QED}} + a_\mu^{\text{EW}} + a_\mu^{\text{Had}} . \quad (4)$$



**Figure 1:** Representative diagrams contributing to  $a_\mu^{\text{SM}}$ . From left to right: first order QED (Schwinger term), lowest-order weak, lowest-order hadronic.



## *Muon magnetic moment anomaly $a_\mu$*

We know  $\vec{\mu} = -g \frac{e}{2m} \vec{s}$ . Which is corrected by 1-loop diagrams, for the muon

$$\vec{\mu}_\mu = \frac{e}{2m_\mu} (1 + a_\mu) \vec{\sigma}$$

The electron spin interacts with an external electromagnetic field. Using Gordon identity

$$\Gamma^\mu = A\gamma^\mu + B(p_1 + p_2)^\mu + \dots = F_1(q^2)\gamma^\mu + \frac{i\sigma^{\mu\nu}q_\nu}{2m}F_2(q^2)$$

$F$  are called form factors and are functions depending on  $q^2 = (p_2 - p_1)^2$ . The magnetic moment anomaly is defined as

$$g = 2[F_1(0) + F_2(0)] = 2 + 2F_2(0) \rightarrow a_\mu \equiv F_2(0) = \frac{g - 2}{2}$$

At lowest order:  $F_1 = 1, F_2 = 0$

## *Bino-sleptons contribution to $(g - 2)$*

② LFV contribution to the anomalous magnetic moment of the muon:

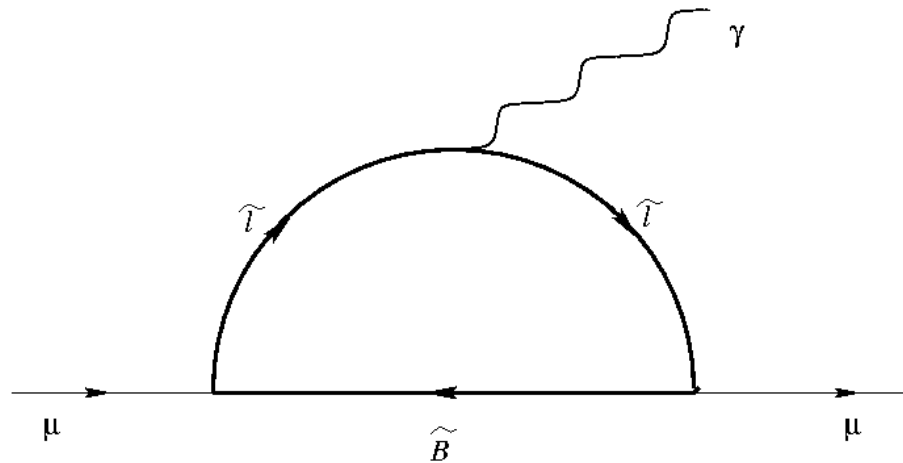


Figure 2: *muon's anomalous magnetic moment Bino-sleptons LFV contribution.*



*Chargino-sneutrino contribution to  $(g - 2)$*

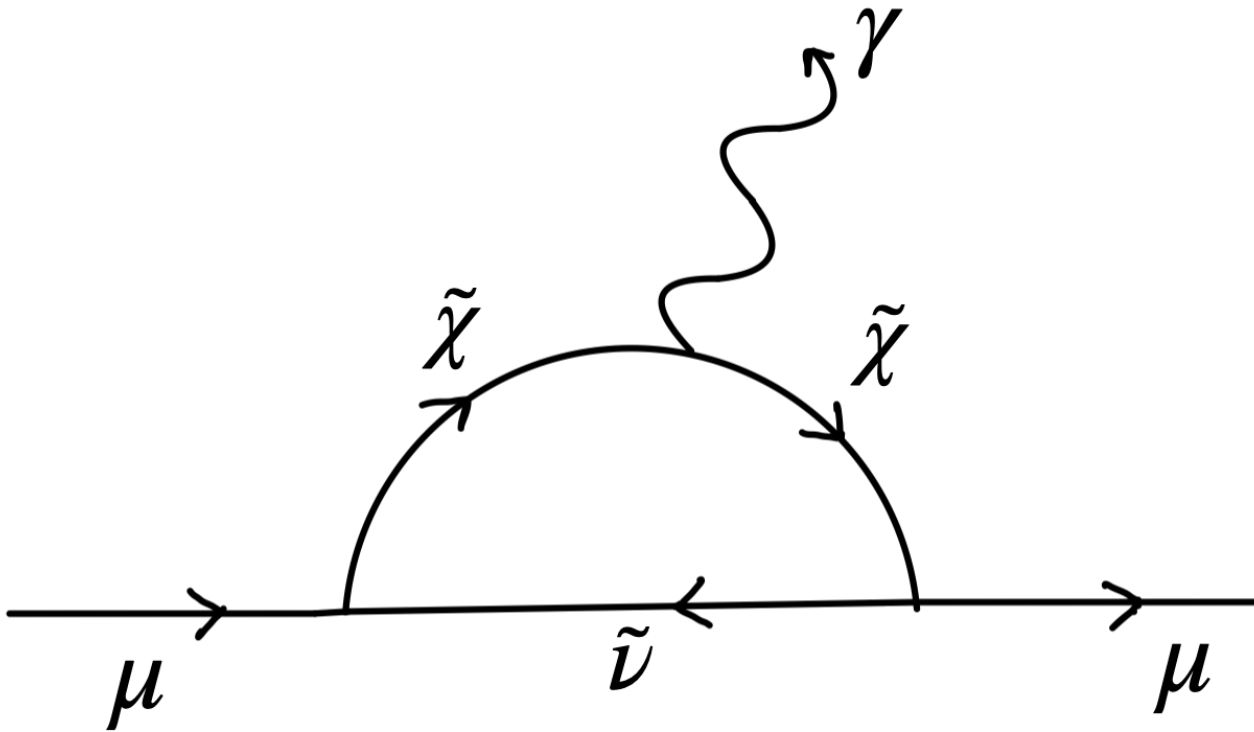


Figure 3: muon's anomalous magnetic moment chargino-sneutrino contribution.

The muon anomalous magnetic moment diagram amplitude is given as

$$\begin{aligned}
\mathcal{M}^{li \rightarrow \gamma li} &= \bar{u}(p_j) \frac{ig}{2} [F_1 + F_2 \gamma^5] \int \frac{d^4 q}{(2\pi)^4} \frac{i}{q^2 - m_{\tilde{\nu}}^2} i \left[ \frac{\not{q} + \not{p}_j + m_{\chi_1}}{(q+p_j)^2 - m_{\chi_1}^2} \right] \\
&\quad \times i e \gamma^\mu \epsilon_\mu(k) i \left[ \frac{\not{q} + \not{p}_i + m_{\chi_1}}{(q+p_i)^2 - m_{\chi_1}^2} \right] \frac{ig}{2} [F_1 - F_2 \gamma^5] u(p_i) \\
&\quad + \mathcal{M}(\chi_1 \rightarrow \chi_2, F_1 \rightarrow F_3, F_2 \rightarrow F_4)
\end{aligned} \tag{26}$$

where the contribution to  $g - 2$  comes from isolation of the term proportional to  $(p_i + p_j)^\mu$ , so we extract this term from all the structure of the amplitude. The numerator is given by

$$\begin{aligned}
N^\mu &= (p_+ \not{q} + p_+ m_{\chi_1} + p_- m) \gamma^\mu (\not{q} p_- + m_{\chi_1} p_- + m p_+) \\
&= p_+^2 \not{q} \gamma^\mu \not{q} + m_{\chi_1} p_+ p_- \not{q} \gamma^\mu + m p_+^2 \not{q} \gamma^\mu + m_{\chi_1} p_+ p_- \gamma^\mu \not{q} \\
&\quad + m_{\chi_1}^2 p_+^2 \gamma^\mu + m_{\chi_1} m p_+ p_- \gamma^\mu + m p_-^2 \gamma^\mu \not{q} + m_{\chi_1} m p_- p_+ \gamma^\mu + m^2 p_-^2 \gamma^\mu
\end{aligned} \tag{27}$$

Then the amplitude will be given as:

$$\mathcal{M}^{li \rightarrow \gamma li} = \bar{u}(p_j) \Gamma_\mu \epsilon^\mu u(p_i) \tag{28}$$

where

$$\Gamma^\mu = \Gamma_s \gamma^\mu + \gamma^5 (A p_i^\mu + C p_j^\mu) + \gamma^5 \gamma^\mu D + i e B (p_i^\mu + p_j^\mu) \quad (29)$$

where  $\Gamma_s$  is a scalar function escalar, A, D and C are also scalars.

$$\mathcal{M}^B = \bar{u}(p_j) e i [B(s^2) (p_i + p_j)^\mu] \epsilon_\mu u(p_i) \quad (30)$$

In the limit  $s^2 \rightarrow 0$  and considering  $m^2/m_\chi^2 \rightarrow 0$ ,  $m^2/m_{\bar{\nu}}^2 \rightarrow 0$ .

The contribution to the anomalous magnetic moment is obtained from

$$\Delta a_\mu = \frac{g - 2}{2} = \mathcal{F}_2(0) \quad (31)$$

$$\mathcal{F}_2(0) = -2mB(0) \quad (32)$$

$$\Delta_{\chi_2 \nu_i} = m_{\bar{\chi}_2}^2 - m_{\bar{\nu}_i}^2.$$

$$h^0 \rightarrow \tau\mu \text{ } FV \text{ slepton loop.}$$

the slepton which interacts with the muon (tau) is labeled with the index  $i$  ( $j$ ), see Fig 1.

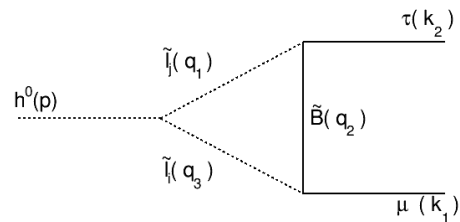


Figure 4: *1-loop SUSY slepton flavor mixing contribution to  $h^0 \rightarrow \mu\tau$ .*

The notation used for the coupling between the bino  $\tilde{B}$ , the slepton  $\tilde{l}$  and the lepton  $l$ , for  $l = \mu, \tau$ , which is denoted as  $\tilde{B}\tilde{l}l$ , can be written in terms of three types of coefficients for each lepton.

## Parameter space analysis considering $FV$ and $(g - 2)$

MGB, Flores-Baez, Mondragón (2016)

$\mu_{susy} \in [-15, 15] \text{ TeV}$	$A_0 \in [50, 5000] \text{ GeV}$
$\tilde{m}_S \in [50, 5000] \text{ GeV}$	$\frac{M_1}{\tilde{m}_S} \in [0.2, 5] \text{ GeV}$
$\tan \beta \in [1, 60]$	$w = -1, y = 1$

Table 2: The table shows the parameter space where the scan was performed. The values were taken at random for each variable within the bounds shown

$BR(\tau \rightarrow \mu\gamma)$	$\alpha_\mu^{\tilde{I}\tilde{B}}$	$\tan \beta$	$M_1(\text{GeV})$	$\mu_{susy}(\text{GeV})$	$\tilde{m}_S (\text{GeV})$	$A_0(\text{GeV})$
$3.06 \times 10^{-8}$	$2.17 \times 10^{-9}$	15.4	1205	7324.6	457.6	145.2
$3.01 \times 10^{-8}$	$2.06 \times 10^{-9}$	45	714	10298	991	1236.7
$2.33 \times 10^{-8}$	$2.42 \times 10^{-9}$	1.35	697	-2832.2	831.8	4003.5
$2.22 \times 10^{-8}$	$3.13 \times 10^{-9}$	30.7	363.7	12554.7	832.2	340
$1.22 \times 10^{-8}$	$3 \times 10^{-9}$	46.3	509.7	4681.2	691	408.5
$2.06 \times 10^{-11}$	$2 \times 10^{-9}$	45.6	2064	9127	1005.7	50.7

Table 3: Sample of parameter sets that solve entirely the muon  $g - 2$  discrepancy, consistent with the experimental bound on  $BR(\tau \rightarrow \mu\gamma)$ , calculated using random values of the parameters given in Table 2. For all these sets the LSP is a Bino.

## Previous results $g - 2$ contribution. (color code)

For  $w = -1$ ,  $y = 1$ .

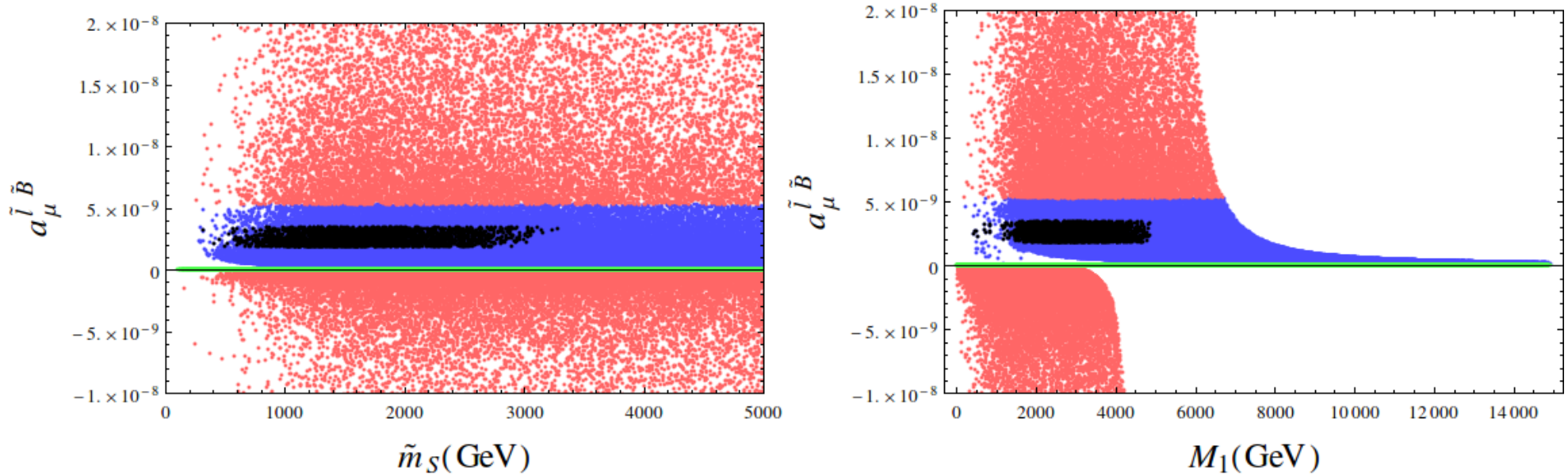


Figure 5: The plots show the dependence of the value of our calculation for  $a_{\mu}^{\tilde{l}\tilde{B}}$  with the SUSY scalar mass (left) and the Bino mass (right). Here the color code used in Figs. 6, 8 and 9 is shown explicit as ranges of the  $a_{\mu}^{\tilde{l}\tilde{B}}$ . The green points correspond to no FV Bino-slepton loop, considering only the smuons in their mass eigenstates and  $A_0 = 0$  the same as green points in previous figure (fig. 10).



## Previous results $BR(\tau \rightarrow \mu\gamma)$

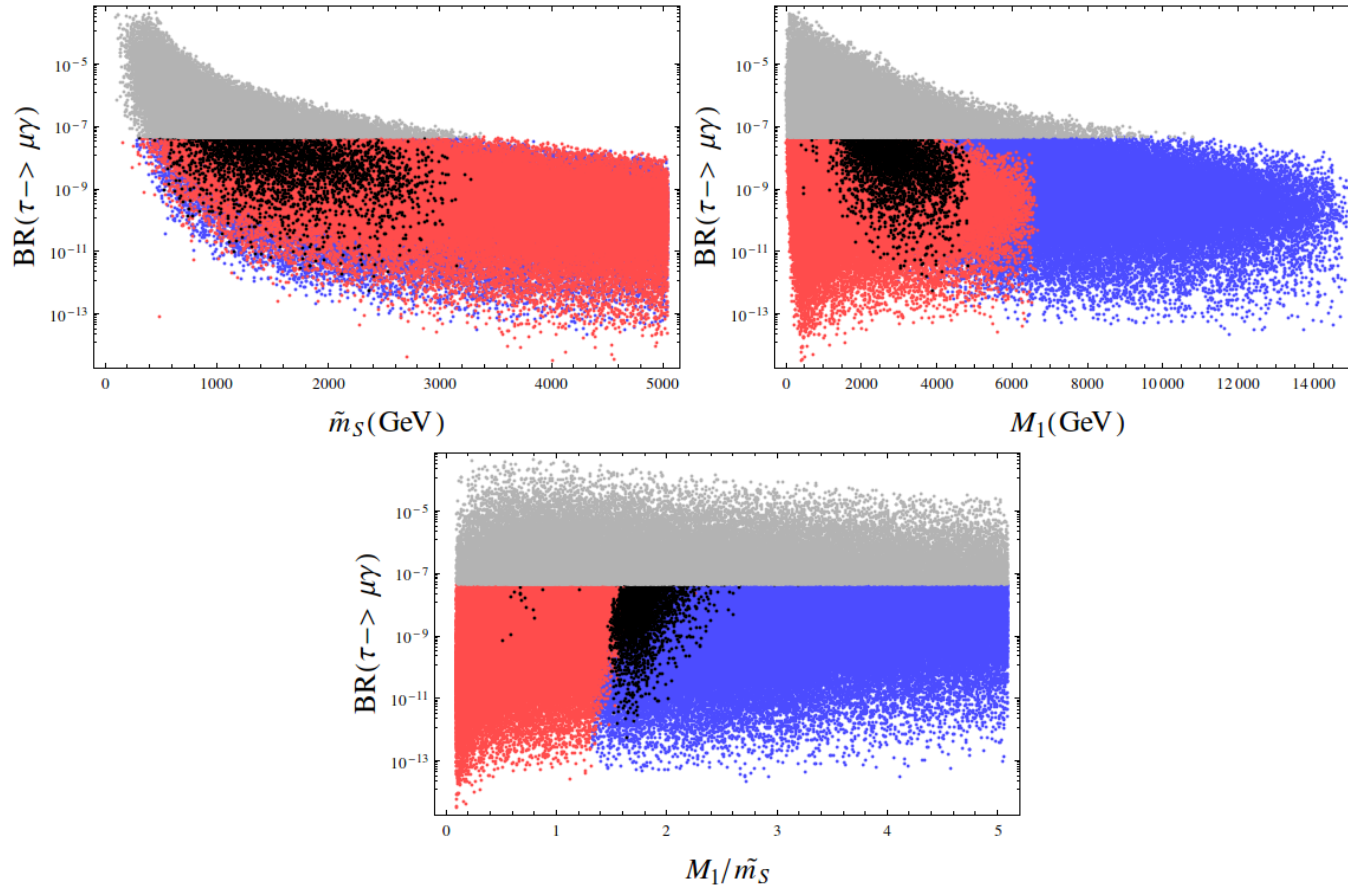


Figure 6: The plots show the dependence on  $BR^{theo}(\tau \rightarrow \mu\gamma)$  on the SUSY scalar mass  $\tilde{m}_S$  (left) and the Bino mass  $M_1$  (right) and on the ratio of them (down). The gray points are excluded by the experimental bound on  $BR(\tau \rightarrow \mu\gamma)$ . The rest of the color code is shown explicit in Fig.5, which separates ranges of FV contributions to  $g - 2$ .

## Preliminary new results $g - 2$

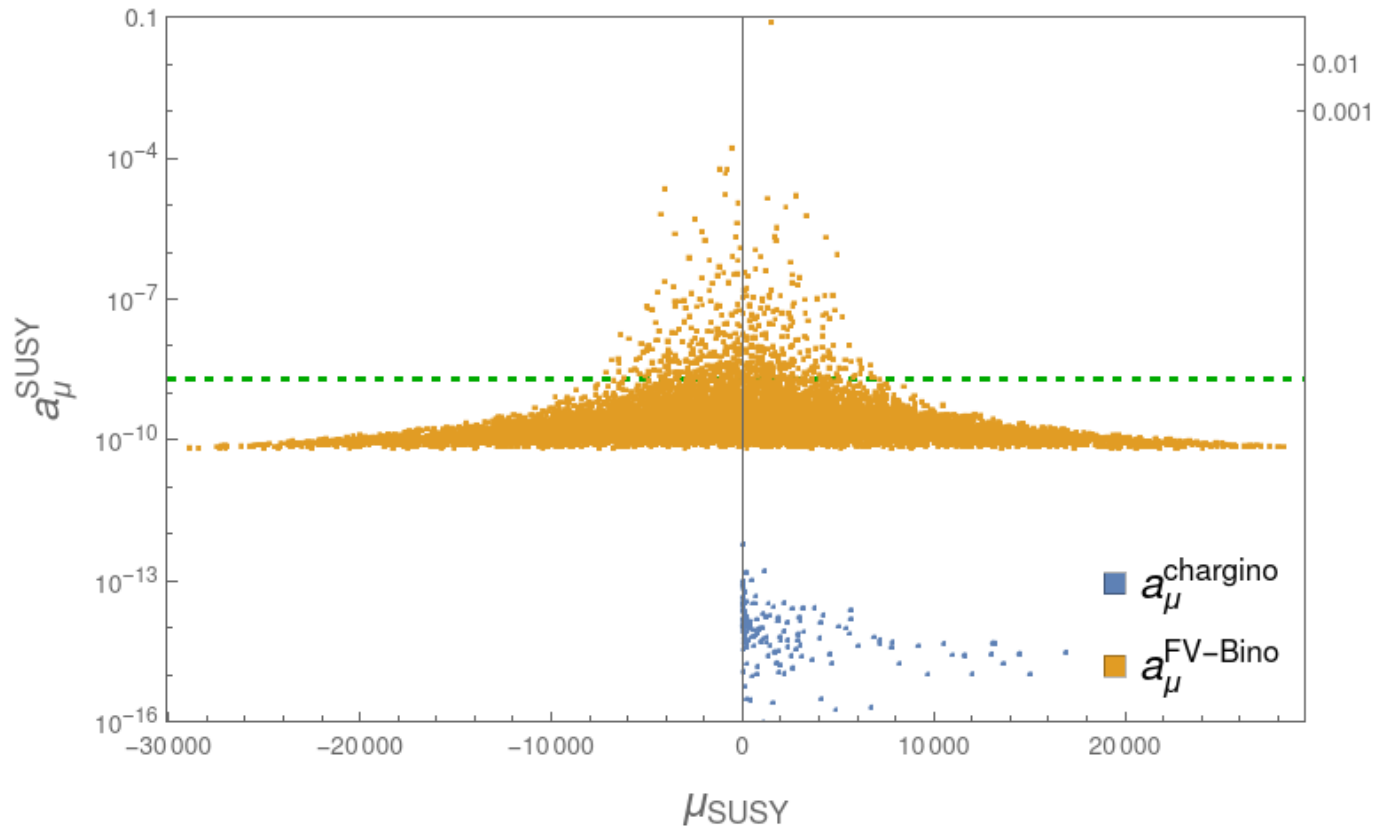
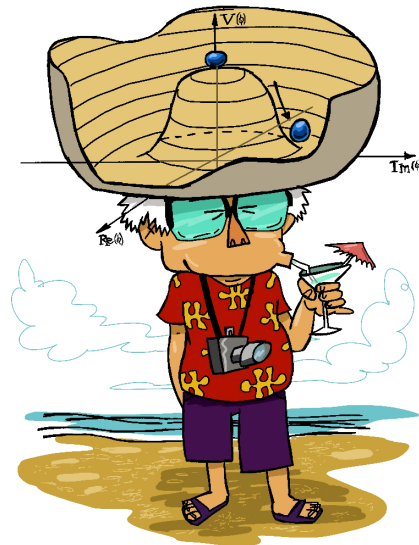


Figure 7:  $a_\mu^{\text{SUSY}}$  with the  $\mu_{\text{SUSY}}$  chargino-sneutrino loop and the Bino-FV slepton.

## Conclusions

- We obtain analytical mixing angles for a possible flavor mixing within 2nd and 3rd sfermion families through soft breaking terms.
- We obtain FV couplings which avoids approximated methods as MI to accomplish for FV processes as:
  - ◆  $BR_{susy}(\tau \rightarrow \mu\gamma)$   
     $\rightsquigarrow$  2 types of diagrams: Bino-sleptones and Chargino-sneutrinos
  - ◆  $BR_{susy}(h^0 \rightarrow \tau\mu)$   
     $\rightsquigarrow$  (16 diagrams Bino-FV charged sleptons)
  - ◆  $g - 2$  muon anomalous magnetic moment contribution.
- We search for the MSSM-FV parameter space where is compatible with  $g - 2$ .  
2 types of diagrams: Bino-sleptones and Chargino-sneutrinos

*thank you!*



## Results on SUSY usual parameters

For  $w = -1$ ,  $y = 1$ .

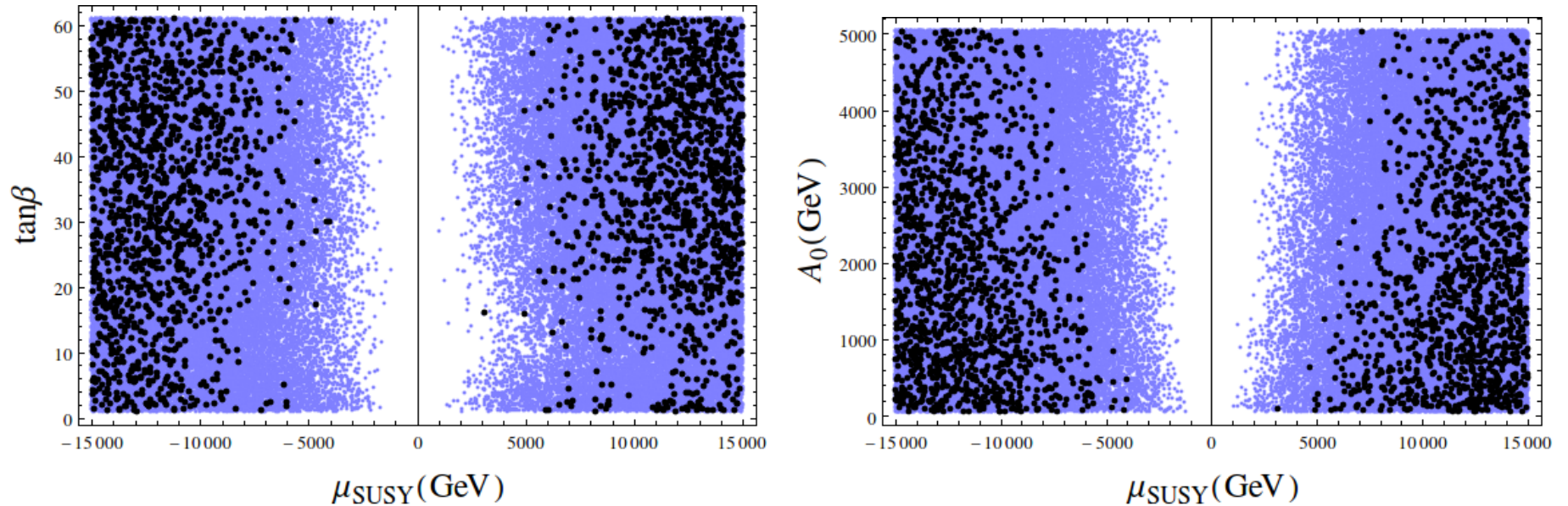


Figure 8: Values of  $\tan\beta$  (left) and  $A_0$  (right) dependence on  $\mu_{SUSY}$  for which the  $a_\mu$  discrepancy would get solved partially by the LFV contributions (blue), or completely up to  $1\sigma$  with the restriction  $M_1 < \frac{1}{3}\mu_{susy}$  (black).

## Results: Stringent bounds on $M_1/\tilde{m}_S$ ratio

For  $w = -1$ ,  $y = 1$ .

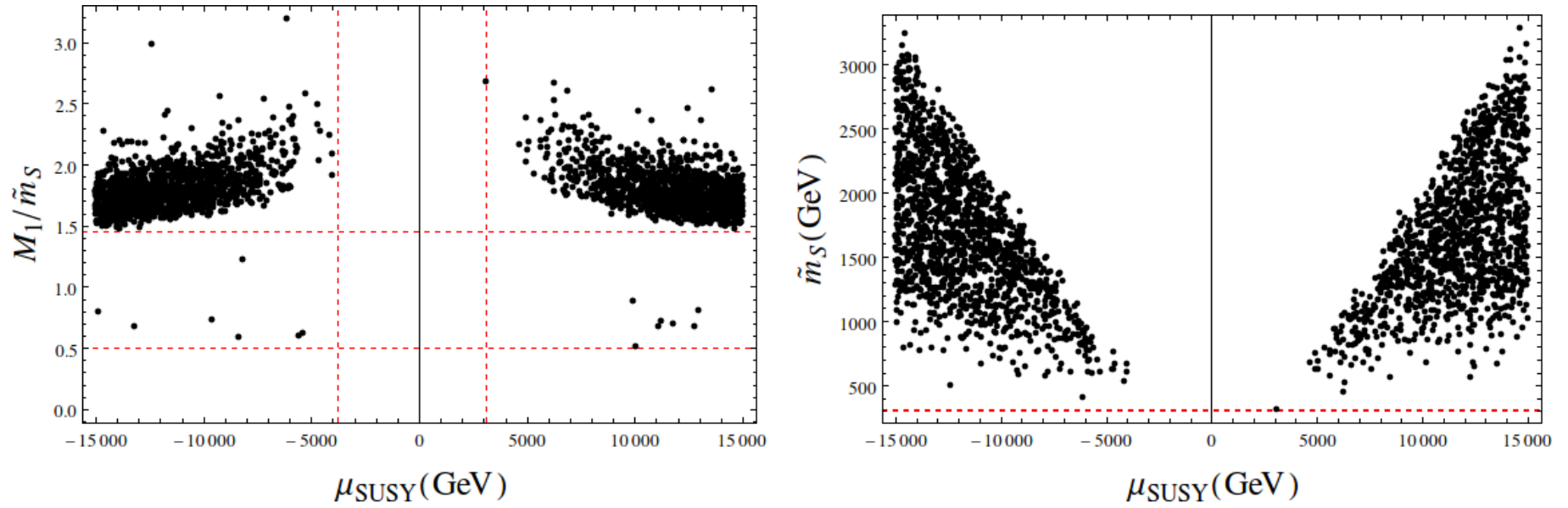


Figure 9: The values for which the LFV contribution would explain completely the  $a_\mu$  discrepancy within theory and experimental data up to  $1\sigma$ , considering  $M_1 < \frac{1}{3}\mu_{\text{susy}}$ . We show ratio on susy mass parameters  $M_1/\tilde{m}_S$  (left) and  $\tilde{m}_S$  (right), both with respect on  $\mu_{\text{susy}}$  values.

## Results: No-FV limit

For  $w = -1$ ,  $y = 1$ .

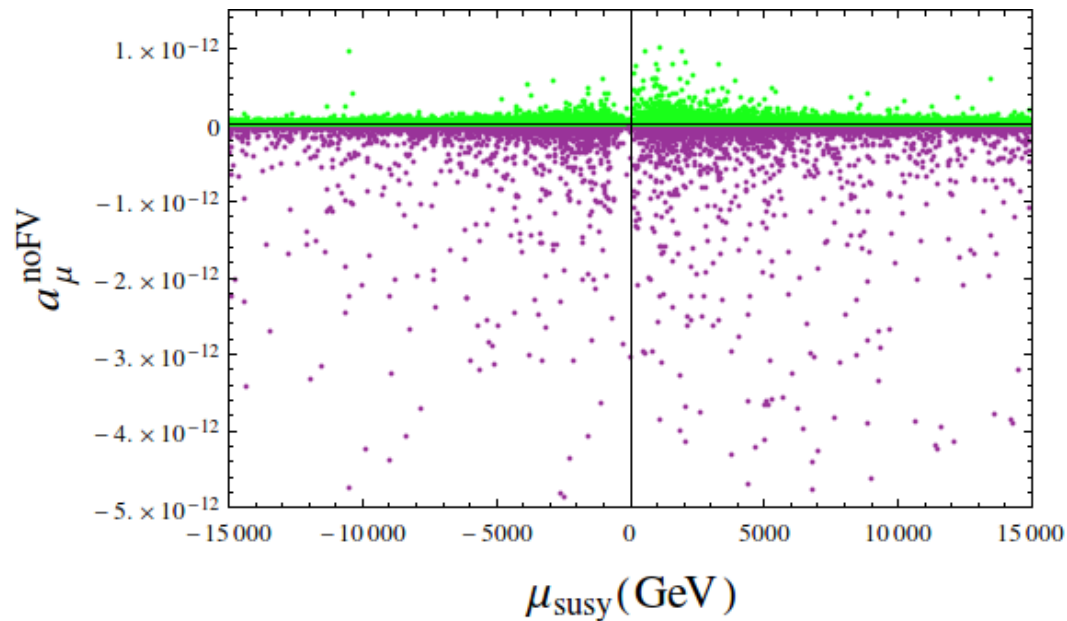


Figure 10: Complete Bino-smuon loop contribution on MSSM with no flavour violation to  $g - 2$ , considering  $A_0 = 0$  green points (lighter), and running  $A_0$  for  $(50, 5000)$  GeV purple points (darker).