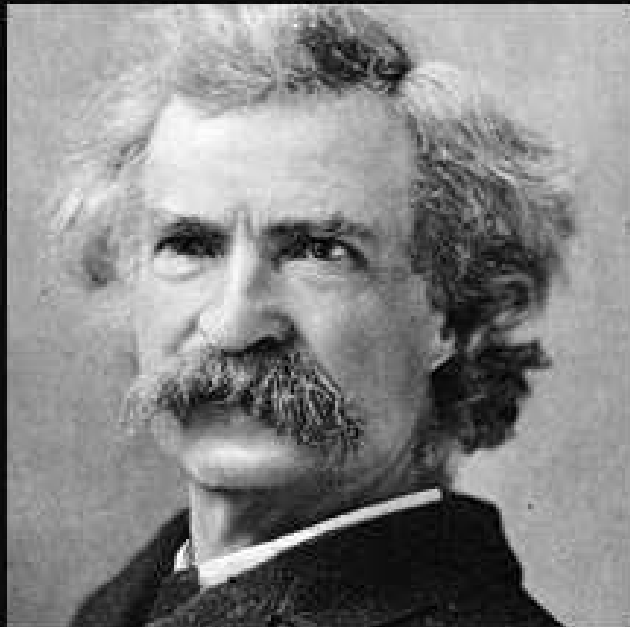


Round Table on “Supersymmetry”

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Madrid, 05/2018



The reports of my death have
been greatly exaggerated.

~ Mark Twain

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
6.

⇒ low-energy SUSY provides the solution(s) (or paves the way)!

⇒ But what about experimental results?

Is SUSY dead? When will I give up on SUSY?

ATLAS SUSY Searches* - 95% CL Lower Limits						ATLAS Preliminary			
December 2017						$\sqrt{s} = 7, 8, 13$ TeV			
Model	e, μ, τ, γ	Jets	E_T^{miss}	$[\mathcal{L} dt(d\mathbb{b}^{-1})]$	Mass limit	$\sqrt{s} = 7, 8$ TeV	$\sqrt{s} = 13$ TeV		
Inclusive Searches	$\tilde{q}\tilde{q}, \tilde{q} \rightarrow g\tilde{t}_1^0$	0	2-6 jets	Yes	36.1	\tilde{q}	1.57 TeV	$m(\tilde{t}_1^0) < 200$ GeV, $m(1^{st} \text{ gen. } \tilde{q}) = m(2^{nd} \text{ gen. } \tilde{q})$	1712.02332
	$\tilde{q}\tilde{q}, \tilde{q} \rightarrow g\tilde{t}_1^0$ (compressed)	mono-jet	1-3 jets	Yes	36.1	\tilde{q}	710 GeV	$m(\tilde{q}) - m(\tilde{t}_1^0) < 5$ GeV	1711.03301
	$\tilde{g}\tilde{g}, \tilde{g} \rightarrow g\tilde{q}\tilde{t}_1^0$	0	2-6 jets	Yes	36.1	\tilde{g}	2.02 TeV	$m(\tilde{t}_1^0) < 200$ GeV	1712.02332
	$\tilde{g}\tilde{g}, \tilde{g} \rightarrow g\tilde{q}\tilde{t}_1^0 \rightarrow gqW^{\pm}\tilde{\chi}_1^0$	0	2-6 jets	Yes	36.1	\tilde{g}	2.01 TeV	$m(\tilde{t}_1^0) < 200$ GeV, $m(\tilde{t}_1^0) - 0.5(m(\tilde{t}_1^0) + m(\tilde{g}))$	1712.02332
	$\tilde{g}\tilde{g}, \tilde{g} \rightarrow g\tilde{q}\tilde{t}_1^0$	e, e, μ, μ	2 jets	Yes	14.7	\tilde{g}	1.7 TeV	$m(\tilde{t}_1^0) < 300$ GeV,	1611.05791
	$\tilde{g}\tilde{g}, \tilde{g} \rightarrow g\tilde{q}(\ell\ell/\nu\nu)\tilde{\chi}_1^0$	3 e, μ	4 jets	-	36.1	\tilde{g}	1.87 TeV	$m(\tilde{t}_1^0) < 0$ GeV	1706.03731
	$\tilde{g}\tilde{g}, \tilde{g} \rightarrow g\tilde{q}WZ\tilde{\chi}_1^0$	0	7-11 jets	Yes	36.1	\tilde{g}	1.8 TeV	$m(\tilde{t}_1^0) < 400$ GeV	1708.02794
	GMSB ($\tilde{\ell}$ NLSP)	1-2 $\tau + 0-1 \ell$	0-2 jets	Yes	3.2	\tilde{g}	2.0 TeV	$m(\tilde{t}_1^0) < 400$ GeV	1607.05979
	GGM (bino NLSP)	2 γ	-	Yes	36.1	\tilde{g}	2.15 TeV	$c\tau(\text{NLSP}) < 0.1$ mm	ATLAS-CONF-2017-080
	GGM (higgsino-bino NLSP)	γ	2 jets	Yes	36.1	\tilde{g}	2.05 TeV	$m(\tilde{t}_1^0) = 1700$ GeV, $c\tau(\text{NLSP}) < 0.1$ mm, $\mu > 0$	ATLAS-CONF-2017-080
Gravitino LSP	0	mono-jet	Yes	20.3	\tilde{g}	865 GeV	$m(\tilde{g}) > 1.8 \times 10^{-4}$ eV, $m(\tilde{g}) = m(\tilde{g}) = 1.5$ TeV	1502.01516	
3 rd gen. \tilde{g} med.	$\tilde{g}\tilde{g}, \tilde{g} \rightarrow b\tilde{b}\tilde{\chi}_1^0$	0	3 b	Yes	36.1	\tilde{g}	1.92 TeV	$m(\tilde{t}_1^0) < 600$ GeV	1711.01901
	$\tilde{g}\tilde{g}, \tilde{g} \rightarrow t\tilde{t}\tilde{\chi}_1^0$	0-1 e, μ	3 b	Yes	36.1	\tilde{g}	1.97 TeV	$m(\tilde{t}_1^0) < 200$ GeV	1711.01901
3 rd gen. squarks direct production	$\tilde{b}_1\tilde{b}_1, \tilde{b}_1 \rightarrow b\tilde{\chi}_1^0$	0	2 b	Yes	36.1	\tilde{b}_1	950 GeV	$m(\tilde{t}_1^0) < 420$ GeV	1708.08266
	$\tilde{b}_1\tilde{b}_1, \tilde{b}_1 \rightarrow t\tilde{\chi}_1^0$	2 e, μ (SS)	1 b	Yes	36.1	\tilde{b}_1	275-700 GeV	$m(\tilde{t}_1^0) < 200$ GeV, $m(\tilde{t}_1^0) = m(\tilde{t}_1^0) + 100$ GeV	1706.03731
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1 \rightarrow b\tilde{\chi}_1^0$	0-2 e, μ	1-2 b	Yes	4.7/13.3	\tilde{t}_1	117-170 GeV	$m(\tilde{t}_1^0) = 2m(\tilde{t}_1^0), m(\tilde{t}_1^0) = 55$ GeV	1209.2102, ATLAS-CONF-2016-077
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1 \rightarrow Wb\tilde{\chi}_1^0$ or $\tilde{\chi}_1^0$	0-2 e, μ	0-2 jets/1-2 b	Yes	20.3/36.1	\tilde{t}_1	90-198 GeV	$m(\tilde{t}_1^0) = 1$ GeV	1506.08616, 1709.04193, 1711.11520
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1 \rightarrow c\tilde{\chi}_1^0$	0	mono-jet	Yes	36.1	\tilde{t}_1	90-430 GeV	$m(\tilde{t}_1^0) - m(\tilde{t}_1^0) = 5$ GeV	1711.03301
	$\tilde{t}_1\tilde{t}_1$ (natural GMSB)	2 e, μ (Z)	1 b	Yes	20.3	\tilde{t}_1	150-600 GeV	$m(\tilde{t}_1^0) > 150$ GeV	1403.5222
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1 \rightarrow t\tilde{\chi}_1^0 + Z$	3 e, μ (Z)	1 b	Yes	36.1	\tilde{t}_1	290-790 GeV	$m(\tilde{t}_1^0) = 0$ GeV	1706.03986
$\tilde{t}_1\tilde{t}_1, \tilde{t}_1 \rightarrow t\tilde{\chi}_1^0 + \tilde{h}$	1-2 e, μ	4 b	Yes	36.1	\tilde{t}_1	320-880 GeV	$m(\tilde{t}_1^0) = 0$ GeV	1706.03986	
EW direct	$\tilde{\chi}_1^0\tilde{\chi}_1^0, \tilde{\chi}_1^0 \rightarrow \tilde{\chi}_1^0\tilde{\chi}_1^0$	2 e, μ	0	Yes	36.1	$\tilde{\chi}_1^0$	90-500 GeV	$m(\tilde{t}_1^0) = 0$	ATLAS-CONF-2017-039
	$\tilde{\chi}_1^0\tilde{\chi}_1^0, \tilde{\chi}_1^0 \rightarrow \tilde{\chi}_1^0\tilde{\chi}_1^0$	2 e, μ	0	Yes	36.1	$\tilde{\chi}_1^0$	750 GeV	$m(\tilde{t}_1^0) = 0, m(\tilde{\ell}, \tilde{\nu}) = 0.5(m(\tilde{\chi}_1^0) + m(\tilde{\chi}_1^0))$	ATLAS-CONF-2017-039
	$\tilde{\chi}_1^0\tilde{\chi}_1^0, \tilde{\chi}_1^0 \rightarrow \tilde{\chi}_1^0\tilde{\chi}_1^0$	2 τ	-	Yes	36.1	$\tilde{\chi}_1^0$	760 GeV	$m(\tilde{t}_1^0) = 0, m(\tilde{\tau}, \tilde{\nu}) = 0.5(m(\tilde{\chi}_1^0) + m(\tilde{\chi}_1^0))$	1708.07875
	$\tilde{\chi}_1^0\tilde{\chi}_1^0, \tilde{\chi}_1^0 \rightarrow \tilde{\chi}_1^0\tilde{\chi}_1^0$	3 e, μ	0	Yes	36.1	$\tilde{\chi}_1^0$	1.13 TeV	$m(\tilde{t}_1^0) = m(\tilde{t}_1^0), m(\tilde{t}_1^0) = 0, m(\tilde{\ell}, \tilde{\nu}) = 0.5(m(\tilde{\chi}_1^0) + m(\tilde{\chi}_1^0))$	ATLAS-CONF-2017-039
	$\tilde{\chi}_1^0\tilde{\chi}_1^0, \tilde{\chi}_1^0 \rightarrow W\tilde{\chi}_1^0\tilde{Z}\tilde{\chi}_1^0$	2-3 e, μ	0-2 jets	Yes	36.1	$\tilde{\chi}_1^0$	580 GeV	$m(\tilde{t}_1^0) = m(\tilde{t}_1^0), m(\tilde{t}_1^0) = 0, \tilde{\ell}$ decoupled	ATLAS-CONF-2017-039
	$\tilde{\chi}_1^0\tilde{\chi}_1^0, \tilde{\chi}_1^0 \rightarrow W\tilde{\chi}_1^0\tilde{h}\tilde{\chi}_1^0, \tilde{h} \rightarrow b\tilde{b}/W\tilde{W}/\tau\tau/\gamma\gamma$	e, μ, γ	0-2 b	Yes	20.3	$\tilde{\chi}_1^0$	270 GeV	$m(\tilde{t}_1^0) = m(\tilde{t}_1^0), m(\tilde{t}_1^0) = 0, \tilde{\ell}$ decoupled	1501.07110
	$\tilde{\chi}_1^0\tilde{\chi}_1^0, \tilde{\chi}_1^0 \rightarrow \tilde{\chi}_1^0\tilde{\chi}_1^0$	4 e, μ	0	Yes	20.3	$\tilde{\chi}_1^0$	635 GeV	$m(\tilde{t}_1^0) = m(\tilde{t}_1^0), m(\tilde{t}_1^0) = 0, m(\tilde{\ell}, \tilde{\nu}) = 0.5(m(\tilde{\chi}_1^0) + m(\tilde{\chi}_1^0))$	1405.5086
	GGM (wino NLSP) weak prod., $\tilde{\chi}_1^0 \rightarrow \gamma\tilde{G}$	1 $e, \mu + \gamma$	-	Yes	20.3	\tilde{W}	115-370 GeV	$c\tau < 1$ mm	1507.05493
	GGM (bino NLSP) weak prod., $\tilde{\chi}_1^0 \rightarrow \gamma\tilde{G}$	2 γ	-	Yes	36.1	\tilde{W}	1.06 TeV	$c\tau < 1$ mm	ATLAS-CONF-2017-080
	Long-lived particles	Direct $\tilde{\chi}_1^0\tilde{\chi}_1^0$ prod., long-lived $\tilde{\chi}_1^0$	Disapp. trk	1 jet	Yes	36.1	$\tilde{\chi}_1^0$	460 GeV	$m(\tilde{t}_1^0) - m(\tilde{t}_1^0) = 160$ MeV, $\tau(\tilde{\chi}_1^0) = 0.2$ ns
Direct $\tilde{\chi}_1^0\tilde{\chi}_1^0$ prod., long-lived $\tilde{\chi}_1^0$		dE/dx trk	-	Yes	18.4	$\tilde{\chi}_1^0$	495 GeV	$m(\tilde{t}_1^0) - m(\tilde{t}_1^0) = 160$ MeV, $c\tau(\tilde{\chi}_1^0) < 15$ ns	1506.05332
Stable, stopped \tilde{g} R-hadron		0	1-5 jets	Yes	27.9	\tilde{g}	850 GeV	$m(\tilde{t}_1^0) = 100$ GeV, $10 \mu\text{s} < c\tau(\tilde{g}) < 1000$ s	1310.5584
Stable \tilde{g} R-hadron		trk	-	-	3.2	\tilde{g}	1.58 TeV	-	1606.05129
Metastable \tilde{g} R-hadron		dE/dx trk	-	-	3.2	\tilde{g}	1.57 TeV	$m(\tilde{t}_1^0) = 100$ GeV, $c\tau > 10$ ns	1604.04520
Metastable \tilde{g} R-hadron, $\tilde{g} \rightarrow g\tilde{q}\tilde{\chi}_1^0$		displ. vtx	-	Yes	32.8	\tilde{g}	2.37 TeV	$\tau(\tilde{g}) = 0.17$ ns, $m(\tilde{t}_1^0) = 100$ GeV	1710.04901
GMSB, stable $\tilde{\tau}, \tilde{\chi}_1^0 \rightarrow \tau(\tilde{b}, \tilde{\mu}) + \tau(e, \mu)$		1-2 μ	-	-	19.1	$\tilde{\chi}_1^0$	537 GeV	$10 < \tan\beta < 50$	1411.6795
GMSB, $\tilde{\chi}_1^0 \rightarrow \gamma\tilde{G}$, long-lived $\tilde{\chi}_1^0$		2 γ	-	Yes	20.3	$\tilde{\chi}_1^0$	440 GeV	$1 < c\tau(\tilde{\chi}_1^0) < 3$ ns, SPS8 model	1409.5542
$\tilde{g}\tilde{g}, \tilde{\chi}_1^0 \rightarrow e\tilde{e}/\mu\tilde{\mu}/\mu\tilde{\nu}$		displ. $e\tilde{e}/\mu\tilde{\mu}/\mu\tilde{\nu}$	-	-	20.3	$\tilde{\chi}_1^0$	1.0 TeV	$7 < c\tau(\tilde{\chi}_1^0) < 740$ mm, $m(\tilde{g}) = 1.3$ TeV	1504.05162
RPV		LFV $p\tilde{p} \rightarrow \tilde{\nu}_\tau + X, \tilde{\nu}_\tau \rightarrow e\mu/\tau/\mu/\tau$	$e\mu, e\tau, \mu\tau$	-	-	3.2	$\tilde{\nu}_\tau$	1.9 TeV	$A_{111} = 0.11, A_{122}/A_{133}/A_{233} = 0.07$
	Bilinear RPV CMSSM	2 e, μ (SS)	0-3 b	Yes	20.3	$\tilde{g}, \tilde{\chi}_1^0$	1.45 TeV	$m(\tilde{g}) = m(\tilde{g}), c\tau_{233} < 1$ mm	1404.2500
	$\tilde{\chi}_1^0\tilde{\chi}_1^0, \tilde{\chi}_1^0 \rightarrow W\tilde{\chi}_1^0\tilde{\chi}_1^0 \rightarrow e\nu\nu, \mu\nu, \mu\nu$	4 e, μ	-	Yes	13.3	$\tilde{\chi}_1^0$	1.14 TeV	$m(\tilde{t}_1^0) > 400$ GeV, $A_{12k} \neq 0$ ($k = 1, 2$)	ATLAS-CONF-2016-075
	$\tilde{\chi}_1^0\tilde{\chi}_1^0, \tilde{\chi}_1^0 \rightarrow W\tilde{\chi}_1^0\tilde{\chi}_1^0 \rightarrow \tau\nu\tau, e\tau\nu, e\tau\nu$	3 $e, \mu + \tau$	-	Yes	20.3	$\tilde{\chi}_1^0$	450 GeV	$m(\tilde{t}_1^0) > 0.2 \times m(\tilde{t}_1^0), A_{123} \neq 0$	1405.5086
	$\tilde{g}\tilde{g}, \tilde{g} \rightarrow g\tilde{q}\tilde{\chi}_1^0 \rightarrow gqq$	0	4-5 large-R jets	-	36.1	\tilde{g}	1.875 TeV	$m(\tilde{t}_1^0) = 1075$ GeV	SUSY-2016-22
	$\tilde{g}\tilde{g}, \tilde{g} \rightarrow t\tilde{t}\tilde{\chi}_1^0, \tilde{\chi}_1^0 \rightarrow qqq$	1 e, μ	8-10 jets/0-4 b	-	36.1	\tilde{g}	2.1 TeV	$m(\tilde{t}_1^0) = 1$ TeV, $A_{112} \neq 0$	1704.08493
	$\tilde{g}\tilde{g}, \tilde{g} \rightarrow t\tilde{t}\tilde{\chi}_1^0, \tilde{\chi}_1^0 \rightarrow bss$	1 e, μ	8-10 jets/0-4 b	-	36.1	\tilde{g}	1.65 TeV	$m(\tilde{t}_1^0) = 1$ TeV, $A_{123} \neq 0$	1704.08493
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1 \rightarrow b\tilde{\chi}_1^0$	0	2 jets + 2 b	-	36.7	\tilde{t}_1	100-470 GeV	$m(\tilde{t}_1^0) = 1$ TeV, $A_{123} \neq 0$	1710.07171
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1 \rightarrow b\tilde{\chi}_1^0$	2 e, μ	2 b	-	36.1	\tilde{t}_1	480-610 GeV	$BR(\tilde{t}_1 \rightarrow b\tilde{e}/\mu) > 20\%$	1710.05544
	Other	Scalar charm, $\tilde{c} \rightarrow c\tilde{\chi}_1^0$	0	2 c	Yes	20.3	\tilde{c}	510 GeV	$m(\tilde{t}_1^0) < 200$ GeV

*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]

SUSY is as dead (or alive) as ANY OTHER BSM theory

ATLAS Exotics Searches* - 95% CL Upper Exclusion Limits

Status: July 2017

ATLAS Preliminary

$\int \mathcal{L} dt = (3.2 - 37.0) \text{ fb}^{-1}$

$\sqrt{s} = 8, 13 \text{ TeV}$

Model	ℓ, γ	Jets [†]	E_T^{miss}	$\int \mathcal{L} dt [\text{fb}^{-1}]$	Limit	Reference		
Extra dimensions	ADD $G_{KK} \rightarrow s/q$	$0 e, \mu$	$1-4 j$	Yes	36.1	M_n 7.75 TeV	$n=2$	ATLAS-CONF-2017-050
	ADD non-resonant $\gamma\gamma$	2γ	-	-	36.7	M_5 8.6 TeV	$n=3$ HI 7 NLO	OPRN-PP-2017-02
	ADD QDI	-	$2 j$	-	37.0	M_{10} 8.9 TeV	$n=6$	1703.0927
	ADD HH high $\sum p_T$	$\geq 1 e, \mu$	$\geq 2 j$	-	3.2	M_{10} 8.2 TeV	$n=6, M_p=3 \text{ TeV, m(BH)}$	1505.02265
	ADD BH multijet	-	$\geq 3 j$	-	3.6	M_{10} 9.35 TeV	$n=6, M_p=3 \text{ TeV, m(BH)}$	1512.02566
	PS1 $G_{KK} \rightarrow \gamma\gamma$	2γ	-	-	36.7	G_{KK} mass 4.1 TeV	$k/\overline{M}_p=0.1$	OPRN-PP-2017-032
	Bulk RS $G_{KK} \rightarrow WW \rightarrow qq\bar{q}\bar{q}$	$1 e, \mu$	$1 j$	Yes	36.1	G_{KK} mass 1.75 TeV	$k/M_p=1.0$	ATLAS-CONF-2017-031
	2UCD / RPP	$1 e, \mu$	$> 2 b, > 3 j$	Yes	13.2	KK mass 1.6 TeV	Tier (1,1), $\mathcal{B}(A^{(+)2} \rightarrow \tau\tau)=1$	ATLAS-CONF-2017-104
Gauge bosons	SSM $Z' \rightarrow \ell\ell$	$2 e, \mu$	-	-	36.1	Z' mass 4.5 TeV	-	ATLAS-CONF-2017-027
	SSM $Z' \rightarrow \tau\tau$	2τ	-	-	36.1	Z' mass 2.4 TeV	-	ATLAS-CONF-2017-050
	Leptophobic $Z' \rightarrow b\bar{b}$	-	$2 b$	-	3.2	Z' mass 1.5 TeV	-	1303.08791
	Leptophobic $Z' \rightarrow t\bar{t}$	$1 e, \mu$	$> 1 b, > 1 J[2]$	Yes	3.2	Z' mass 2.0 TeV	$\Gamma_{\text{tot}}=3\%$	ATLAS-CONF-2018-014
	SSM $W' \rightarrow \ell\nu$	$1 e, \mu$	-	Yes	36.1	W' mass 5.1 TeV	-	1705.01766
	HV1 $W' \rightarrow WW \rightarrow qqqq$ mode II	$0 e, \mu$	$2 j$	-	36.7	W' mass 3.5 TeV	$g_V=3$	CERN-EP-2017-117
	HVT $W' \rightarrow WH/ZH$ model B	multi-channel	-	-	36.1	W' mass 2.93 TeV	$g_V=3$	ATLAS-CONF-2017-035
	HSM $W'_R \rightarrow \ell b$	$1 e, \mu$	$2 b, 0 j$	Yes	20.3	W'_R mass 1.92 TeV	-	1410.4123
LRSM $W'_R \rightarrow \ell b$	$0 e, \mu$	$> 1 b, 1 j$	-	20.3	W'_R mass 1.75 TeV	-	1406.3950	
CI	CI $qqqq$	-	$2 j$	-	37.0	Λ 21.6 TeV	κ_{eff}	1703.0927
	CI $\ell\ell qq$	$2 e, \mu$	-	-	36.1	Λ 40.1 TeV	κ_{eff}	ATLAS-CONF-2017-027
	CI $u\bar{u}t\bar{t}$	$2(SSV \geq 3 e, \mu > 1 b, > 1 j)$	Yes	20.3	Λ 4.9 TeV	$\kappa_{\text{eff}}=1$	1504.04805	
DM	Axial vector mediator (Dirac DM)	$0 e, \mu$	$1-4 j$	Yes	36.1	m_{DM} 1.5 TeV	$g_V=0.25, g_A=1.0, m(\gamma) < 400 \text{ GeV}$	ATLAS-CONF-2017-080
	Vector mediator (Dirac DM)	$0 e, \mu, 1 \gamma$	$\leq 1 j$	Yes	36.1	m_{DM} 1.2 TeV	$g_V=0.25, g_A=1.0, m(\gamma) < 480 \text{ GeV}$	1704.03848
	VV _{UV} EFT (Dirac DM)	$0 e, \mu$	$1 j, < 1 j$	Yes	3.2	M_U 700 GeV	$m(\gamma) < 150 \text{ GeV}$	1508.02172
LQ	Scalar LQ 1 st gen	$2 e$	$\geq 2 j$	-	3.2	LQ mass 1.1 TeV	$\beta=1$	1505.06335
	Scalar LQ 2 nd gen	2μ	$\geq 2 j$	-	3.2	LQ mass 1.05 TeV	$\beta=1$	1505.06356
	Scalar LQ 3 rd gen	$1 e, \mu$	$\geq 1 b, \geq 2 j$	Yes	20.3	LQ mass 640 GeV	$\beta=0$	1508.04735
Heavy quarks	VLQ $TT \rightarrow Ht + X$	$0 e, 1 e, \mu$	$\geq 2 b, \geq 3 j$	Yes	13.2	T mass 1.2 TeV	$\mathcal{B}(T \rightarrow Ht)=1$	ATLAS-CONF-2018-104
	VLQ $TT \rightarrow Zt + X$	$1 e, \mu$	$\geq 1 b, \geq 3 j$	Yes	36.1	T mass 1.16 TeV	$\mathcal{B}(T \rightarrow Zt)=1$	1705.10751
	VLQ $TT \rightarrow Wb + X$	$1 e, \mu$	$\geq 1 b, \geq 1 J[2]$	Yes	36.1	T mass 1.35 TeV	$\mathcal{B}(T \rightarrow Wb)=1$	CERN-EP-2017-094
	VLQ $BB \rightarrow Hb + X$	$1 e, \mu$	$\geq 2 b, \geq 3 j$	Yes	20.3	B mass 700 GeV	$\mathcal{B}(B \rightarrow Hb)=1$	1505.04306
	VLQ $BB \rightarrow Zb + X$	$2 > 3 e, \mu$	$\geq 2 > 1 b$	-	20.3	B mass 790 GeV	$\mathcal{B}(B \rightarrow Zb)=1$	1405.5520
	VLQ $BB \rightarrow Wt + X$	$1 e, \mu$	$\geq 1 b, \geq 1 J[2]$	Yes	36.1	B mass 1.25 TeV	$\mathcal{B}(B \rightarrow Wt)=1$	CERN-EP-2017-094
Excited fermions	VLQ $QQ \rightarrow Wq\bar{W}q$	$1 e, \mu$	$\geq 4 j$	Yes	20.3	U mass 690 GeV	-	1505.04261
	Excited quark $q^* \rightarrow qg$	-	$2 j$	-	37.0	q^* mass 6.0 TeV	only u^* and d^* , $\Lambda = m(q^*)$	1703.09127
	Excited quark $q^* \rightarrow q\gamma$	1γ	$1 j$	-	36.7	q^* mass 5.3 TeV	only u^* and d^* , $\Lambda = m(q^*)$	CERN-EP-2017-148
	Excited quark $b^* \rightarrow bg$	-	$1 b, 1 j$	-	13.3	b^* mass 2.3 TeV	-	ATLAS-CONF-2018-080
	Excited quark $h^* \rightarrow W\tau$	$1 e, 2 e, \mu$	$1 b, 2-0 j$	Yes	20.3	h^* mass 1.5 TeV	$\xi_1 = \xi_2 = \xi_3 = 1$	1512.02564
	Excited lepton ℓ^*	$3 e, \mu$	-	-	20.3	ℓ^* mass 3.0 TeV	$\Lambda = 3.0 \text{ TeV}$	1411.2997
Other	Excited lepton ν^*	$3 e, \mu, \tau$	-	-	20.3	ν^* mass 1.6 TeV	$\Lambda = 1.6 \text{ TeV}$	1411.2997
	IPSM Majorana ν	$2 e, \mu$	$2 j$	-	20.3	N^0 mass 2.0 TeV	$m(W_2) > 4 \text{ TeV, no mixing}$	1505.06320
	Higgs triplet $H^{\pm\pm} \rightarrow \ell\ell$	$2, 3, 4 e, \mu$ (SS)	-	-	36.1	$H^{\pm\pm}$ mass 870 GeV	DY production	ATLAS-CONF-2017-035
	Higgs triplet $H^{\pm\pm} \rightarrow \tau\tau$	$3 e, \mu, \tau$	-	-	20.3	$H^{\pm\pm}$ mass 400 GeV	DY production, $\mathcal{B}(H^{\pm\pm} \rightarrow \tau\tau)=1$	1411.2997
	Monotop (iron-res prod)	$1 e, \mu$	$1 b$	Yes	20.3	spin-1 visible particle mass 657 GeV	$\sigma_{\text{tot}}=0.2$	1410.5424
	Multi-charged particles	-	-	-	20.3	multi-charged particle mass 785 GeV	DY production, $ q =5e$	1504.01158
Magnetic monopoles	-	-	-	7.0	monopole mass 1.34 TeV	DY production, $ g \leq g_p, \text{ spin } 1/2$	1505.06308	

*Only a selection of the available mass limits on new states or phenomena is shown.

† Small-radius (large-radius) jets are denoted by the letter j (J).

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⇒ **focus on the theoretically most appealing theory!**

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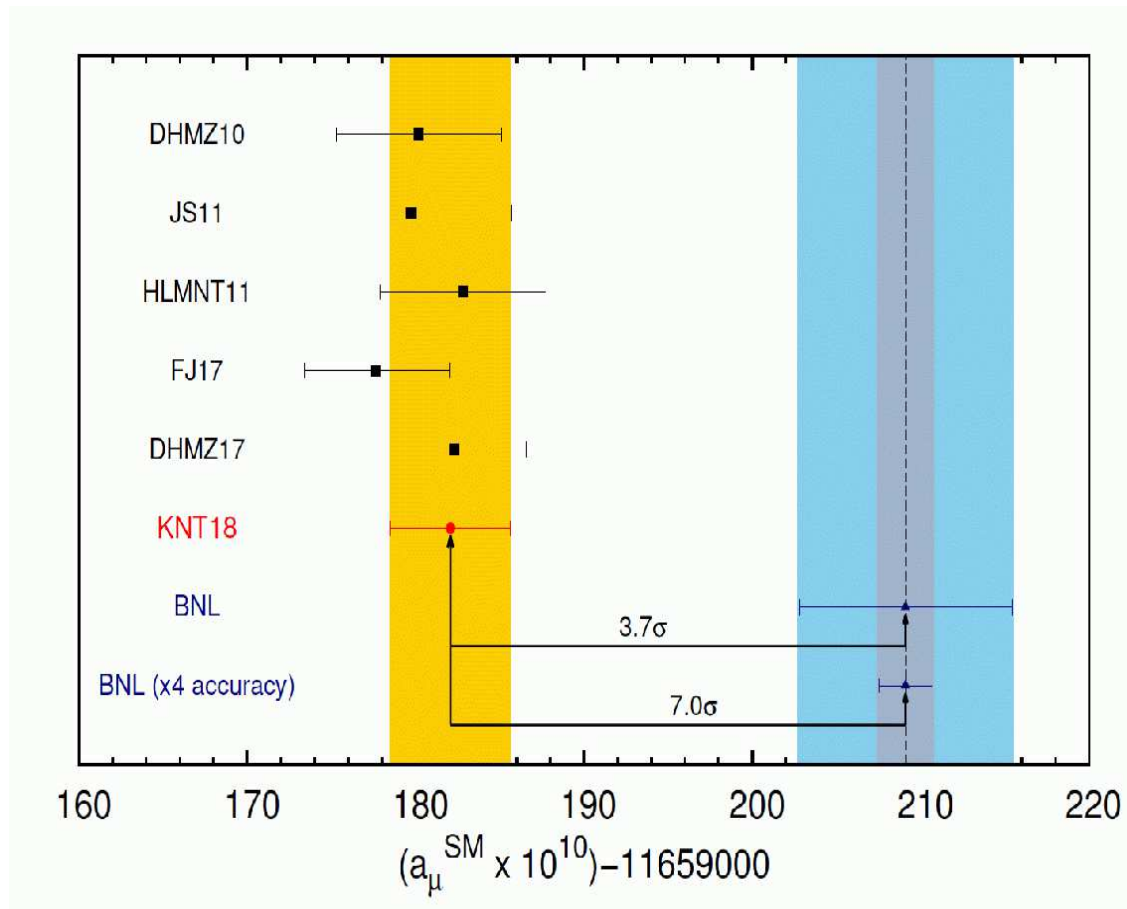
- It is nearly inconceivable that there is no symmetry between bosons and fermions (at low or high energy?)
- SUSY is the only non-trivial extension of (the SM) gauge symmetries
- SUSY gives you coupling constant unification
- SUSY predicted correctly the top quark mass
- SUSY predicted correctly the Higgs boson mass
- SUSY predicted correctly an SM-like Higgs boson
- SUSY predicted correctly DM properties

The anomalous magnetic moment of the muon

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

Overview about the current **experimental** and **SM (theory)** result:

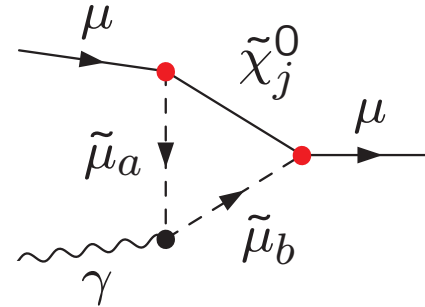
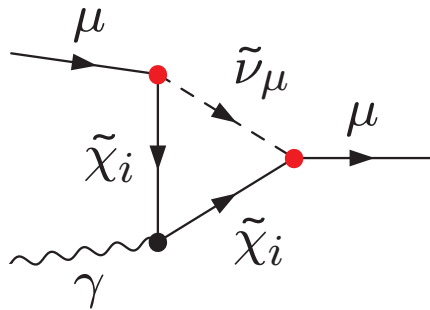
[A. Keshavarzia, D. Nomura, T. Teubner '18]



$$a_\mu^{\text{exp}} - a_\mu^{\text{theo,SM}} \approx (27.05 \pm 7.26) \times 10^{-10} : 3.7 \sigma$$

SUSY can easily explain the deviation:

Feynman diagrams for MSSM 1L corrections:

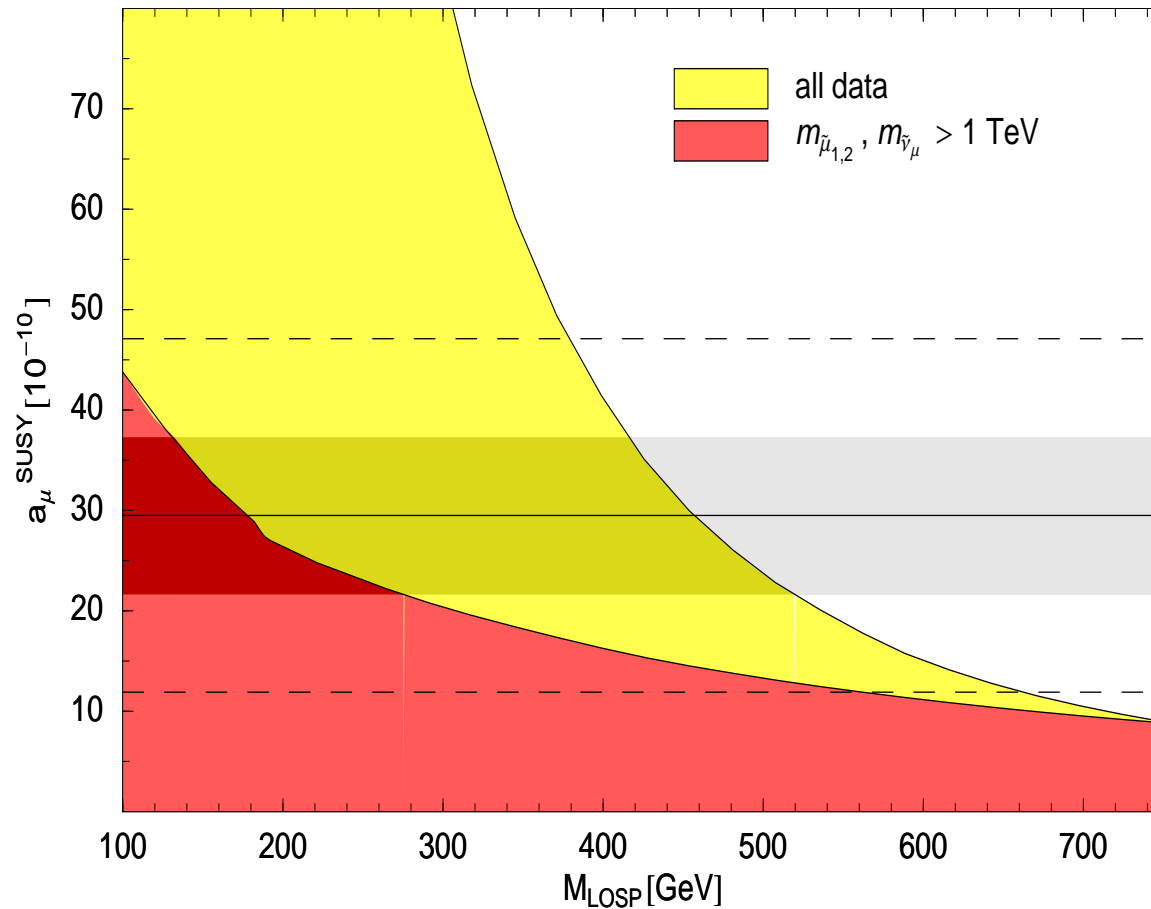


- Diagrams with chargino/sneutrino exchange
- Diagrams with neutralino/smuon exchange

If SUSY exists: it could explain $(g - 2)_\mu$

\Rightarrow there should be (relatively) light EW SUSY particles!

Example: Scan over SUSY parameter space



Scan over

$\mu, M_2, m_{\tilde{\mu}}, A_\mu$

LOSP = lightest observable
SUSY particle

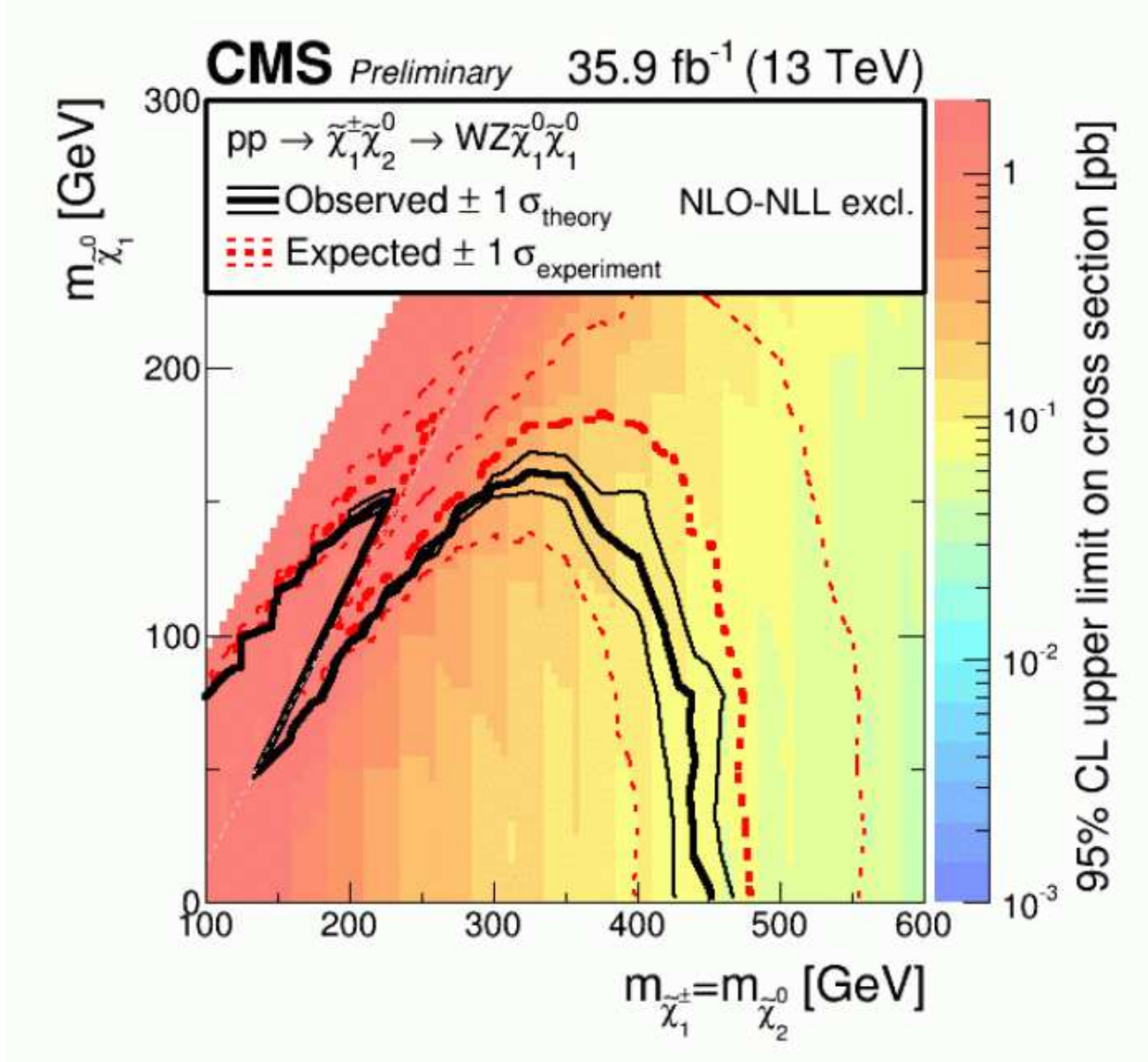
LOSP = $\tilde{\mu}$ or $\tilde{\chi}$

[D. Stöckinger '06]

SUSY could easily explain
discrepancy

⇒ upper bound on EW SUSY particles!

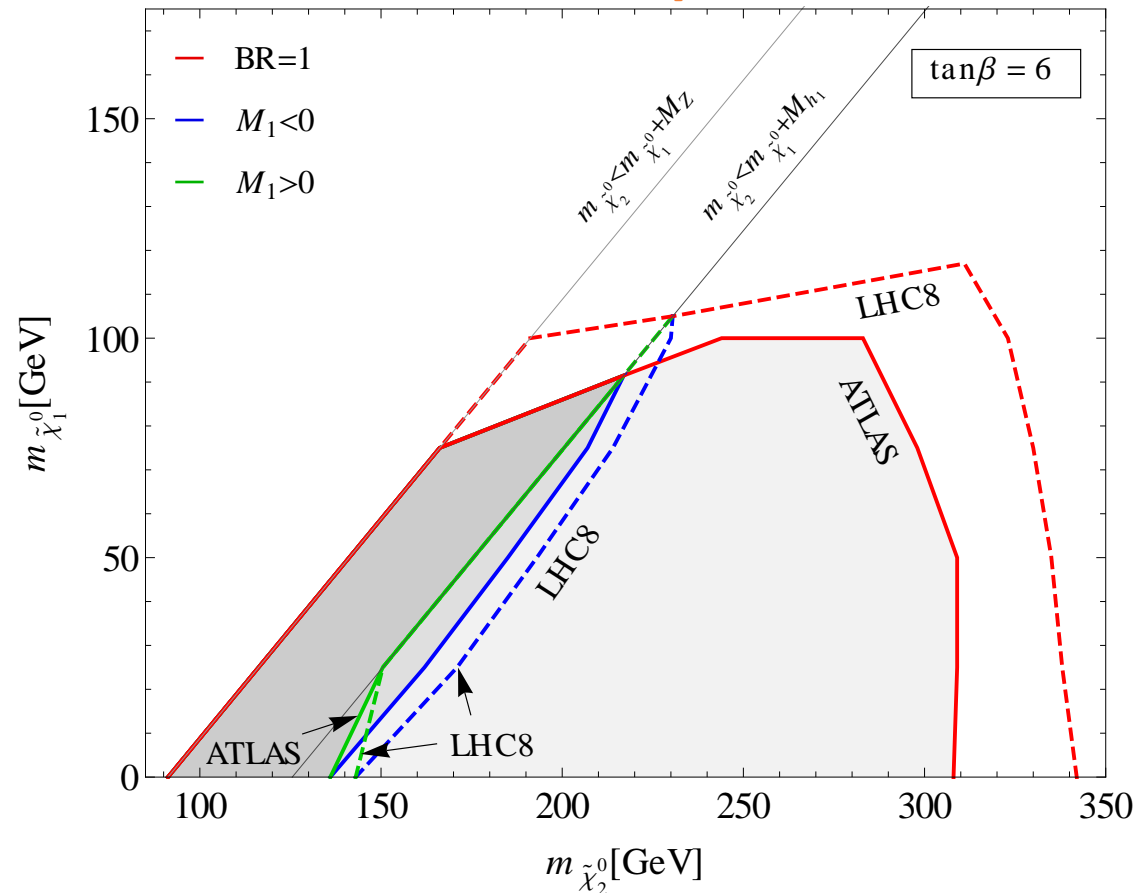
Electroweak searches:



LHC is looking for $pp \rightarrow \tilde{\chi}_1^\pm \tilde{\chi}_2^0 \rightarrow W^\pm \tilde{\chi}_1^0 Z \tilde{\chi}_1^0$

Reality: $\text{BR}(\tilde{\chi}_2^0 \rightarrow Z \tilde{\chi}_1^0) = 1$ is NEVER correct because $\tilde{\chi}_2^0 \rightarrow h \tilde{\chi}_1^0$ is possible

[A. Bharucha, S.H., F. v.d. Pahlen '13]

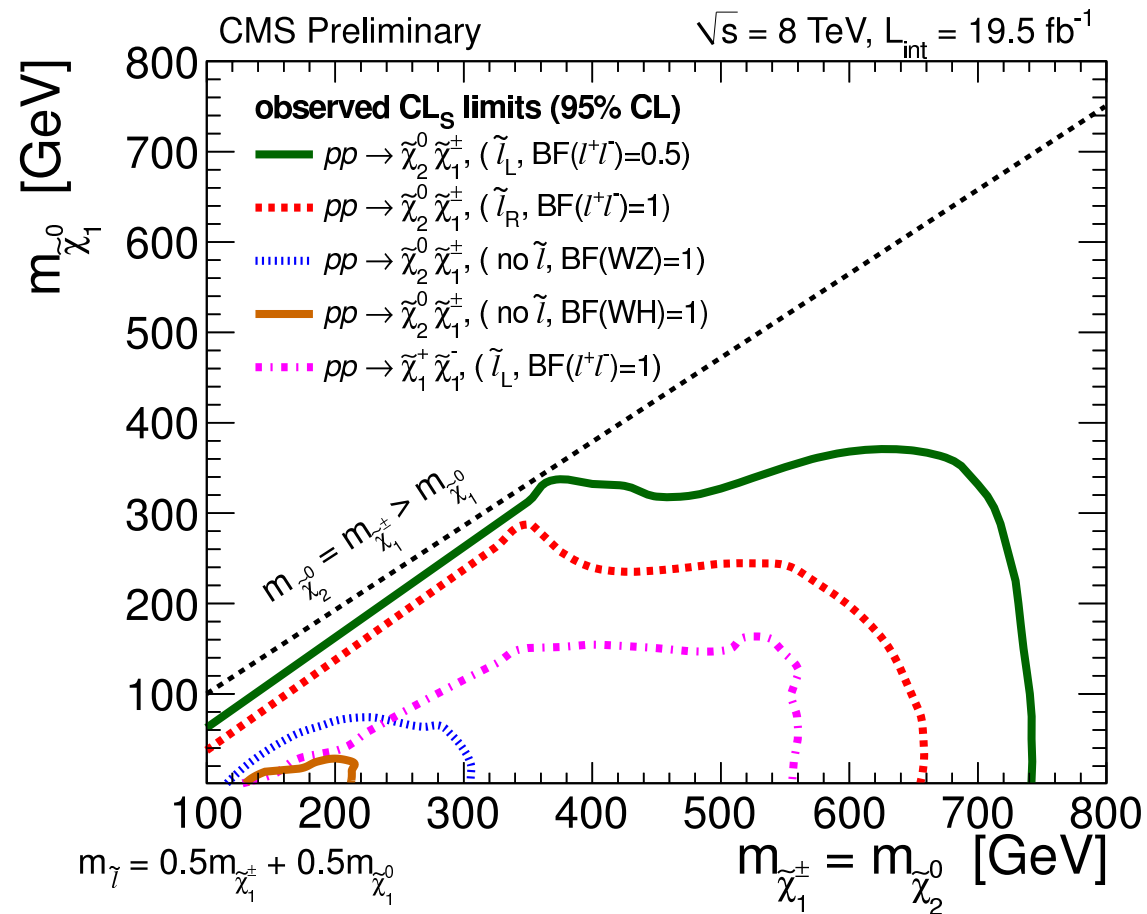


\Rightarrow huge reduction of exclusion region (where $\tilde{\chi}_2^0 \rightarrow \tilde{\chi}_1^0 h$ allowed)

More recently:

ATLAS and CMS are now also searching for

$$pp \rightarrow \tilde{\chi}_1^\pm \tilde{\chi}_2^0 \rightarrow W^\pm \tilde{\chi}_1^0 \tilde{\chi}_2^0 \rightarrow W^\pm \tilde{\chi}_1^0 h \tilde{\chi}_1^0 \rightarrow W^\pm \tilde{\chi}_1^0 b\bar{b} \tilde{\chi}_1^0$$



⇒ strongly reduced bounds!

⇒ **THIS is where to look!**