Hi!

Simplifying life with simplified models

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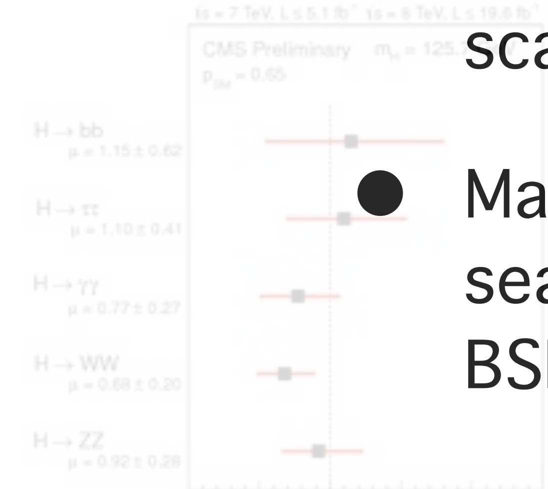
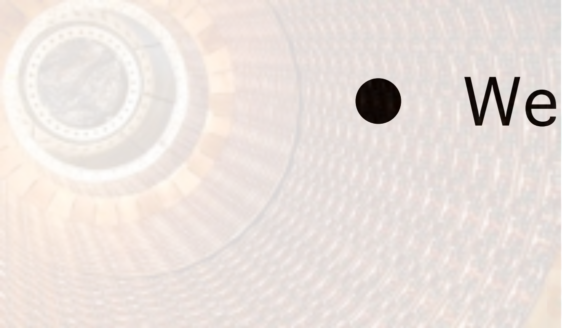
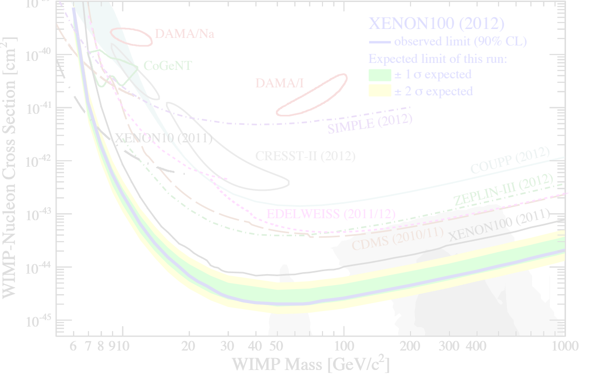
based on:
arXiv: 1312.4175
S. Kraml, U. Laa, A. Lessa, W. Magerl, D. Proschofsky, W. Waltenberger
and
arXiv: 1308.3735
G. Belanger, G. Drieu La Rochelle, B. Dumont, R. Godbole, S. Kraml

The scene






- Hunt for BSM physics is strong from the smallest to largest scales
- Many new and interesting results from astrophysics and collider searches exist and they must be taken into account to test a BSM theory
- Many BSM theories and no conclusive evidence for any of them
- We expect emergence of new physics at TeV scale

The LHC BSM frontier

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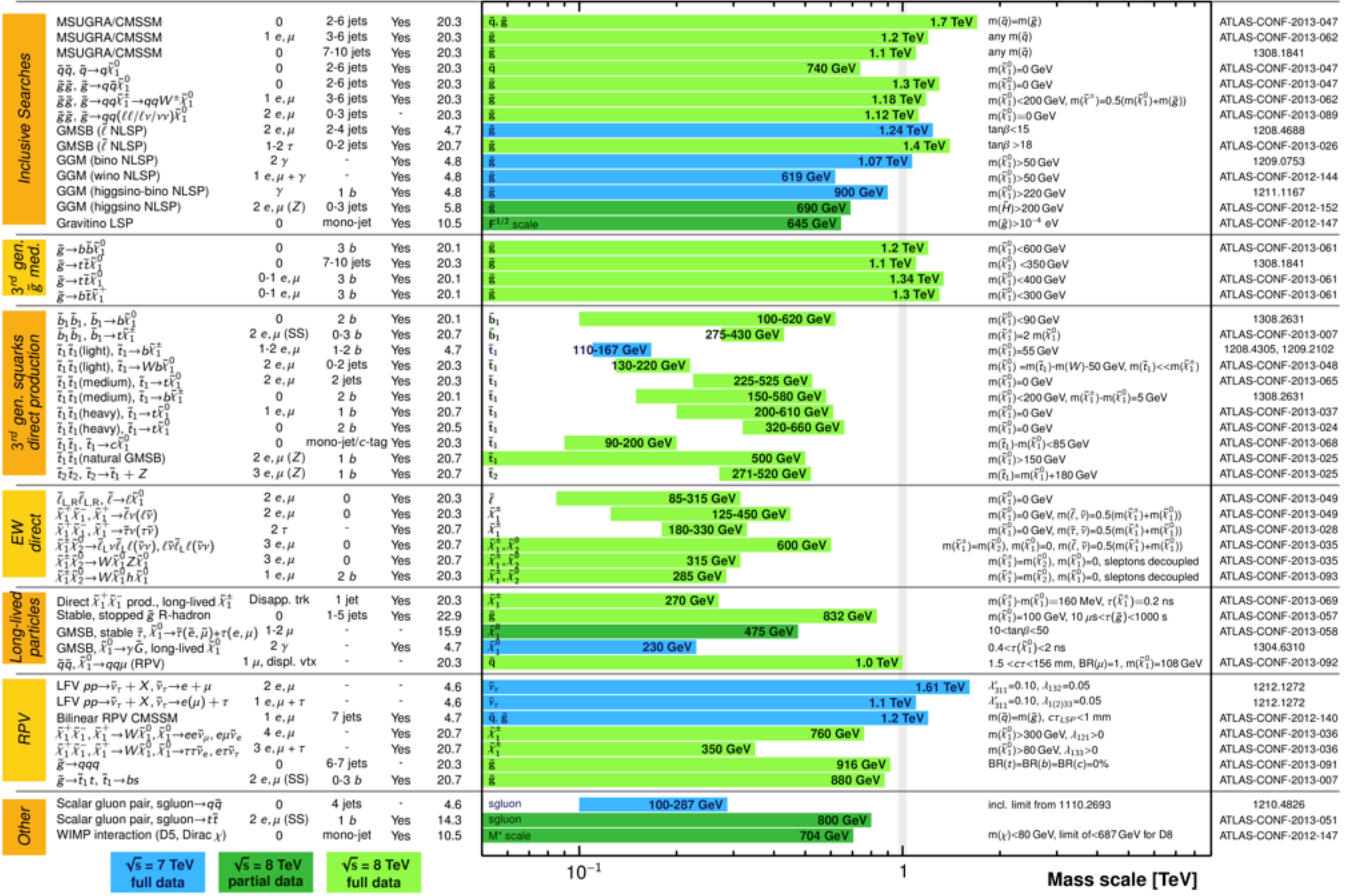
... is it?

ATLAS SUSY Searches* - 95% CL Lower Limits

Status: SUSY 2013

ATLAS Preliminary

$\int \mathcal{L}\, dt = (4.6 - 22.9)\ \mathrm{fb}^{-1}$ $\sqrt{s} = 7, 8$ TeV



	Model	e, μ, τ, γ	Jets	E_T^{miss}	$\int \mathcal{L}\, dt[\mathrm{fb}^{-1}]$	Mass limit		Reference
Inclusive Searches	MSUGRA/CMSSM	0	2-6 jets	Yes	20.3	$\tilde{q}, \tilde{g}$ 1.7 TeV	$m(\tilde{q})=m(\tilde{g})$	ATLAS-CONF-2013-047
	MSUGRA/CMSSM	1 e,μ	3-6 jets	Yes	20.3	$\tilde{g}$ 1.2 TeV	any $m(\tilde{q})$	ATLAS-CONF-2013-062
	MSUGRA/CMSSM	0	7-10 jets	Yes	20.3	$\tilde{g}$ 1.1 TeV	any $m(\tilde{q})$	1308.1841
	$\tilde{q}\tilde{q}, \tilde{q}\rightarrow q\tilde{\chi}_1^0$	0	2-6 jets	Yes	20.3	$\tilde{q}$ 740 GeV	$m(\tilde{\chi}_1^0)$=0 GeV	ATLAS-CONF-2013-047
	$\tilde{g}\tilde{g}, \tilde{g}\rightarrow q\bar{q}\tilde{\chi}_1^0$	0	2-6 jets	Yes	20.3	$\tilde{g}$ 1.3 TeV	$m(\tilde{\chi}_1^0)$=0 GeV	ATLAS-CONF-2013-047
	$\tilde{g}\tilde{g}, \tilde{g}\rightarrow qq\tilde{\chi}_1^{\pm}\rightarrow qqW^{\pm}\tilde{\chi}_1^0$	1 e,μ	3-6 jets	Yes	20.3	$\tilde{g}$ 1.18 TeV	$m(\tilde{\chi}_1^0)$<200 GeV, $m(\tilde{\chi}^{\pm})=0.5(m(\tilde{\chi}_1^0)+m(\tilde{g}))$	ATLAS-CONF-2013-062
	$\tilde{g}\tilde{g}, \tilde{g}\rightarrow qq(\ell\ell/\ell\nu/\nu\nu)\tilde{\chi}_1^0$	2 e,μ	0-3 jets	-	20.3	$\tilde{g}$ 1.12 TeV	$m(\tilde{\chi}_1^0)$=0 GeV	ATLAS-CONF-2013-089
	GMSB ($\tilde{\ell}$ NLSP)	2 e,μ	2-4 jets	Yes	4.7	$\tilde{g}$ 1.24 TeV	$\tan\beta$<15	1208.4688
	GMSB ($\tilde{\ell}$ NLSP)	1-2 τ	0-2 jets	Yes	20.7	$\tilde{g}$ 1.4 TeV	$\tan\beta$ >18	ATLAS-CONF-2013-026
	GGM (bino NLSP)	2 γ	-	Yes	4.8	$\tilde{g}$ 1.07 TeV	$m(\tilde{\chi}_1^0)$>50 GeV	1209.0753
	GGM (wino NLSP)	1 $e,\mu+\gamma$	-	Yes	4.8	$\tilde{g}$ 619 GeV	$m(\tilde{\chi}_1^0)$>50 GeV	ATLAS-CONF-2012-144
	GGM (higgsino-bino NLSP)	γ	1 b	Yes	4.8	$\tilde{g}$ 900 GeV	$m(\tilde{\chi}_1^0)$>220 GeV	1211.1167
	GGM (higgsino NLSP)	2 e,μ (Z)	0-3 jets	Yes	5.8	$\tilde{g}$ 690 GeV	$m(\tilde{H})$>200 GeV	ATLAS-CONF-2012-152
	Gravitino LSP	0	mono-jet	Yes	10.5	$F^{1/2}$ scale 645 GeV	$m(\tilde{g})>10^{-4}$ eV	ATLAS-CONF-2012-147
3rd gen. $\tilde{g}$ med.	$\tilde{g}\rightarrow b\bar{b}\tilde{\chi}_1^0$	0	3 b	Yes	20.1	$\tilde{g}$ 1.2 TeV	$m(\tilde{\chi}_1^0)$<600 GeV	ATLAS-CONF-2013-061
	$\tilde{g}\rightarrow t\bar{t}\tilde{\chi}_1^0$	0	7-10 jets	Yes	20.3	$\tilde{g}$ 1.1 TeV	$m(\tilde{\chi}_1^0)$ <350 GeV	1308.1841
	$\tilde{g}\rightarrow t\bar{t}\tilde{\chi}_1^0$	0-1 e,μ	3 b	Yes	20.1	$\tilde{g}$ 1.34 TeV	$m(\tilde{\chi}_1^0)$<400 GeV	ATLAS-CONF-2013-061
	$\tilde{g}\rightarrow b\bar{t}\tilde{\chi}_1^+$	0-1 e,μ	3 b	Yes	20.1	$\tilde{g}$ 1.3 TeV	$m(\tilde{\chi}_1^0)$<300 GeV	ATLAS-CONF-2013-061
3rd gen. squarks direct production	$\tilde{b}_1\tilde{b}_1, \tilde{b}_1\rightarrow b\tilde{\chi}_1^0$	0	2 b	Yes	20.1	$\tilde{b}_1$ 100-620 GeV	$m(\tilde{\chi}_1^0)$<90 GeV	1308.2631
	$\tilde{b}_1\tilde{b}_1, \tilde{b}_1\rightarrow t\tilde{\chi}_1^{\pm}$	2 e,μ (SS)	0-3 b	Yes	20.7	$\tilde{b}_1$ 275-430 GeV	$m(\tilde{\chi}_1^{\pm})=2\,m(\tilde{\chi}_1^0)$	ATLAS-CONF-2013-007
	$\tilde{t}_1\tilde{t}_1$(light), $\tilde{t}_1\rightarrow b\tilde{\chi}_1^{\pm}$	1-2 e,μ	1-2 b	Yes	4.7	$\tilde{t}_1$ 110-167 GeV	$m(\tilde{\chi}_1^0)$=55 GeV	1208.4305, 1209.2102
	$\tilde{t}_1\tilde{t}_1$(light), $\tilde{t}_1\rightarrow Wb\tilde{\chi}_1^0$	2 e,μ	0-2 jets	Yes	20.3	$\tilde{t}_1$ 130-220 GeV	$m(\tilde{\chi}_1^0)$ $=m(\tilde{t}_1)-m(W)$-50 GeV, $m(\tilde{t}_1)<<m(\tilde{\chi}_1^{\pm})$	ATLAS-CONF-2013-048
	$\tilde{t}_1\tilde{t}_1$(medium), $\tilde{t}_1\rightarrow t\tilde{\chi}_1^0$	2 e,μ	2 jets	Yes	20.3	$\tilde{t}_1$ 225-525 GeV	$m(\tilde{\chi}_1^0)$=0 GeV	ATLAS-CONF-2013-065
	$\tilde{t}_1\tilde{t}_1$(medium), $\tilde{t}_1\rightarrow b\tilde{\chi}_1^{\pm}$	0	2 b	Yes	20.1	$\tilde{t}_1$ 150-580 GeV	$m(\tilde{\chi}_1^0)$<200 GeV, $m(\tilde{\chi}_1^{\pm})-m(\tilde{\chi}_1^0)$=5 GeV	1308.2631
	$\tilde{t}_1\tilde{t}_1$(heavy), $\tilde{t}_1\rightarrow t\tilde{\chi}_1^0$	1 e,μ	1 b	Yes	20.7	$\tilde{t}_1$ 200-610 GeV	$m(\tilde{\chi}_1^0)$=0 GeV	ATLAS-CONF-2013-037
	$\tilde{t}_1\tilde{t}_1$(heavy), $\tilde{t}_1\rightarrow t\tilde{\chi}_1^0$	0	2 b	Yes	20.5	$\tilde{t}_1$ 320-660 GeV	$m(\tilde{\chi}_1^0)$=0 GeV	ATLAS-CONF-2013-024
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\rightarrow c\tilde{\chi}_1^0$	0	mono-jet/c-tag	Yes	20.3	$\tilde{t}_1$ 90-200 GeV	$m(\tilde{t}_1)-m(\tilde{\chi}_1^0)$<85 GeV	ATLAS-CONF-2013-068
	$\tilde{t}_1\tilde{t}_1$(natural GMSB)	2 e,μ (Z)	1 b	Yes	20.7	$\tilde{t}_1$ 500 GeV	$m(\tilde{\chi}_1^0)$>150 GeV	ATLAS-CONF-2013-025
	$\tilde{t}_2\tilde{t}_2, \tilde{t}_2\rightarrow\tilde{t}_1+Z$	3 e,μ (Z)	1 b	Yes	20.7	$\tilde{t}_2$ 271-520 GeV	$m(\tilde{t}_1)=m(\tilde{\chi}_1^0)$+180 GeV	ATLAS-CONF-2013-025
EW direct	$\tilde{\ell}_{\mathrm{L,R}}\tilde{\ell}_{\mathrm{L,R}}, \tilde{\ell}\rightarrow\ell\tilde{\chi}_1^0$	2 e,μ	0	Yes	20.3	$\tilde{\ell}$ 85-315 GeV	$m(\tilde{\chi}_1^0)$=0 GeV	ATLAS-CONF-2013-049
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\rightarrow\tilde{\ell}\nu(\ell\tilde{\nu})$	2 e,μ	0	Yes	20.3	$\tilde{\chi}_1^{\pm}$ 125-450 GeV	$m(\tilde{\chi}_1^0)$=0 GeV, $m(\tilde{\ell},\tilde{\nu})=0.5(m(\tilde{\chi}_1^{\pm})+m(\tilde{\chi}_1^0))$	ATLAS-CONF-2013-049
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\rightarrow\tilde{\tau}\nu(\tau\tilde{\nu})$	2 τ	-	Yes	20.7	$\tilde{\chi}_1^{\pm}$ 180-330 GeV	$m(\tilde{\chi}_1^0)$=0 GeV, $m(\tilde{\tau},\tilde{\nu})=0.5(m(\tilde{\chi}_1^{\pm})+m(\tilde{\chi}_1^0))$	ATLAS-CONF-2013-028
	$\tilde{\chi}_1^{\pm}\tilde{\chi}_2^0\rightarrow\tilde{\ell}_{\mathrm{L}}\nu\tilde{\ell}_{\mathrm{L}}\ell(\tilde{\nu}\nu), \ell\tilde{\nu}\tilde{\ell}_{\mathrm{L}}\ell(\tilde{\nu}\nu)$	3 e,μ	0	Yes	20.7	$\tilde{\chi}_1^{\pm}, \tilde{\chi}_2^0$ 600 GeV	$m(\tilde{\chi}_1^{\pm})=m(\tilde{\chi}_2^0)$, $m(\tilde{\chi}_1^0)=0$, $m(\tilde{\ell},\tilde{\nu})=0.5(m(\tilde{\chi}_1^{\pm})+m(\tilde{\chi}_1^0))$	ATLAS-CONF-2013-035
	$\tilde{\chi}_1^{\pm}\tilde{\chi}_2^0\rightarrow W\tilde{\chi}_1^0Z\tilde{\chi}_1^0$	3 e,μ	0	Yes	20.7	$\tilde{\chi}_1^{\pm}, \tilde{\chi}_2^0$ 315 GeV	$m(\tilde{\chi}_1^{\pm})=m(\tilde{\chi}_2^0)$, $m(\tilde{\chi}_1^0)=0$, sleptons decoupled	ATLAS-CONF-2013-035
	$\tilde{\chi}_1^{\pm}\tilde{\chi}_2^0\rightarrow W\tilde{\chi}_1^0h\tilde{\chi}_1^0$	1 e,μ	2 b	Yes	20.3	$\tilde{\chi}_1^{\pm}, \tilde{\chi}_2^0$ 285 GeV	$m(\tilde{\chi}_1^{\pm})=m(\tilde{\chi}_2^0)$, $m(\tilde{\chi}_1^0)=0$, sleptons decoupled	ATLAS-CONF-2013-093
Long-lived particles	Direct $\tilde{\chi}_1^+\tilde{\chi}_1^-$ prod., long-lived $\tilde{\chi}_1^{\pm}$	Disapp. trk	1 jet	Yes	20.3	$\tilde{\chi}_1^{\pm}$ 270 GeV	$m(\tilde{\chi}_1^{\pm})-m(\tilde{\chi}_1^0)$=160 MeV, $\tau(\tilde{\chi}_1^{\pm})$=0.2 ns	ATLAS-CONF-2013-069
	Stable, stopped $\tilde{g}$ R-hadron	0	1-5 jets	Yes	22.9	$\tilde{g}$ 832 GeV	$m(\tilde{\chi}_1^0)$=100 GeV, 10 μs<$\tau(\tilde{g})$<1000 s	ATLAS-CONF-2013-057
	GMSB, stable $\tilde{\tau}$, $\tilde{\chi}_1^0\rightarrow\tilde{\tau}(\tilde{e},\tilde{\mu})+\tau(e,\mu)$	1-2 μ	-	-	15.9	$\tilde{\chi}_1^0$ 475 GeV	10<$\tan\beta$<50	ATLAS-CONF-2013-058
	GMSB, $\tilde{\chi}_1^0\rightarrow\gamma\tilde{G}$, long-lived $\tilde{\chi}_1^0$	2 γ	-	Yes	4.7	$\tilde{\chi}_1^0$ 230 GeV	0.4<$\tau(\tilde{\chi}_1^0)$<2 ns	1304.6310
	$\tilde{q}\tilde{q}, \tilde{\chi}_1^0\rightarrow qq\mu$ (RPV)	1 μ, displ. vtx	-	-	20.3	$\tilde{q}$ 1.0 TeV	1.5 <$c\tau$<156 mm, BR(μ)=1, $m(\tilde{\chi}_1^0)$=108 GeV	ATLAS-CONF-2013-092
RPV	LFV $pp\rightarrow\tilde{\nu}_{\tau}+X, \tilde{\nu}_{\tau}\rightarrow e+\mu$	2 e,μ	-	-	4.6	$\tilde{\nu}_{\tau}$ 1.61 TeV	λ'_{311}=0.10, λ_{132}=0.05	1212.1272
	LFV $pp\rightarrow\tilde{\nu}_{\tau}+X, \tilde{\nu}_{\tau}\rightarrow e(\mu)+\tau$	1 $e,\mu+\tau$	-	-	4.6	$\tilde{\nu}_{\tau}$ 1.1 TeV	λ'_{311}=0.10, $\lambda_{1(2)33}$=0.05	1212.1272
	Bilinear RPV CMSSM	1 e,μ	7 jets	Yes	4.7	$\tilde{q}, \tilde{g}$ 1.2 TeV	$m(\tilde{q})=m(\tilde{g})$, $c\tau_{LSP}$<1 mm	ATLAS-CONF-2012-140
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\rightarrow W\tilde{\chi}_1^0, \tilde{\chi}_1^0\rightarrow ee\tilde{\nu}_{\mu}, e\mu\tilde{\nu}_e$	4 e,μ	-	Yes	20.7	$\tilde{\chi}_1^{\pm}$ 760 GeV	$m(\tilde{\chi}_1^0)$>300 GeV, λ_{121}>0	ATLAS-CONF-2013-036
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\rightarrow W\tilde{\chi}_1^0, \tilde{\chi}_1^0\rightarrow\tau\tau\tilde{\nu}_e, e\tau\tilde{\nu}_{\tau}$	3 $e,\mu+\tau$	-	Yes	20.7	$\tilde{\chi}_1^{\pm}$ 350 GeV	$m(\tilde{\chi}_1^0)$>80 GeV, λ_{133}>0	ATLAS-CONF-2013-036
	$\tilde{g}\rightarrow qqq$	0	6-7 jets	-	20.3	$\tilde{g}$ 916 GeV	BR(t)=BR(b)=BR(c)=0%	ATLAS-CONF-2013-091
	$\tilde{g}\rightarrow\tilde{t}_1t, \tilde{t}_1\rightarrow bs$	2 e,μ (SS)	0-3 b	Yes	20.7	$\tilde{g}$ 880 GeV		ATLAS-CONF-2013-007
Other	Scalar gluon pair, sgluon$\rightarrow q\bar{q}$	0	4 jets	-	4.6	sgluon 100-287 GeV	incl. limit from 1110.2693	1210.4826
	Scalar gluon pair, sgluon$\rightarrow t\bar{t}$	2 e,μ (SS)	1 b	Yes	14.3	sgluon 800 GeV		ATLAS-CONF-2013-051
	WIMP interaction (D5, Dirac χ)	0	mono-jet	Yes	10.5	M* scale 704 GeV	$m(\chi)$<80 GeV, limit of<687 GeV for D8	ATLAS-CONF-2012-147

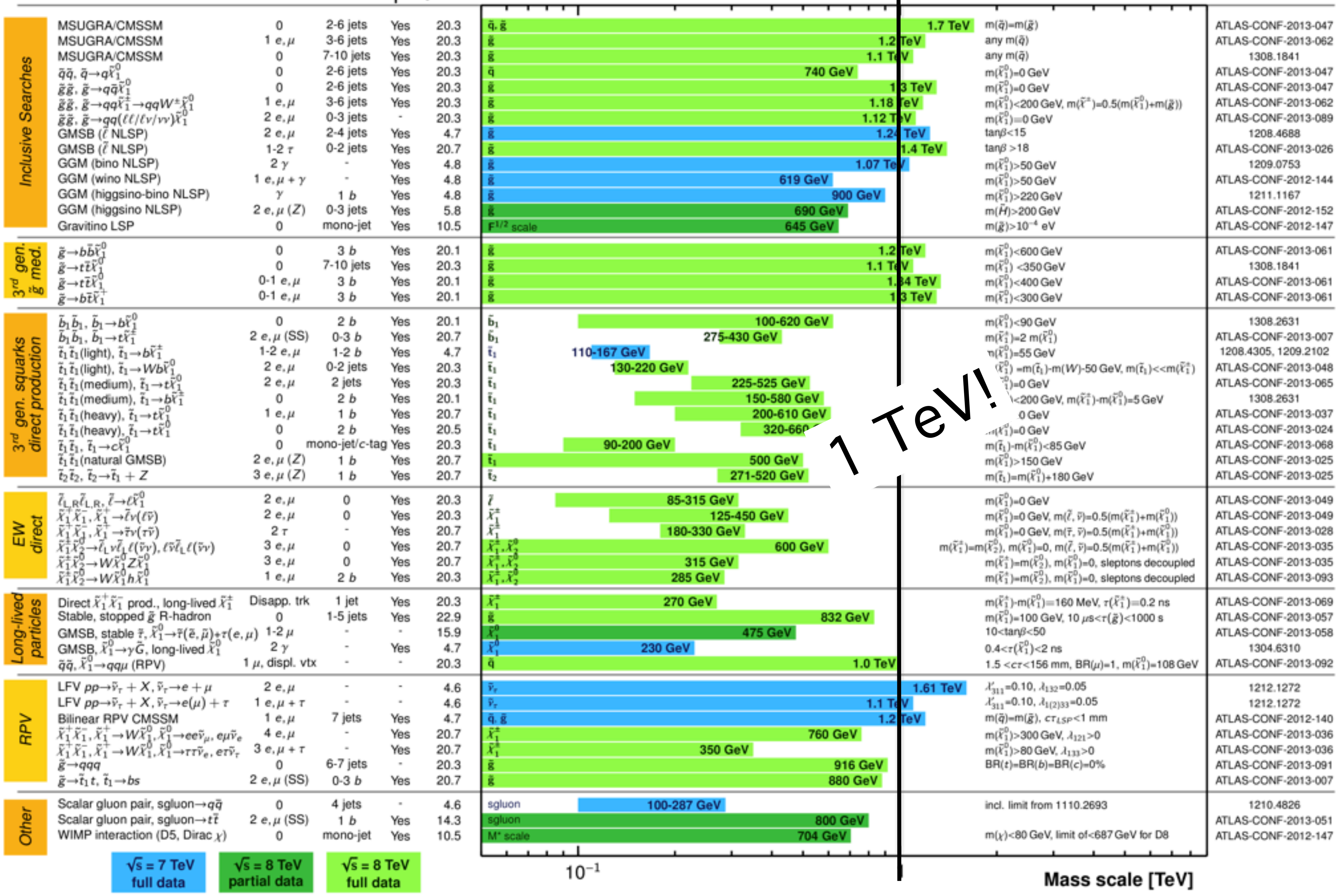
*Only a selection of the available mass limits on new states or phenomena is shown. All limits quoted are observed minus 1σ theoretical signal cross section uncertainty.

ATLAS SUSY Searches* - 95% CL Lower Limits

Status: SUSY 2013

ATLAS Preliminary

$\int \mathcal{L}\,dt = (4.6 - 22.9)$ fb^{-1} $\sqrt{s}$ = 7, 8 TeV



	Model	e, μ, τ, γ	Jets	E_T^{miss}	$\int \mathcal{L}\,dt[\mathrm{fb}^{-1}]$	Mass limit			Reference
Inclusive Searches	MSUGRA/CMSSM	0	2-6 jets	Yes	20.3	$\tilde{q}, \tilde{g}$	1.7 TeV	$m(\tilde{q})=m(\tilde{g})$	ATLAS-CONF-2013-047
	MSUGRA/CMSSM	1 e, μ	3-6 jets	Yes	20.3	$\tilde{g}$	1.2 TeV	any $m(\tilde{q})$	ATLAS-CONF-2013-062
	MSUGRA/CMSSM	0	7-10 jets	Yes	20.3	$\tilde{g}$	1.1 TeV	any $m(\tilde{q})$	1308.1841
	$\tilde{q}\tilde{q}, \tilde{q}\rightarrow q\tilde{\chi}_1^0$	0	2-6 jets	Yes	20.3	$\tilde{q}$	740 GeV	$m(\tilde{\chi}_1^0)$=0 GeV	ATLAS-CONF-2013-047
	$\tilde{g}\tilde{g}, \tilde{g}\rightarrow q\bar{q}\tilde{\chi}_1^0$	0	2-6 jets	Yes	20.3	$\tilde{g}$	1.3 TeV	$m(\tilde{\chi}_1^0)$=0 GeV	ATLAS-CONF-2013-047
	$\tilde{g}\tilde{g}, \tilde{g}\rightarrow qq\tilde{\chi}_1^\pm\rightarrow qqW^\pm\tilde{\chi}_1^0$	1 e, μ	3-6 jets	Yes	20.3	$\tilde{g}$	1.18 TeV	$m(\tilde{\chi}_1^0)$<200 GeV, $m(\tilde{\chi}^\pm)=0.5(m(\tilde{\chi}_1^0)+m(\tilde{g}))$	ATLAS-CONF-2013-062
	$\tilde{g}\tilde{g}, \tilde{g}\rightarrow qq(\ell\ell/\ell\nu/\nu\nu)\tilde{\chi}_1^0$	2 e, μ	0-3 jets	-	20.3	$\tilde{g}$	1.12 TeV	$m(\tilde{\chi}_1^0)$=0 GeV	ATLAS-CONF-2013-089
	GMSB ($\tilde{\ell}$ NLSP)	2 e, μ	2-4 jets	Yes	4.7	$\tilde{g}$	1.24 TeV	$\tan\beta$<15	1208.4688
	GMSB ($\tilde{\tau}$ NLSP)	1-2 τ	0-2 jets	Yes	20.7	$\tilde{g}$	1.4 TeV	$\tan\beta$ >18	ATLAS-CONF-2013-026
	GGM (bino NLSP)	2 γ	-	Yes	4.8	$\tilde{g}$	1.07 TeV	$m(\tilde{\chi}_1^0)$>50 GeV	1209.0753
	GGM (wino NLSP)	1 $e, \mu + \gamma$	-	Yes	4.8	$\tilde{g}$	619 GeV	$m(\tilde{\chi}_1^0)$>50 GeV	ATLAS-CONF-2012-144
	GGM (higgsino-bino NLSP)	γ	1 b	Yes	4.8	$\tilde{g}$	900 GeV	$m(\tilde{\chi}_1^0)$>220 GeV	1211.1167
	GGM (higgsino NLSP)	2 e, μ (Z)	0-3 jets	Yes	5.8	$\tilde{g}$	690 GeV	$m(\tilde{H})$>200 GeV	ATLAS-CONF-2012-152
	Gravitino LSP	0	mono-jet	Yes	10.5	F$^{1/2}$ scale	645 GeV	$m(\tilde{g})>10^{-4}$ eV	ATLAS-CONF-2012-147
3rd gen. $\tilde{g}$ med.	$\tilde{g}\rightarrow b\bar{b}\tilde{\chi}_1^0$	0	3 b	Yes	20.1	$\tilde{g}$	1.2 TeV	$m(\tilde{\chi}_1^0)$<600 GeV	ATLAS-CONF-2013-061
	$\tilde{g}\rightarrow t\bar{t}\tilde{\chi}_1^0$	0	7-10 jets	Yes	20.3	$\tilde{g}$	1.1 TeV	$m(\tilde{\chi}_1^0)$ <350 GeV	1308.1841
	$\tilde{g}\rightarrow t\bar{t}\tilde{\chi}_1^0$	0-1 e, μ	3 b	Yes	20.1	$\tilde{g}$	1.34 TeV	$m(\tilde{\chi}_1^0)$<400 GeV	ATLAS-CONF-2013-061
	$\tilde{g}\rightarrow b\bar{t}\tilde{\chi}_1^+$	0-1 e, μ	3 b	Yes	20.1	$\tilde{g}$	1.3 TeV	$m(\tilde{\chi}_1^0)$<300 GeV	ATLAS-CONF-2013-061
3rd gen. squarks direct production	$\tilde{b}_1\tilde{b}_1, \tilde{b}_1\rightarrow b\tilde{\chi}_1^0$	0	2 b	Yes	20.1	$\tilde{b}_1$	100-620 GeV	$m(\tilde{\chi}_1^0)$<90 GeV	1308.2631
	$\tilde{b}_1\tilde{b}_1, \tilde{b}_1\rightarrow t\tilde{\chi}_1^\pm$	2 e, μ (SS)	0-3 b	Yes	20.7	$\tilde{b}_1$	275-430 GeV	$m(\tilde{\chi}_1^\pm)=2\ m(\tilde{\chi}_1^0)$	ATLAS-CONF-2013-007
	$\tilde{t}_1\tilde{t}_1$(light), $\tilde{t}_1\rightarrow b\tilde{\chi}_1^\pm$	1-2 e, μ	1-2 b	Yes	4.7	$\tilde{t}_1$	110-167 GeV	$m(\tilde{\chi}_1^0)$=55 GeV	1208.4305, 1209.2102
	$\tilde{t}_1\tilde{t}_1$(light), $\tilde{t}_1\rightarrow Wb\tilde{\chi}_1^0$	2 e, μ	0-2 jets	Yes	20.3	$\tilde{t}_1$	130-220 GeV	$(\tilde{\chi}_1^0)$ $=m(\tilde{t}_1)-m(W)$-50 GeV, $m(\tilde{t}_1)<<m(\tilde{\chi}_1^\pm)$	ATLAS-CONF-2013-048
	$\tilde{t}_1\tilde{t}_1$(medium), $\tilde{t}_1\rightarrow t\tilde{\chi}_1^0$	2 e, μ	2 jets	Yes	20.3	$\tilde{t}_1$	225-525 GeV	)=0 GeV	ATLAS-CONF-2013-065
	$\tilde{t}_1\tilde{t}_1$(medium), $\tilde{t}_1\rightarrow b\tilde{\chi}_1^\pm$	0	2 b	Yes	20.1	$\tilde{t}_1$	150-580 GeV	<200 GeV, $m(\tilde{\chi}_1^\pm)-m(\tilde{\chi}_1^0)$=5 GeV	1308.2631
	$\tilde{t}_1\tilde{t}_1$(heavy), $\tilde{t}_1\rightarrow t\tilde{\chi}_1^0$	1 e, μ	1 b	Yes	20.7	$\tilde{t}_1$	200-610 GeV	0 GeV	ATLAS-CONF-2013-037
	$\tilde{t}_1\tilde{t}_1$(heavy), $\tilde{t}_1\rightarrow t\tilde{\chi}_1^0$	0	2 b	Yes	20.5	$\tilde{t}_1$	320-660	$(\tilde{\chi}_1^0)$=0 GeV	ATLAS-CONF-2013-024
	$\tilde{t}_1\tilde{t}_1, \tilde{t}_1\rightarrow c\tilde{\chi}_1^0$	0	mono-jet/c-tag	Yes	20.3	$\tilde{t}_1$	90-200 GeV	$m(\tilde{t}_1)-m(\tilde{\chi}_1^0)$<85 GeV	ATLAS-CONF-2013-068
	$\tilde{t}_1\tilde{t}_1$(natural GMSB)	2 e, μ (Z)	1 b	Yes	20.7	$\tilde{t}_1$	500 GeV	$m(\tilde{\chi}_1^0)$>150 GeV	ATLAS-CONF-2013-025
	$\tilde{t}_2\tilde{t}_2, \tilde{t}_2\rightarrow\tilde{t}_1 + Z$	3 e, μ (Z)	1 b	Yes	20.7	$\tilde{t}_2$	271-520 GeV	$m(\tilde{t}_1)=m(\tilde{\chi}_1^0)$+180 GeV	ATLAS-CONF-2013-025
EW direct	$\tilde{\ell}_{L,R}\tilde{\ell}_{L,R}, \tilde{\ell}\rightarrow\ell\tilde{\chi}_1^0$	2 e, μ	0	Yes	20.3	$\tilde{\ell}$	85-315 GeV	$m(\tilde{\chi}_1^0)$=0 GeV	ATLAS-CONF-2013-049
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\rightarrow\tilde{\ell}\nu(\ell\tilde{\nu})$	2 e, μ	0	Yes	20.3	$\tilde{\chi}_1^\pm$	125-450 GeV	$m(\tilde{\chi}_1^0)$=0 GeV, $m(\tilde{\ell},\tilde{\nu})=0.5(m(\tilde{\chi}_1^\pm)+m(\tilde{\chi}_1^0))$	ATLAS-CONF-2013-049
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\rightarrow\tilde{\tau}\nu(\tau\tilde{\nu})$	2 τ	-	Yes	20.7	$\tilde{\chi}_1^\pm$	180-330 GeV	$m(\tilde{\chi}_1^0)$=0 GeV, $m(\tilde{\tau},\tilde{\nu})=0.5(m(\tilde{\chi}_1^\pm)+m(\tilde{\chi}_1^0))$	ATLAS-CONF-2013-028
	$\tilde{\chi}_1^\pm\tilde{\chi}_2^0\rightarrow\tilde{\ell}_L\nu\tilde{\ell}_L\ell(\tilde{\nu}\nu), \ell\tilde{\nu}\tilde{\ell}_L\ell(\tilde{\nu}\nu)$	3 e, μ	0	Yes	20.7	$\tilde{\chi}_1^\pm, \tilde{\chi}_2^0$	600 GeV	$m(\tilde{\chi}_1^\pm)=m(\tilde{\chi}_2^0)$, $m(\tilde{\chi}_1^0)$=0, $m(\tilde{\ell},\tilde{\nu})=0.5(m(\tilde{\chi}_1^\pm)+m(\tilde{\chi}_1^0))$	ATLAS-CONF-2013-035
	$\tilde{\chi}_1^\pm\tilde{\chi}_2^0\rightarrow W\tilde{\chi}_1^0Z\tilde{\chi}_1^0$	3 e, μ	0	Yes	20.7	$\tilde{\chi}_1^\pm, \tilde{\chi}_2^0$	315 GeV	$m(\tilde{\chi}_1^\pm)=m(\tilde{\chi}_2^0)$, $m(\tilde{\chi}_1^0)$=0, sleptons decoupled	ATLAS-CONF-2013-035
	$\tilde{\chi}_1^\pm\tilde{\chi}_2^0\rightarrow W\tilde{\chi}_1^0h\tilde{\chi}_1^0$	1 e, μ	2 b	Yes	20.3	$\tilde{\chi}_1^\pm, \tilde{\chi}_2^0$	285 GeV	$m(\tilde{\chi}_1^\pm)=m(\tilde{\chi}_2^0)$, $m(\tilde{\chi}_1^0)$=0, sleptons decoupled	ATLAS-CONF-2013-093
Long-lived particles	Direct $\tilde{\chi}_1^+\tilde{\chi}_1^-$ prod., long-lived $\tilde{\chi}_1^\pm$	Disapp. trk	1 jet	Yes	20.3	$\tilde{\chi}_1^\pm$	270 GeV	$m(\tilde{\chi}_1^\pm)-m(\tilde{\chi}_1^0)$=160 MeV, $\tau(\tilde{\chi}_1^\pm)$=0.2 ns	ATLAS-CONF-2013-069
	Stable, stopped $\tilde{g}$ R-hadron	0	1-5 jets	Yes	22.9	$\tilde{g}$	832 GeV	$m(\tilde{\chi}_1^0)$=100 GeV, 10 μs<$\tau(\tilde{g})$<1000 s	ATLAS-CONF-2013-057
	GMSB, stable $\tilde{\tau}$, $\tilde{\chi}_1^0\rightarrow\tilde{\tau}(\tilde{e},\tilde{\mu})+\tau(e,\mu)$	1-2 μ	-	-	15.9	$\tilde{\chi}_1^0$	475 GeV	10<$\tan\beta$<50	ATLAS-CONF-2013-058
	GMSB, $\tilde{\chi}_1^0\rightarrow\gamma\tilde{G}$, long-lived $\tilde{\chi}_1^0$	2 γ	-	Yes	4.7	$\tilde{\chi}_1^0$	230 GeV	0.4<$\tau(\tilde{\chi}_1^0)$<2 ns	1304.6310
	$\tilde{q}\tilde{q}, \tilde{\chi}_1^0\rightarrow qq\mu$ (RPV)	1 μ, displ. vtx	-	-	20.3	$\tilde{q}$	1.0 TeV	1.5 <$c\tau$<156 mm, BR(μ)=1, $m(\tilde{\chi}_1^0)$=108 GeV	ATLAS-CONF-2013-092
RPV	LFV $pp\rightarrow\tilde{\nu}_\tau + X, \tilde{\nu}_\tau\rightarrow e + \mu$	2 e, μ	-	-	4.6	$\tilde{\nu}_\tau$	1.61 TeV	λ'_{311}=0.10, λ_{132}=0.05	1212.1272
	LFV $pp\rightarrow\tilde{\nu}_\tau + X, \tilde{\nu}_\tau\rightarrow e(\mu) + \tau$	1 $e, \mu + \tau$	-	-	4.6	$\tilde{\nu}_\tau$	1.1 TeV	λ'_{311}=0.10, $\lambda_{1(2)33}$=0.05	1212.1272
	Bilinear RPV CMSSM	1 e, μ	7 jets	Yes	4.7	$\tilde{q}, \tilde{g}$	1.2 TeV	$m(\tilde{q})=m(\tilde{g})$, $c\tau_{LSP}$<1 mm	ATLAS-CONF-2012-140
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\rightarrow W\tilde{\chi}_1^0, \tilde{\chi}_1^0\rightarrow ee\tilde{\nu}_\mu, e\mu\tilde{\nu}_e$	4 e, μ	-	Yes	20.7	$\tilde{\chi}_1^\pm$	760 GeV	$m(\tilde{\chi}_1^0)$>300 GeV, λ_{121}>0	ATLAS-CONF-2013-036
	$\tilde{\chi}_1^+\tilde{\chi}_1^-, \tilde{\chi}_1^+\rightarrow W\tilde{\chi}_1^0, \tilde{\chi}_1^0\rightarrow\tau\tau\tilde{\nu}_e, e\tau\tilde{\nu}_\tau$	3 $e, \mu + \tau$	-	Yes	20.7	$\tilde{\chi}_1^\pm$	350 GeV	$m(\tilde{\chi}_1^0)$>80 GeV, λ_{133}>0	ATLAS-CONF-2013-036
	$\tilde{g}\rightarrow qqq$	0	6-7 jets	-	20.3	$\tilde{g}$	916 GeV	BR(t)=BR(b)=BR(c)=0%	ATLAS-CONF-2013-091
	$\tilde{g}\rightarrow\tilde{t}_1t, \tilde{t}_1\rightarrow bs$	2 e, μ (SS)	0-3 b	Yes	20.7	$\tilde{g}$	880 GeV		ATLAS-CONF-2013-007
Other	Scalar gluon pair, sgluon$\rightarrow q\bar{q}$	0	4 jets	-	4.6	sgluon	100-287 GeV	incl. limit from 1110.2693	1210.4826
	Scalar gluon pair, sgluon$\rightarrow t\bar{t}$	2 e, μ (SS)	1 b	Yes	14.3	sgluon	800 GeV		ATLAS-CONF-2013-051
	WIMP interaction (D5, Dirac χ)	0	mono-jet	Yes	10.5	M* scale	704 GeV	$m(\chi)$<80 GeV, limit of<687 GeV for D8	ATLAS-CONF-2012-147

*Only a selection of the available mass limits on new states or phenomena is shown. All limits quoted are observed minus 1σ theoretical signal cross section uncertainty.

The LHC frontier

- Theoretical model development is influenced by conclusions at 8 TeV, e.g. GUT scale SUSY models like cMSSM are pushed to higher scales and we are thinking of more non-minimal models
- The strategies for 13 TeV results depend on the conclusions at 8 TeV
- It is necessary to interpret the results in the most generic fashion and test as many models as possible

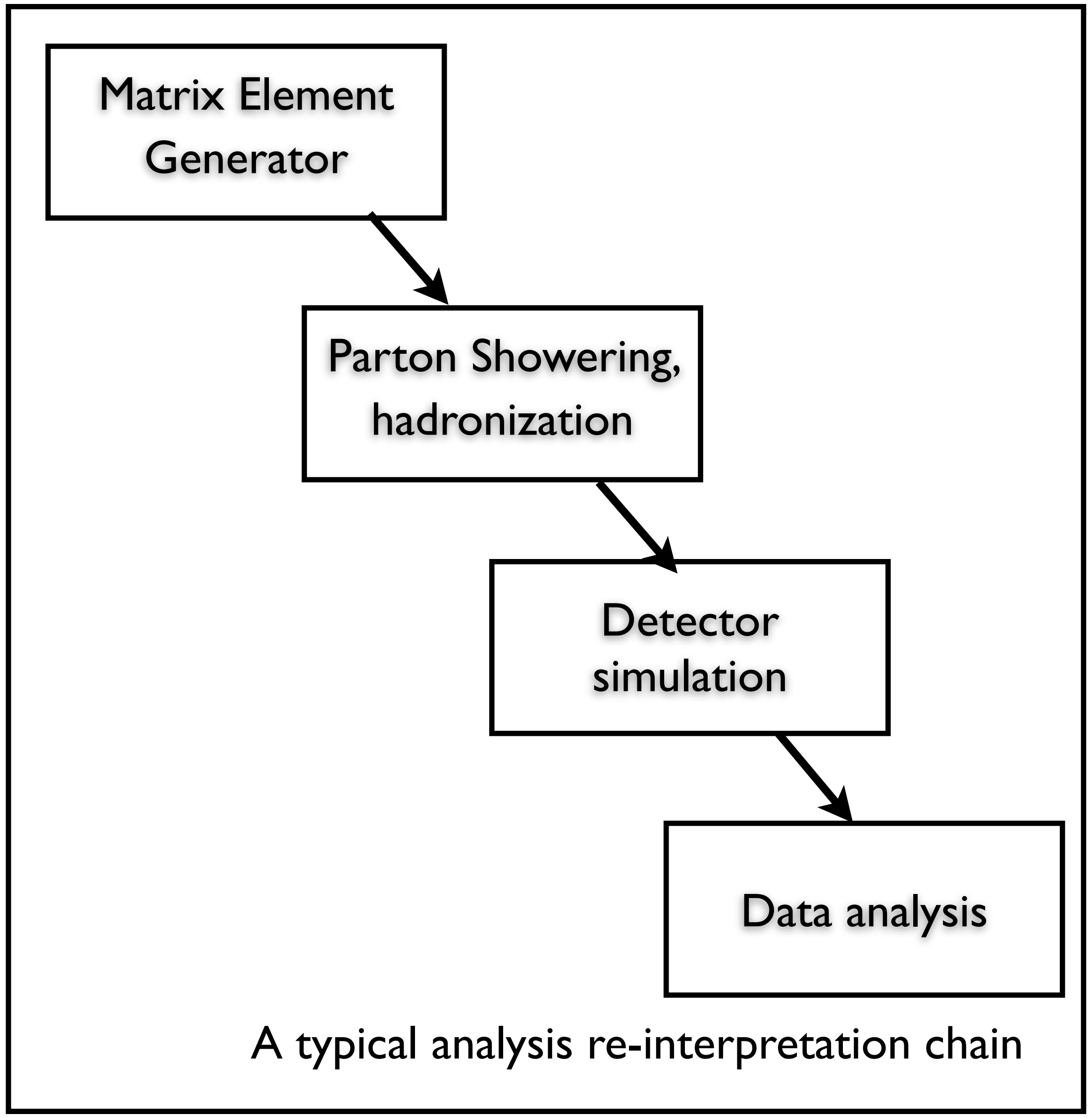
Huge number of searches
Easier said than done!

Analyses statistics (SUSY searches only)

	8 TeV (Any luminosity)	8 TeV (20 fb-1)
ATLAS	39	23
CMS	28	20

- A way to test our favorite BSM model against LHC results should exist

Traditional approach



A typical analysis re-interpretation chain

- Interpretation of LHC searches are model dependent
- Model dependence comes while converting the number of events observed to a limit on particle masses
- For a more generic case:

1. Re-interpret the results yourself
2. Use simplified model spectra

- Re-interpreting the results yourself involves re-implementing the analysis, requires expertise, large computing power, time consuming
- We stick to simplified models results

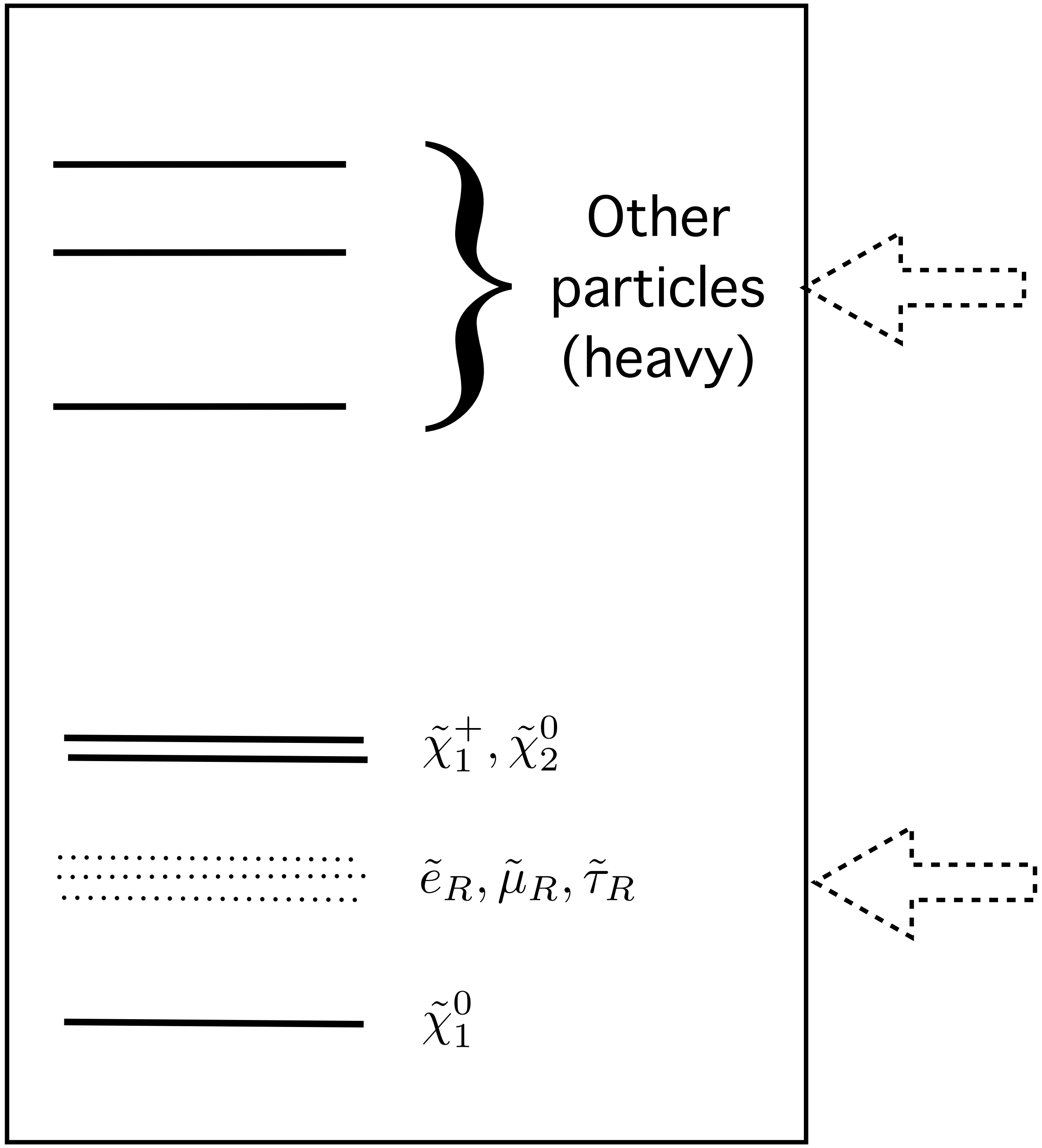
What is an SMS result?

- All SMS results exist for SUSY searches, I stick to SUSY scenario

What is an SMS result?

- Simplified Model Spectra (SMS) are an effective-Lagrangian description of BSM involving a limited set of new particles.

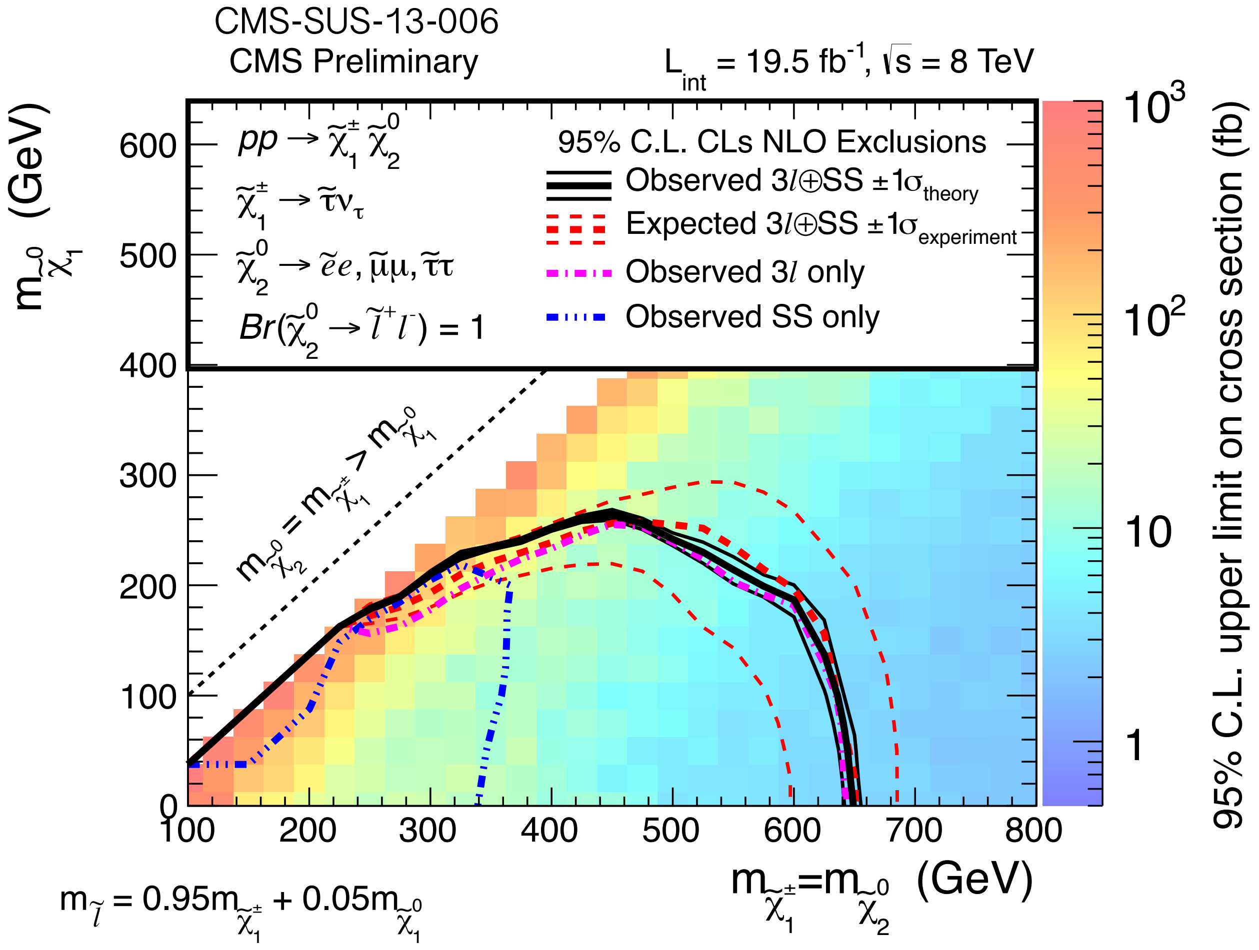
What is an SMS result?



We don’t care about them

Effective theory contains only some electroweak -inos and some sleptons

What is an SMS result?



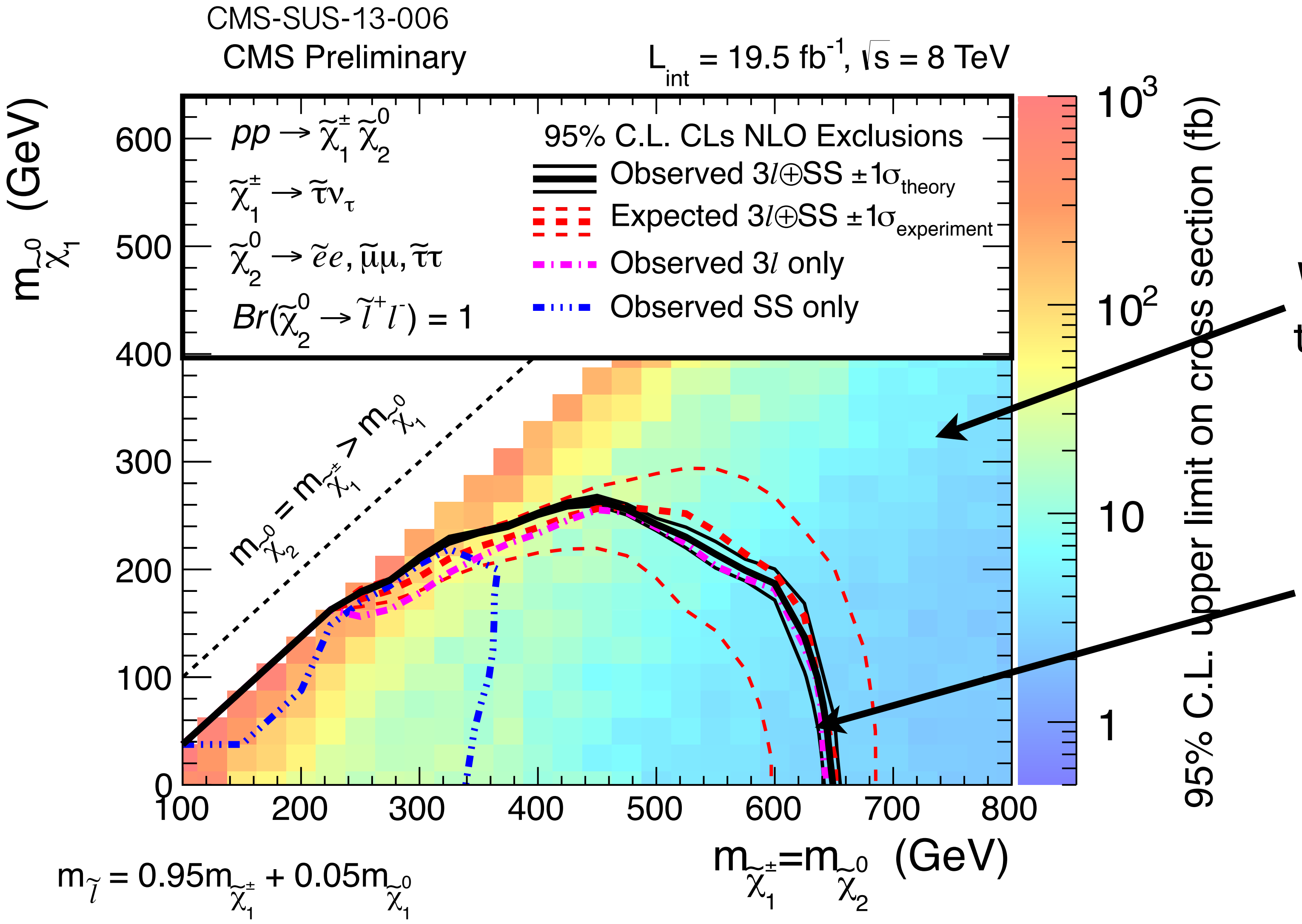
Note: the grid numbers on the plot are more important than the exclusion lines

- Assume all the leptons in this search originate only because of electroweak -ino decays
- Convert the number of events into limit on the cross-section, involves computing acceptance and efficiency

$$N_{evts} = L \times A \times \epsilon \times \sigma \times BR$$

- Every SMS interpretation is based on a set of assumptions and is applicable for specific topologies

How to read an SMS result



We should use these numbers

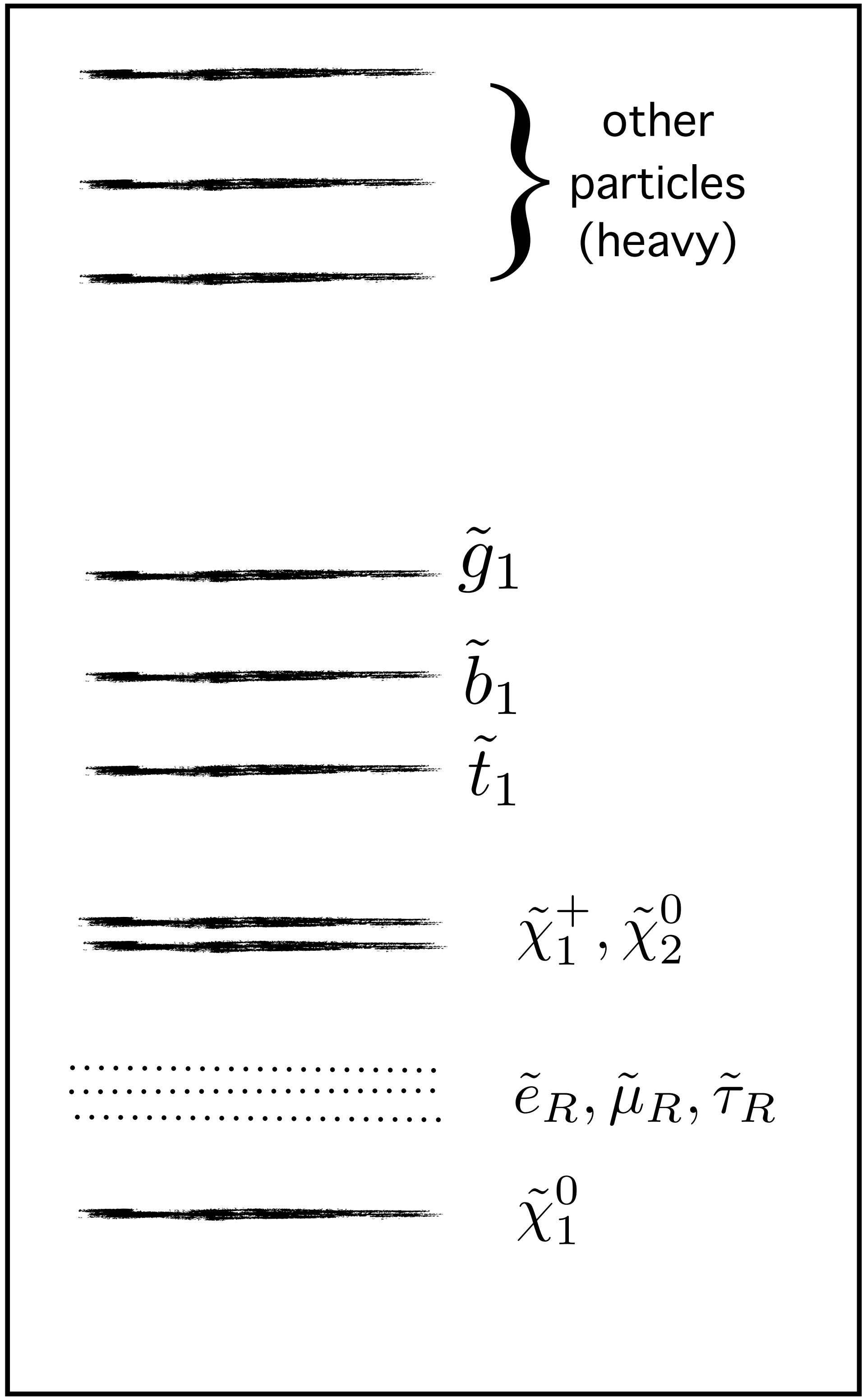
Useful but not the most important outcome

- 95% CL UL is the maximum visible cross-section allowed for a specific decay chain and a mass combination

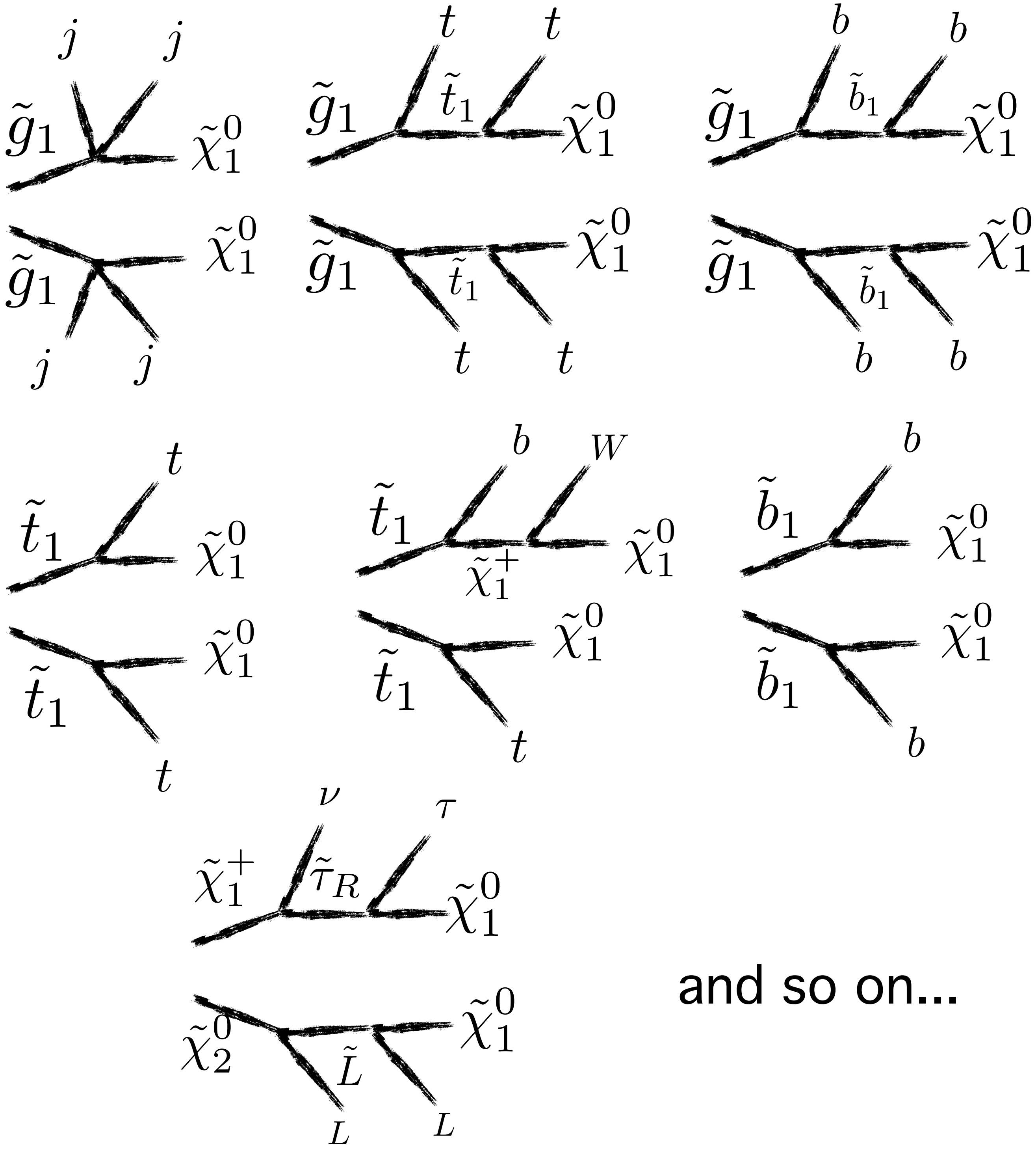
Is sigmaXBR(ttbar + MET, Mother mass, LSP mass) of your model > the number on the plot? -- Yes, point excluded; No, point allowed

Theory space

Arbitrary SUSY spectrum



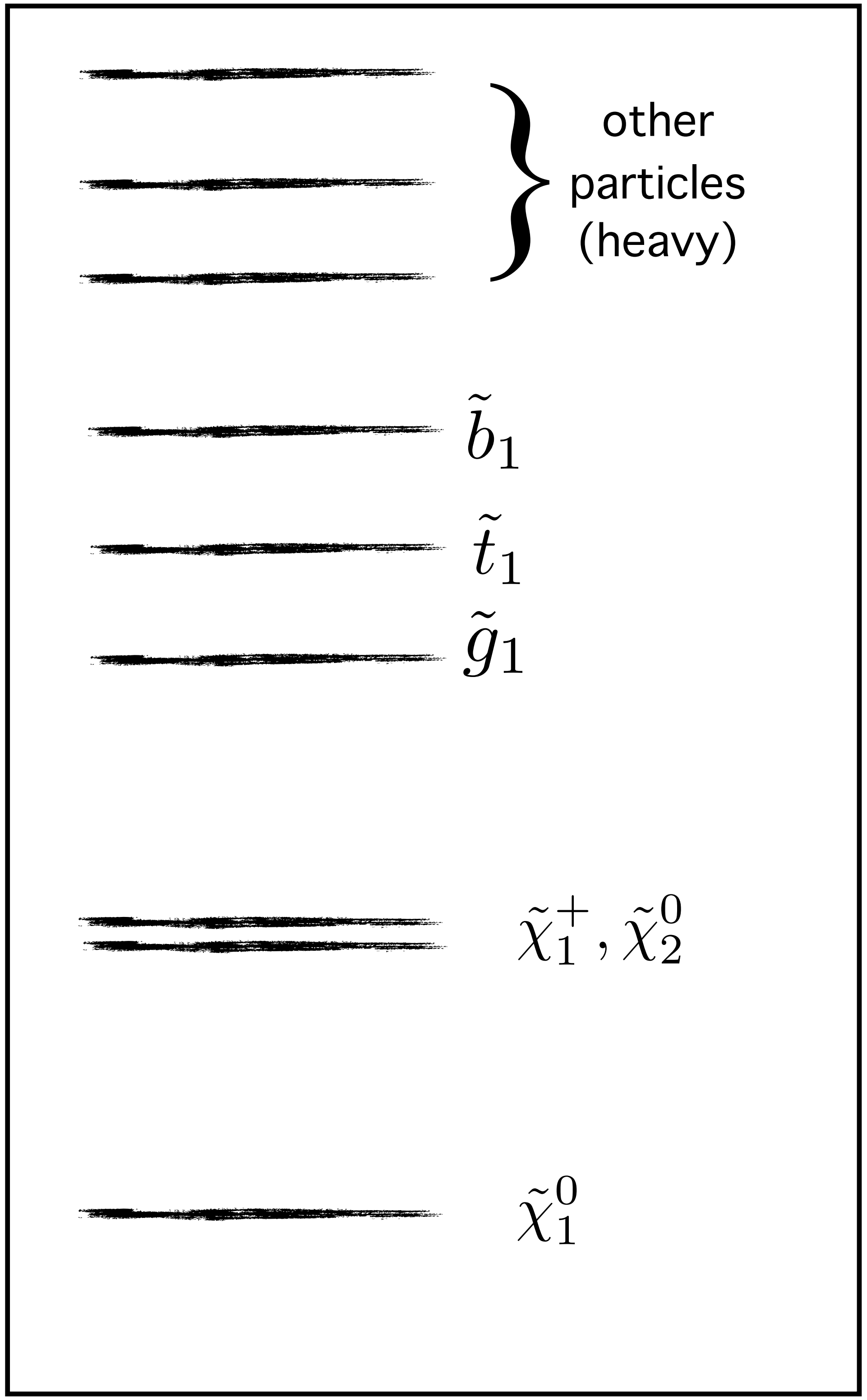
Contains many such topologies



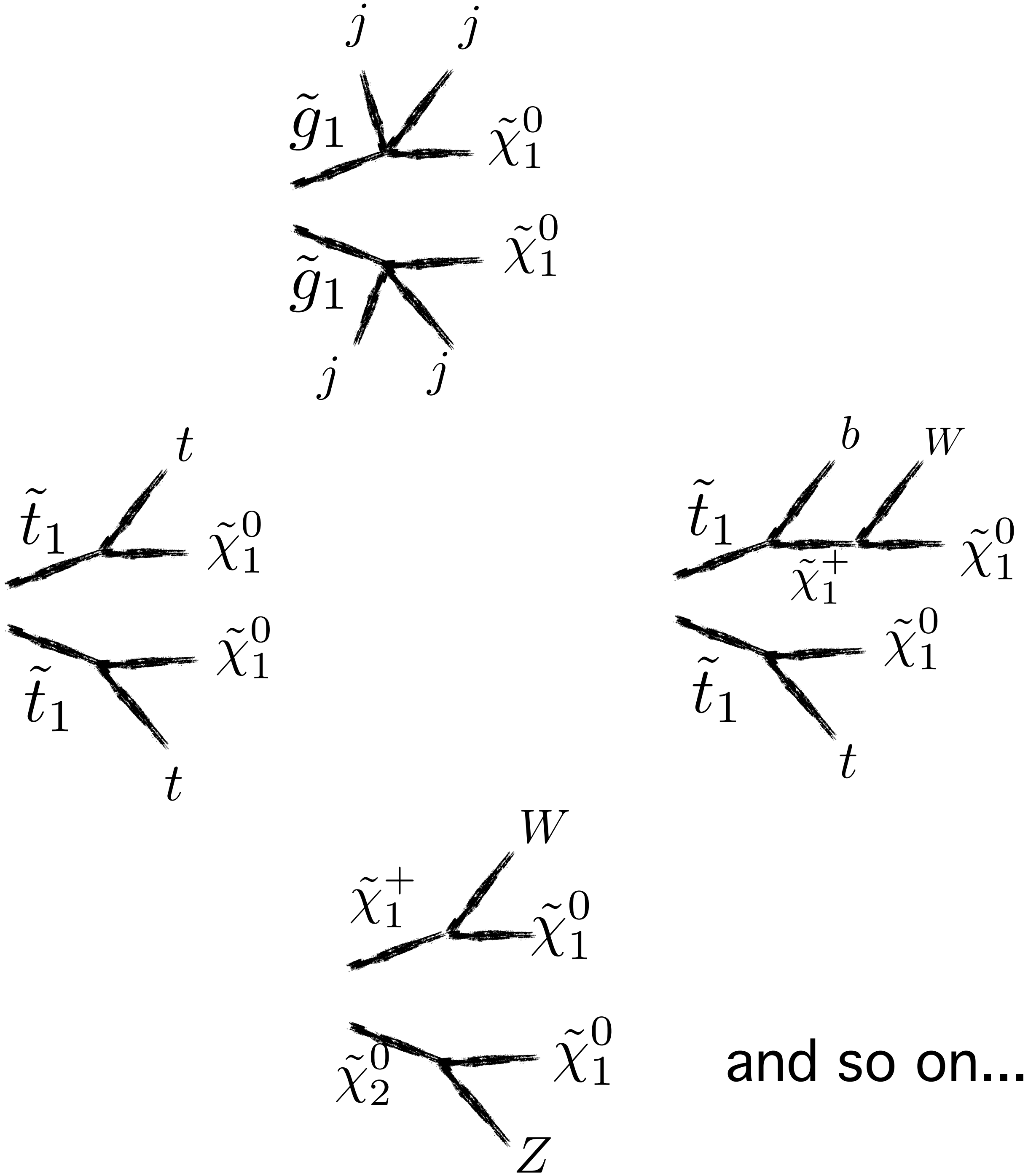
and so on...

Theory space

Arbitrary SUSY spectrum - II



Contains many such topologies



and so on...

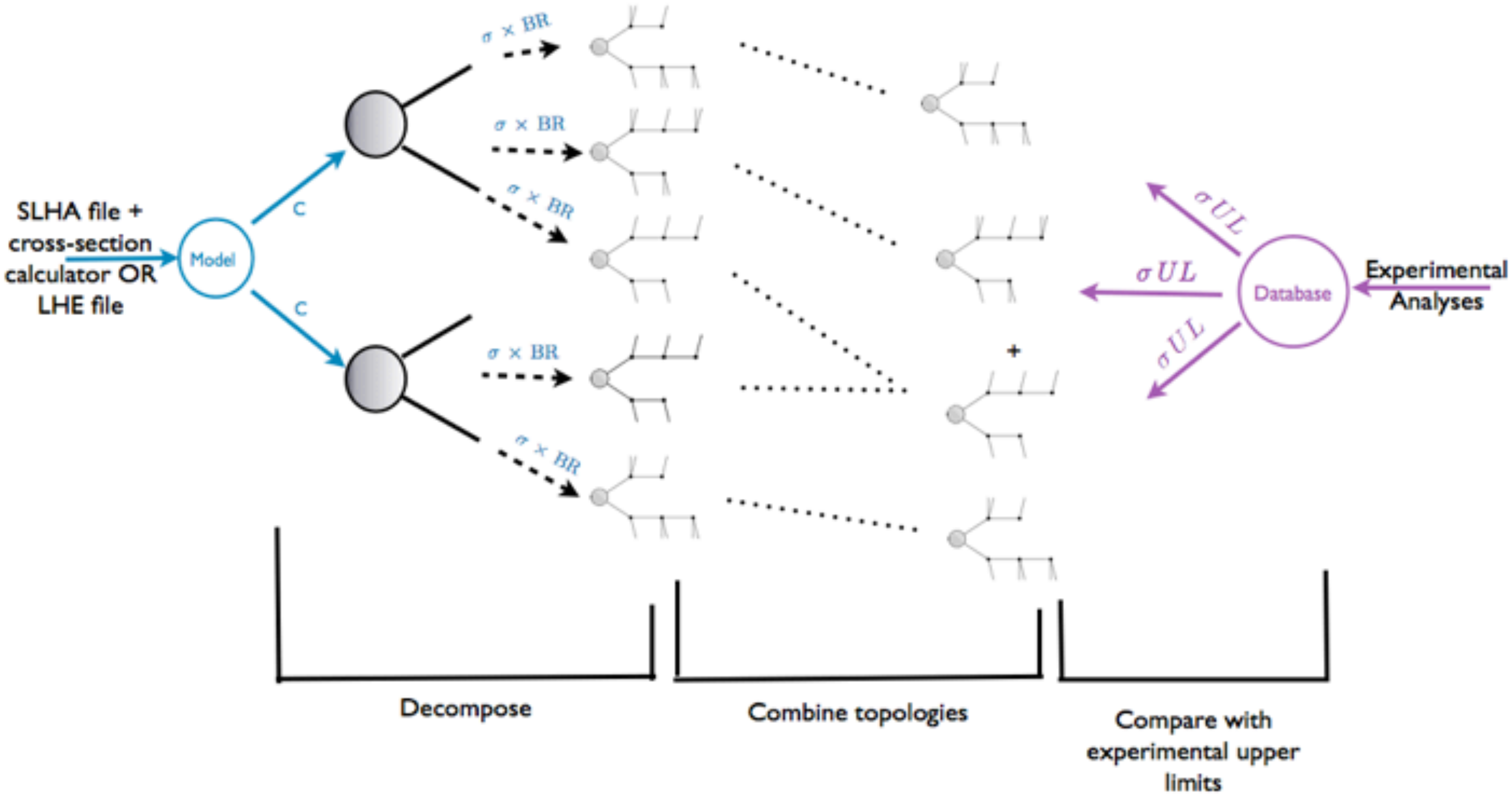
Can we have a centralized database of all the SMS results to check a given SUSY point in parameter space by decomposing it into SMS topologies?

Central concept of

SModelS

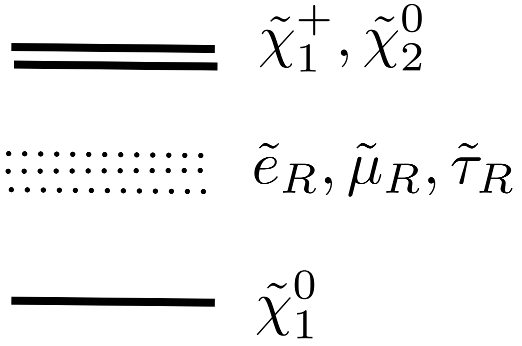
SModelS framework

- It assumes, for most experimental searches, the BSM model can be approximated by a sum over effective simplified models



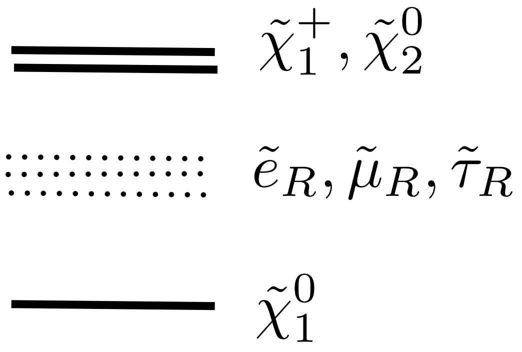
- Current implementation assumes R-parity is conserved

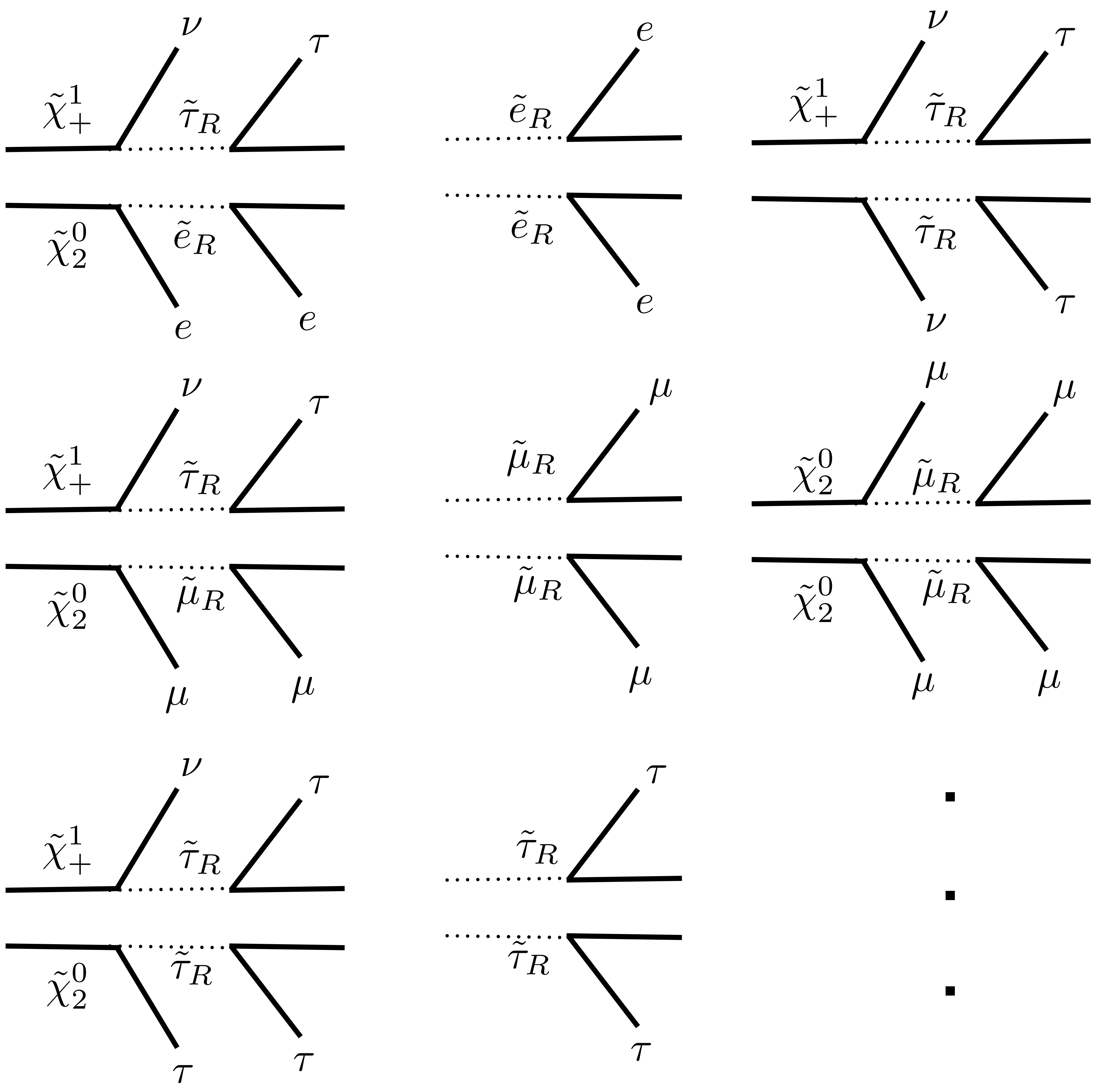
Given Spectra

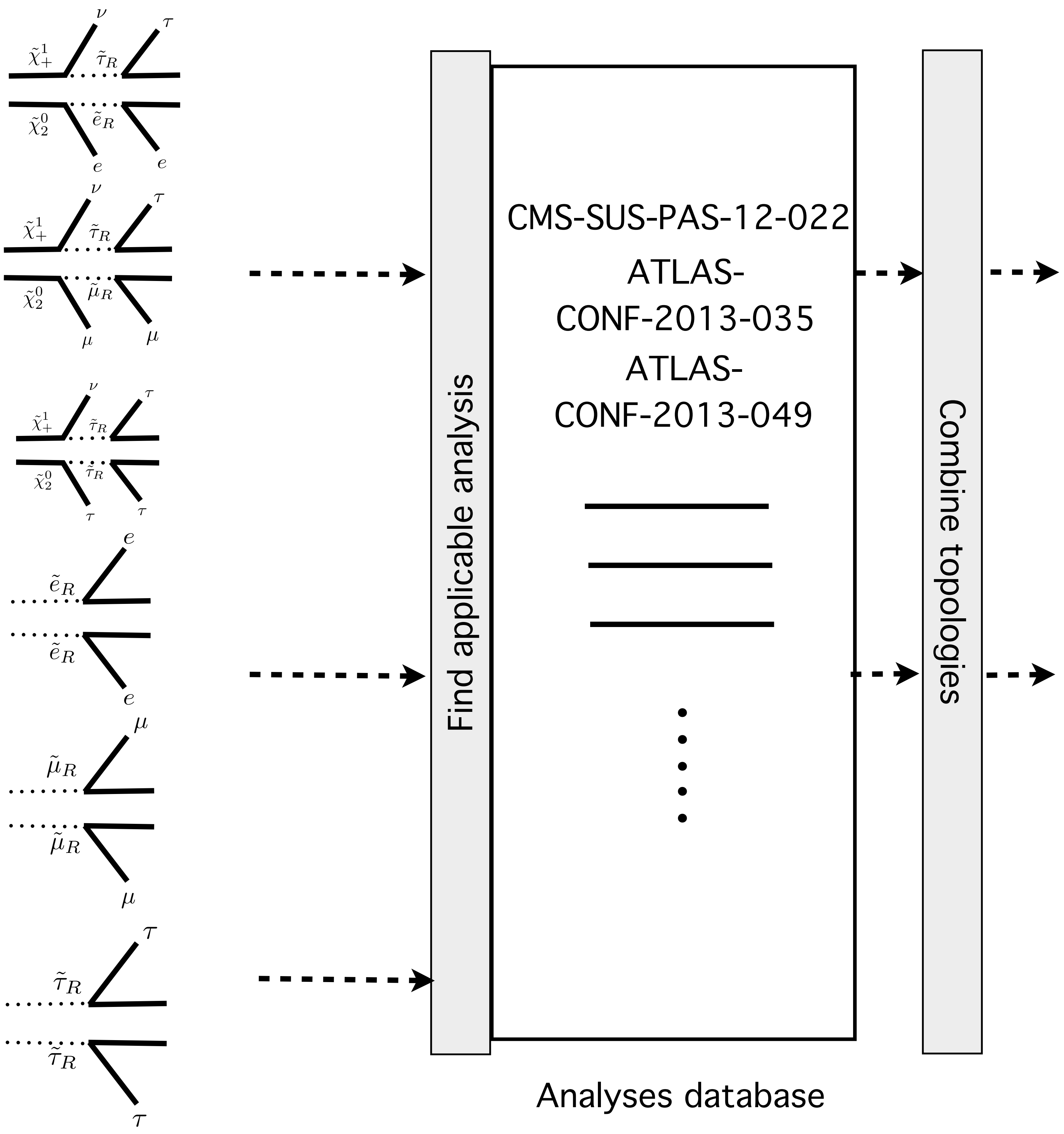


Decomposition

Given Spectra



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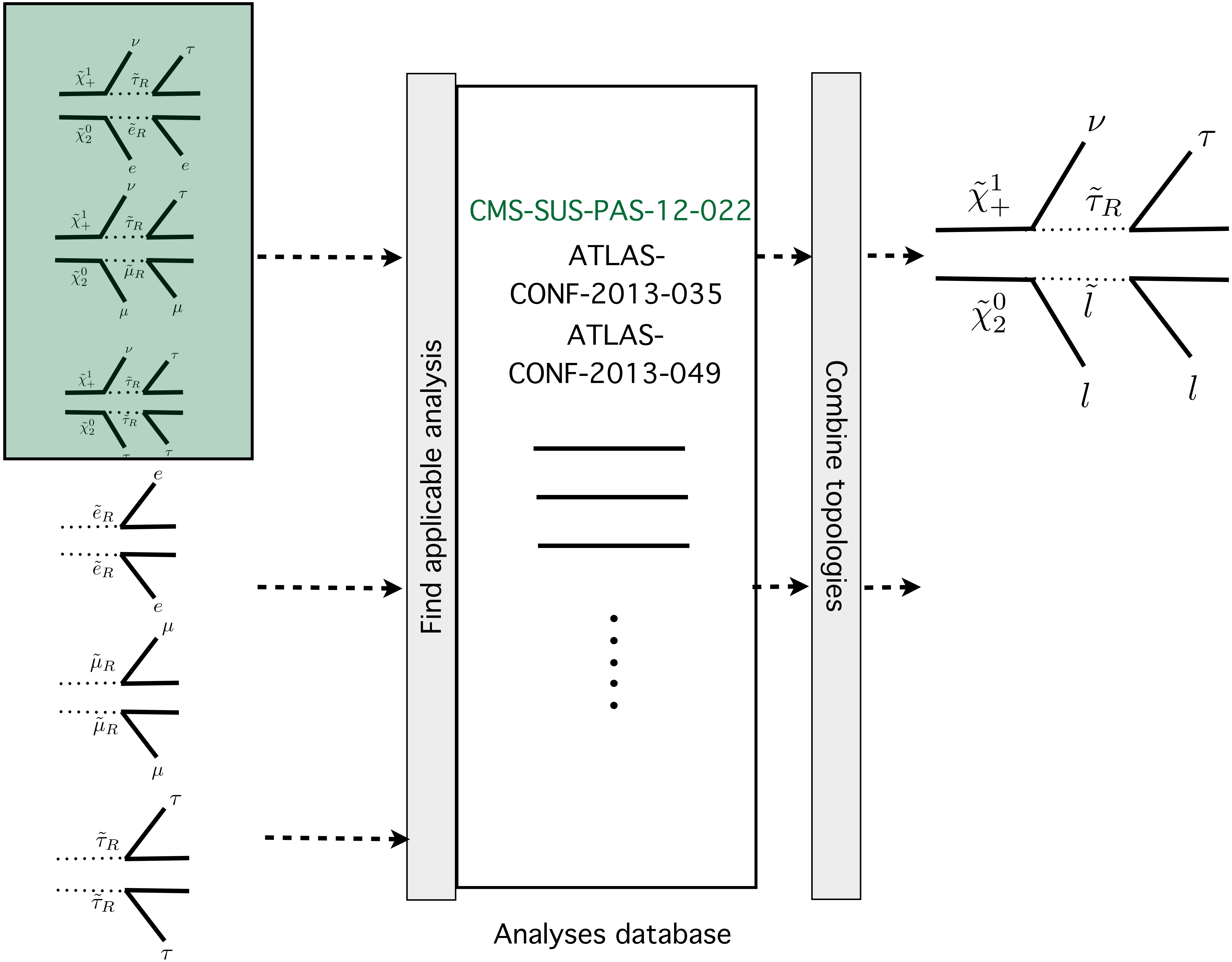
ATLAS-CONF-2013-049
Combine topologies
Analyses database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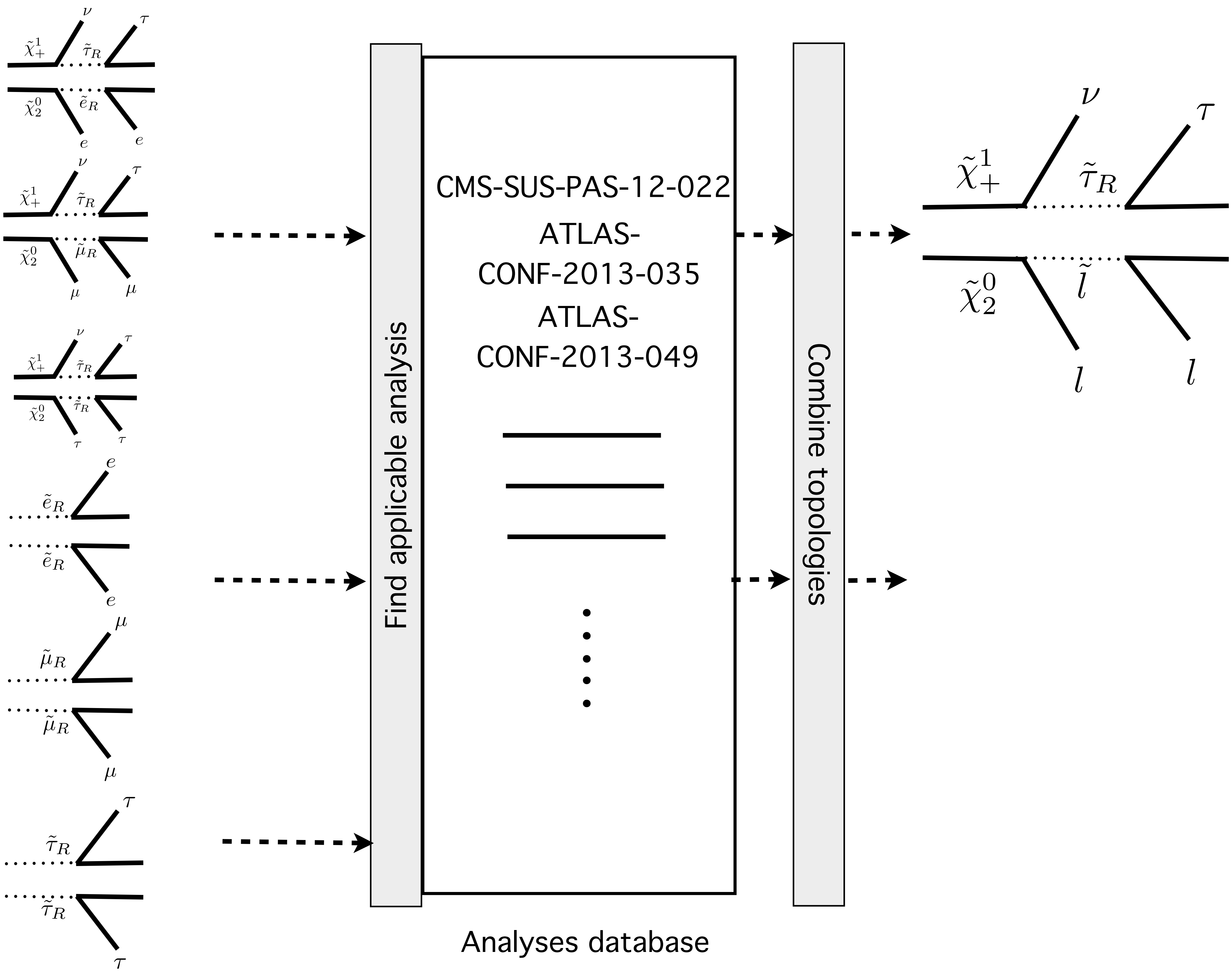
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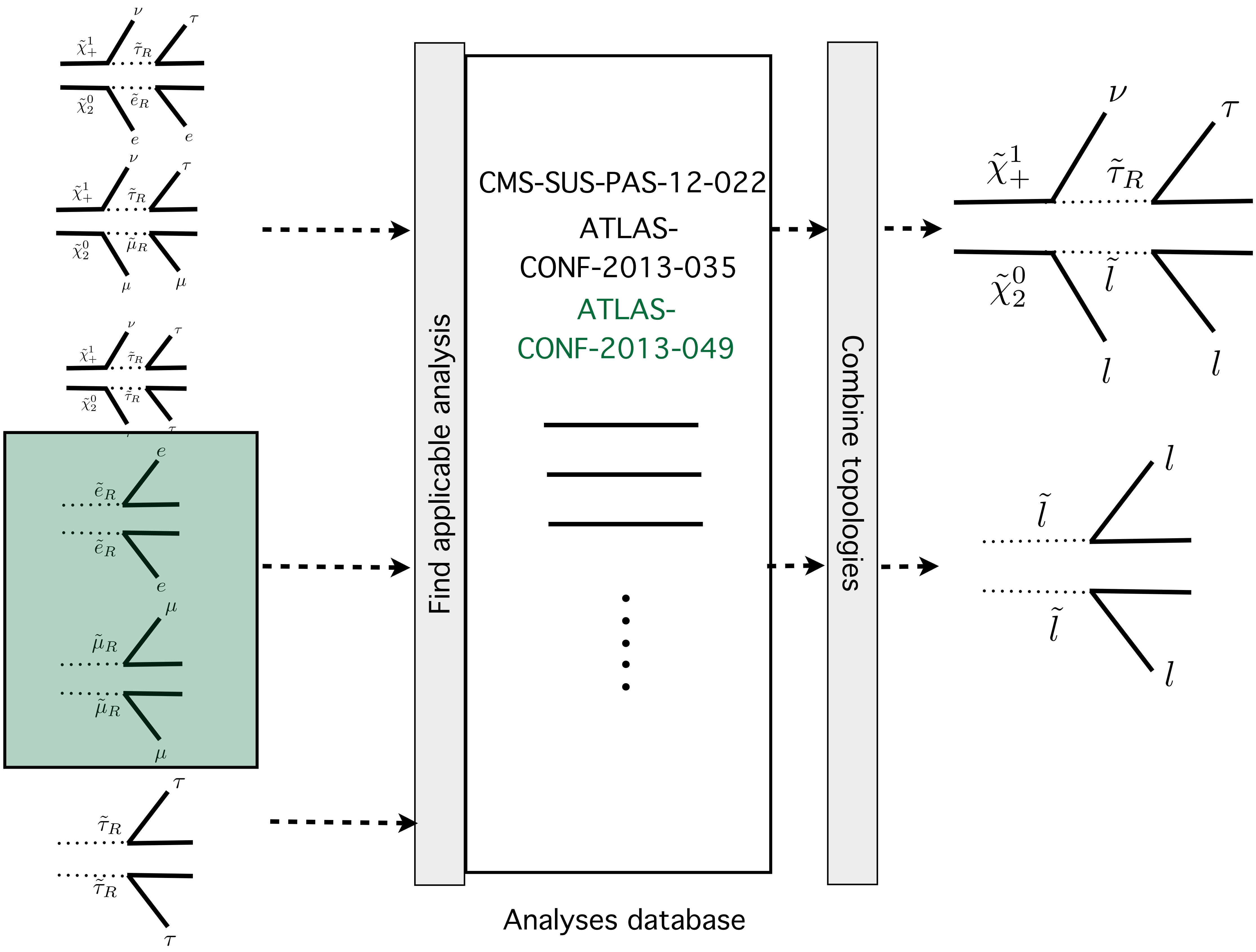
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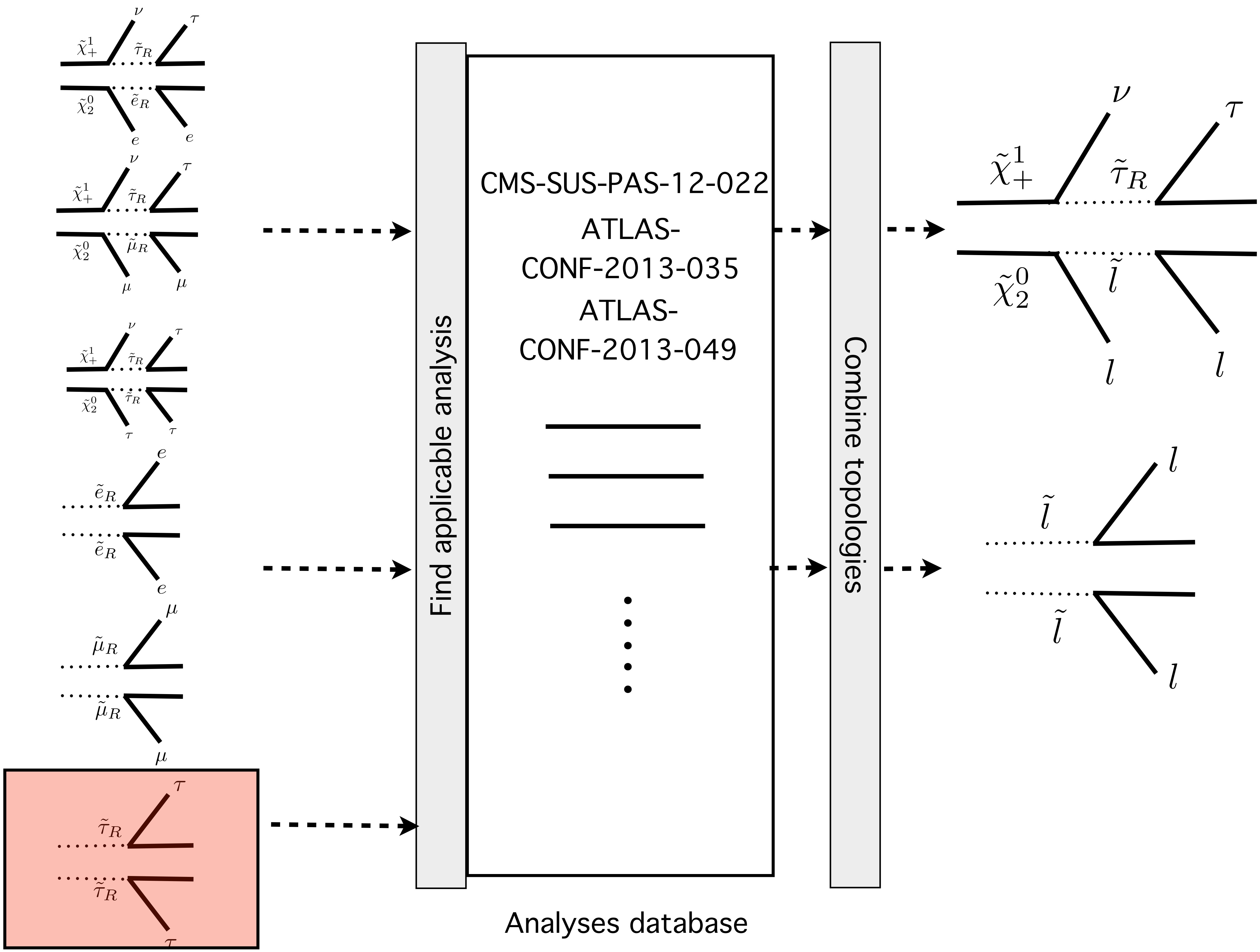
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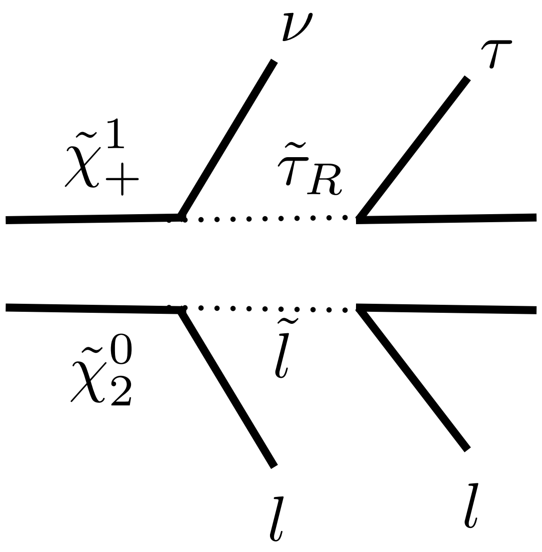
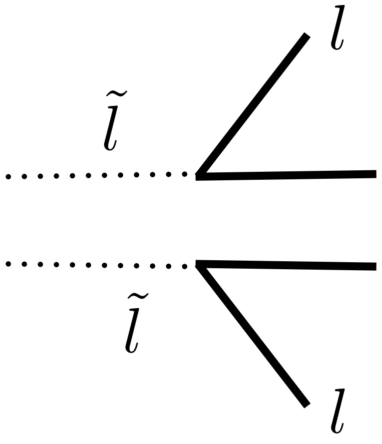
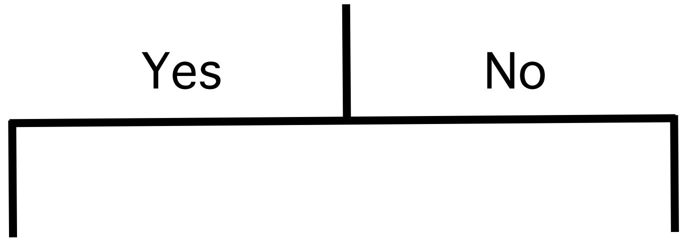




Look-up experimental limits

Is theory prediction > experimental limit?

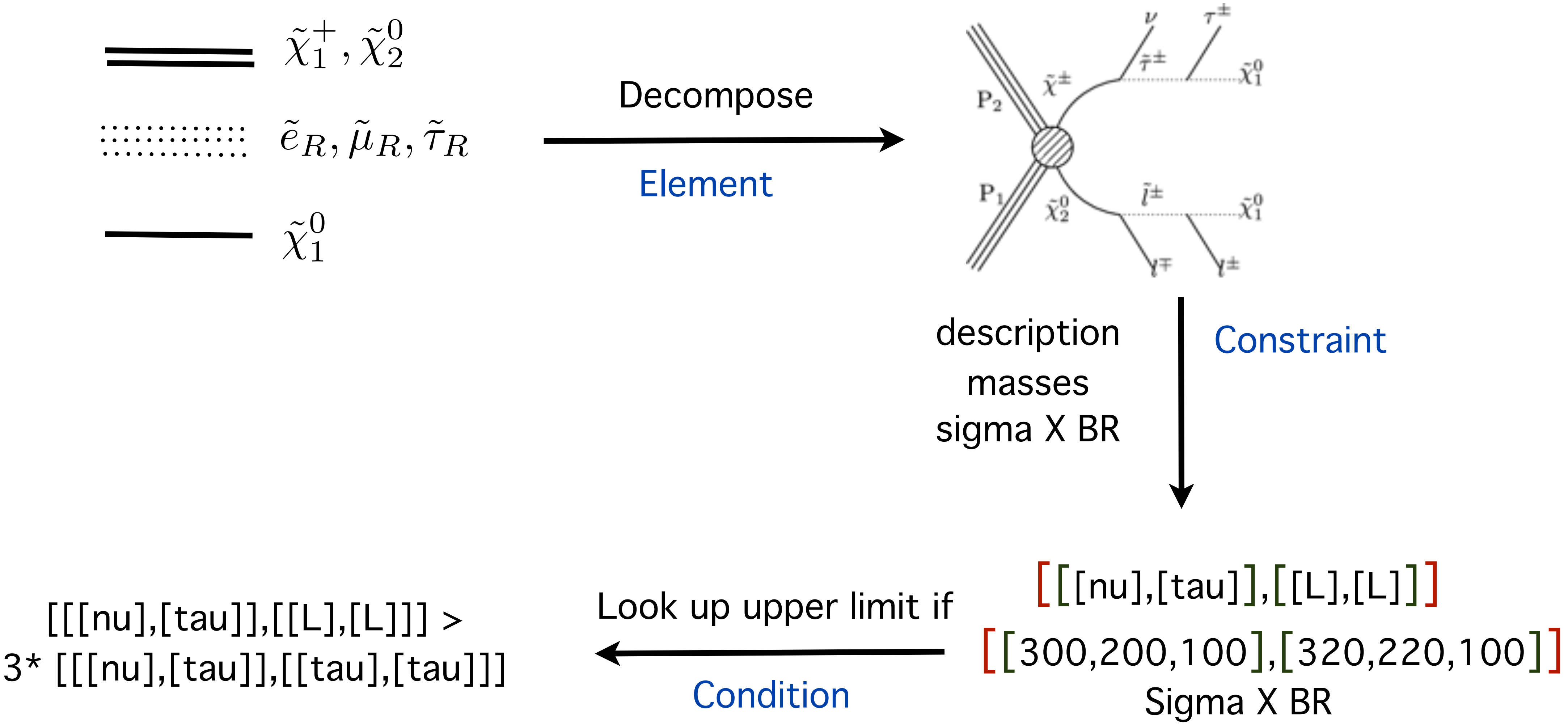


Yes → Point excluded

No → Point allowed

SModelS framework

- Consider:



$\tilde{\chi}_1^+, \tilde{\chi}_2^0$

$\tilde{e}_R, \tilde{\mu}_R, \tilde{\tau}_R$

$\tilde{\chi}_1^0$

Decompose

Element

description
masses
sigma X BR

Constraint

[[[nu],[tau]],[[L],[L]]]
[[300,200,100],[320,220,100]]
Sigma X BR

Look up upper limit if

Condition

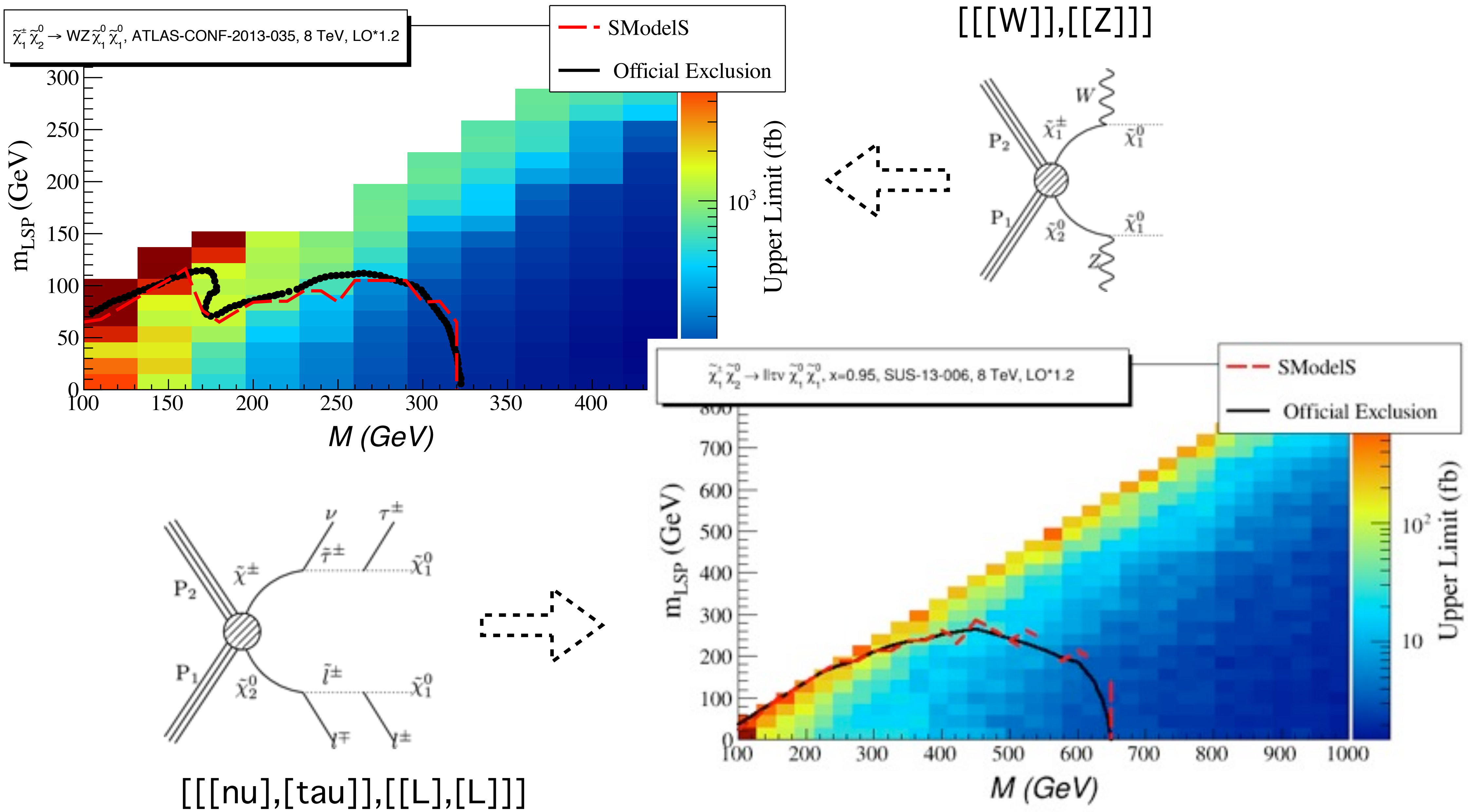
[[[nu],[tau]],[[L],[L]]] >
3* [[[nu],[tau]],[[tau],[tau]]]

- The framework does not depend on characteristics of SUSY particles, can also be applied to decompose any BSM spectra of arbitrary complexity

SModelS language

How do we know it works?

- The code has been validated through the reproduction of various SMS exclusion curves



[[[W]],[[Z]]]

[[[nu],[tau]],[[L],[L]]]

Typical examples of validation plot

Salient features

- Code is equipped to decompose any BSM model with a Z2 symmetry
- It can handle compressed topologies
- It can take care of invisible decays
- It has the most comprehensive database of simplified model results, 22 CMS, 24 ATLAS (7 + 8 TeV)
- Now a web SLHA interface is available to check your point

http://smodels.hephy.at/online/pmssm.py

Good, so what do you learn out of it?

based on:
arXiv: 1312.4175 [hep-ph]

SUSY scan - weak sector

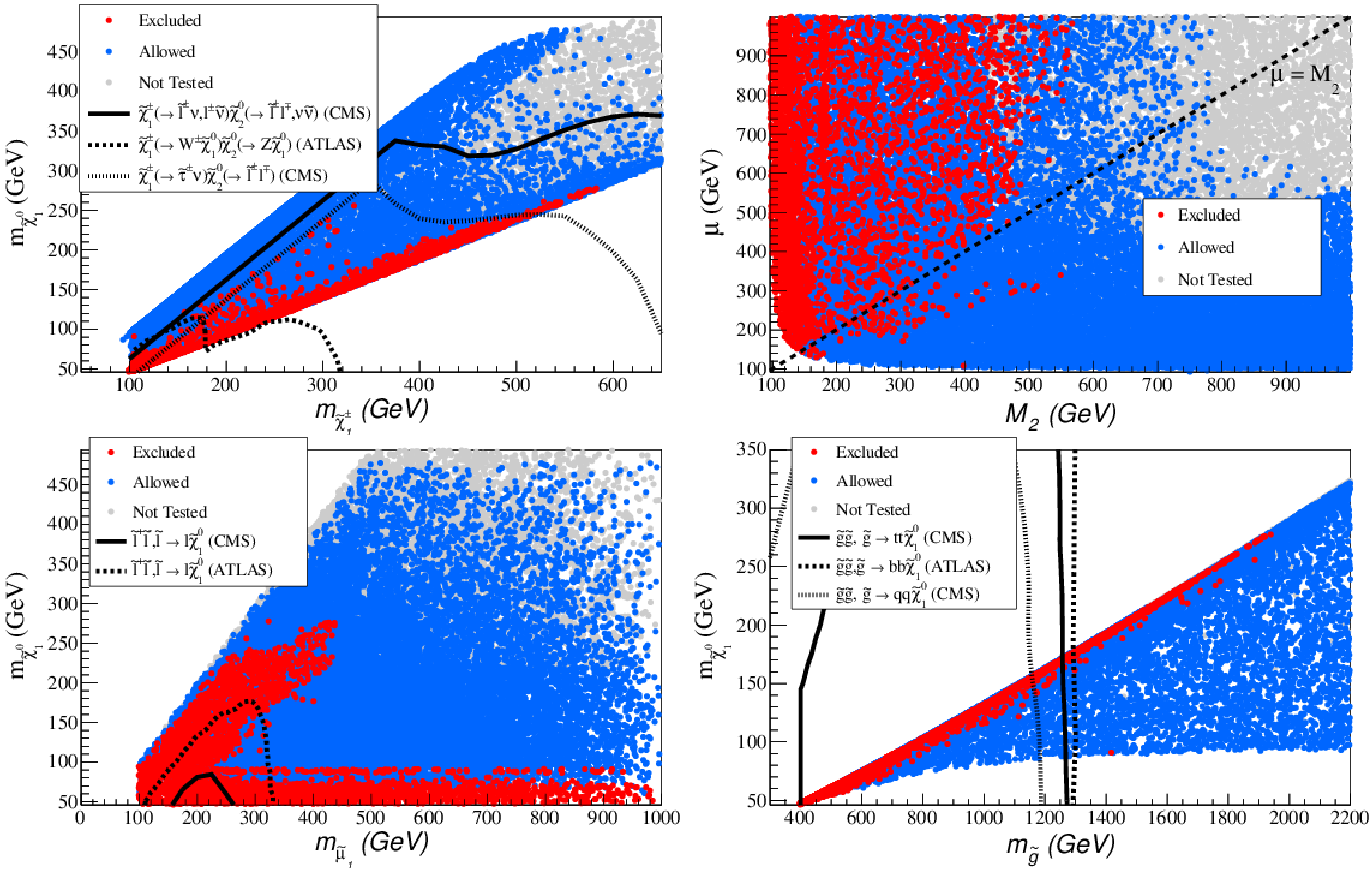
- pMSSM scan over 6 parameters
  -

M_2	μ	$\tan\beta$	$M_{\tilde{L}}$	$M_{\tilde{E}}$	A_τ
0.1–1	0.1–1	3–60	0.1–1	0.1–1	±1

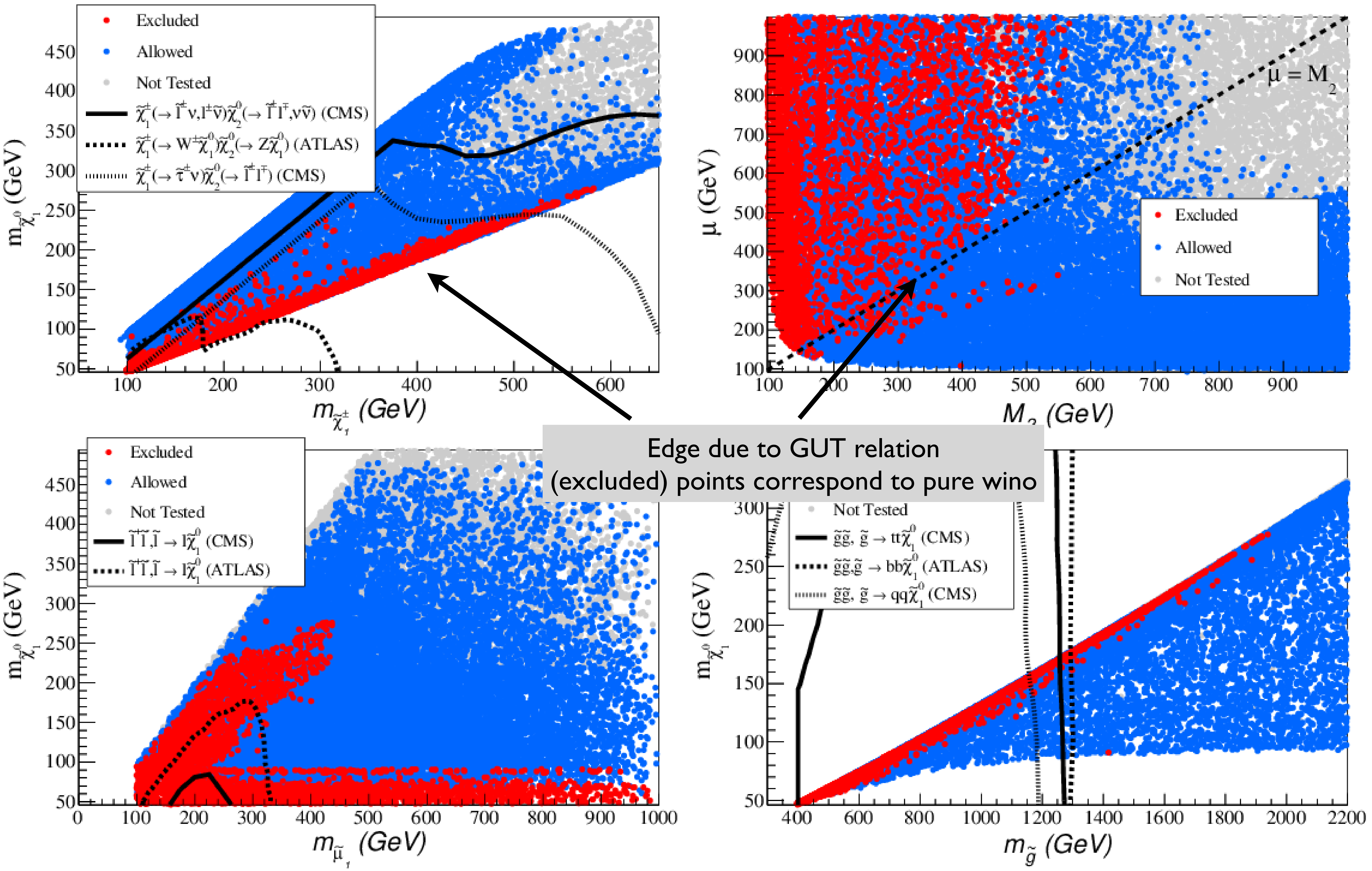
  - Gaugino masses obey GUT relation
  - Flavor constraints, invisible Z width, Higgs mass, LEP limits imposed
- Limits obtained will always be conservative
- We probe electroweak -ino decays via WZ and sleptons, direct slepton production and gluino decays

NB: A similar scan was also performed
for strong sector particles

SUSY scan - weak sector

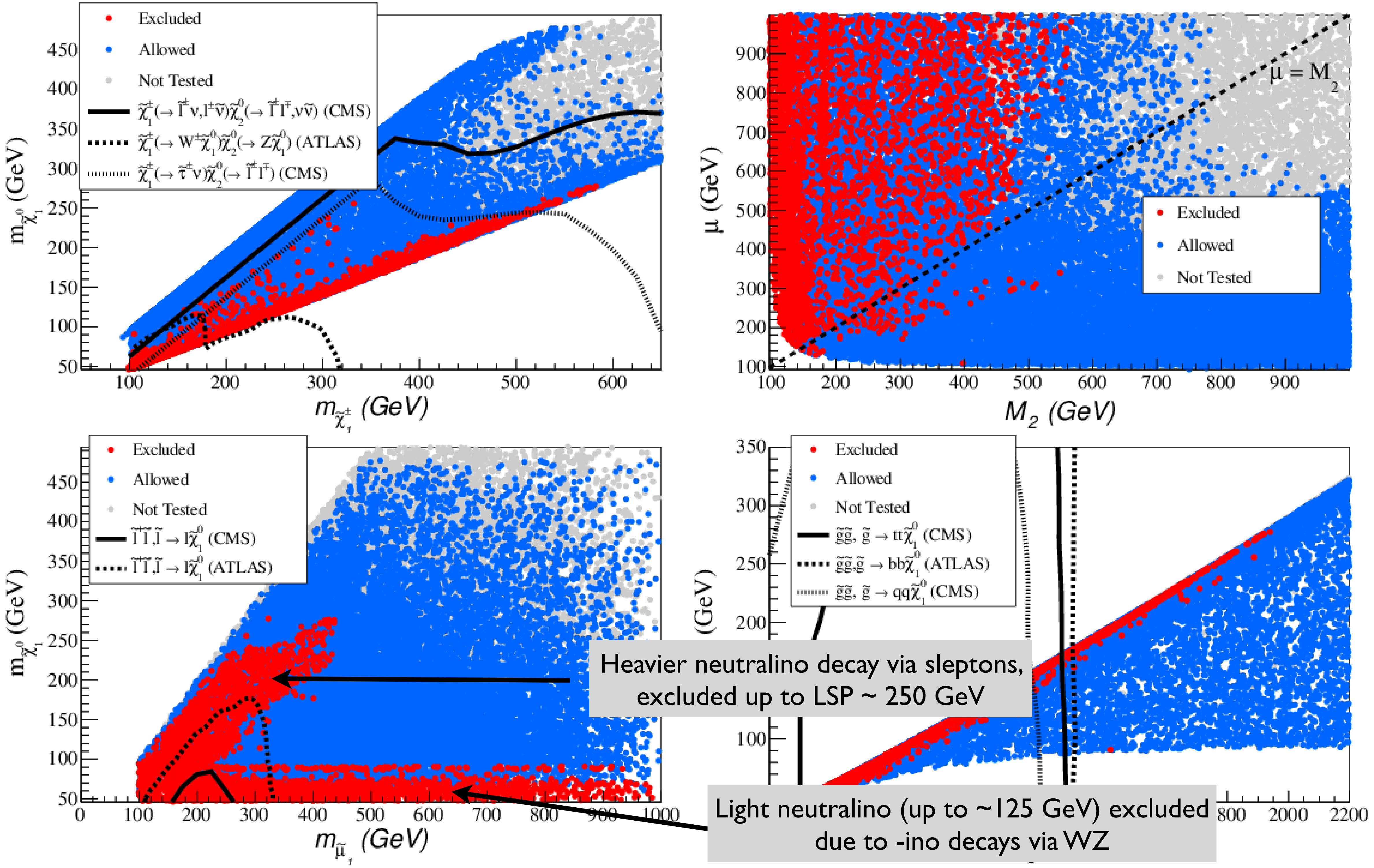


SUSY scan - weak sector



Edge due to GUT relation
(excluded) points correspond to pure wino

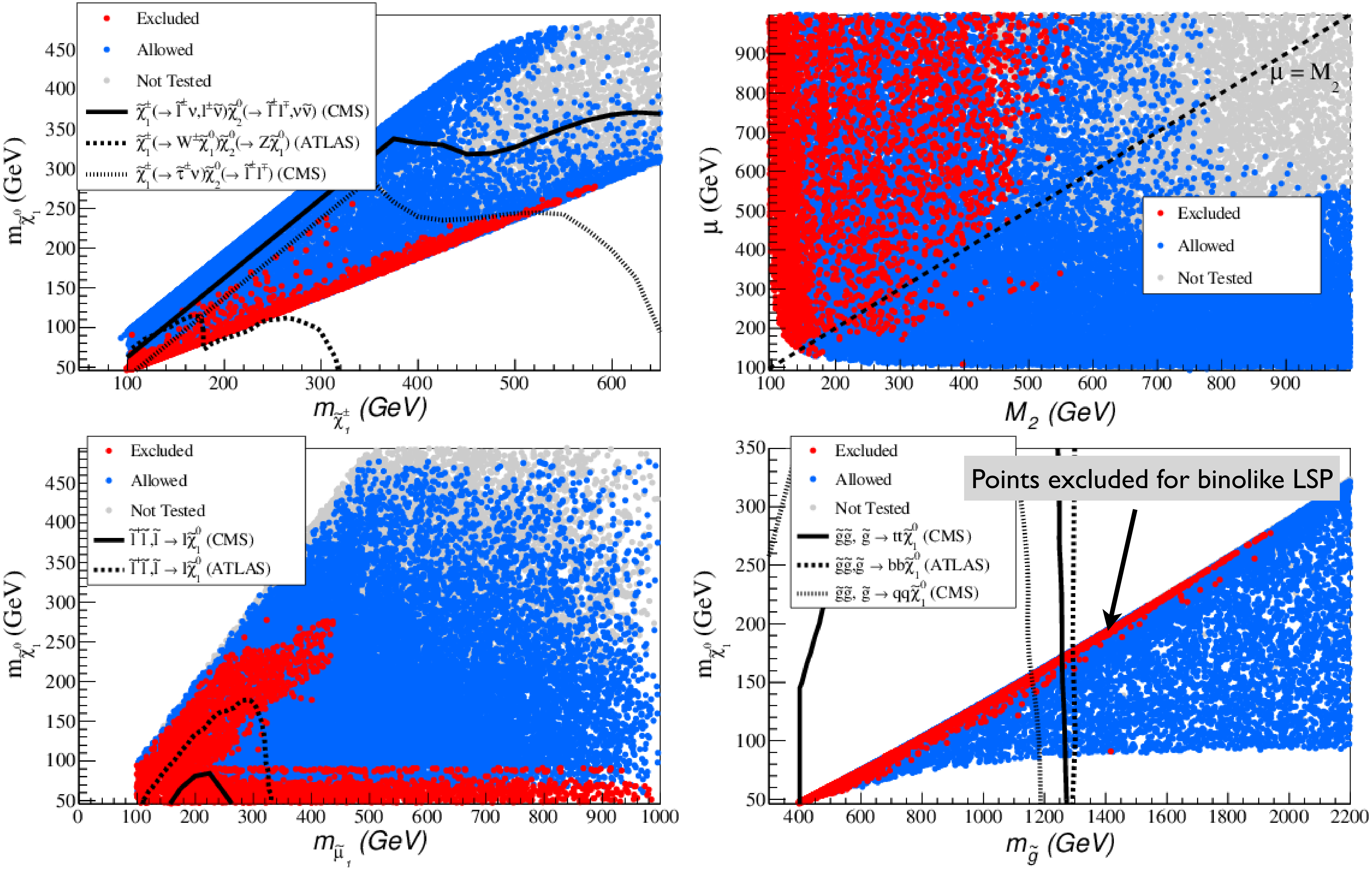
SUSY scan - weak sector



Heavier neutralino decay via sleptons, excluded up to LSP ~ 250 GeV

Light neutralino (up to ~125 GeV) excluded due to -ino decays via WZ

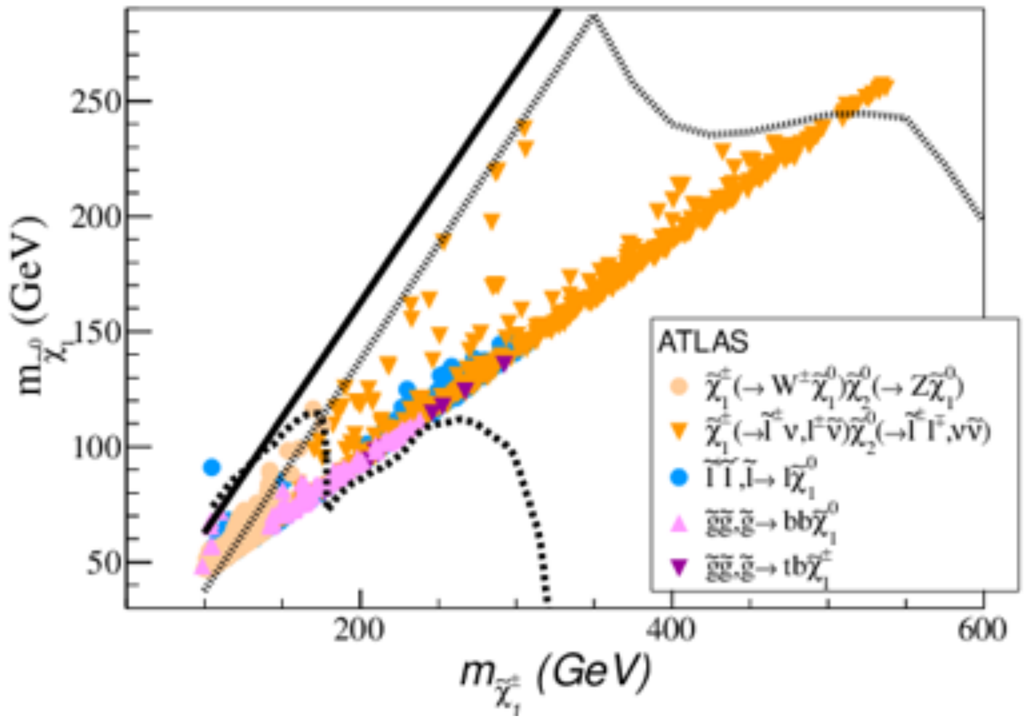
SUSY scan - weak sector

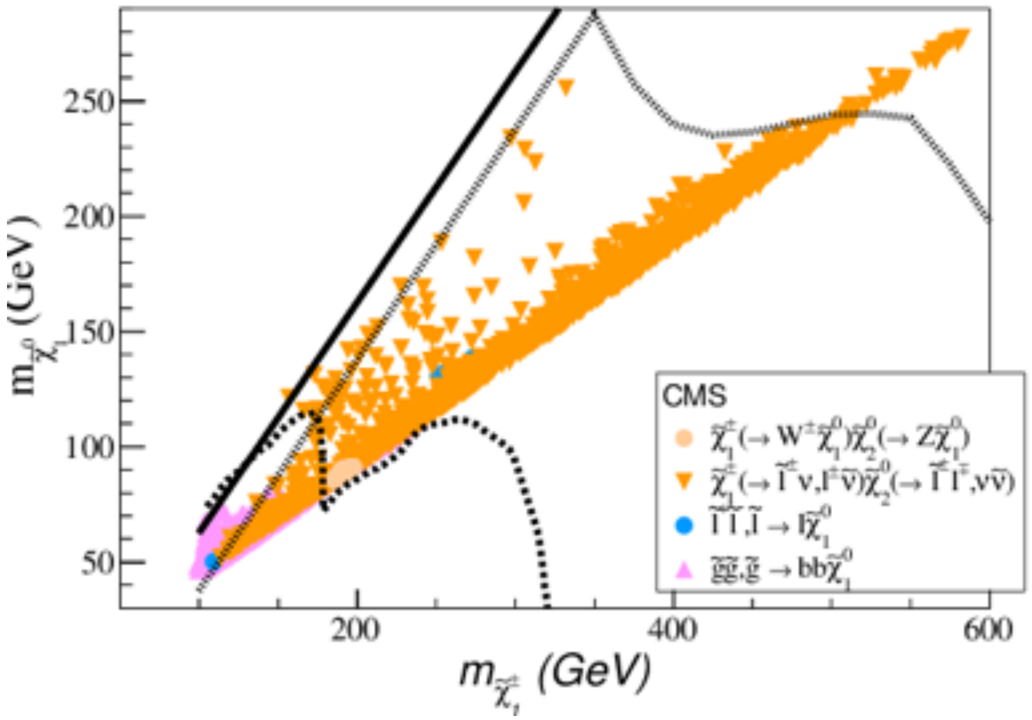


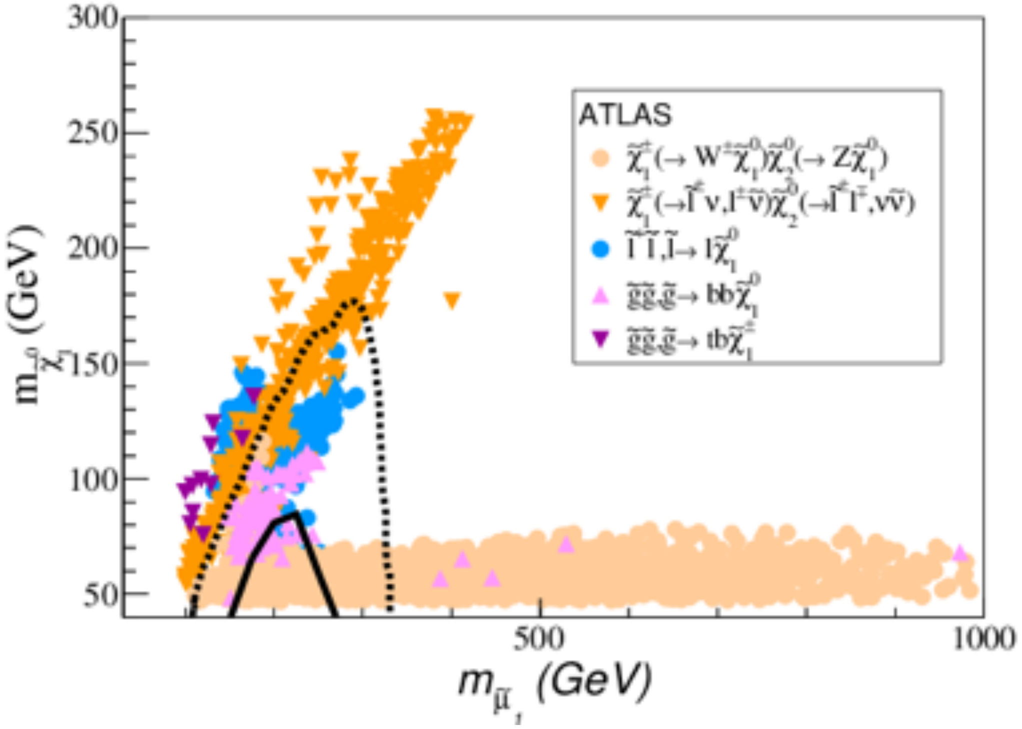
Points excluded for binolike LSP

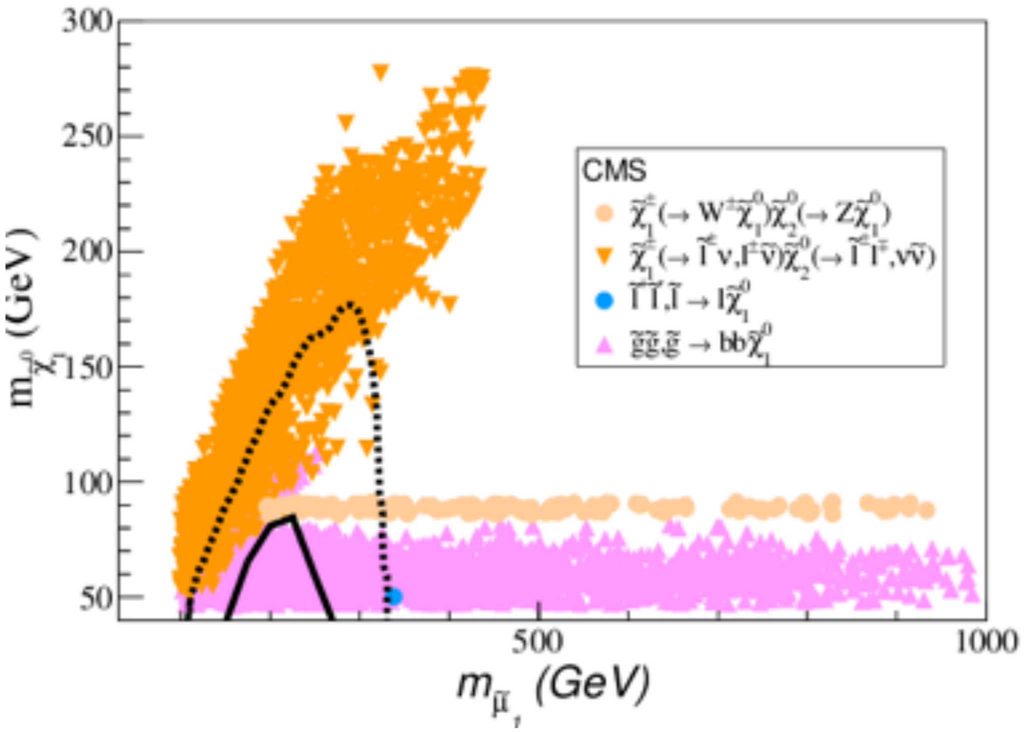
SUSY scan - weak sector

- Breakdown of the excluded parameter space by analysis



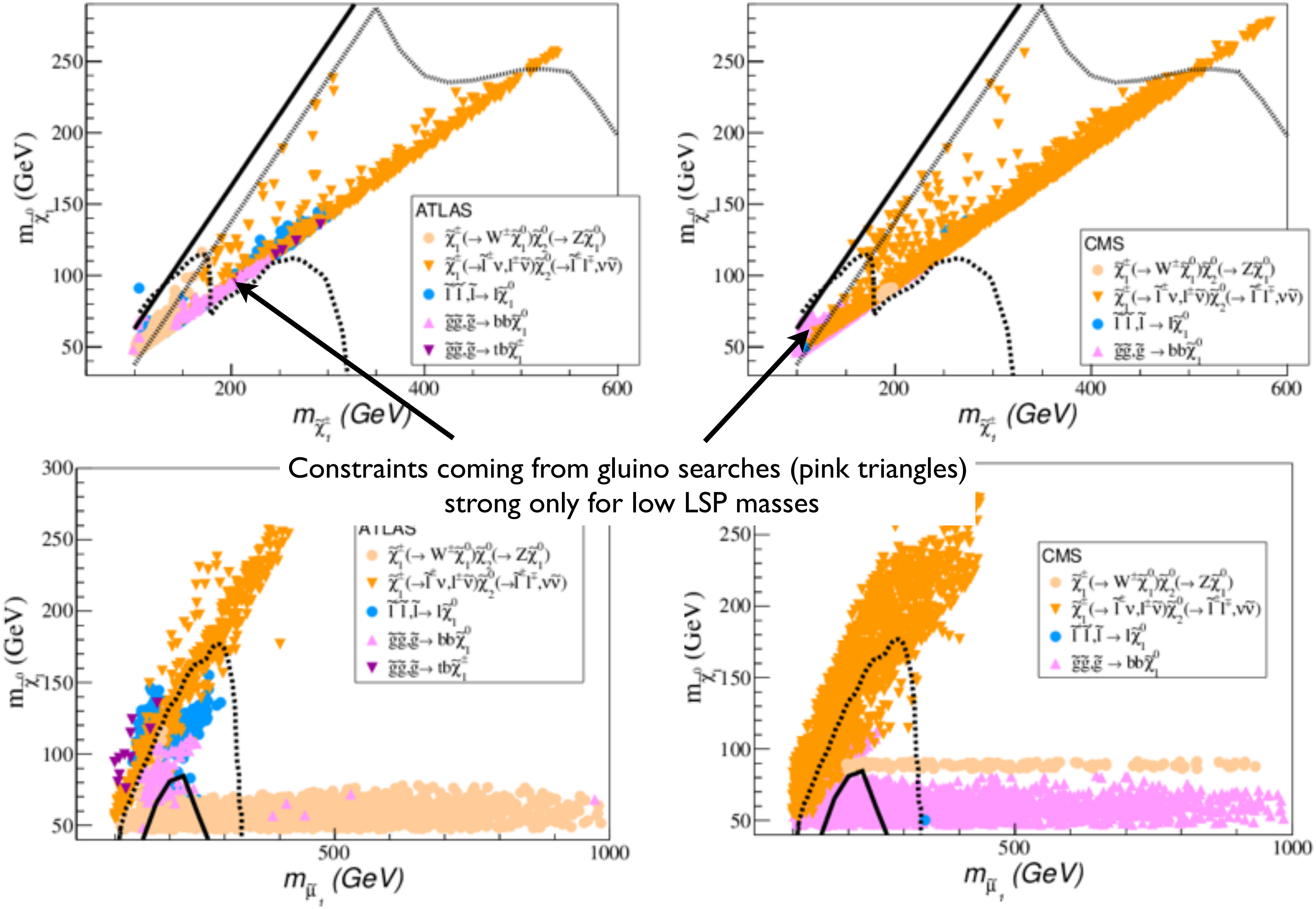






SUSY scan - weak sector

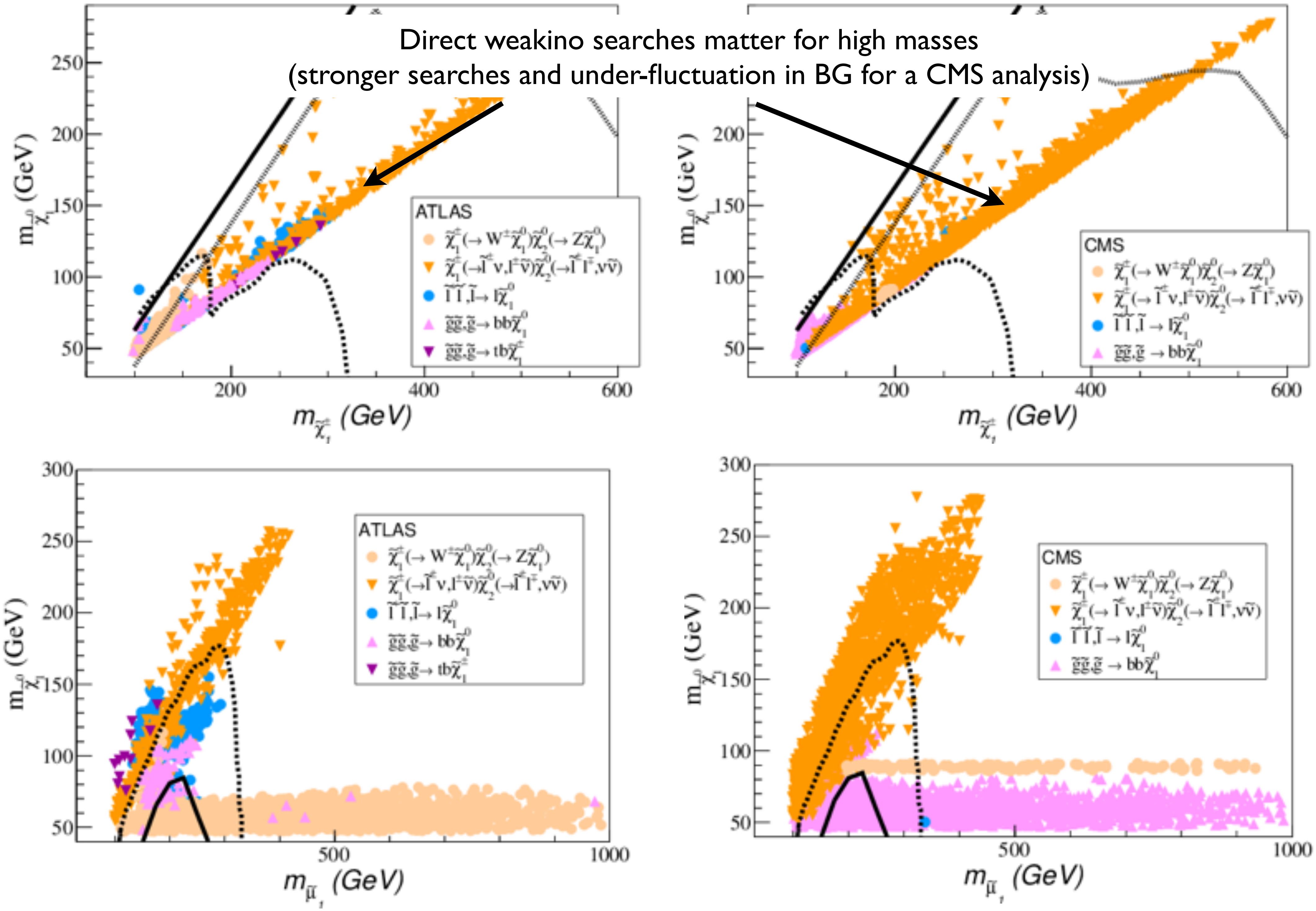
- Breakdown of the excluded parameter space by analysis



Constraints coming from gluino searches (pink triangles) strong only for low LSP masses

SUSY scan - weak sector

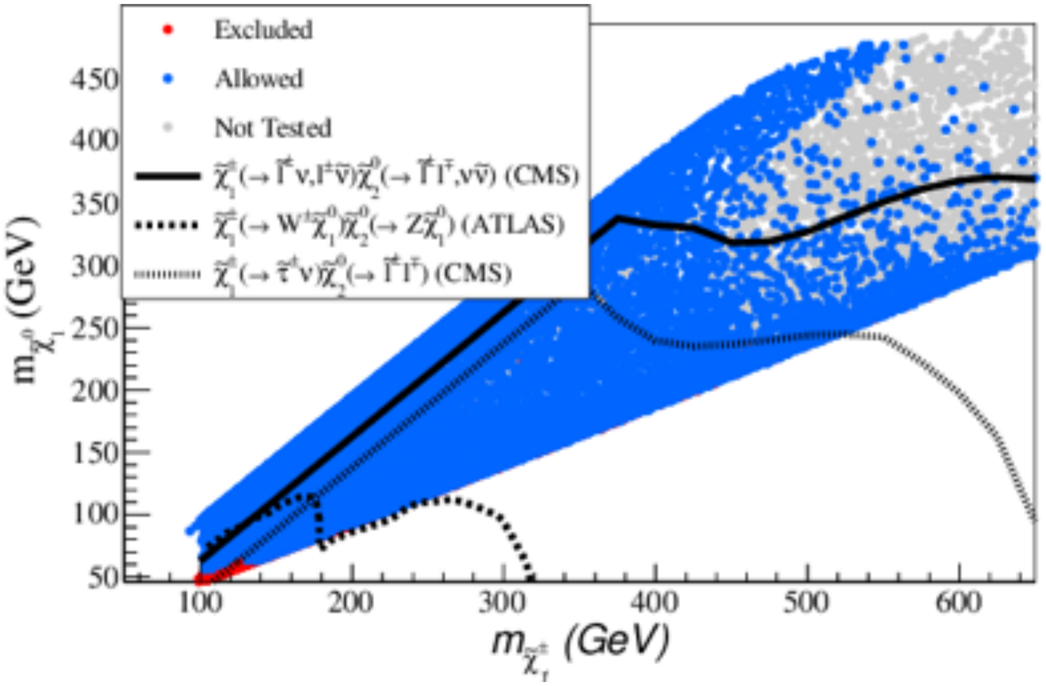
- Breakdown of the excluded parameter space by analysis



Direct weakino searches matter for high masses
(stronger searches and under-fluctuation in BG for a CMS analysis)

SUSY scan - weak sector

- Some allowed points may lie below excluded points

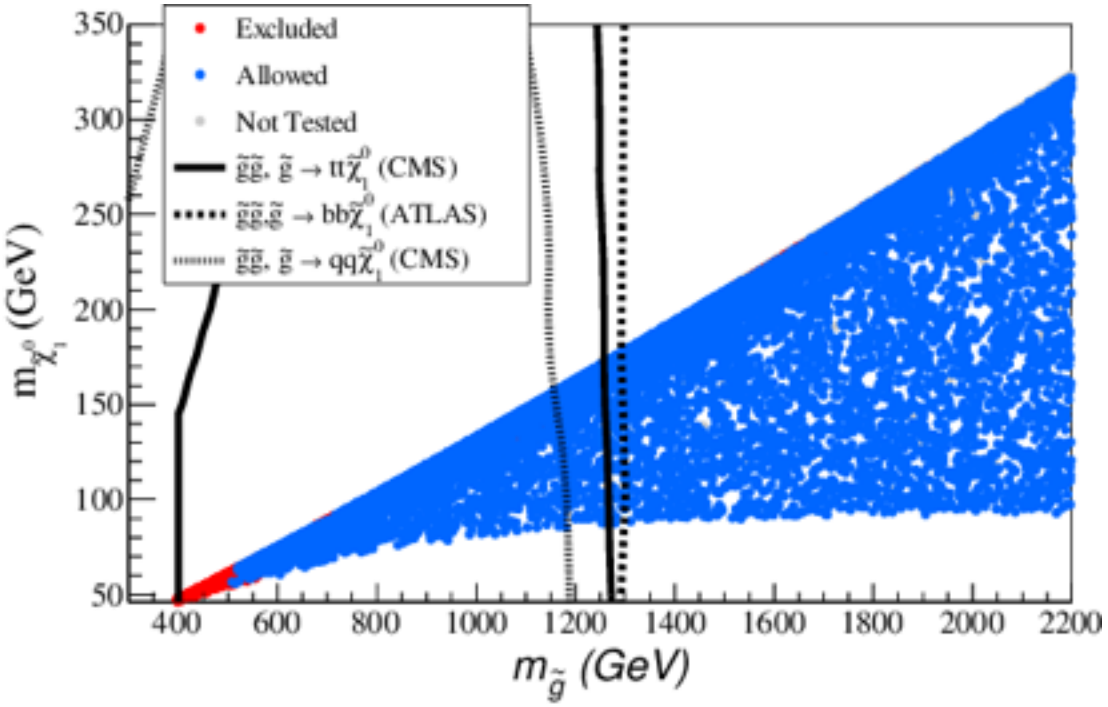


- Chargino - LSP nature, higgsino have smaller production cross-section

- Right handed sleptons have smaller production CS

- Gluino decays via on-shell squarks are kinematically forbidden for small masses

- Uncovered gluino decay topologies e.g. $BR(\tilde{g} \rightarrow \tilde{\chi}^{\pm} + tb)$



Can it be used to test parameter space for some interesting scenario?

A real life application

Do LHC results on the SUSY particles, Higgs signal strengths and constraints on DM from direct and indirect detection experiments rule out light neutralino DM?

Already many studies exist in literature, I'll not list them here

based on:
arxiv:1308.3735 [hep-ph] (published PLB)

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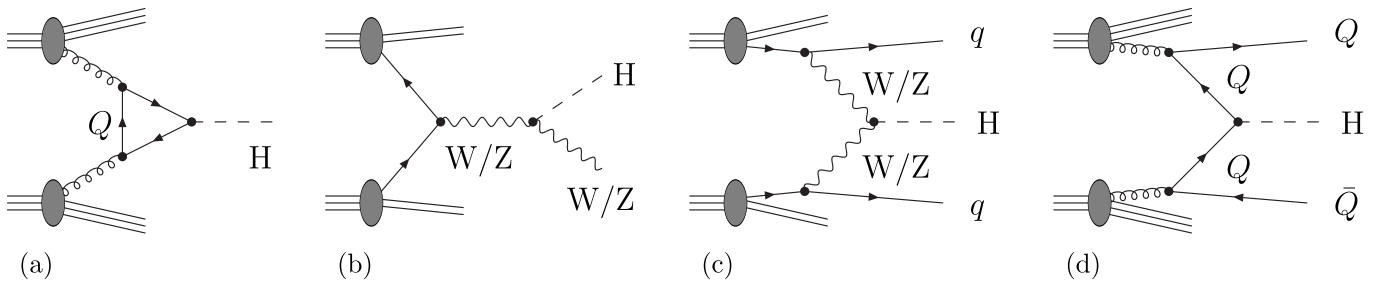
126 GeV Higgs at the LHC

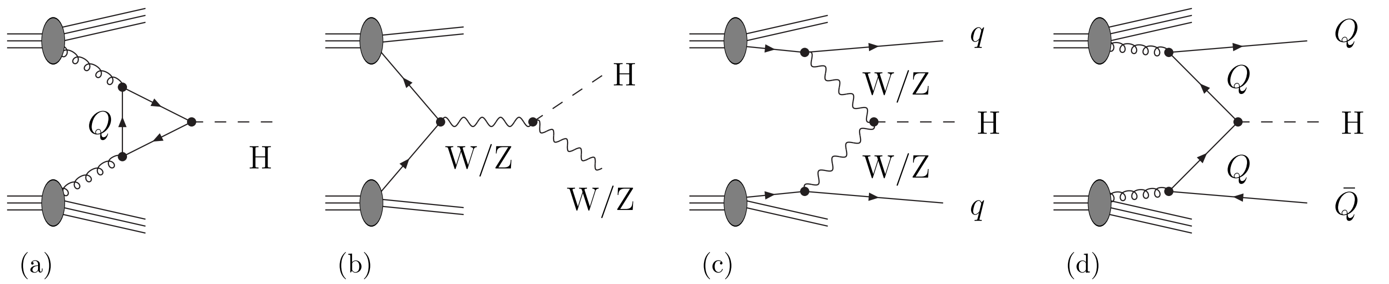


- Four production modes ggF, VH, VBF, and ttH
- Five final states: $\gamma\gamma$, $ZZ^{(*)}$, $WW^{(*)}$, $b\bar{b}$ and $\tau\tau$. only four are independent - ZZ and WW related by custodial symmetry
- Loop induced ggF production and $\gamma\gamma$ final state are susceptible to BSM contributions - in case of SUSY light staus and neutralino contribute
- Experimentally we get information on the signal strengths

$$\mu_i \equiv (\sigma \times \mathrm{BR})_i / (\sigma \times \mathrm{BR})_i^{\mathrm{SM}},$$

for each final state

126 GeV Higgs at the LHC



- Higgs effective Lagrangian:

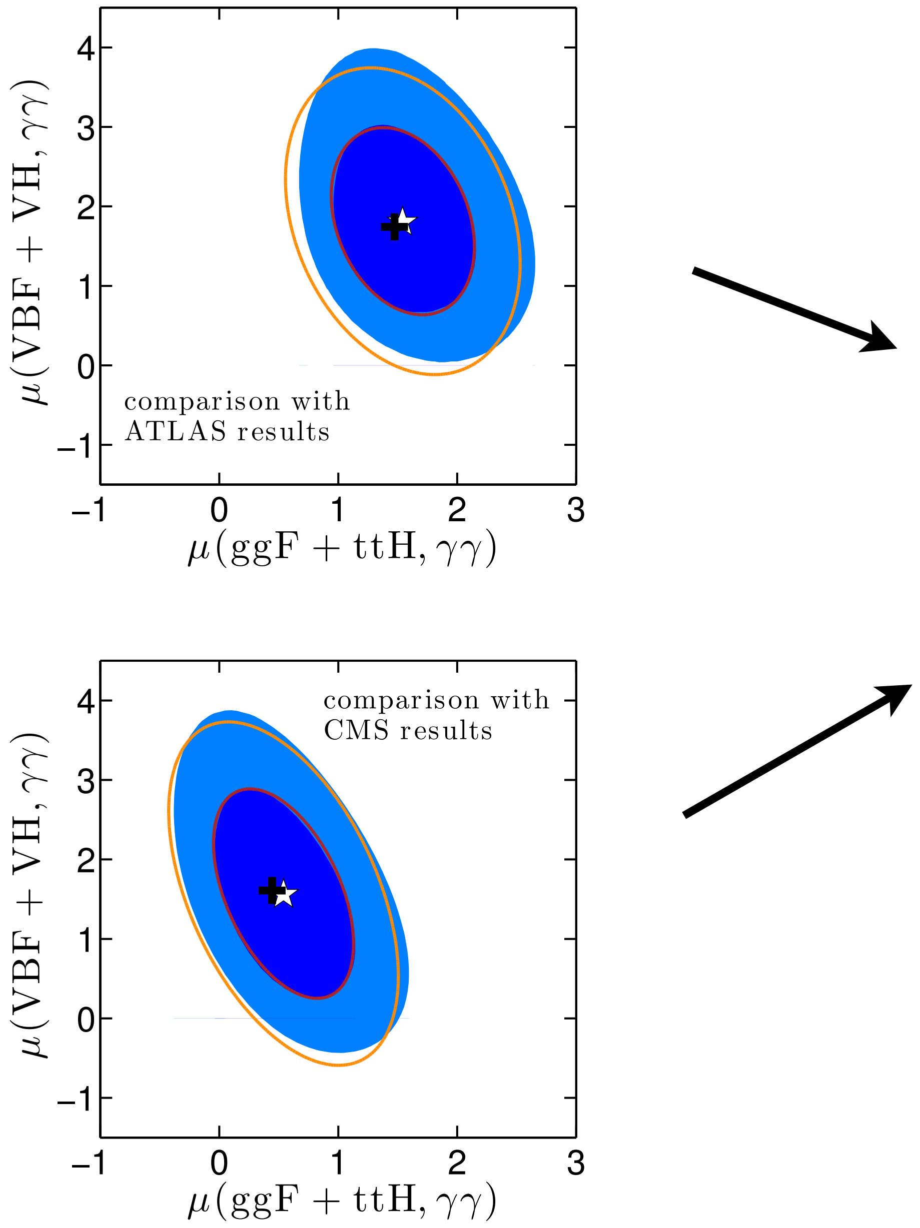
$$\mathcal{L} = g\left[C_V\left(M_W W_\mu W^\mu + \frac{M_Z}{\cos\theta_W} Z_\mu Z^\mu\right) - C_U \frac{m_t}{2M_W}\bar{t}t - C_D \frac{m_b}{2M_W}\bar{b}b - C_D \frac{m_\tau}{2M_W}\bar{\tau}\tau\right] H\,.$$

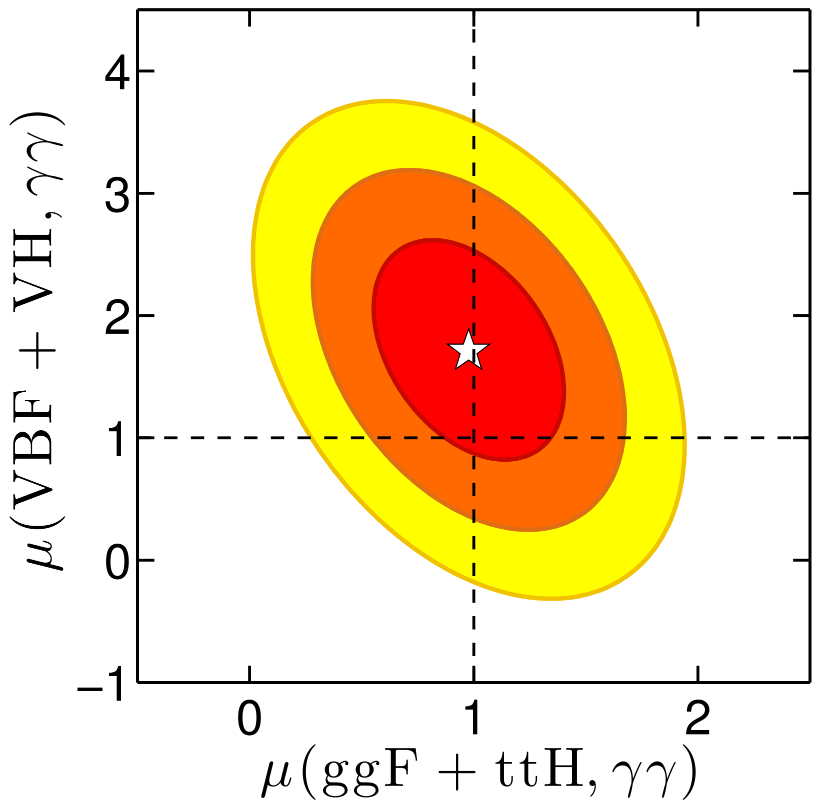
C's scale couplings relative to SM ones; $C_U=C_D=C_V=1$ is SM.

- Additional loop contribution modify the couplings to gluons and photons

126 GeV Higgs at the LHC

- A combined likelihood in (ggF+ttH) and (VBF+VH) planes was derived using ATLAS, CMS and Tevatron results

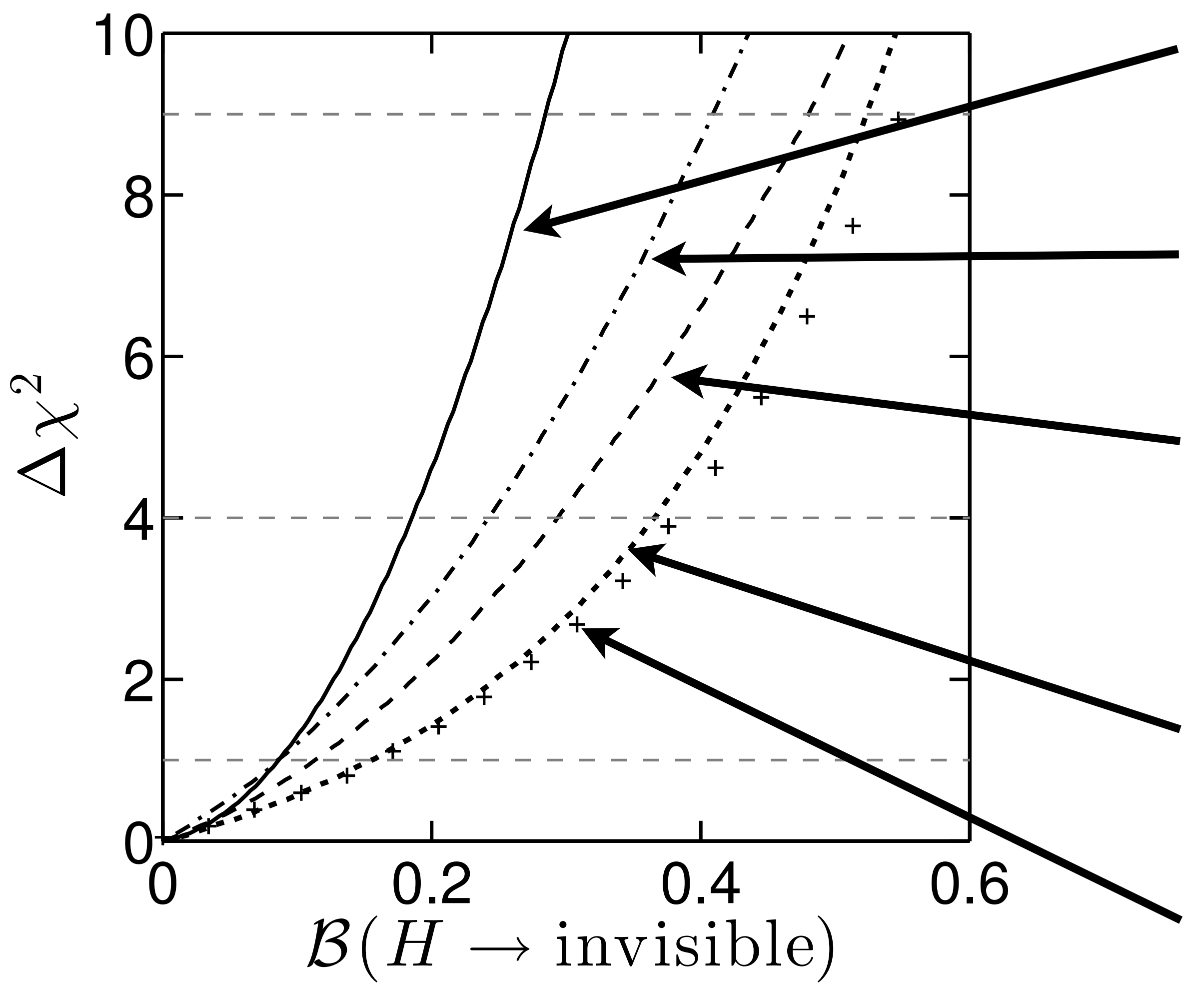




G. Belanger, B. Dumont, U. Ellwanger, J. Gunion, S, Kraml
arXiv:1306.2941

126 GeV Higgs at the LHC

- How much invisible Higgs decay is allowed?



SM+invisible
$\mathcal{B}(H \to \text{inv.}) < 0.19$ at 95% CL

$C_U + C_D + (C_V \leq 1)$+invisible
$\mathcal{B}(H \to \text{inv.}) < 0.24$ at 95% CL

SM+$\Delta C_g + \Delta C_\gamma$+invisible
$\mathcal{B}(H \to \text{inv.}) < 0.29$ at 95% CL

$C_U + C_D + C_V$+invisible
$\mathcal{B}(H \to \text{inv.}) < 0.36$ at 95% CL

$C_U + C_D + C_V + \Delta C_g + \Delta C_\gamma$+invisible
$\mathcal{B}(H \to \text{inv.}) < 0.38$ at 95% CL

G. Belanger, B. Dumont, U. Ellwanger, J. Gunion, S, Kraml
arXiv:1306.2941

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A real life application

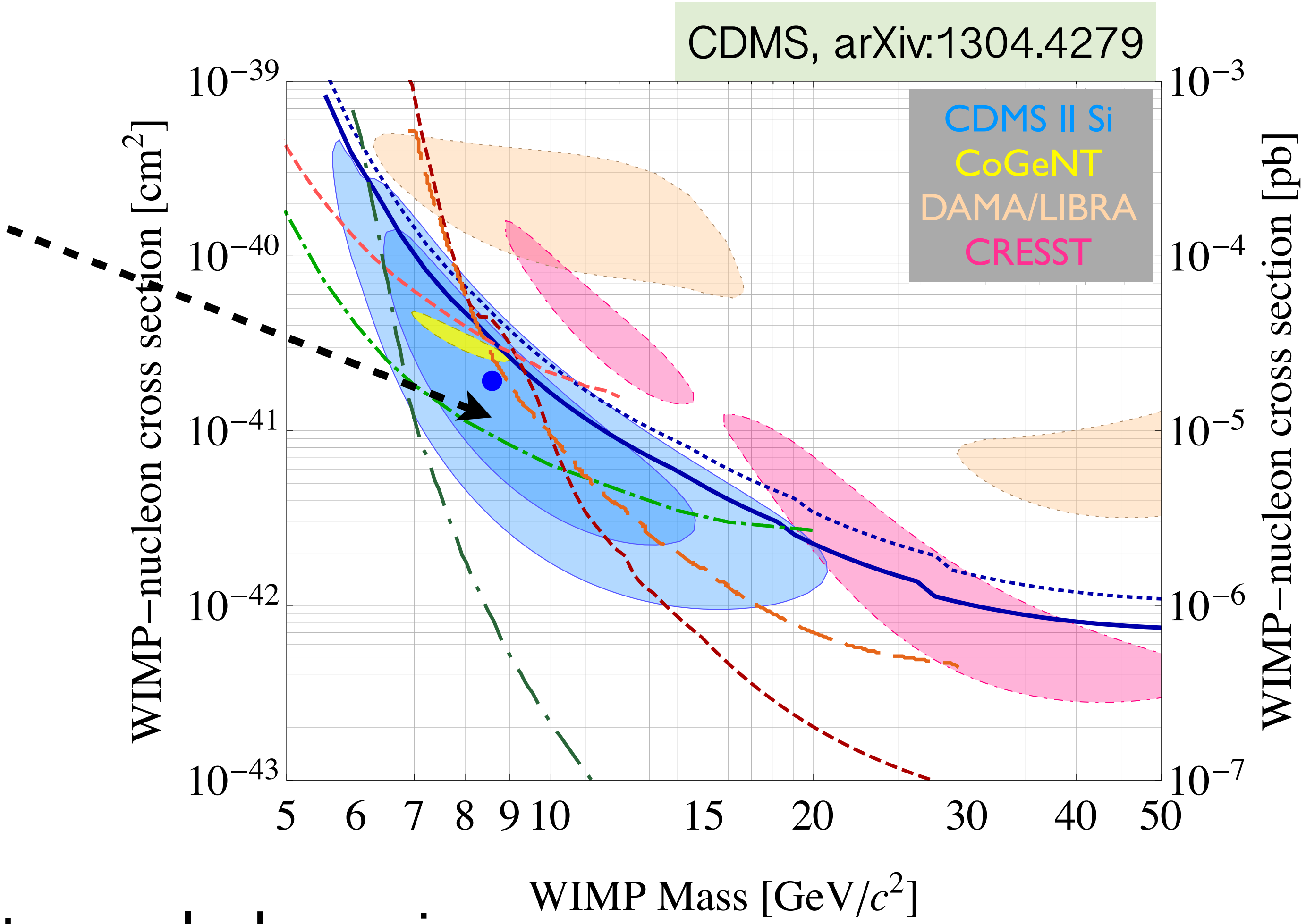
Do LHC results on the SUSY particles, Higgs signal strengths and constraints on DM from direct and indirect detection experiments rule out light neutralino DM?

Already many studies exist in literature, I'll not list them here

based on:
arXiv:1308.3735 [hep-ph] (published PLB)

Why light neutralino?

- Light SUSY spectrum
- Hints from direct (and may be indirect detection) ~ 10 GeV



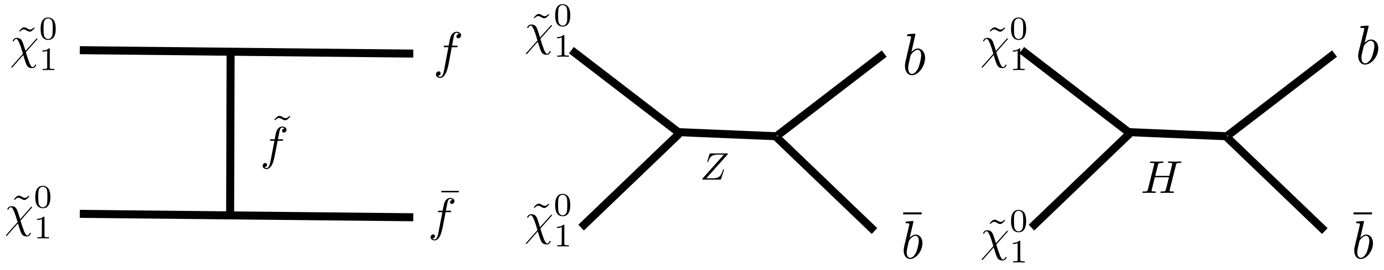
CDMS, arXiv:1304.4279

Light dark matter?

- Easy to exclude region
  - No resonance below 45 GeV (Mz/2)
  - No co-annihilation under 100 GeV (LEP limits) (counter example light sbottoms) arXiv:1308.2153

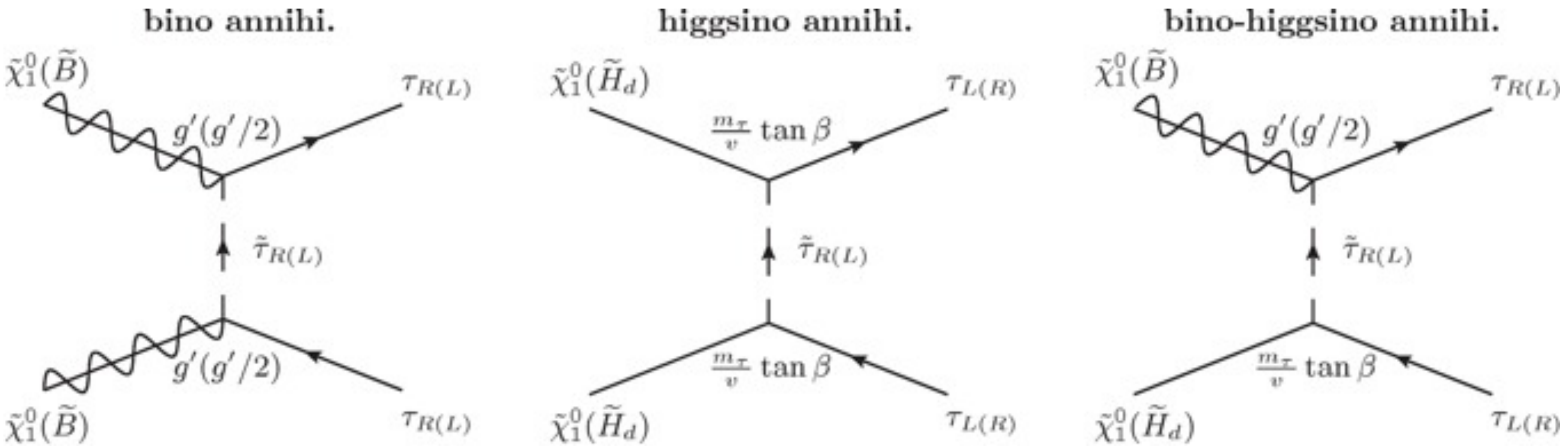
How light is light?

- Relaxing gaugino universality: few collider constraints
  - Z width, LEP bounds, invisible Higgs decays
- Most important annihilation channels:



- Region of interest: $m_{\tilde{\chi}_1^0} < m_h/2$
- Light slepton exchange of interest to us here

How light is light?

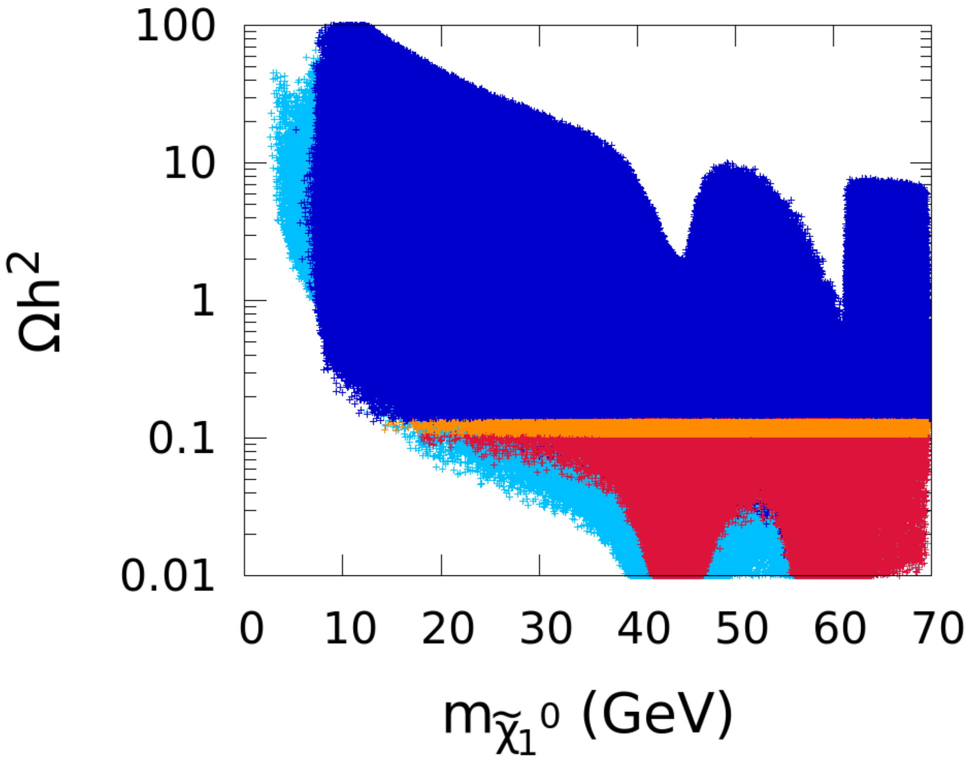


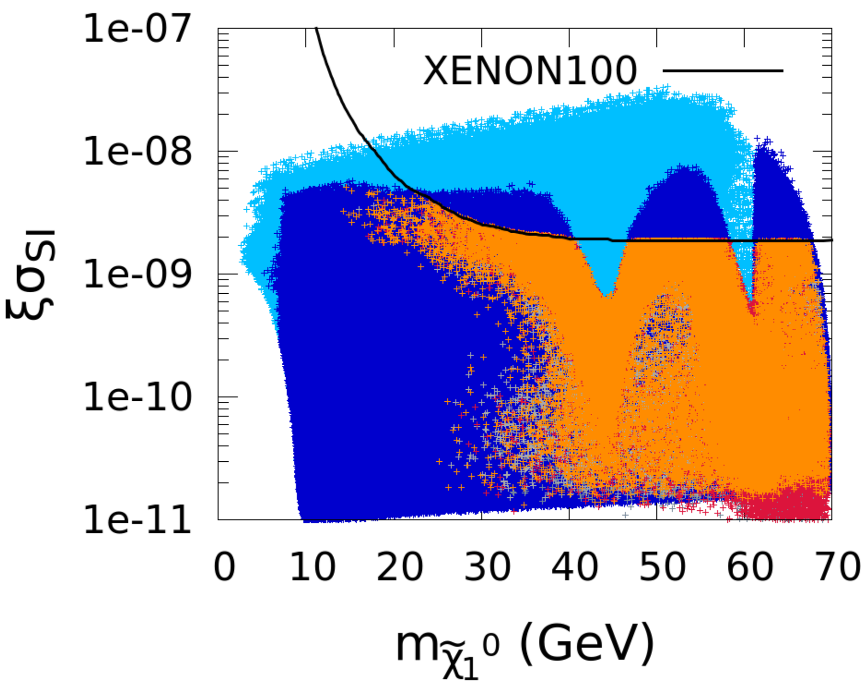
- RH stau annihilation is more efficient, also get enhancements for high tan(beta) and higgsino LSP

Light chargino	LEP and LHC	✓
Invisible Z, Higgs decays	LEP and LHC	✓
Light neutralino 2	LEP$\sigma(e^+ e^- \to \tilde\chi_1^0 \tilde\chi_2^0)$	✓
Slepton and stau	LEP and LHC	✓

How light is light?

- pMSSM scan over 11 parameters
  - $M_1, M_2, \mu, tan\beta, M_A, A_t, M_{1L}.M_{1R}, M_{3L}, M_{3R}, A_\tau$
  - LEP limits, Z width, flavor physics, heavy Higgs searches @LHC, Higgs mass, Higgs couplings, Xenon100





Basic constraints

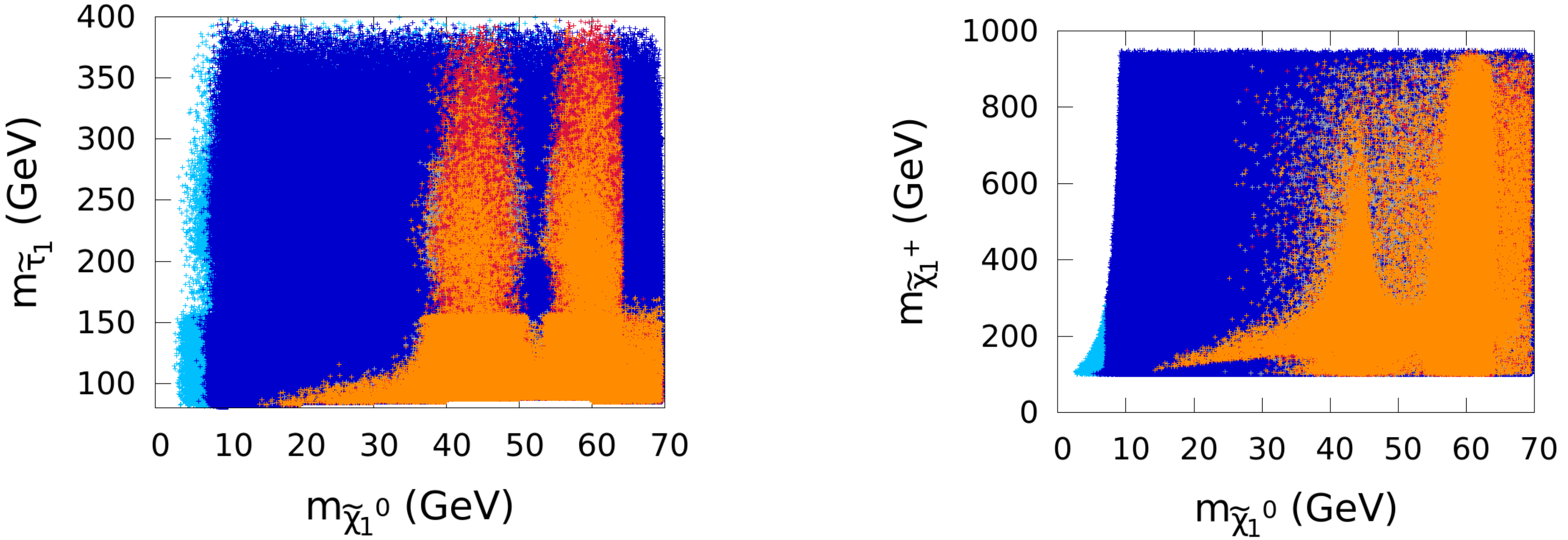
Higgs couplings fits

LHC results + upper limit of relic

LHC results + exact relic

How light is light?

- DM < 35 GeV associated with light stau + light chargino



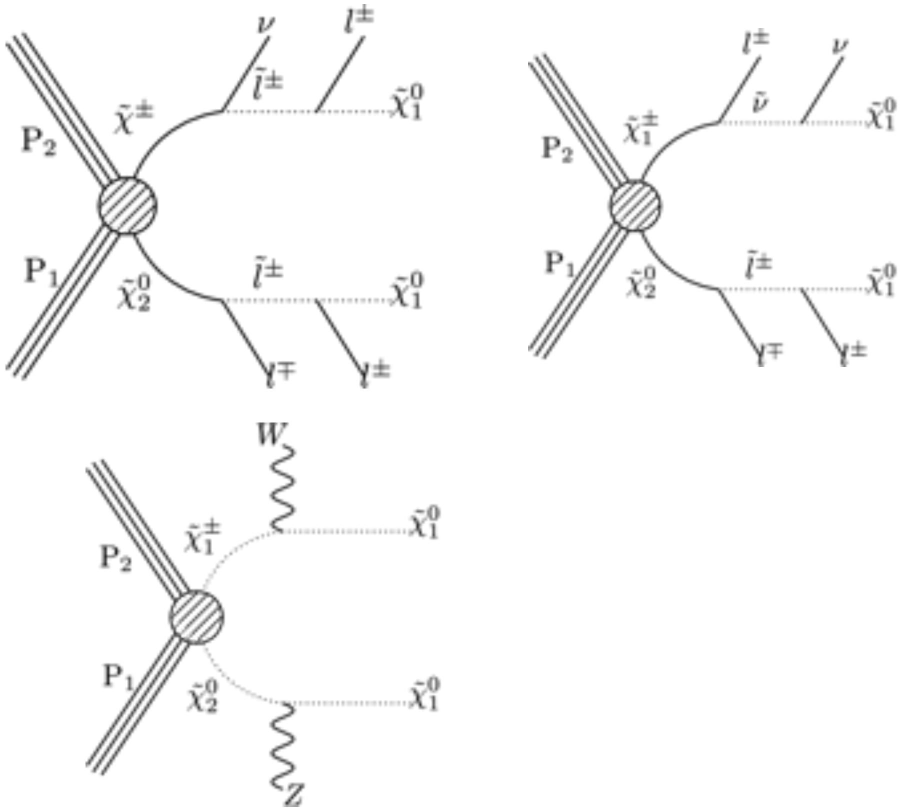
- LHC searches put constraints on light electroweak -ino and slepton production

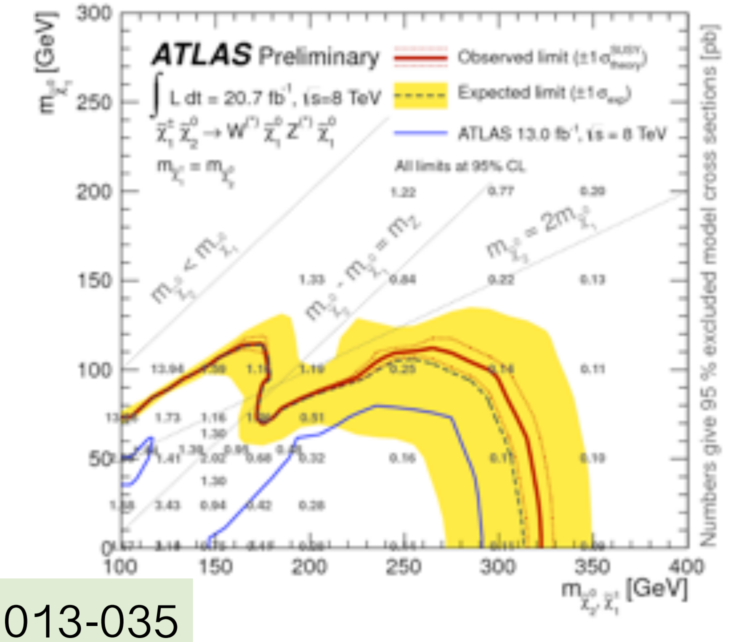
Basic constraints
Higgs couplings fits

LHC results + upper limit of relic
LHC results + exact relic

LHC searches

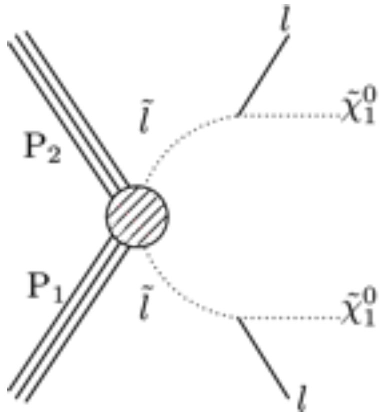
- Direct electroweak -ino production

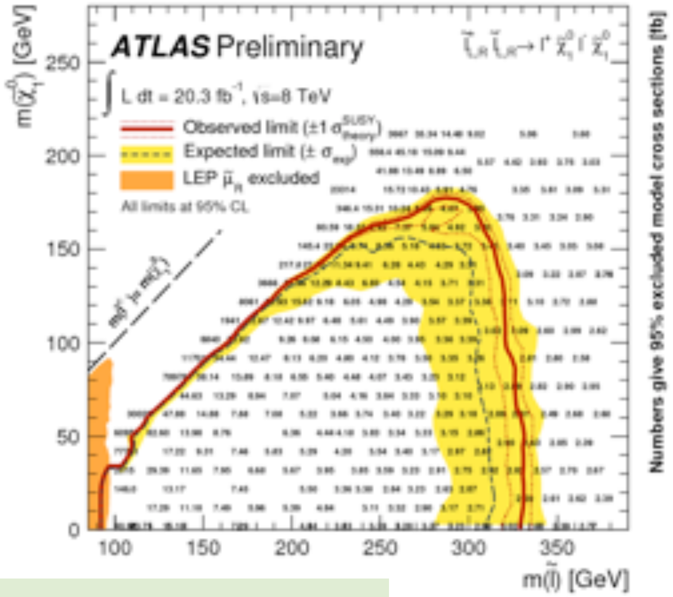




ATLAS-CONF-2013-035

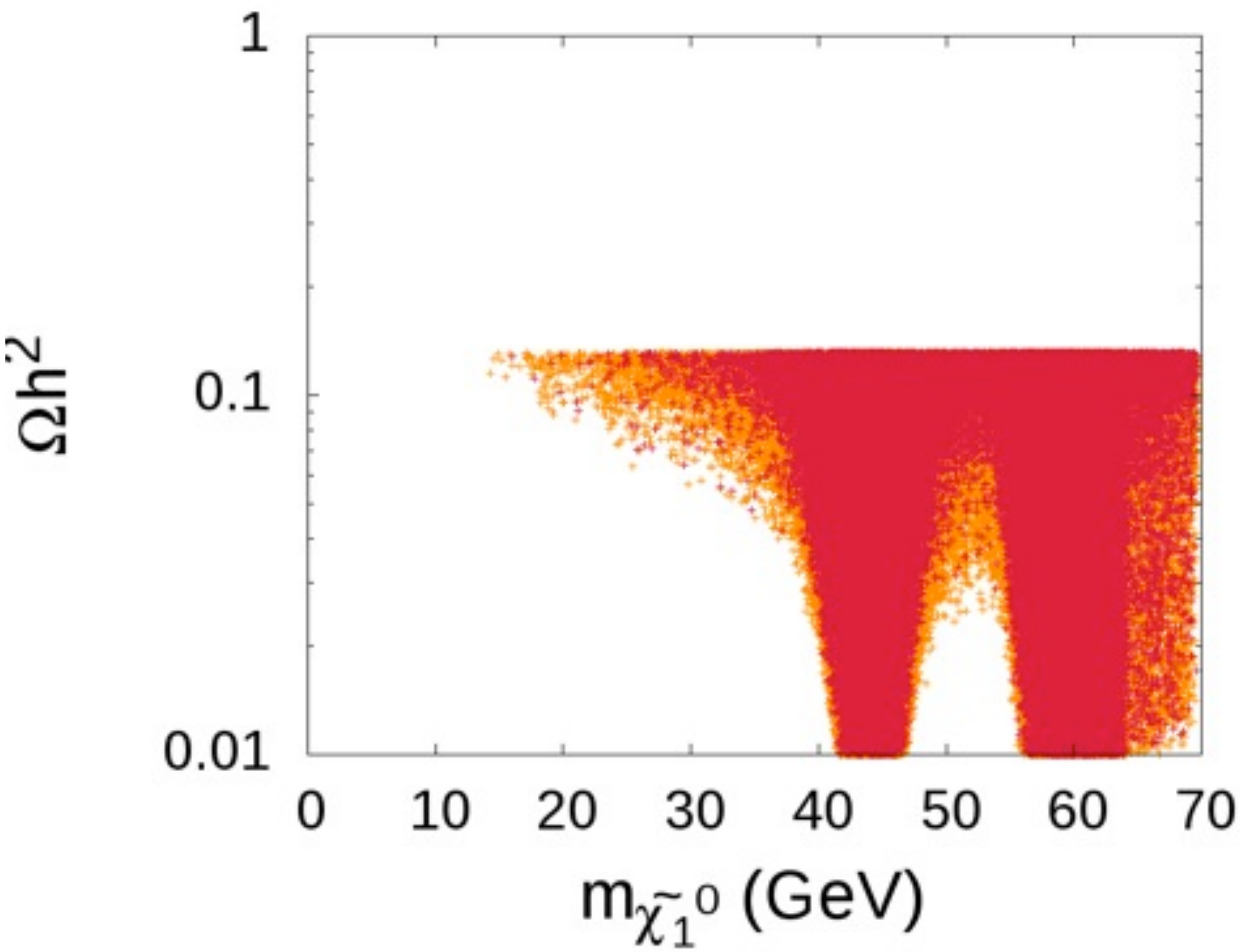
- Direct slepton production





ATLAS-CONF-2013-049

Applying SModelS

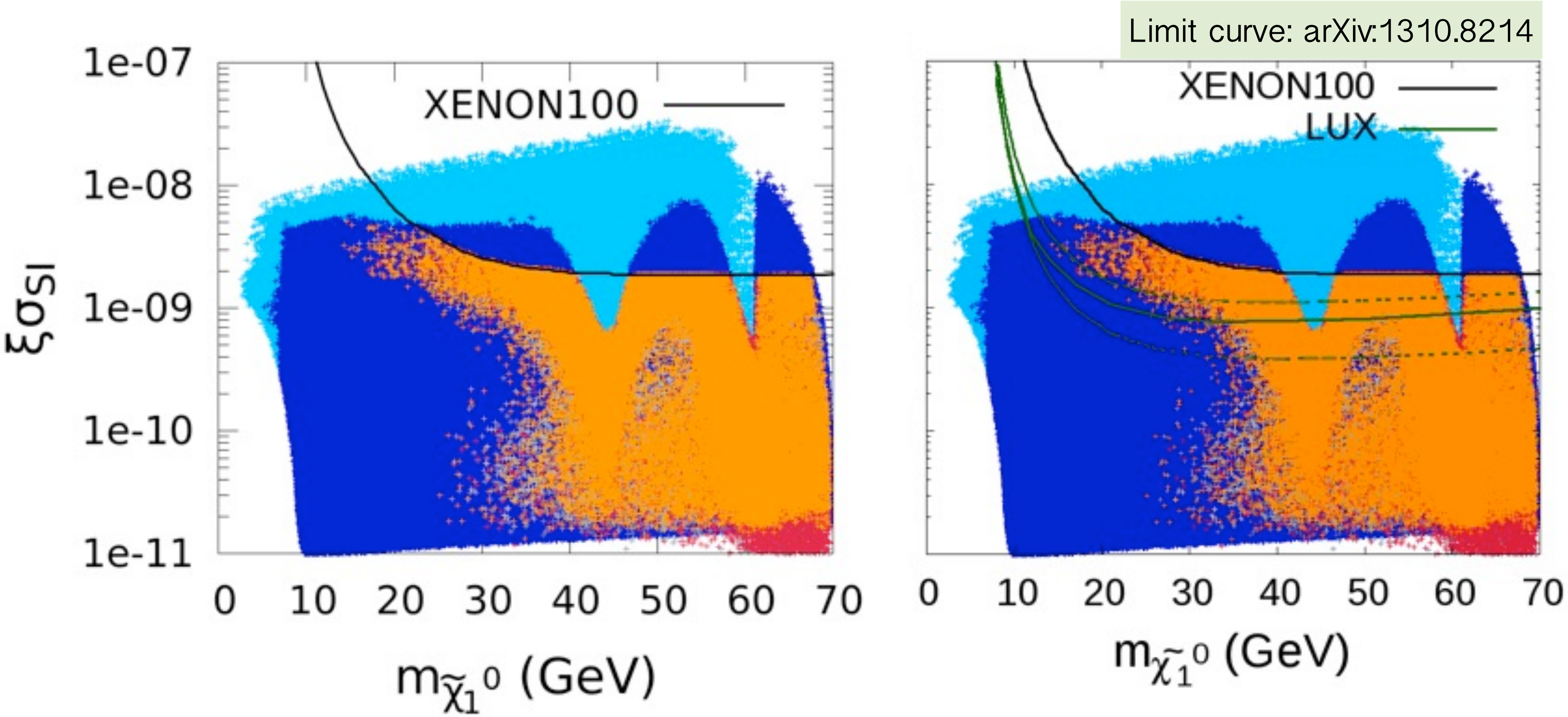


All points passing relic density upper limits

Points excluded by the LHC limits

- SMS results used from ATLAS-CONF-2013-049, CMS-PAS-SUS-12-022, ATLAS-CONF-2013-035
- Density of points reduced - LHC SMS results do rule out some scenarios
- In general light neutralino still possible

LUX limits


Limit curve: arXiv:1310.8214

- Neutralino DD CS is driven by higgsino component, suppressed when LSP has small higgsino component

- LUX disfavors the light neutralino DM region we had identified to be viable

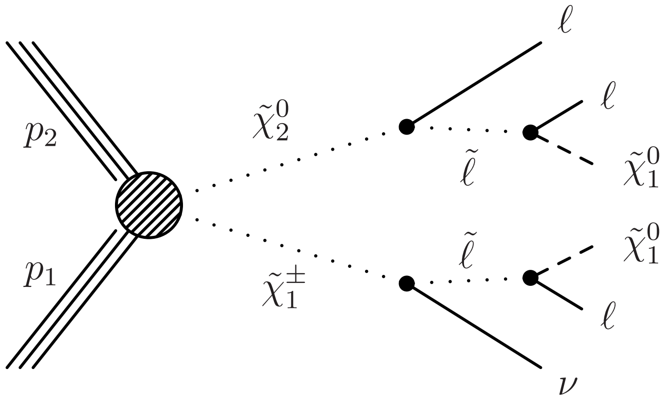
Basic constraints
Higgs couplings fits

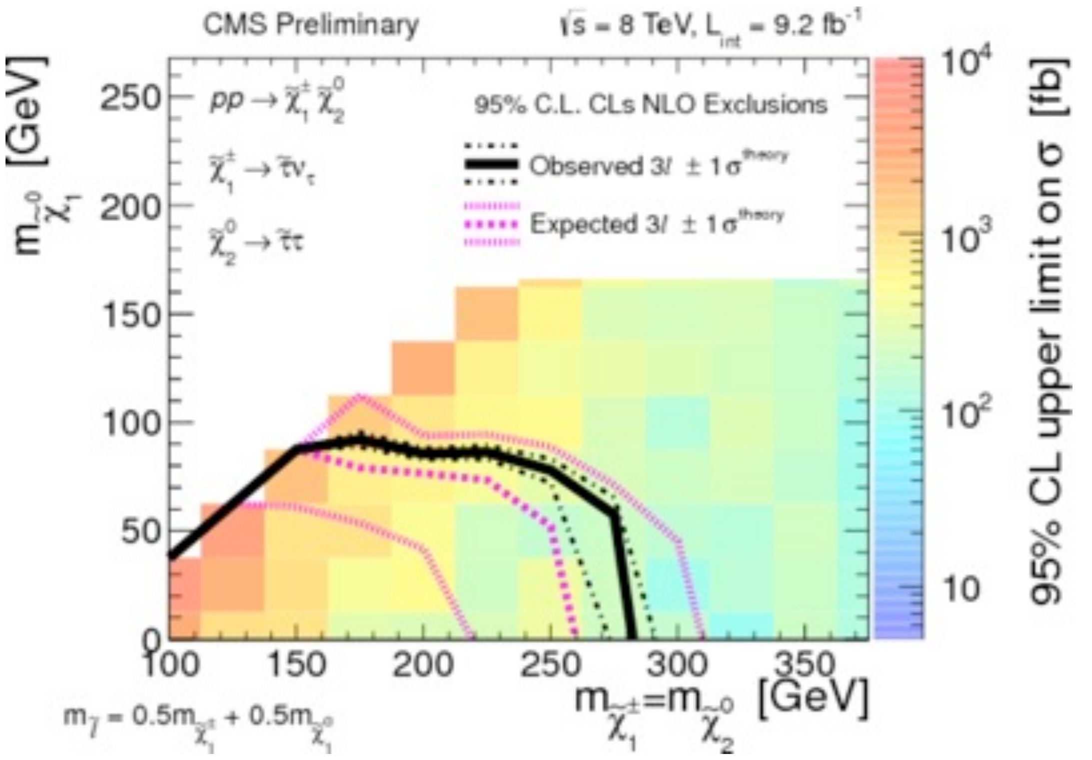
LHC results + upper limit of relic
LHC results + exact relic

SMS approach - what's next?

- SMS approach is not perfect yet
- Not all SMS topologies are present
- It is not always possible to use experimental SMS results, sometimes the results have a coarse grid or in case of a one step decay, only one mass slice is given

CMS - SUS -12-022



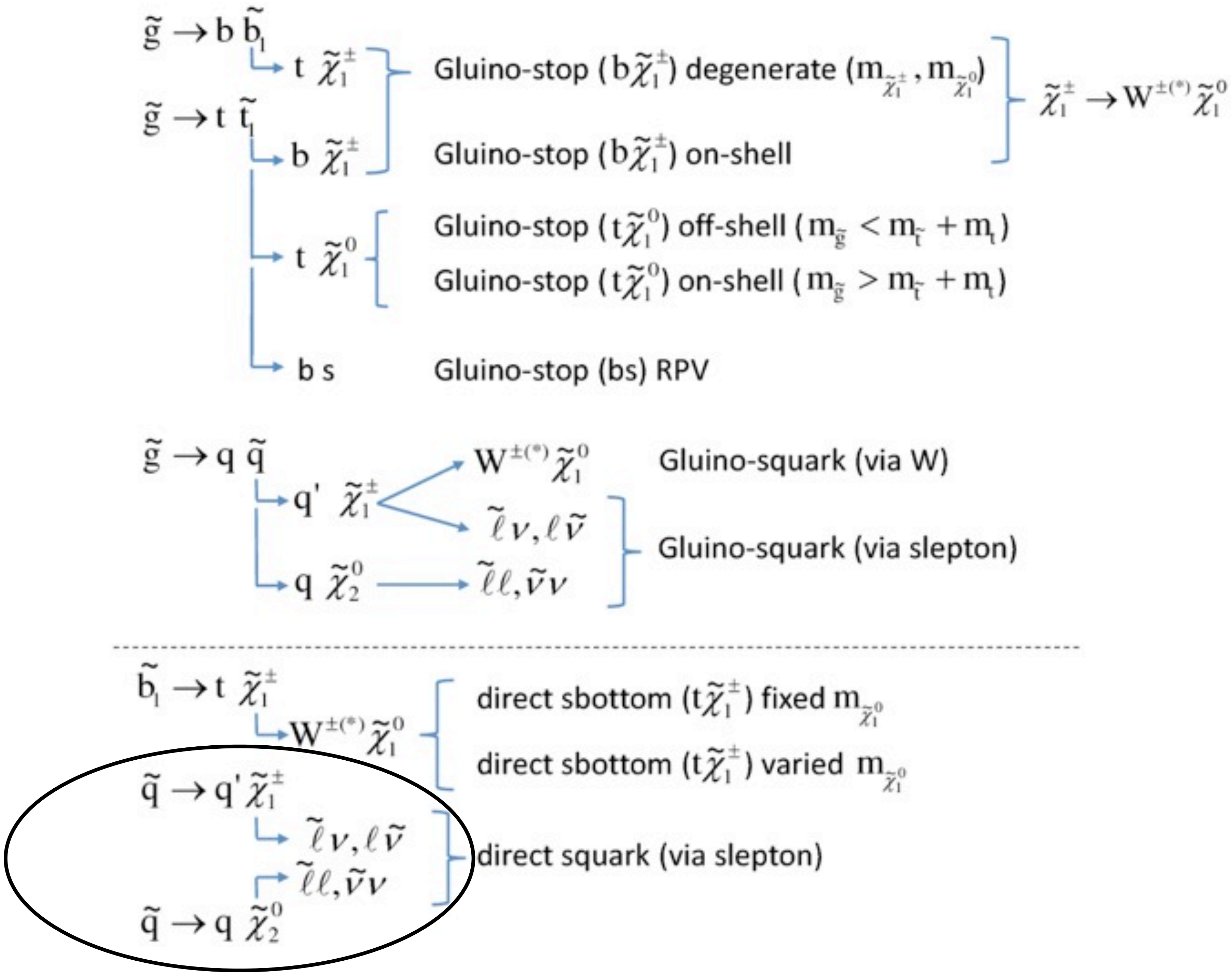


SMS approach - what's next?

- Results presented are not always usable
- My nightmare SMS analysis: ATLAS-CONF-2013-007
  - Involves topologies with more than four SUSY particles
  - Plots often include strong assumptions on the masses involved
  - Binning is not uniform

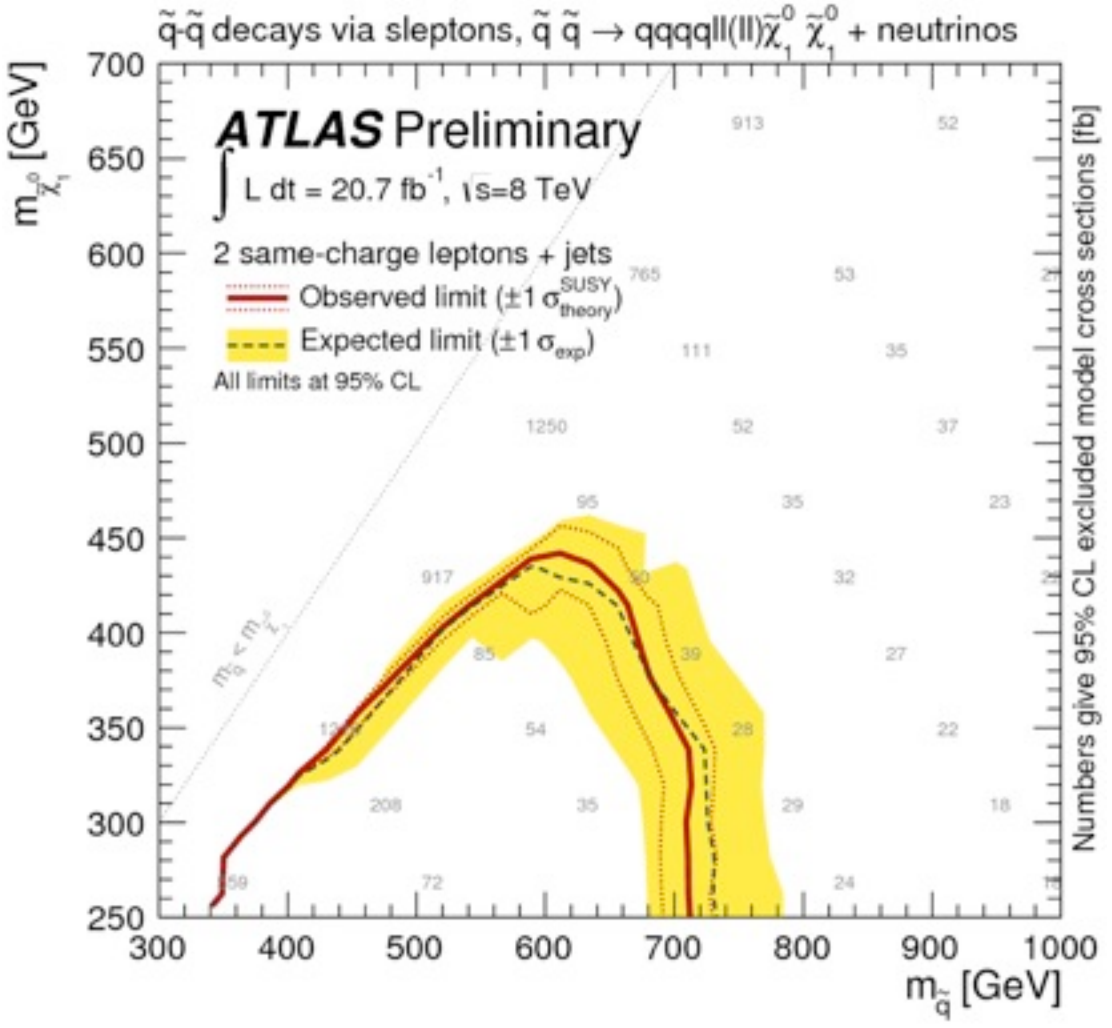
SMS approach - what's next?

ATLAS-CONF-2013-007



SMS approach - what's next?

ATLAS-CONF-2013-007

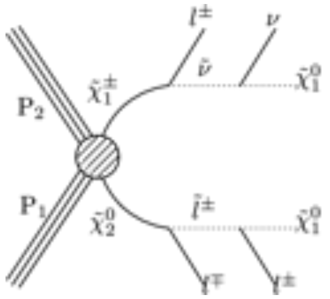


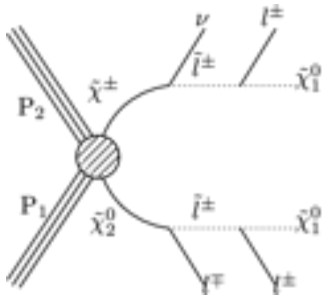
- Two of the four masses fixed
- Only democratic slepton decays
- Irregular binning (less severe)

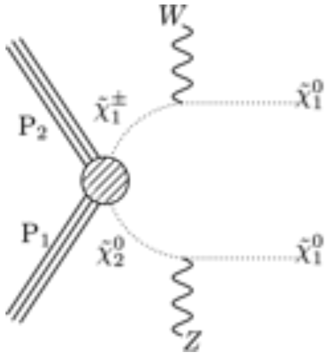
SMS approach - what's next?

- In principle several topologies can contribute to the same final state with different efficiencies

Tri-lepton final state: ATLAS-CONF-2013-035







SMS approach - what’s next?

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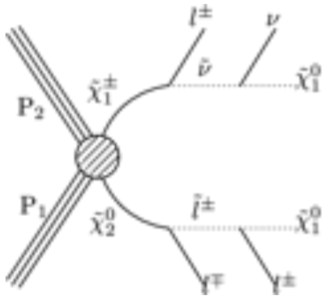
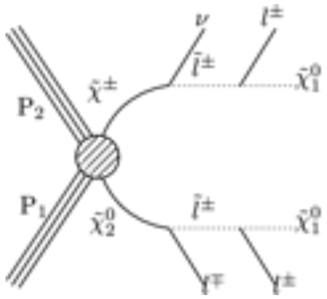
Tri-lepton final state: ATLAS-CONF-2013-035

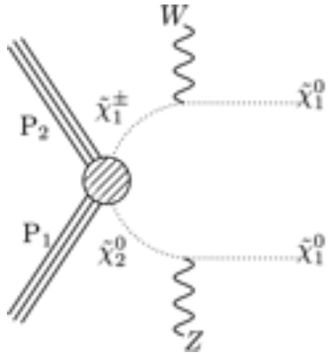
Real life ϵ_1



$+ \ \epsilon_2$



$+ \ \epsilon_3$



SMS approach - what's next?

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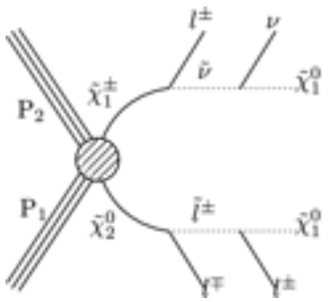
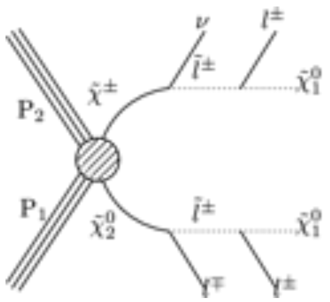
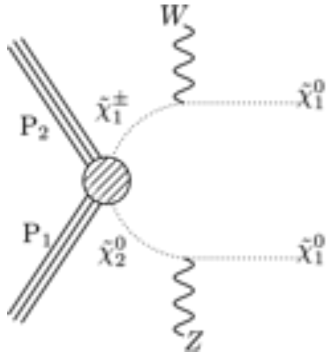
Tri-lepton final state: ATLAS-CONF-2013-035







SMS approach - what’s next?

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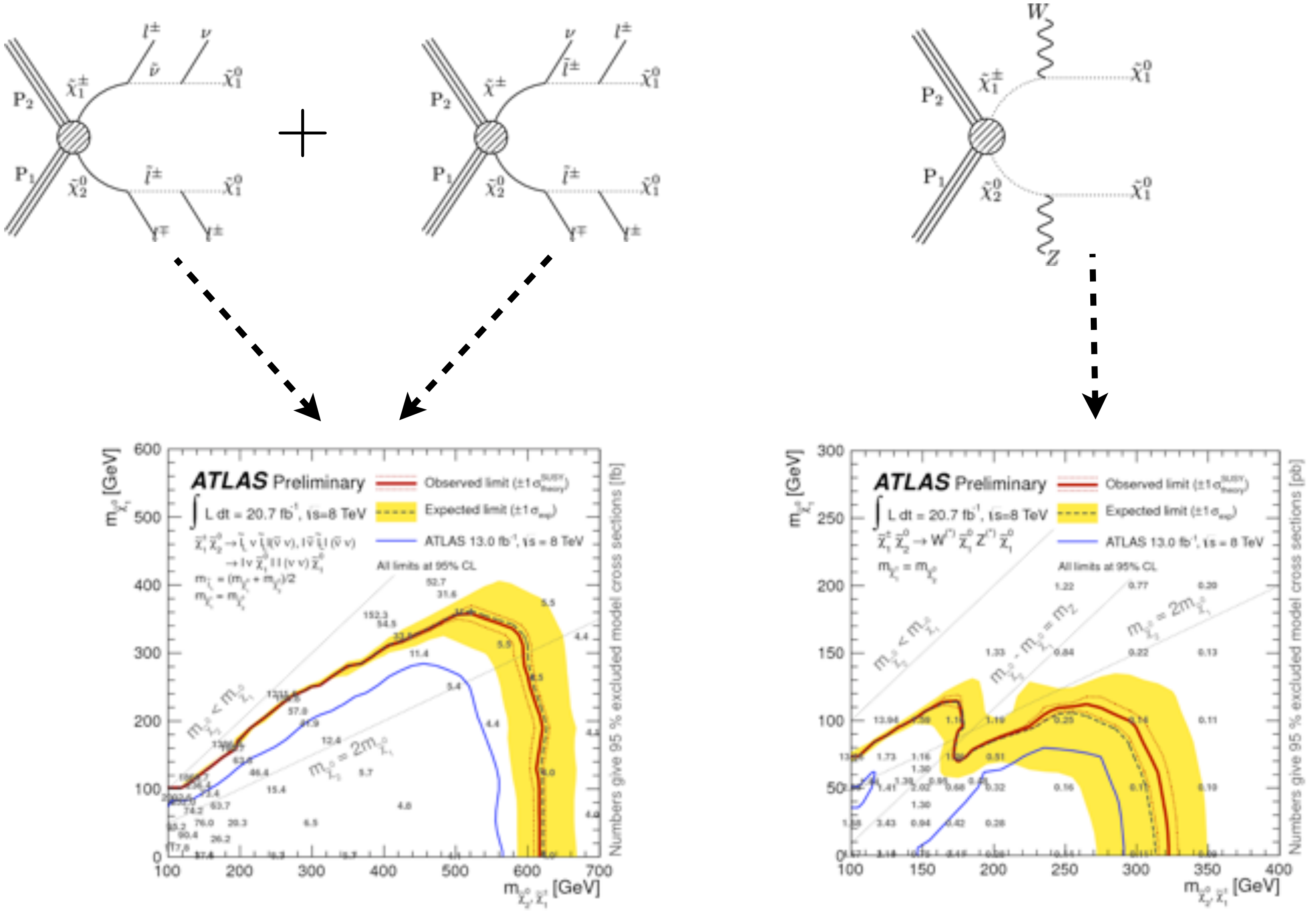
Tri-lepton final state: ATLAS-CONF-2013-035



Current SMS results

SMS approach - what’s next?

- To utilize this approach one needs to develop efficiency maps for each analysis and for each topology that can potentially contribute to the final state
- Need to re-implement the analysis - requires manpower and availability of information from experimental collaborations in a systematic manner
- FastLim is developing efficiency maps, aim is to reconstruct the number of events for each signal region
- SModelS is also capable of supporting efficiency maps approach, and in future we might consider exploiting this feature

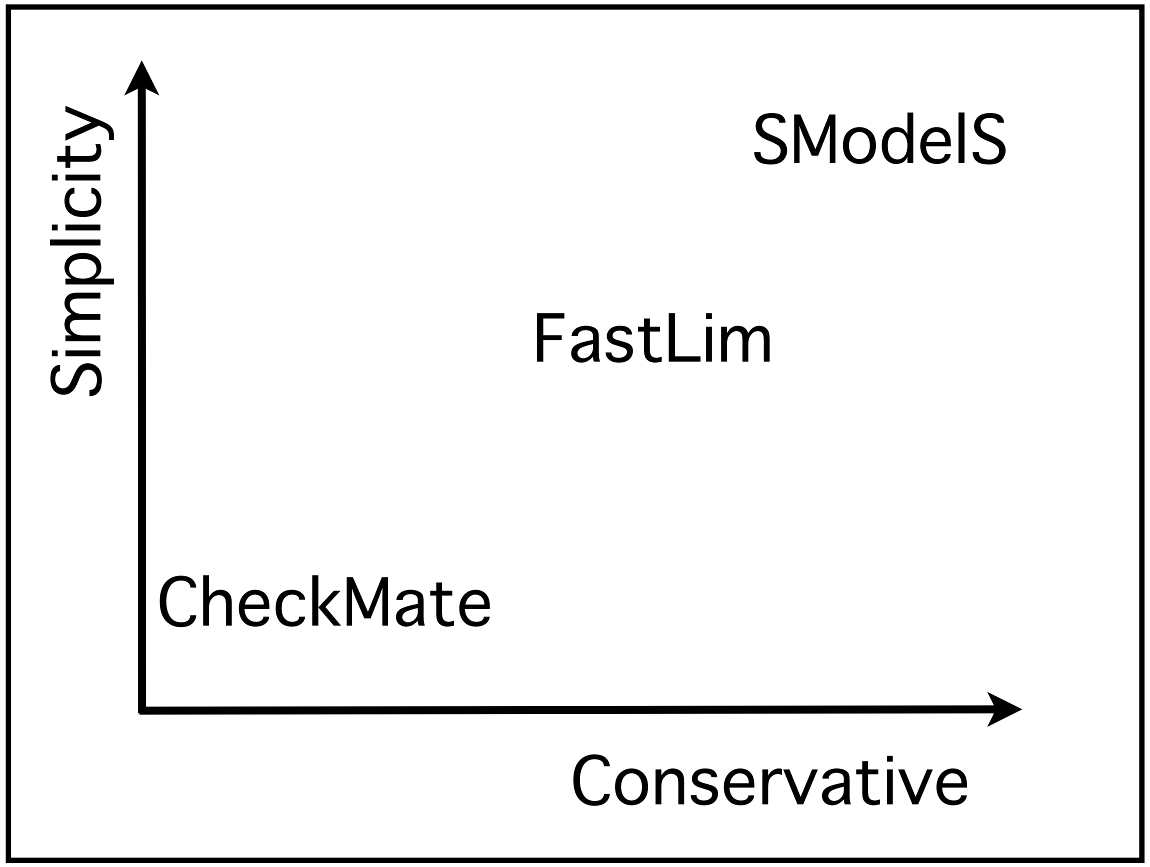
FastLim arXiv:1402.0492

SMS approach - what’s next?

- Generally the development will be slow - a community effort to contribute to the efficiency maps is underway, it will be useful to make the re-implemented analysis publicly available
- Also need to develop a reasonable likelihood in order to be able to combine several signal regions - e.g. CMS-SUS-PAS-13-011 has 16 signal regions

SMS approach - what's next?

- It will be difficult to tackle long cascade decays with SMS approach
- A completely different approach is being taken by checkMATE
- The tool identifies the most sensitive topology and then tests it via Monte Carlo simulation



CheckMATE arXiv:1312.2591

Conclusions

- SMS results are a good way to test BSM theories and can have a good constraining power
- SModelS is designed to utilize this power and constrain BSM scenarios
- The formalism of the code is generic and can be applied to any BSM spectra for which SMS results are applicable
- Currently, the code can handle scenarios with Z2 parity
- It contains the most comprehensive database of SMS SUSY results
- It can be used in order to understand the features of parameter space under consideration, it can also be used to study viability of an interesting BSM scenario
- Stay tuned applying LHC searches to your favorite BSM model is being made easy!