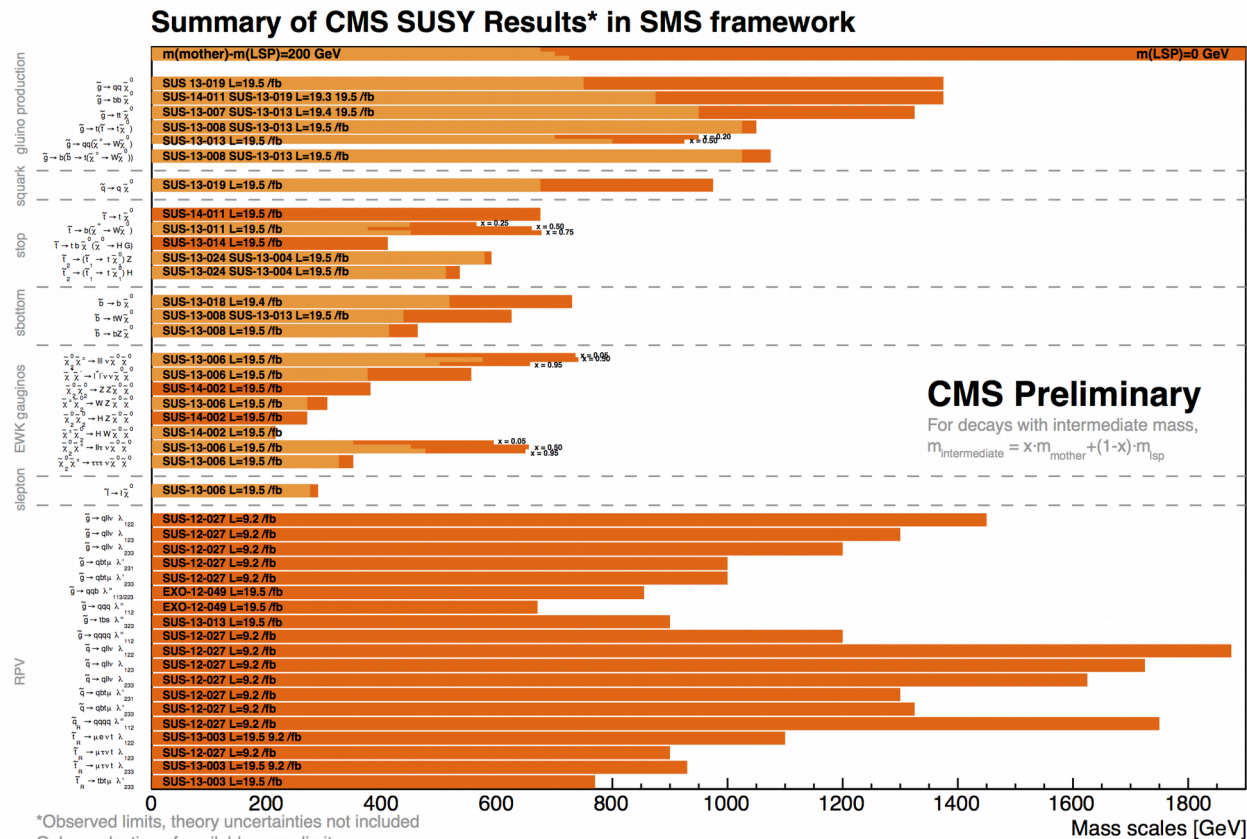


Lund, Sweden, 13 – 18 June 2016

Searching for Physics Beyond the Standard Model

A huge number of searches for BSM physics has been performed by CMS and ATLAS:



CMS,
8 TeV results
SUSY,
ICHEP 2014

Searching for Physics Beyond the Standard Model

A huge number of searches for BSM physics has been performed by CMS and ATLAS:

ATLAS SUSY Searches* - 95% CL Lower Limits

Status: March 2016

ATLAS Preliminary

$\sqrt{s} = 7, 8, 13 \text{ TeV}$

RPV
slepton
EWK gauginos
bottom
stop
squark, gluino production

Summary

$m(\text{mother})-m(\text{LSP})$

SUS-13-019 L=19.5 fb

SUS-13-011 L=19.5 fb

SUS-13-014 L=19.5 fb

SUS-13-024 L=19.5 fb

SUS-13-007 L=19.5 fb

SUS-13-008 L=19.5 fb

SUS-13-013 L=19.5 fb

SUS-13-008 L=19.5 fb

SUS-13-019 L=19.5 fb

SUS-14-011 L=19.5 fb

SUS-13-011 L=19.5 fb

SUS-13-024 L=19.5 fb

SUS-13-018 L=19.4 fb

SUS-13-008 L=19.5 fb

SUS-13-006 L=19.5 fb

SUS-13-006 L=19.5 fb

SUS-14-002 L=19.5 fb

SUS-13-006 L=19.5 fb

SUS-13-006 L=19.5 fb

SUS-13-006 L=19.5 fb

SUS-13-006 L=19.5 fb

SUS-13-006 L=19.5 fb

SUS-13-006 L=19.5 fb

SUS-13-006 L=19.5 fb

SUS-13-006 L=19.5 fb

SUS-13-006 L=19.5 fb

SUS-13-006 L=19.5 fb

SUS-13-006 L=19.5 fb

SUS-13-006 L=19.5 fb

SUS-13-006 L=19.5 fb

SUS-13-006 L=19.5 fb

SUS-13-006 L=19.5 fb

SUS-13-006 L=19.5 fb

SUS-13-006 L=19.5 fb

Model	e, μ, τ, γ	Jets	E_T^{miss}	$d\mathcal{L} d\Omega [\text{fb}^{-1}]$	Mass limit	$\sqrt{s} = 7, 8 \text{ TeV}$	$\sqrt{s} = 13 \text{ TeV}$	Reference
MSUGRA/CMSSM	0-3 $e, \mu/1-2 \tau$	2-10 jets/3 b	Yes	20.3	\tilde{q}, \tilde{g}	1.85 TeV	$m(\tilde{q})=m(\tilde{g})$	1507.05525
$\tilde{q}\tilde{q}, \tilde{q}-\tilde{q}\tilde{g}$	0	2-6 jets	Yes	3.2	\tilde{q}	980 GeV	$m(\tilde{q})=0 \text{ GeV}, m(1^{\text{st}} \text{ gen. } \tilde{q})=m(2^{\text{nd}} \text{ gen. } \tilde{q})$	ATLAS-CONF-2015-062
$\tilde{q}\tilde{q}, \tilde{q}-\tilde{q}\tilde{g}$ (compressed)	mono-jet	1-3 jets	Yes	3.2	\tilde{q}	610 GeV	$m(\tilde{q})-m(\tilde{g}) < 5 \text{ GeV}$	To appear
$\tilde{q}\tilde{q}, \tilde{q}-\tilde{q}\tilde{g}(\ell\ell/\nu\nu/\nu\tau)\tilde{g}$	2 e, μ (off-Z)	2 jets	Yes	20.3	\tilde{q}	820 GeV	$m(\tilde{q})=0 \text{ GeV}$	1503.03290
$\tilde{g}\tilde{g}, \tilde{g}-\tilde{q}\tilde{g}\tilde{g}$	0	2-6 jets	Yes	3.2	\tilde{g}	1.52 TeV	$m(\tilde{g})=0 \text{ GeV}$	ATLAS-CONF-2015-062
$\tilde{g}\tilde{g}, \tilde{g}-\tilde{q}\tilde{g}\tilde{g} \rightarrow \tilde{q}\tilde{q}W^{\pm}\tilde{g}$	1 e, μ	2-6 jets	Yes	3.3	\tilde{g}	1.6 TeV	$m(\tilde{g}) < 350 \text{ GeV}, m(\tilde{g}^{\pm})=0.5(m(\tilde{g})+m(\tilde{g}))$	ATLAS-CONF-2015-076
$\tilde{g}\tilde{g}, \tilde{g}-\tilde{q}\tilde{g}(\ell\ell/\nu\nu/\nu\tau)\tilde{g}$	2 e, μ	0-3 jets	-	20	\tilde{g}	1.38 TeV	$m(\tilde{g})=0 \text{ GeV}$	1501.03555
$\tilde{g}\tilde{g}, \tilde{g}-\tilde{q}\tilde{g}WZ\tilde{g}$	0	7-10 jets	Yes	3.2	\tilde{g}	1.4 TeV	$m(\tilde{g})=100 \text{ GeV}$	1602.06194
GMSB (\tilde{g} NLSP)	1-2 $\tau + 0-1 \ell$	0-2 jets	Yes	20.3	\tilde{g}	1.63 TeV	$\tan\beta > 20$	1407.0603
GGM (bino NLSP)	2 γ	-	Yes	20.3	\tilde{g}	1.34 TeV	$c\tau(\text{NLSP}) < 0.1 \text{ mm}$	1507.05493
GGM (higgsino-bino NLSP)	7	1 b	Yes	20.3	\tilde{g}	1.37 TeV	$m(\tilde{g}) < 950 \text{ GeV}, c\tau(\text{NLSP}) < 0.1 \text{ mm}, \mu < 0$	1507.05493
GGM (higgsino NLSP)	γ	2 jets	Yes	20.3	\tilde{g}	1.3 TeV	$m(\text{NLSP}) > 420 \text{ GeV}$	1503.03290
GGM (higgsino NLSP)	2 e, μ (Z)	2 jets	Yes	20.3	\tilde{g}	900 GeV	$m(\tilde{g}) > 1.8 \times 10^{-4} \text{ eV}, m(\tilde{g})=m(\tilde{g})=1.5 \text{ TeV}$	1502.01518
Gravitino LSP	0	mono-jet	Yes	20.3	$\tilde{g}^{1/2} \text{ scale}$	865 GeV		
$\tilde{g}\tilde{g}, \tilde{g}-\tilde{b}\tilde{b}\tilde{g}$	0	3 b	Yes	3.3	\tilde{g}	1.78 TeV	$m(\tilde{g}) < 800 \text{ GeV}$	ATLAS-CONF-2015-067
$\tilde{g}\tilde{g}, \tilde{g}-\tilde{t}\tilde{t}\tilde{g}$	0-1 e, μ	3 b	Yes	3.3	\tilde{g}	1.76 TeV	$m(\tilde{g})=0 \text{ GeV}$	To appear
$\tilde{g}\tilde{g}, \tilde{g}-\tilde{b}\tilde{b}\tilde{g}$	0-1 e, μ	3 b	Yes	20.1	\tilde{g}	1.37 TeV	$m(\tilde{g}) < 300 \text{ GeV}$	1407.0600
$\tilde{b}_1\tilde{b}_1, \tilde{b}_1-\tilde{b}\tilde{b}\tilde{g}$	0	2 b	Yes	3.2	\tilde{b}_1	840 GeV	$m(\tilde{b}_1) < 100 \text{ GeV}$	ATLAS-CONF-2015-066
$\tilde{b}_1\tilde{b}_1, \tilde{b}_1-\tilde{b}\tilde{b}\tilde{g}$	2 e, μ (SS)	0-3 b	Yes	3.2	\tilde{b}_1	325-540 GeV	$m(\tilde{b}_1) = 50 \text{ GeV}, m(\tilde{b}_1^{\pm}) = m(\tilde{b}_1^{\mp}) + 100 \text{ GeV}$	1602.09058
$\tilde{t}_1\tilde{t}_1, \tilde{t}_1-\tilde{b}\tilde{b}\tilde{g}$	1-2 e, μ	1-2 b	Yes	4.7/20.3	\tilde{t}_1	117-170 GeV	$m(\tilde{t}_1) = 2m(\tilde{b}_1), m(\tilde{t}_1^{\pm}) = 55 \text{ GeV}$	1209.2102, 1407.0583
$\tilde{t}_1\tilde{t}_1, \tilde{t}_1-W\tilde{b}\tilde{g}$ or $\tilde{b}\tilde{b}\tilde{g}$	0-2 e, μ	0-2 jets/1-2 b	Yes	20.3	\tilde{t}_1	90-198 GeV	$m(\tilde{t}_1) = 1 \text{ GeV}$	1508.08616, ATLAS-CONF-2016-007
$\tilde{t}_1\tilde{t}_1, \tilde{t}_1-c\tilde{c}\tilde{g}$	0	mono-jet/c-tag	Yes	20.3	\tilde{t}_1	90-245 GeV	$m(\tilde{t}_1)-m(\tilde{b}_1) < 85 \text{ GeV}$	1407.0608
$\tilde{t}_1\tilde{t}_1$ (natural GMSB)	2 e, μ (Z)	1 b	Yes	20.3	\tilde{t}_1	150-600 GeV	$m(\tilde{t}_1) > 150 \text{ GeV}$	1403.5222
$\tilde{t}_2\tilde{t}_2, \tilde{t}_2-\tilde{t}_1 + Z$	2 e, μ (Z)	1 b	Yes	20.3	\tilde{t}_2	290-610 GeV	$m(\tilde{t}_2) < 200 \text{ GeV}$	1403.5222
$\tilde{t}_2\tilde{t}_2, \tilde{t}_2-\tilde{t}_1 + h$	1 e, μ	6 jets + 2 b	Yes	20.3	\tilde{t}_2	320-620 GeV	$m(\tilde{t}_2)=0 \text{ GeV}$	1506.08616
$\tilde{t}_1\tilde{t}_1, \tilde{t}_1-\tilde{t}\tilde{t}\tilde{g}$	2 e, μ	0	Yes	20.3	\tilde{t}_1	90-335 GeV	$m(\tilde{t}_1)=0 \text{ GeV}$	1403.5294
$\tilde{t}_1\tilde{t}_1, \tilde{t}_1-\tilde{t}\tilde{t}\tilde{g}$	2 e, μ	0	Yes	20.3	\tilde{t}_1	140-475 GeV	$m(\tilde{t}_1)=0 \text{ GeV}, m(\tilde{t}_1, \tilde{t}_2)=0.5(m(\tilde{t}_1^{\pm})+m(\tilde{t}_2^{\pm}))$	1403.5294
$\tilde{t}_1\tilde{t}_1, \tilde{t}_1-\tilde{t}\tilde{t}\tilde{g}$	2 τ	-	Yes	20.3	\tilde{t}_1	355 GeV	$m(\tilde{t}_1)=0 \text{ GeV}, m(\tilde{t}_1, \tilde{t}_2)=0.5(m(\tilde{t}_1^{\pm})+m(\tilde{t}_2^{\pm}))$	1407.0350
$\tilde{t}_1\tilde{t}_1, \tilde{t}_1-\tilde{t}\tilde{t}\tilde{g}$	3 e, μ	0	Yes	20.3	\tilde{t}_1, \tilde{t}_2	715 GeV	$m(\tilde{t}_1)=m(\tilde{t}_2), m(\tilde{t}_1^{\pm})=0, m(\tilde{t}_2, \tilde{t}_2)=0.5(m(\tilde{t}_1^{\pm})+m(\tilde{t}_2^{\pm}))$	1402.7029
$\tilde{t}_1\tilde{t}_1, \tilde{t}_1-W\tilde{b}\tilde{g}$	2-3 e, μ	0-2 jets	Yes	20.3	\tilde{t}_1, \tilde{t}_2	425 GeV	$m(\tilde{t}_1)=m(\tilde{t}_2), m(\tilde{t}_1^{\pm})=0, \text{ sleptons decoupled}$	1403.5294, 1402.7029
$\tilde{t}_1\tilde{t}_1, \tilde{t}_1-W\tilde{b}\tilde{g}$	e, μ, γ	0-2 b	Yes	20.3	\tilde{t}_1, \tilde{t}_2	270 GeV	$m(\tilde{t}_1)=m(\tilde{t}_2), m(\tilde{t}_1^{\pm})=0, \text{ sleptons decoupled}$	1501.07110
$\tilde{t}_1\tilde{t}_1, \tilde{t}_1-\tilde{t}\tilde{t}\tilde{g}$	4 e, μ	0	Yes	20.3	\tilde{t}_1, \tilde{t}_2	635 GeV	$m(\tilde{t}_1)=m(\tilde{t}_2), m(\tilde{t}_1^{\pm})=0, m(\tilde{t}_2, \tilde{t}_2)=0.5(m(\tilde{t}_1^{\pm})+m(\tilde{t}_2^{\pm}))$	1405.5086
$\tilde{t}_1\tilde{t}_1, \tilde{t}_1-\tilde{t}\tilde{t}\tilde{g}$	1 $e, \mu + \gamma$	-	Yes	20.3	\tilde{t}_1	115-370 GeV	$c\tau < 1 \text{ mm}$	1507.05493
GGM (wino NLSP) weak prod.	-	-	-	-	\tilde{W}	-	-	-
Direct $\tilde{t}_1\tilde{t}_1, \tilde{t}_1$ prod., long-lived \tilde{t}_1^{\pm}	Disapp. trk	1 jet	Yes	20.3	\tilde{t}_1^{\pm}	270 GeV	$m(\tilde{t}_1^{\pm})-m(\tilde{t}_1^{\mp}) < 160 \text{ MeV}, \tau(\tilde{t}_1^{\pm}) = 0.2 \text{ ns}$	1310.3675
Direct $\tilde{t}_1\tilde{t}_1, \tilde{t}_1$ prod., long-lived \tilde{t}_1^{\pm}	dE/dx trk	-	Yes	18.4	\tilde{t}_1^{\pm}	495 GeV	$m(\tilde{t}_1^{\pm})-m(\tilde{t}_1^{\mp}) < 160 \text{ MeV}, \tau(\tilde{t}_1^{\pm}) < 15 \text{ ns}$	1506.05332
Stable, stopped \tilde{t}_1 -hadron	0	1-5 jets	Yes	27.9	\tilde{t}_1	850 GeV	$m(\tilde{t}_1)=100 \text{ GeV}, 10 \mu\text{s} < c\tau(\tilde{t}_1) < 1000 \text{ s}$	1310.6584
Metastable \tilde{t}_1 -hadron	dE/dx trk	-	-	3.2	\tilde{t}_1	1.54 TeV	$m(\tilde{t}_1)=100 \text{ GeV}, \tau > 10 \text{ ns}$	To appear
GMSB, stable $\tilde{t}_1, \tilde{t}_1^{\pm} \rightarrow \tilde{t}(\tilde{g}, \tilde{b}) + \tau(e, \mu)$	1-2 μ	-	-	19.1	\tilde{t}_1^{\pm}	537 GeV	$10 < \tan\beta < 50$	1411.6795
GMSB, $\tilde{t}_1 \rightarrow \gamma\tilde{g}$, long-lived \tilde{t}_1^{\pm}	2 γ	-	Yes	20.3	\tilde{t}_1^{\pm}	440 GeV	$1 < c\tau(\tilde{t}_1^{\pm}) < 3 \text{ ns}$, SPSB model	1409.5542
$\tilde{g}\tilde{g}, \tilde{g} \rightarrow \tilde{e}\tilde{e}\nu/\mu\mu\nu$	displ. ee/ $\mu\mu$	-	-	20.3	\tilde{g}	1.0 TeV	$7 < c\tau(\tilde{g}) < 740 \text{ mm}, m(\tilde{g}) = 1.3 \text{ TeV}$	1504.05162
GGM $\tilde{g}\tilde{g}, \tilde{g} \rightarrow Z\tilde{g}$	displ. vtx + jets	-	-	20.3	\tilde{g}	1.0 TeV	$6 < c\tau(\tilde{g}) < 480 \text{ mm}, m(\tilde{g}) = 1.1 \text{ TeV}$	1504.05162
LFV $pp \rightarrow \tilde{e}_\tau + X, \tilde{e}_\tau \rightarrow e\mu/\tau\mu$	$e\mu, \tau\mu$	-	-	20.3	\tilde{e}_τ	1.7 TeV	$A'_{11}=0.11, A'_{12}/A'_{13}/A'_{23}=0.07$	1503.04430
RPV CMSSM	2 e, μ (SS)	0-3 b	Yes	20.3	\tilde{q}, \tilde{g}	1.45 TeV	$m(\tilde{q})=m(\tilde{g}), c\tau_{\text{LSP}} < 1 \text{ mm}$	1404.2500
$\tilde{t}_1\tilde{t}_1, \tilde{t}_1 \rightarrow W\tilde{b}\tilde{g}$	4 e, μ	-	Yes	20.3	\tilde{t}_1	760 GeV	$m(\tilde{t}_1) > 0.2 \times m(\tilde{t}_1^{\pm}), A_{121} \neq 0$	1405.5086
$\tilde{t}_1\tilde{t}_1, \tilde{t}_1 \rightarrow W\tilde{b}\tilde{g}$	3 $e, \mu + \tau$	-	Yes	20.3	\tilde{t}_1	450 GeV	$m(\tilde{t}_1) > 0.2 \times m(\tilde{t}_1^{\pm}), A_{133} \neq 0$	1405.5086
$\tilde{g}\tilde{g}, \tilde{g} \rightarrow q\bar{q}q$	0	6-7 jets	-	20.3	\tilde{g}	917 GeV	$\text{BR}(\tilde{g})-\text{BR}(\tilde{b})-\text{BR}(\tilde{c}) > 0\%$	1502.05686
$\tilde{g}\tilde{g}, \tilde{g} \rightarrow q\bar{q}q, \tilde{g} \rightarrow q\bar{q}q$	0	6-7 jets	-	20.3	\tilde{g}	980 GeV	$m(\tilde{g})=600 \text{ GeV}$	1502.05686
$\tilde{g}\tilde{g}, \tilde{g} \rightarrow i\bar{i}, i_1 \rightarrow b\bar{s}$	2 e, μ (SS)	0-3 b	Yes	20.3	\tilde{g}	880 GeV	-	1404.2500
$\tilde{t}_1\tilde{t}_1, \tilde{t}_1 \rightarrow b\bar{s}$	0	2 jets + 2 b	-	20.3	\tilde{t}_1	320 GeV	$\text{BR}(\tilde{t}_1 \rightarrow b\bar{e}/\mu) > 20\%$	1601.07453
$\tilde{t}_1\tilde{t}_1, \tilde{t}_1 \rightarrow b\bar{t}$	2 e, μ	2 b	-	20.3	\tilde{t}_1	0.4-1.0 TeV	-	ATLAS-CONF-2015-015
Scalar charm, $\tilde{c} \rightarrow c\tilde{g}$	0	2 c	Yes	20.3	\tilde{c}	510 GeV	$m(\tilde{c}) < 200 \text{ GeV}$	1501.01325

*Observed limits, theory uncertain
Only a selection of available mass
Probe *up to* the quoted mass limit

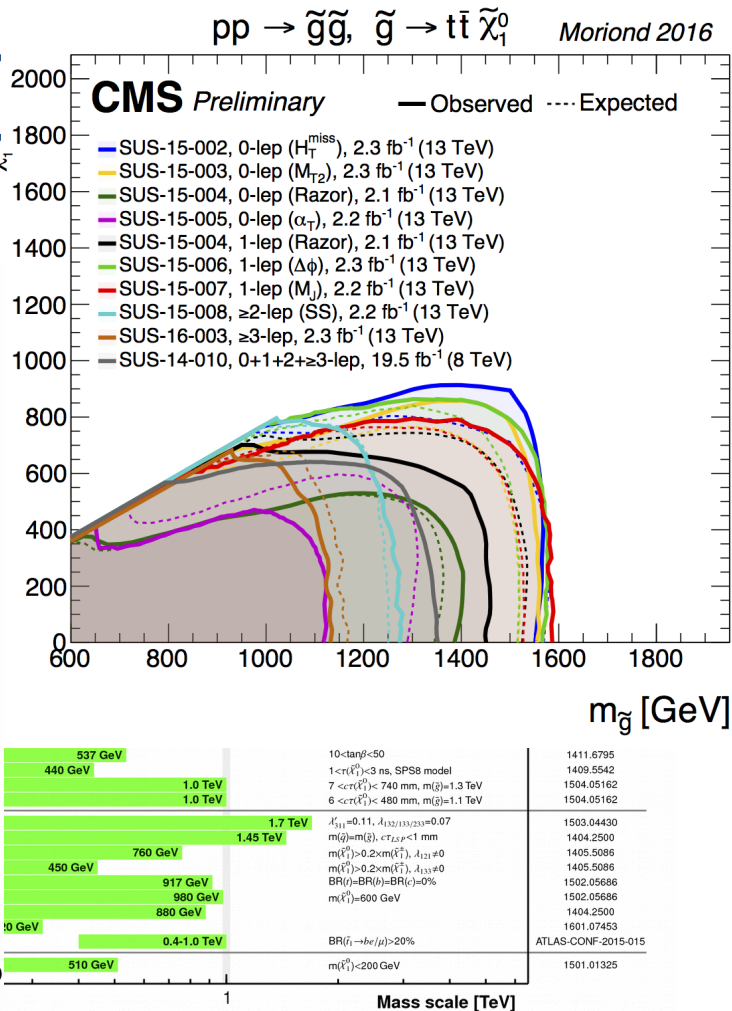
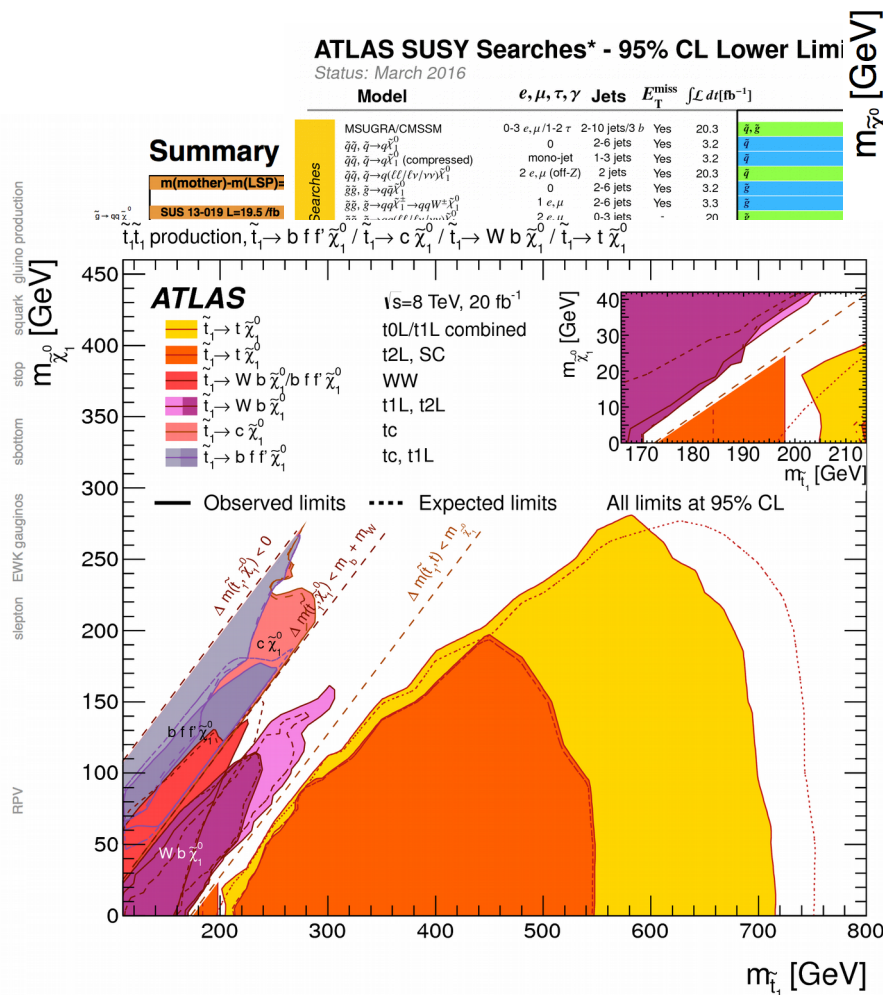
*Only a selection of the available mass limits on new
states or phenomena is shown.

Mass scale [TeV]

ATLAS
7 + 8 + 13
TeV
SUSY
March 2016
(incomplete!)

Searching for Physics Beyond the Standard Model

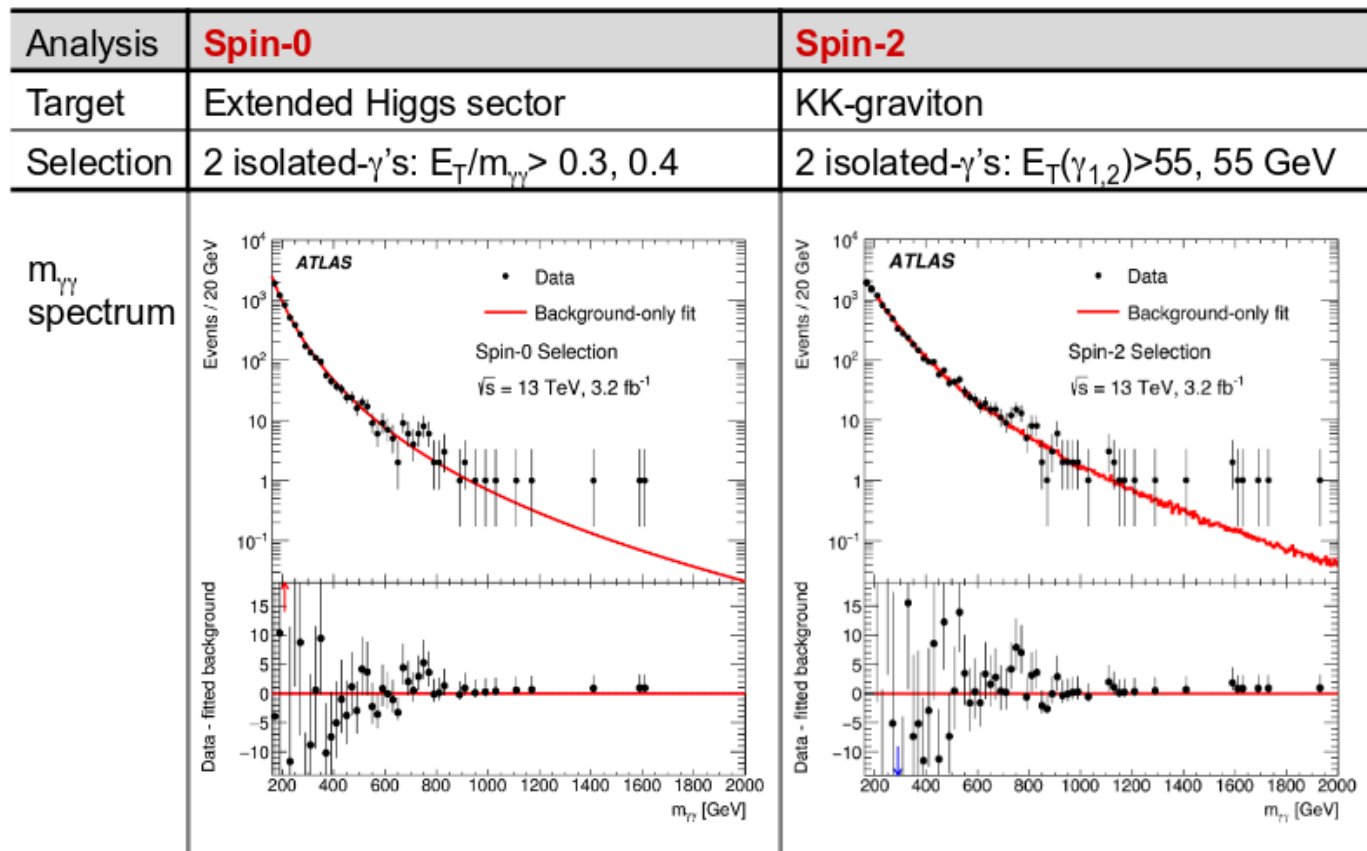
A huge number of searches for BSM physics has been performed by CMS and ATLAS:



CMS & ATLAS
13 TeV

Searching for Physics Beyond the Standard Model

Yes, in addition to all the null results we see mild excesses e.g. in the 750 GeV di-photons:

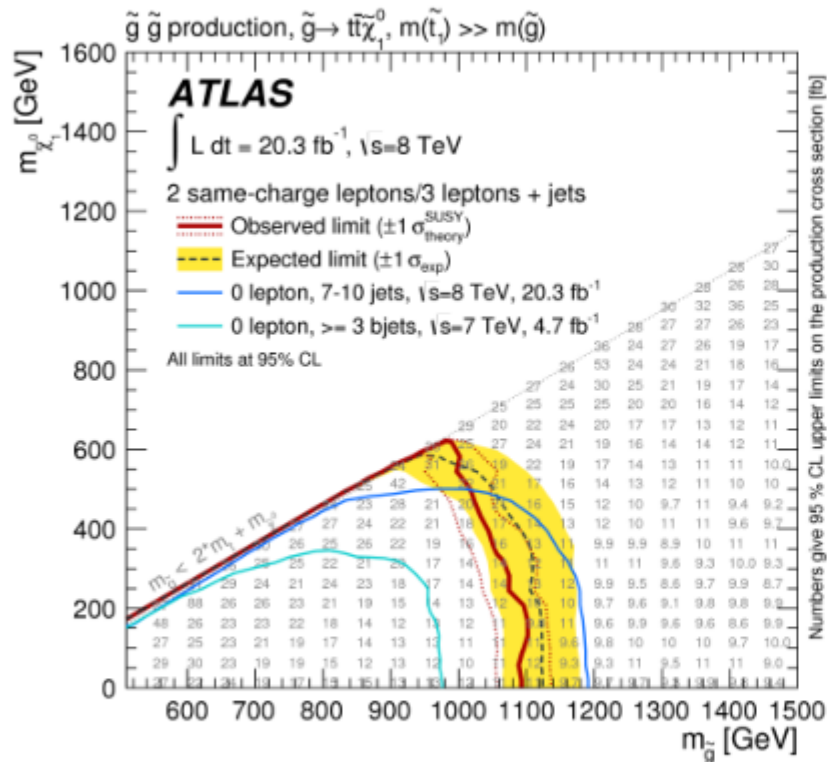


Using 3.2 fb⁻¹ of $\sqrt{s} = 13$ TeV data collected in 2015

16

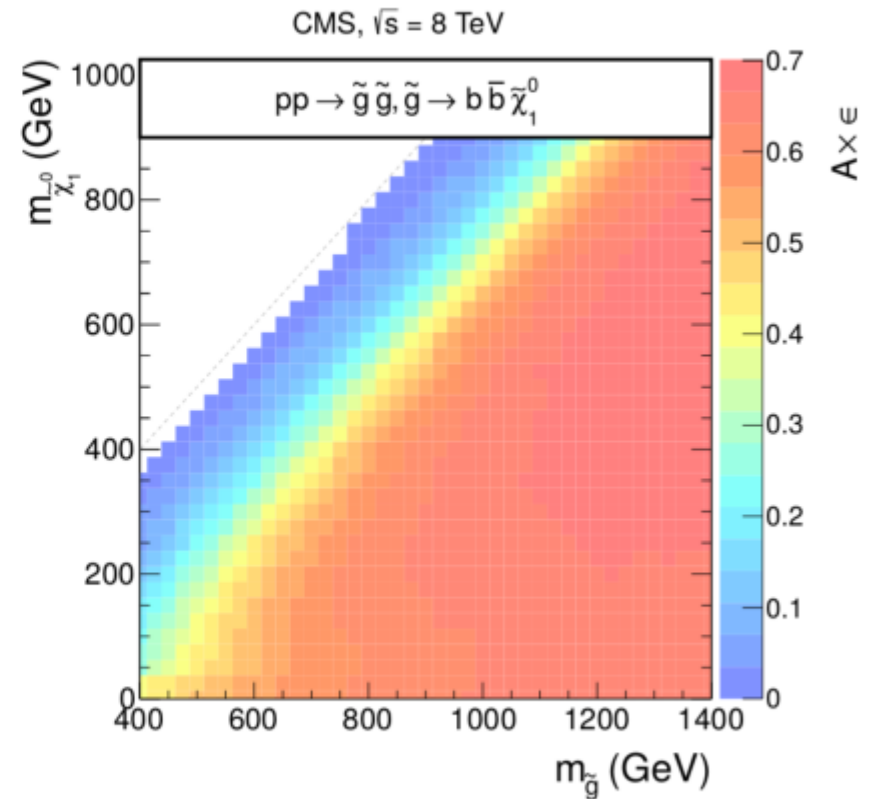
Null results for BSM searches are typically presented as:

Upper Limit (UL) maps:



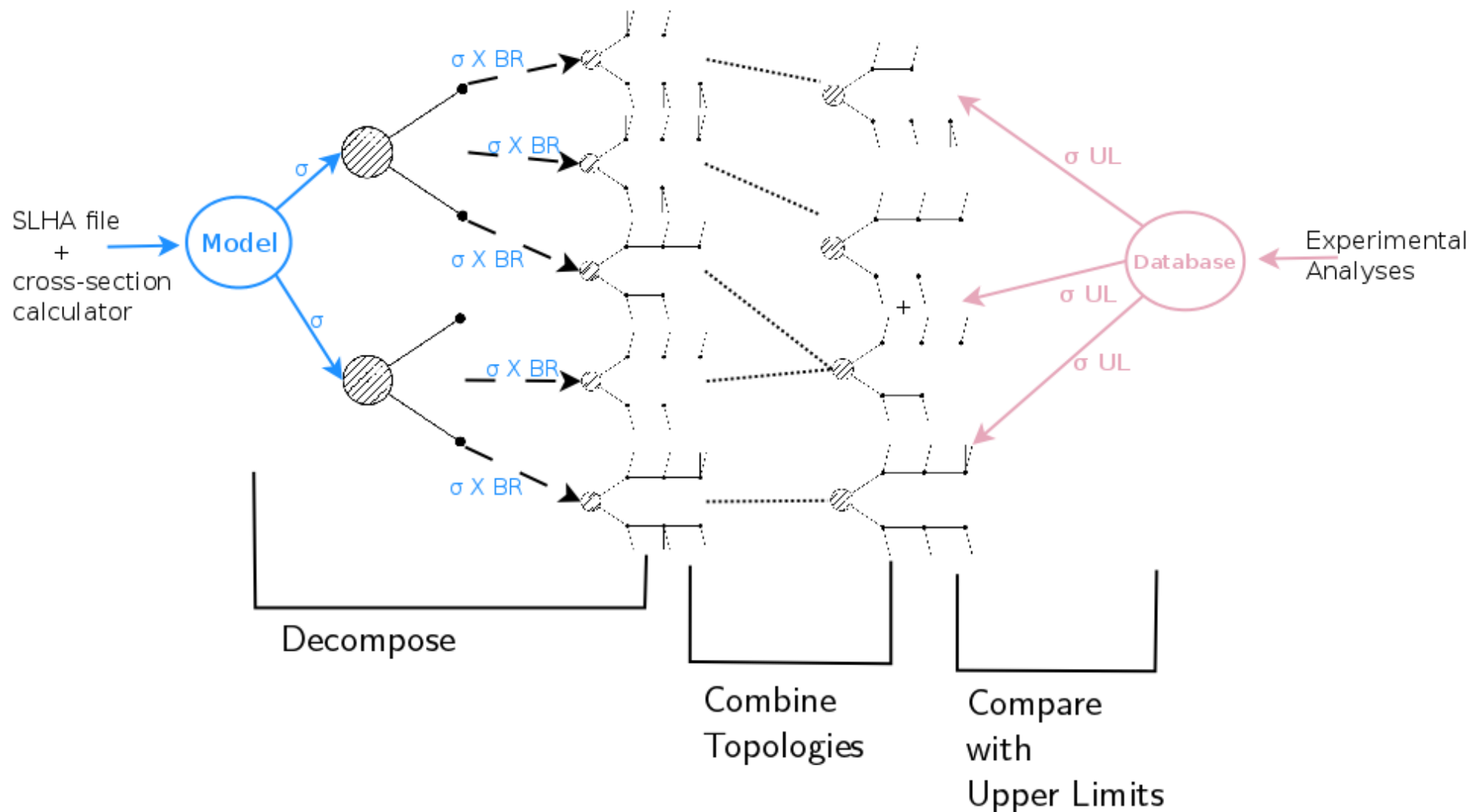
(ATLAS SUSY-2013-09)

Efficiency maps:



(CMS SUS-12-024)

- a tool for making systematic use of simplified models null results

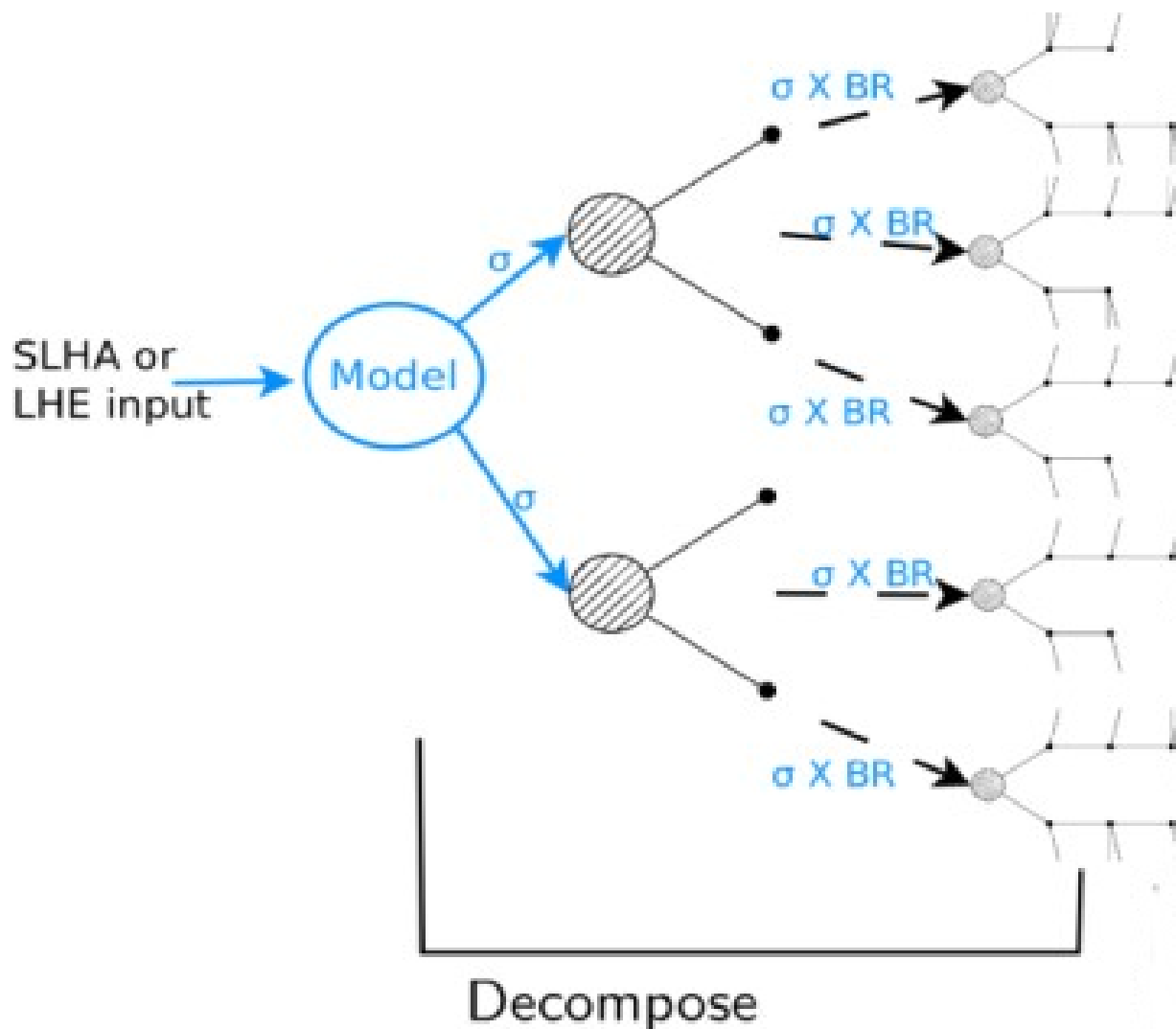


How



works:

1) Decomposition of a fundamental model



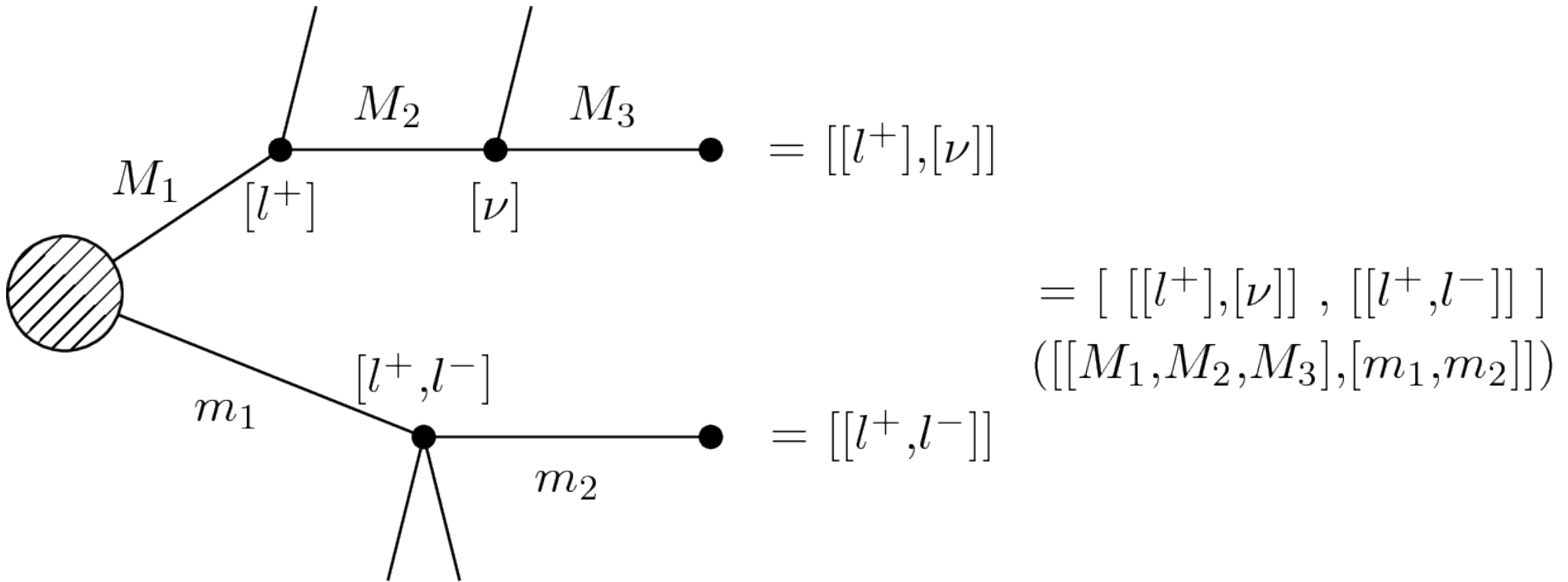
Input: SLHA file (mass spectrum, BRs) or LHE file (parton level)

Currently the model must have a Z_2 symmetry

The decomposition produces a set of simplified model topologies (dubbed “elements”)

[illegible]

Simplified Model Topology:



Each topology is described by:

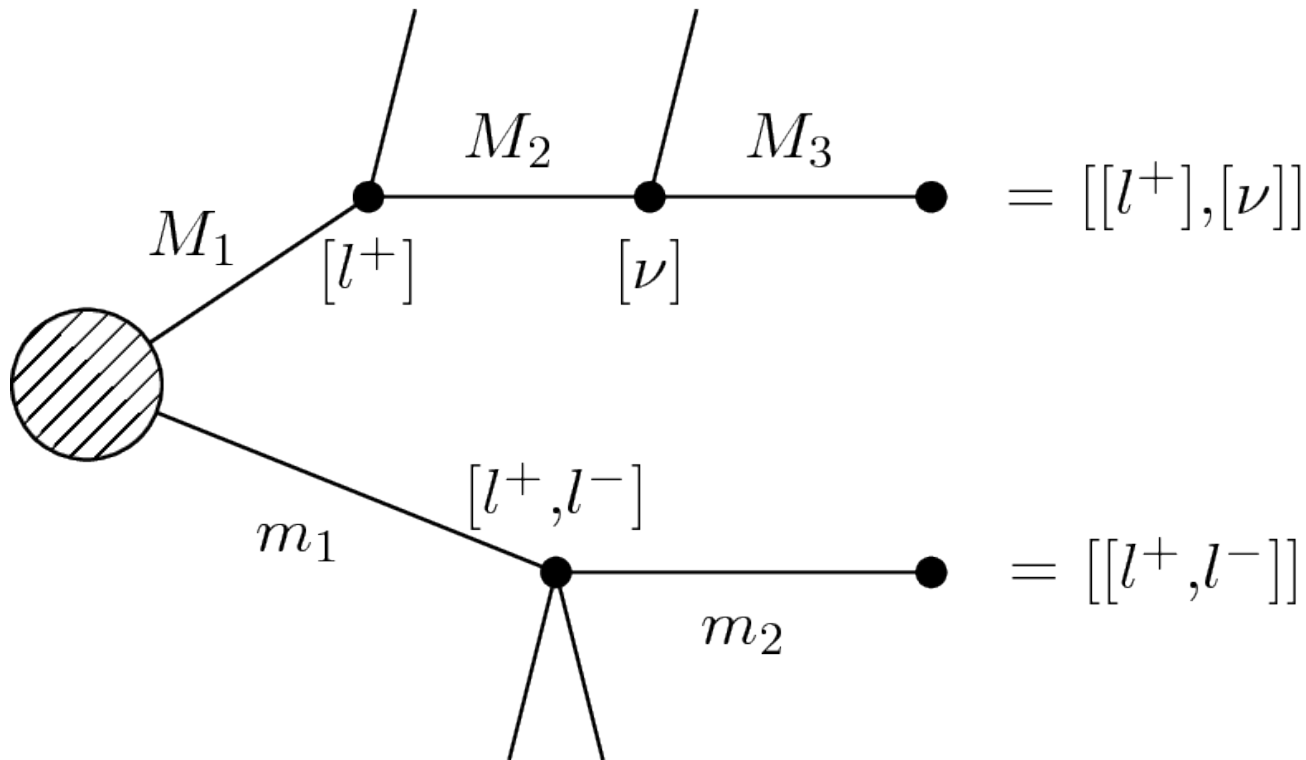
- Topology shape + final states
- BSM masses
- $\sigma \times \text{BR}$

We (currently) ignore spin, color, etc of the BSM particles

It is model independent, there is no reference to the original model

How works:

Simplified Model Topology:



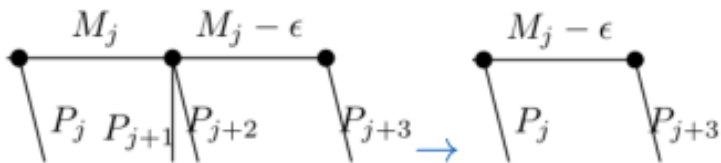
$$= [[l^+], [\nu]]$$

$$= [[[l^+], [\nu]] , [[l^+, l^-]]]$$

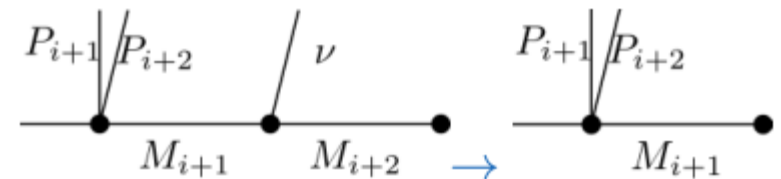
$$([[M_1, M_2, M_3], [m_1, m_2]])$$

$$= [[l^+, l^-]]$$

Soft particles are ommitted:



Invisible final states are grouped into effective LSPs:

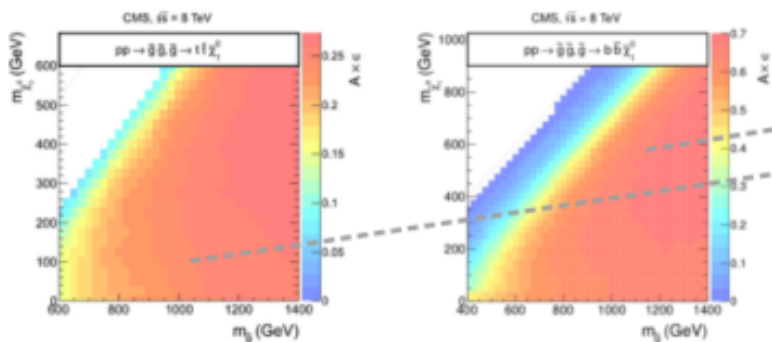


works:

2) Computation of predicted signal strength:

For **efficiency map results** we have signal efficiencies for various “elements”, and we can add them together:

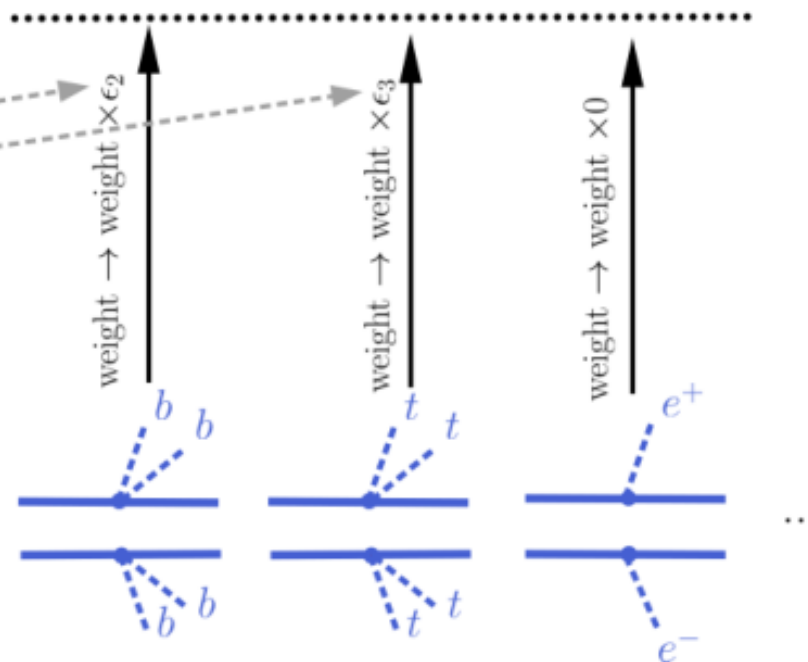
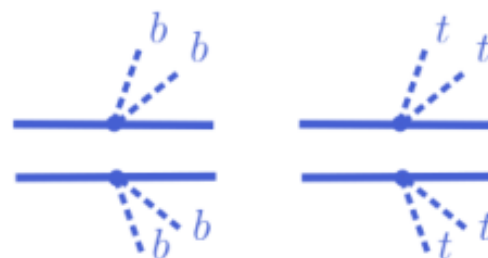
Experimental Result (EM)



Decomposition Elements:

$$\underset{b_{\text{in}}}{\text{weight}} \times \epsilon_2 + \underset{t_{\text{in}}}{\text{weight}} \times \epsilon_3 + 0 = \sigma \times BR \times \epsilon$$

(Theory Prediction)



How  works:

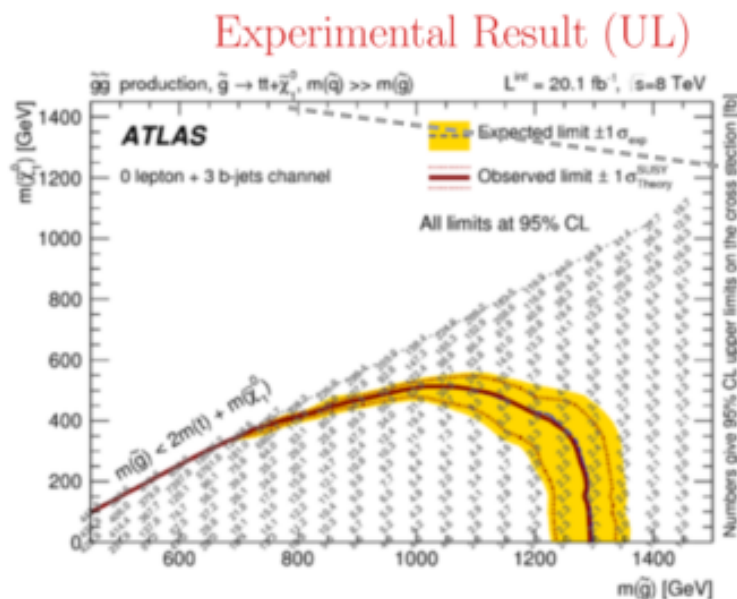
works:

2) Computation of predicted signal strength:

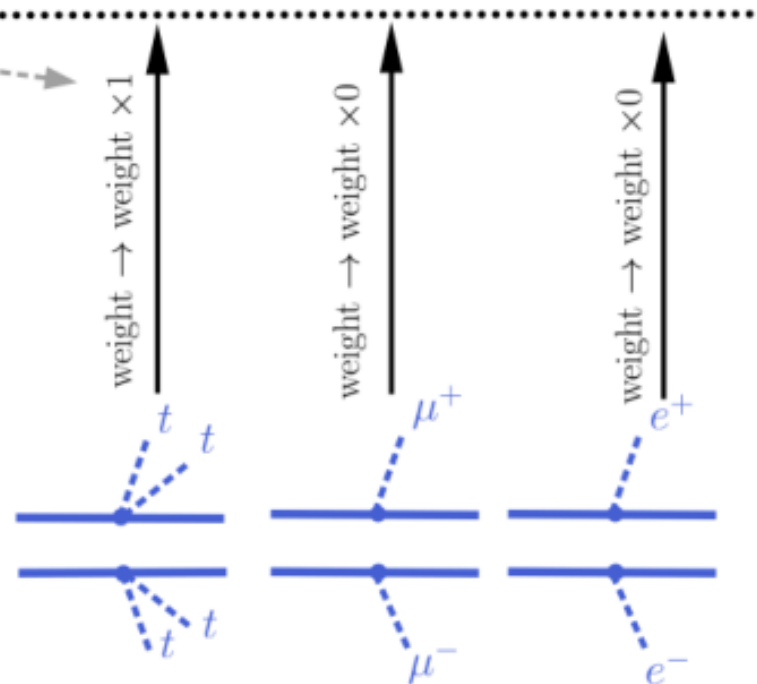
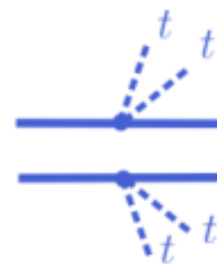
Upper limit results we cannot add up:

$$\text{weight} + 0 + 0 = \sigma \times BR$$

(Theory Prediction)



Decomposition Elements:

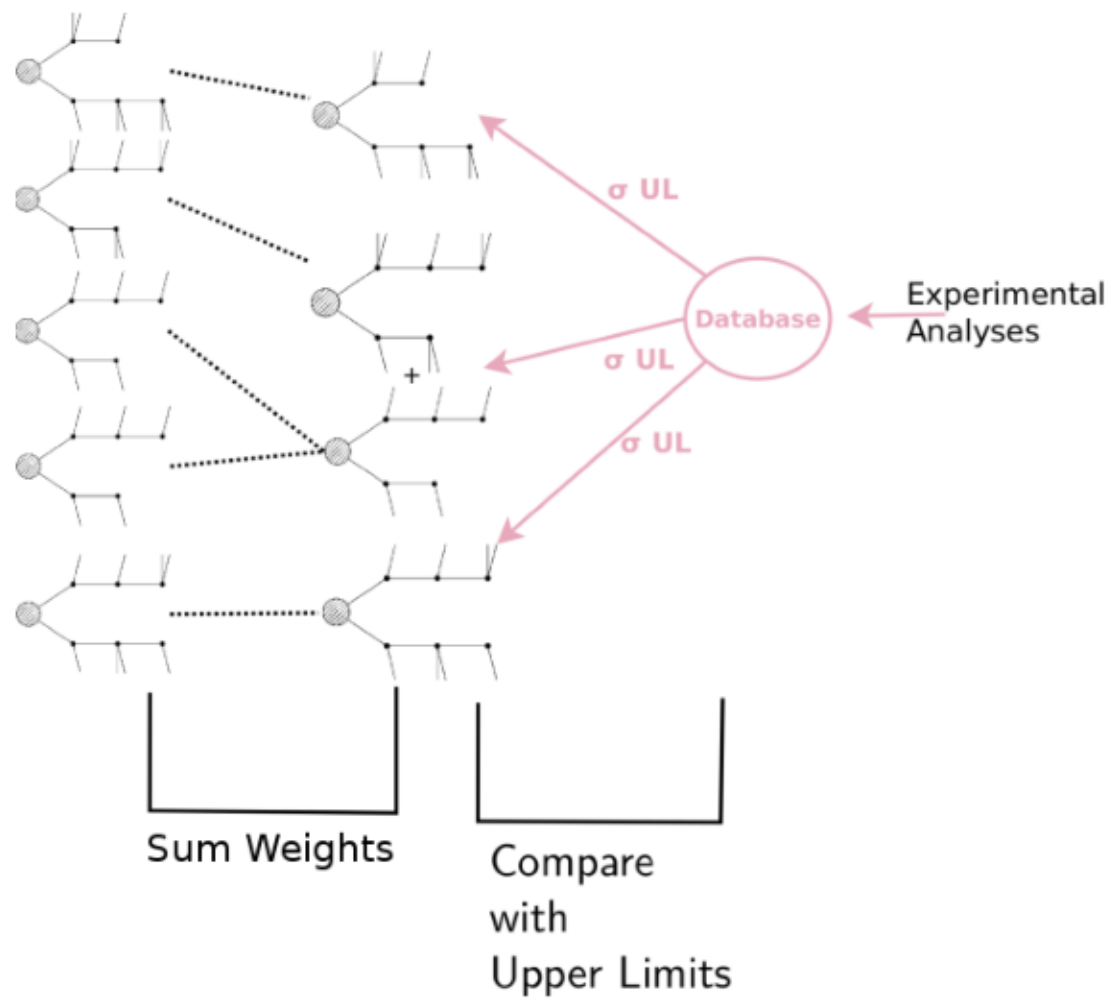


How



works:

3) Comparison of predicted signal strengths with experimental result:



- **Upper Limit Results:**
Predicted signal strength = $\sigma \times BR$
Experimental result: σ_{UL}
- **Efficiency Map Results:**
Predicted signal strength = $\sum \sigma \times BR \times \epsilon$
Experimental result: $\sigma_{UL} = N_{UL} / L$ from $N_{observed}$, $expected(BG)$, $error(BG)$
- $r = \text{predicted} / \sigma_{UL}$
- Model is excluded if most constraining analysis has $r > 1$

What's in the database?

~ 30 ATLAS CONF-Notes/publications



~ 20 CMS CONF-Notes/publications



Experimental Result	\sqrt{s}	lumi	data type
ATLAS-CONF-2012-105	8	5.8	upperLimit
ATLAS-CONF-2012-166	8	13.0	upperLimit
ATLAS-CONF-2013-001	8	12.8	upperLimit
ATLAS-CONF-2013-007	8	20.7	upperLimit
...
ATLAS-SUSY-2013-14	8	20.3	upperLimit
ATLAS-SUSY-2013-15	8	20.3	efficiencyMap
ATLAS-SUSY-2013-15	8	20.3	upperLimit
ATLAS-SUSY-2013-16	8	20.1	efficiencyMap
ATLAS-SUSY-2013-16	8	20.1	upperLimit
ATLAS-SUSY-2013-18	8	20.1	efficiencyMap
ATLAS-SUSY-2013-18	8	20.1	upperLimit
ATLAS-SUSY-2013-19	8	20.3	upperLimit
ATLAS-SUSY-2013-23	8	20.3	upperLimit
ATLAS-SUSY-2014-03	8	20.3	efficiencyMap
ATLAS-SUSY-2015-09	13	3.2	upperLimit

Experimental Result	\sqrt{s}	lumi	data type
CMS-SUS-12-024	8	19.4	efficiencyMap
CMS-SUS-12-024	8	19.4	upperLimit
CMS-SUS-12-028	8	11.7	upperLimit
CMS-SUS-13-002	8	19.5	upperLimit
CMS-SUS-13-004	8	19.3	upperLimit
CMS-SUS-13-006	8	19.5	upperLimit
CMS-SUS-13-007	8	19.3	efficiencyMap
CMS-SUS-13-007	8	19.3	upperLimit
CMS-SUS-13-011	8	19.5	efficiencyMap
CMS-SUS-13-011	8	19.5	upperLimit
CMS-SUS-13-012	8	19.5	efficiencyMap
CMS-SUS-13-012	8	19.5	upperLimit
CMS-SUS-13-015	8	19.4	efficiencyMap
CMS-SUS-13-015	8	19.4	upperLimit
CMS-SUS-13-019	8	19.5	upperLimit
...
CMS-SUS-PAS-13-016	8	19.7	upperLimit
CMS-SUS-PAS-13-018	8	19.4	upperLimit
CMS-SUS-PAS-15-002	13	2.2	upperLimit

We can and will (and do) extend our database by using efficiency maps produced outside the experimental collaborations (using recasting tools like MadAnalysis5)

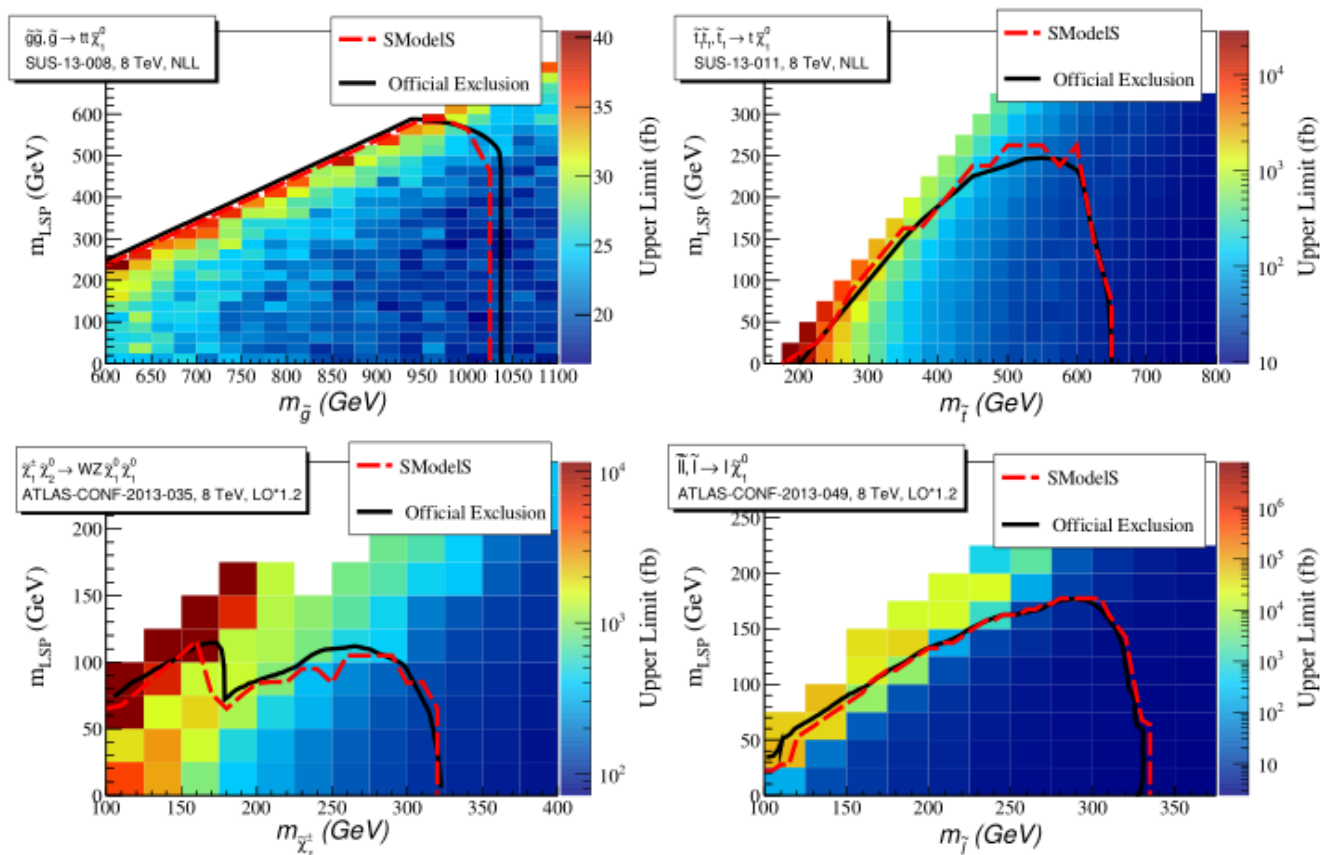
Validation

For validating our database, we define:

full model := simplified model

And check if we can reproduce the official exclusion curves.

When we have efficiencies, we can also check σ_{UL} for every point in the “mass planes”:

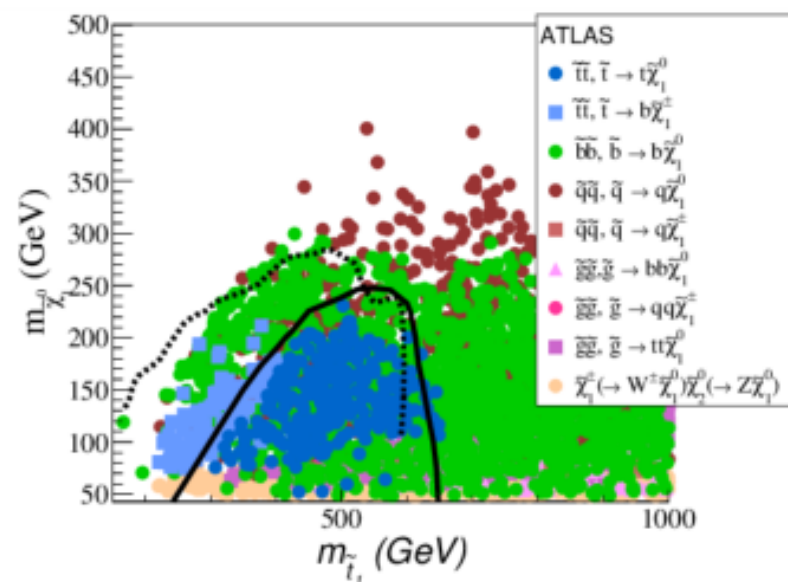
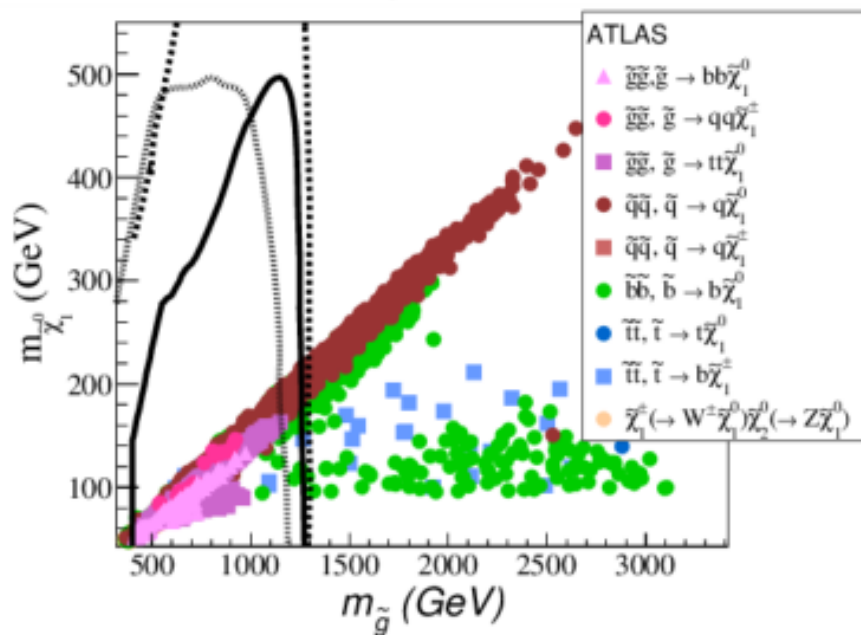
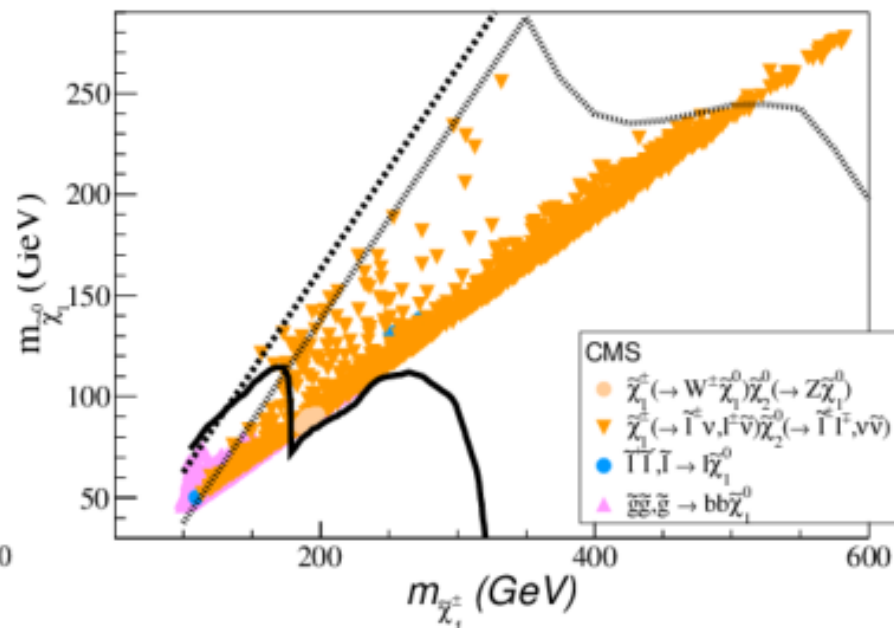
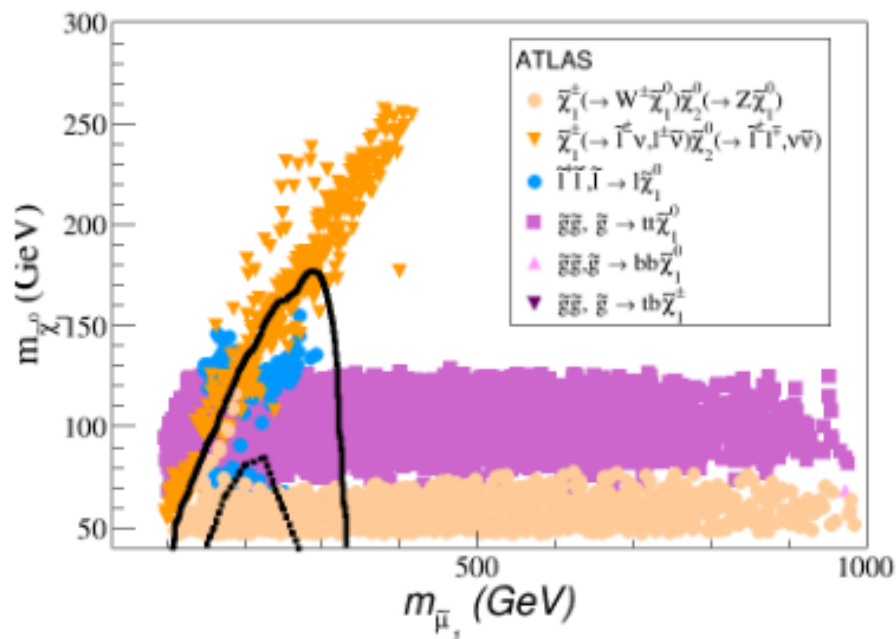


Physics Applications

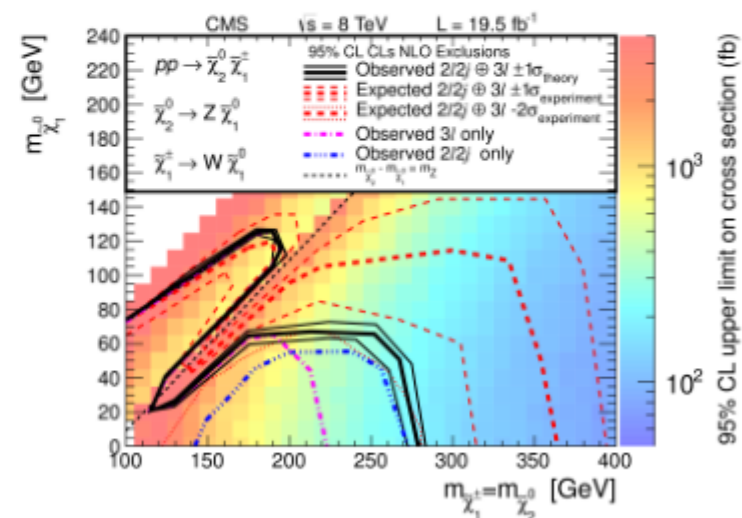
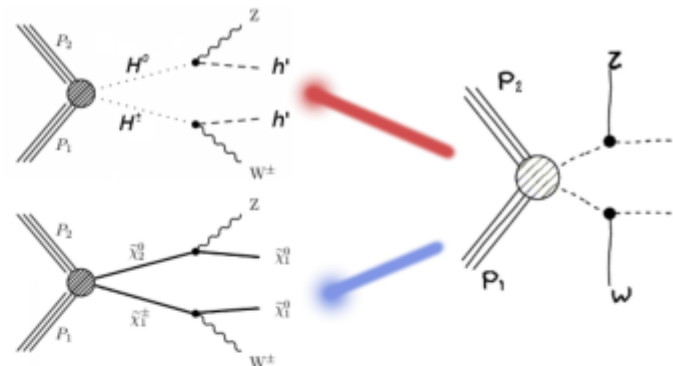
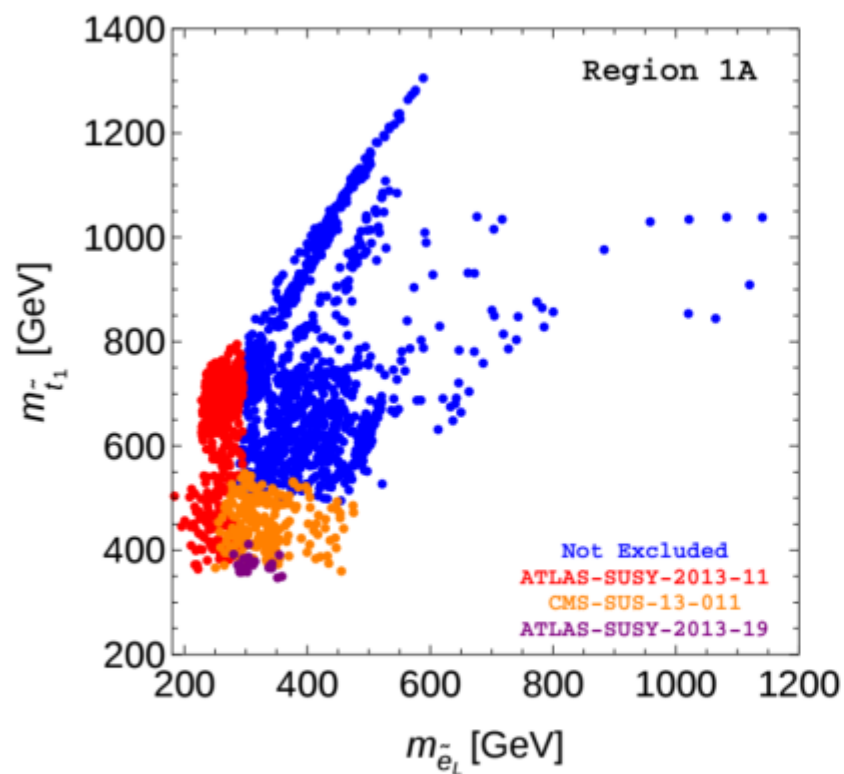
SModelS has so far been used to:

-) quickly identify regions of model parameter space that can easily be excluded by analyses, before employing more “heavy weight” strategies for exploring model parameter spaces.
-) identify the most constraining analyses for a model
-) identify topologies and regions of parameter space that CMS and ATLAS are blind to.
-) Very quickly recast results to different models

Physics Applications



Physics Applications



D. Barducci, G. Bélanger, C. Hugonie and A. Pukhov, JHEP 1601 (2016) 050

⇒ LHC constraints on 2HDM

Availability

SModelS is written entirely in python and is available here:

<http://smodels.hephy.at>

It uses pythia and nllfast for the computation of the cross sections.

Future

We intend to extend the functionality of SModelS in several ways:

- Extend to non- Z_2 / non-MET topologies
- Extend to long-lived particles (HCSP scenarios)
- Make use of likelihoods
- Make use of positive results (“excesses”)

Summary

SModelS can be used to quickly:

- Identify the most constraining topologies and analyses for a given model
- Identify the topologies missed by CMS and ATLAS
- Recast results to different scenarios
- Since it does not have to run simulations, it is very fast

Limitations:

- It is tied to the simplified models results, for upper limit maps it is overly conservative
- No simplified models results available for long decay chains
- It is only as good as its database of results

Thanks!