

Likelihoods in the interpretation of searches for BSM physics

Wolfgang Waltenberger

On the theoretical contexts

For interpretation of BSM searches, theoretical contexts – i.e. models – are needed.

Currently I see three different types of approaches in the community of the SUSY searchers:

- constrained models, e.g. the cMSSM
- phenomenological models, e.g. the pMSSM
- simplified models

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- ~~– constrained models, e.g. the cMSSM~~
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- simplified models

In this talk I want to skip the constrained models, **present** one **effort** done in the context of the **pMSSM**, then talk a little about the connection between **simplified models and likelihoods**.

phenomenological models: Likelihoods and the pMSSM



Example:

Interpreting LHC SUSY searches in the
phenomenological MSSM

S. Sekmen^a, S. Kraml^b, J. Lykken^c, F. Moortgat^d, S. Padhi^e,
L. Pape^d, M. Pierini^f, H. B. Prosper^a, M. Spiropulu^{f,g}

Arxiv:1109.5119

pMSSM parameters:

$$-3 \text{ TeV} \leq M_1, M_2 \leq 3 \text{ TeV}$$

$$0 \leq M_3 \leq 3 \text{ TeV}$$

$$0 \leq \mu \leq 3 \text{ TeV}$$

$$0 \leq m_A \leq 3 \text{ TeV}$$

$$2 \leq \tan \beta \leq 60$$

$$0 \leq \tilde{Q}_{1,2}, \tilde{U}_{1,2}, \tilde{D}_{1,2}, \tilde{L}_{1,2}, \tilde{E}_{1,2}, \tilde{Q}_3, \tilde{U}_3, \tilde{D}_3, \tilde{L}_3, \tilde{E}_3 \leq 3 \text{ TeV}$$

$$-7 \text{ TeV} \leq A_t, A_b, A_\tau \leq 7 \text{ TeV}$$

SM parameters:

$$m_t, m_b(m_b), \alpha_S(M_Z)$$

(constrained by likelihood)

Bayesian MCMC walk in the pMSSM space:

- **two-step** approach: the prior for the final Bayesian CMS-fit is the posterior of the preCMS data.

$$\begin{aligned} P(\theta|D) &= L(D^{\text{CMS}}|\theta)L(D^{\text{preCMS}}|\theta)\pi(\theta) \\ &= L'(D^{\text{CMS}}|\theta)\pi^{\text{preCMS}}(\theta) \end{aligned}$$

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$$\pi^{\text{preCMS}}(\theta) = L(D^{\text{preCMS}}|\theta)\pi(\theta)$$

posterior for preCMS data*
prior for CMS data

$$L(D^{\text{CMS}}|\theta)$$

likelihood for CMS data

* preCMS data: all data but CMS SUSY and EXO results

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 &= L'(D^{\text{CMS}}|\theta)\pi^{\text{preCMS}}(\theta)
 \end{aligned}$$

$\pi(\theta)$

Cowanscher Ur-Prior: flat

$$\pi^{\text{preCMS}}(\theta) = L(D^{\text{preCMS}}|\theta)\pi(\theta)$$

posterior for preCMS data*

prior for CMS data

$$L(D^{\text{CMS}}|\theta)$$

likelihood for CMS data

* preCMS data: all data but CMS SUSY and EXO results

preCMS likelihood

$$L(D^{\text{preCMS}}|\theta) = \prod_i L(D_i^{\text{preCMS}}|\mu_i^{\text{preCMS}}(\theta))$$

D_i^{preCMS} : measurement of preCMS observable i
 $\mu_i^{\text{preCMS}}(\theta)$: prediction for preCMS observable i

Observable $\mu_j(\theta)$	Experimental result D_j^{preCMS}	Likelihood function $L(D_j^{\text{preCMS}} \mu_j(\theta))$	MCMC / post-MCMC
$BR(b \rightarrow s\gamma)$	$(3.55 \pm 0.23 \pm 0.24 \pm 0.09) \times 10^{-4}$	Gaussian	MCMC
$BR(B_s \rightarrow \mu\mu)$	observed CLs curve from latest LHC combination: BPH-12-009	$d(1 - CLs)/dx$	MCMC
$R(B_u \rightarrow \tau\nu)$	1.63 ± 0.54	Gaussian	MCMC
Δa_μ	$(26.1 \pm 12.8) \times 10^{-10} [e^+ e^-]$	Gaussian	MCMC
m_t	$173 \pm 1.4 \text{ GeV}$	Gaussian	MCMC
$m_b(m_b)$	$4.19^{+0.18}_{-0.06} \text{ GeV}$	Two-sided Gaussian	MCMC
$\alpha_s(M_Z)$	0.1184 ± 0.0007	Gaussian	MCMC
m_h	pre-LHC: $m_h^{\text{low}} = 112$	1 if $m_h \geq m_h^{\text{low}}$ 0 if $m_h < m_h^{\text{low}}$	MCMC
m_h	LHC: $m_h^{\text{low}} = 120, m_h^{\text{up}} = 130$	1 if $m_h^{\text{low}} \leq m_h \leq m_h^{\text{up}}$ 0 if $m_h < m_h^{\text{low}}$ or $m_h > m_h^{\text{up}}$	post-MCMC
sparticle masses	LEP (micrOMEGAs)	1 if allowed 0 if excluded	MCMC

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Made-up likelihoods!

Likelihoods of simple counting experiments

For each search region l :

$$\mathbf{L}(\mathbf{D}_l^{\text{CMS}} | \theta) = \int \text{Pois}(N_l | s_l(\theta) + \mathbf{b}_l) \pi(\mathbf{b}_l | \mathbf{B}_l, \delta \mathbf{B}_l) d\mathbf{b}_l$$

CMS lhd

Poisson models
 event count

prior handles
 uncertainty
 bkg prediction

N_l : observed count in signal region

s_l : expected signal count

b_l : expected bkg count

B_l : bkg prediction

δ_l : uncertainty bkg prediction

prior for bkg prediction

assumption: bkg in signal region is predicted by scaling observed bkg in control region

$$\pi(b_l | B_l, \delta B_l) = \text{Gamma}(b_l; Q_l + 1; K_l)$$

scaled poisson distribution

b_l : expected bkg count

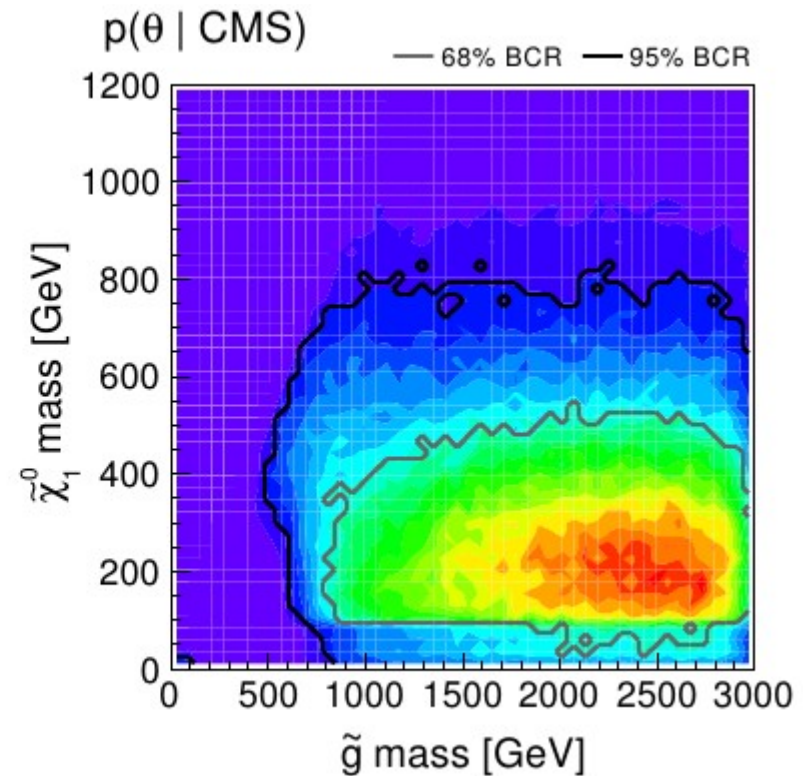
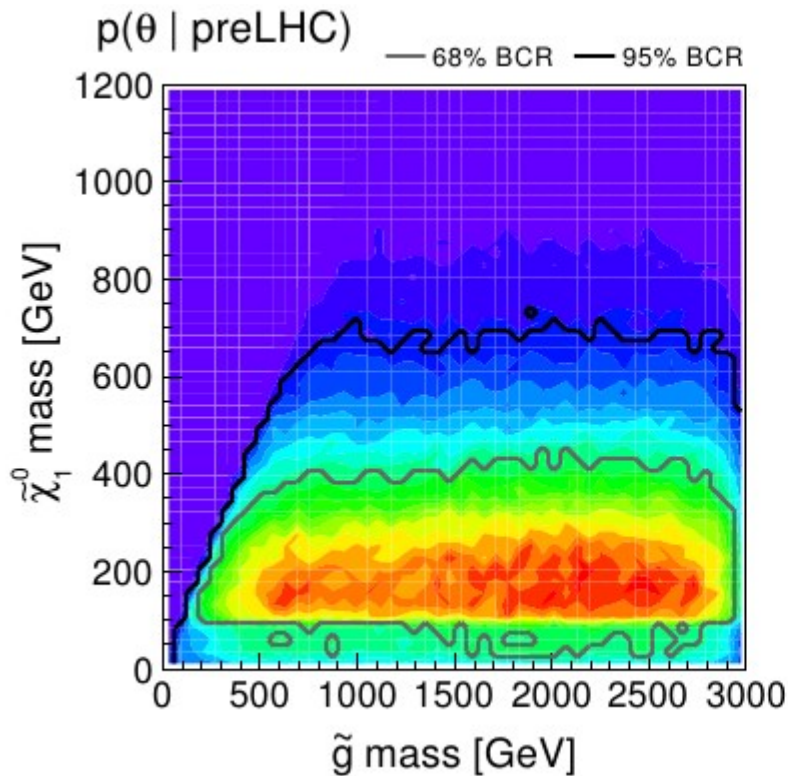
B_l : bkg prediction

δ_l : uncertainty bkg prediction

$Q_l = (B_l/\delta B_l)^2$: observed count in control region

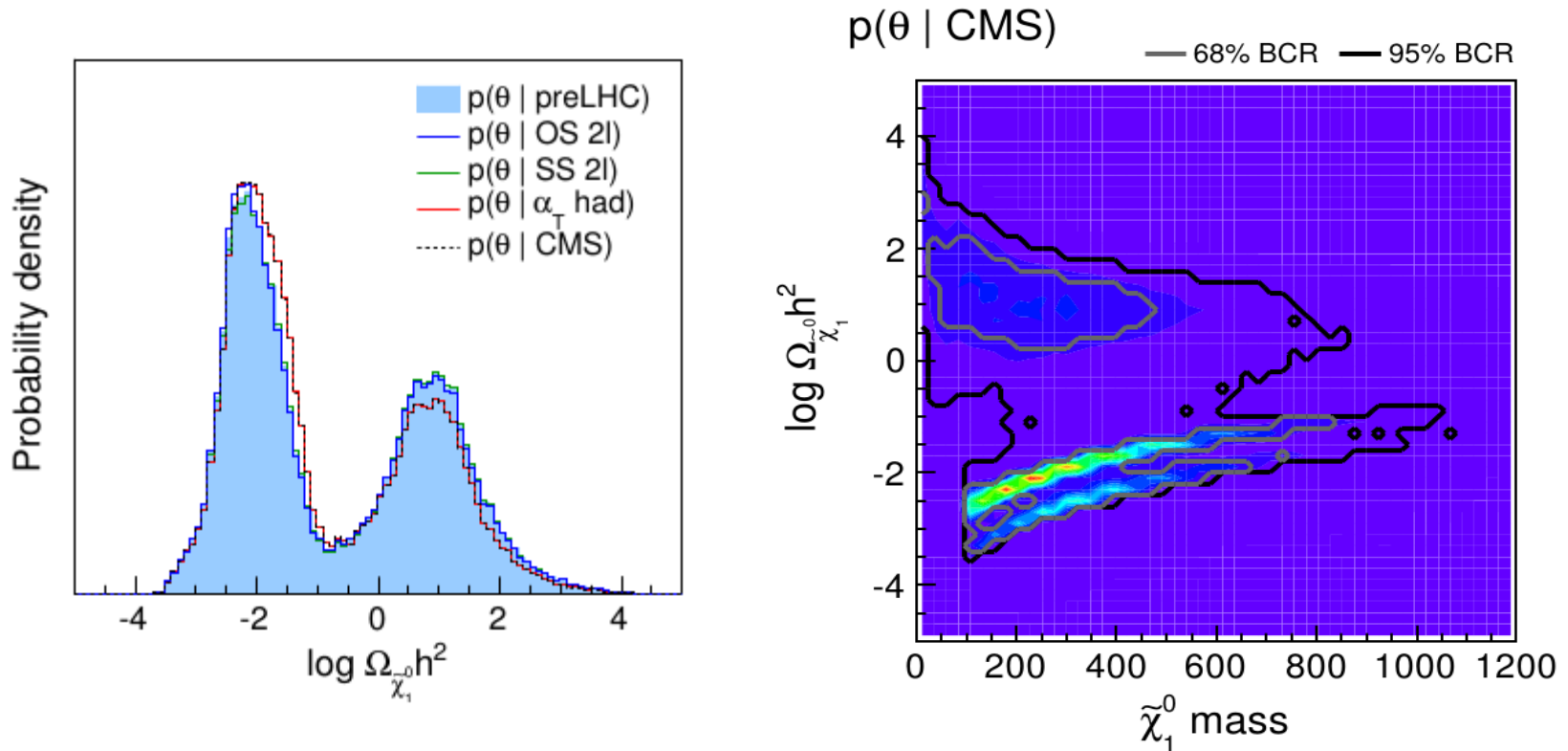
$K_l = Q_l/B_l$: scaling factor

Results



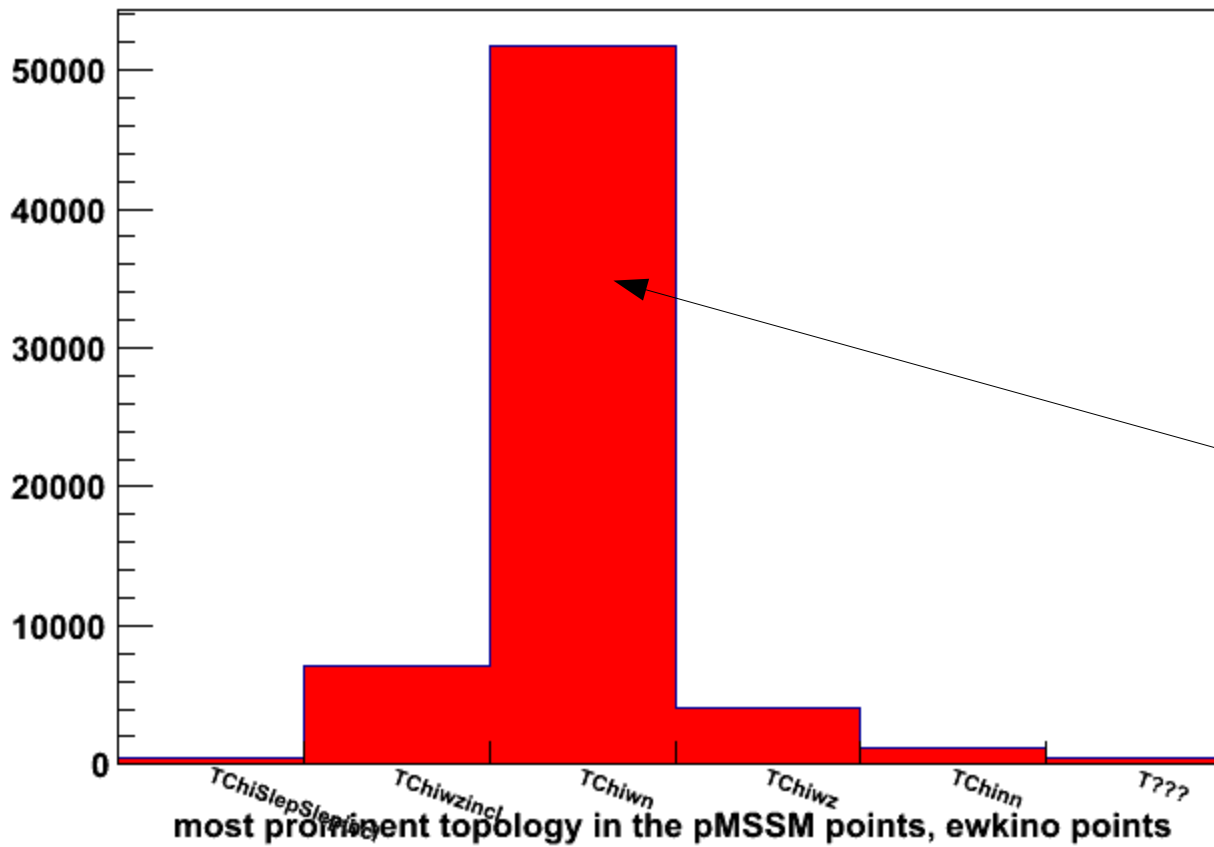
Marginalized posteriors before (left) and after (right) adding CMS searches, gluino mass (x-axis) versus neutralino mass (y-axis). CMS pushes the gluino masses to higher values.

Results

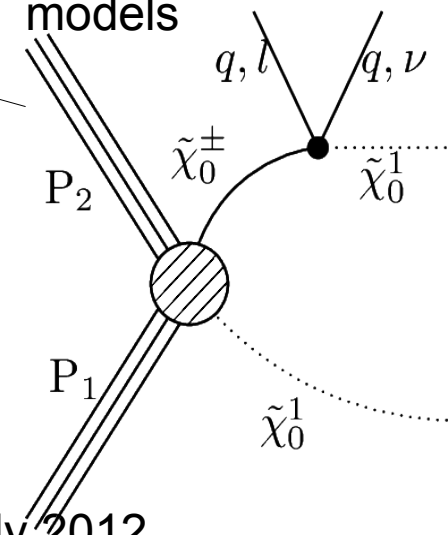


Left: Marginalized posterior of the dark matter relic density, before (filled blue) and after (various lines) including CMS information (left). Right: Dark matter relic density versus neutralino mass, marginalized 2d posterior.

In a small follow-up work presented in the last LPCC “implications” workshop, we dug into **pmssm regions which have high production cross sections, but were nevertheless missed**. To answer why they were missed, we used the technique of **SMS decomposition**:

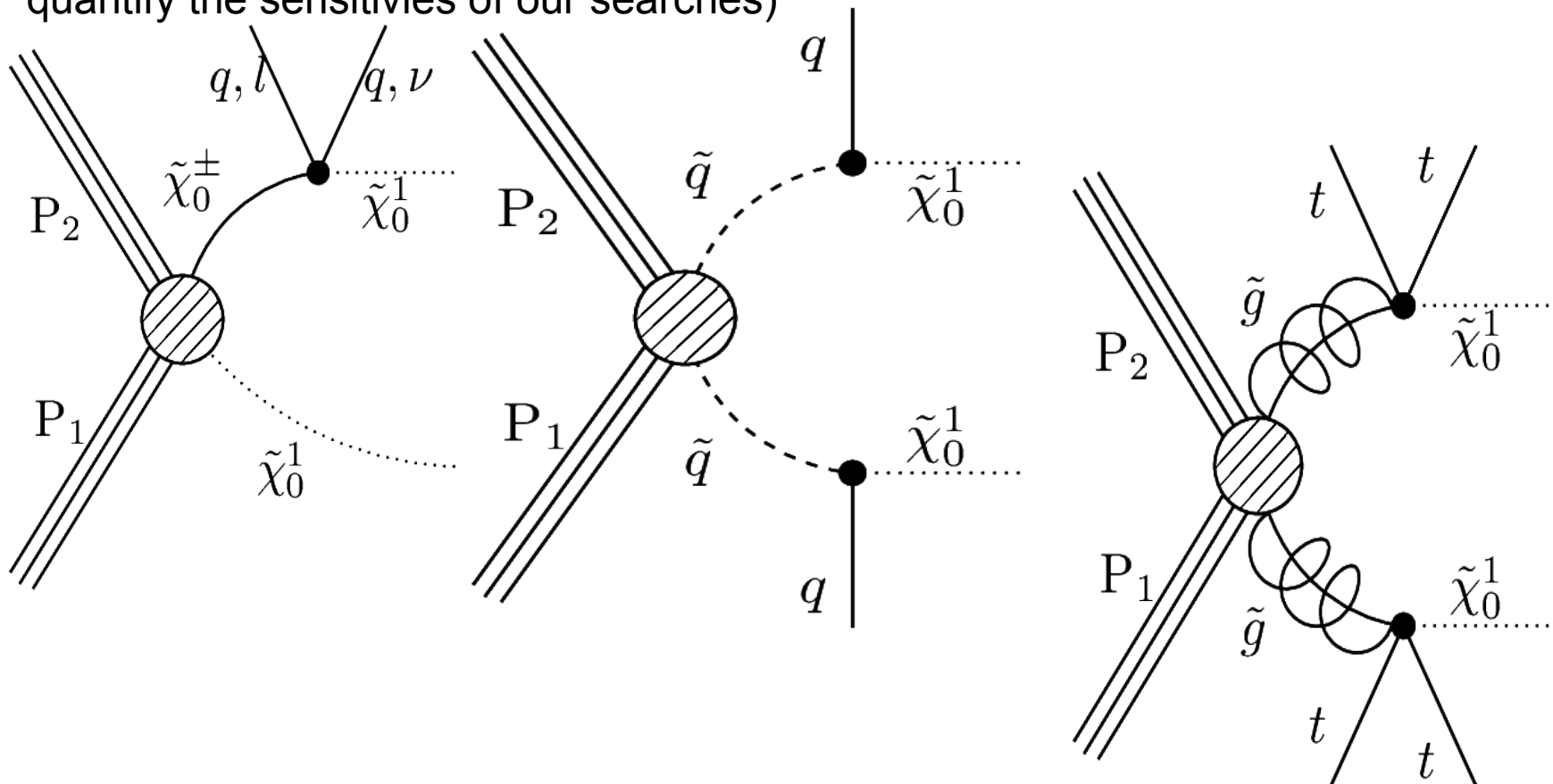


for all points with predominant weakino production, these are the relative occurrences of the simplified models



WW, “Implications of LHC results for TeV-scale physics”, July 2012

(simplified models can be thought of as effective Lagrangians which introduce only a limited number of particles. All masses and branching ratios are free parameters. No production cross section is assumed. We use the SMSeS to quantify the sensitivities of our searches)



Simplified models: Likelihoods and the SMSeS

→ where do we stand right now?

→ where do we want to go from here?

Status: Simplified models and CMS

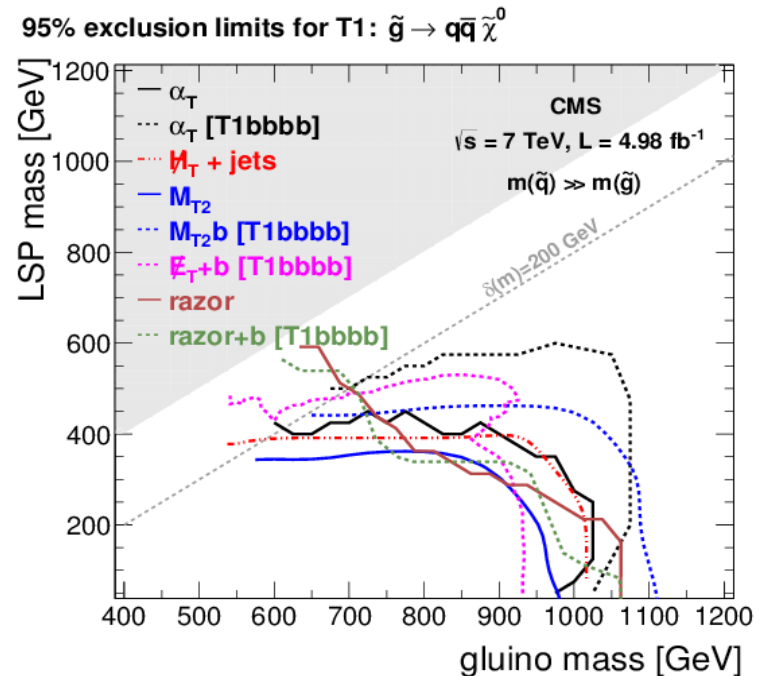
Hadronic / razor	CMS preliminary	Leptonic
$m(\text{LSP})=0 \text{ GeV}$ $x=0.25$ $x=0.15$ $x=0.75$	$m(\text{mother})-m(\text{LSP})=200 \text{ GeV}$	$m(\text{mother})-m(\text{LSP})=200 \text{ GeV}$ $x=0.25$ $x=0.15$ $x=0.75$
T1: $\tilde{g} \rightarrow q\bar{q}\tilde{\chi}^0, \alpha_T$	T3lh: $\tilde{g} \rightarrow q\bar{q}(\tilde{\chi}_2^0 \rightarrow l^+ l^- \tilde{\chi}^0), \text{OS } e/\mu \text{ edge}$	
T1: $\tilde{g} \rightarrow q\bar{q}\tilde{\chi}^0, \text{jets} + \cancel{E}_T$	T3lh: $\tilde{g} \rightarrow q\bar{q}(\tilde{\chi}_2^0 \rightarrow l^+ l^- \tilde{\chi}^0), \text{OS count } e/\mu + \cancel{E}_T$	
T1: $\tilde{g} \rightarrow q\bar{q}\tilde{\chi}^0, \text{razor}$	T3lh: $\tilde{g} \rightarrow q\bar{q}(\tilde{\chi}_2^0 \rightarrow l^+ l^- \tilde{\chi}^0), \text{OS ANN}$	
T1: $\tilde{g} \rightarrow q\bar{q}\tilde{\chi}^0, M_{T2}$	T5lnu: $\tilde{\chi}^\pm \rightarrow l^\pm \nu \tilde{\chi}^0, \text{SS } e/\mu$	
T1tttt: $\tilde{g} \rightarrow t\bar{t}\tilde{\chi}^0, \alpha_T$	T1tttt: $\tilde{g} \rightarrow t\bar{t}\tilde{\chi}^0, \text{SS} + b$	
T1tttt: $\tilde{g} \rightarrow t\bar{t}\tilde{\chi}^0, \cancel{E}_T + b$	T1tttt: $\tilde{g} \rightarrow t\bar{t}\tilde{\chi}^0, e/\mu \geq 2b + \cancel{E}_T$	
T1tttt: $\tilde{g} \rightarrow t\bar{t}\tilde{\chi}^0, M_{T2} + b$	T1tttt: $\tilde{g} \rightarrow t\bar{t}\tilde{\chi}^0, e/\mu \geq 3b, Y_{\text{MET}}$	
T1tttt: $\tilde{g} \rightarrow t\bar{t}\tilde{\chi}^0, \text{razor}$		
T1tttt: $\tilde{g} \rightarrow t\bar{t}\tilde{\chi}^0, \text{razor} + b$		
T1tttt: $\tilde{g} \rightarrow t\bar{t}\tilde{\chi}^0, \text{razor multijets}$		
T1bbbb: $\tilde{g} \rightarrow b\bar{b}\tilde{\chi}^0, \alpha_T$	T3w: $\tilde{g} \rightarrow q\bar{q}(\tilde{\chi}^\pm \rightarrow W\tilde{\chi}^0[\tilde{\chi}^0]), e/\mu \text{ LS}$	
T1bbbb: $\tilde{g} \rightarrow b\bar{b}\tilde{\chi}^0, \cancel{E}_T + b$		
T1bbbb: $\tilde{g} \rightarrow b\bar{b}\tilde{\chi}^0, M_{T2} + b$		
T1bbbb: $\tilde{g} \rightarrow b\bar{b}\tilde{\chi}^0, \text{razor} + b$	T5zz: $\tilde{g} \rightarrow q\bar{q}(\tilde{\chi}_2^0 \rightarrow Z\tilde{\chi}^0), Z + \cancel{E}_T$	
T5zz: $\tilde{g} \rightarrow q\bar{q}(\tilde{\chi}_2^0 \rightarrow Z\tilde{\chi}^0), M_{T2}$	T5zz: $\tilde{g} \rightarrow q\bar{q}(\tilde{\chi}_2^0 \rightarrow Z\tilde{\chi}^0), \text{JZB}$	
T5zz: $\tilde{g} \rightarrow q\bar{q}(\tilde{\chi}_2^0 \rightarrow Z\tilde{\chi}^0), M_{T2} + b$		
T2: $\tilde{q} \rightarrow q\tilde{\chi}^0, \alpha_T$	TChiSlepSlep: $\tilde{\chi}_2^0 \tilde{\chi}^\pm \rightarrow ll\nu\tilde{\chi}^0 \tilde{\chi}^0, \text{multilepton } (\geq 3)$	
T2: $\tilde{q} \rightarrow q\tilde{\chi}^0, \text{jets} + \cancel{E}_T$	TChiSlepSlep: $\tilde{\chi}_2^0 \tilde{\chi}^\pm \rightarrow ll\nu\tilde{\chi}^0 \tilde{\chi}^0, \text{comb leptons}$	
T2: $\tilde{q} \rightarrow q\tilde{\chi}^0, \text{razor}$	TChiwz: $\tilde{\chi}^\pm \tilde{\chi}_2^0 \rightarrow WZ\tilde{\chi}^0 \tilde{\chi}^0, \text{comb leptons}$	
T2bb: $\tilde{b} \rightarrow b\tilde{\chi}^0, \alpha_T$		
T2bb: $\tilde{b} \rightarrow b\tilde{\chi}^0, \text{razor} + b$		
T2tt: $\tilde{t} \rightarrow t\tilde{\chi}^0, \alpha_T$		
T2tt: $\tilde{t} \rightarrow t\tilde{\chi}^0, \text{razor}$		
T2tt: $\tilde{t} \rightarrow t\tilde{\chi}^0, \text{razor} + b$		

Mass scales [GeV]

7 TeV, $\leq 4.98 \text{ fb}^{-1}$

<https://twiki.cern.ch/twiki/bin/view/CMSPublic/SUSYSMSSummaryPlots>

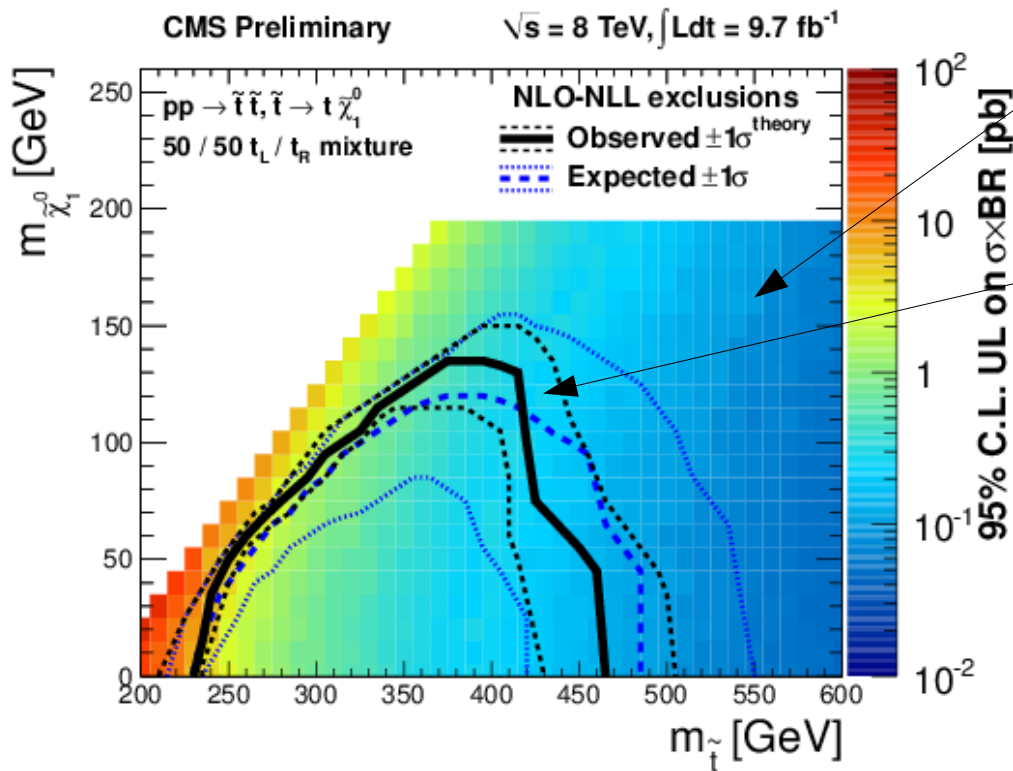
[arxiv.org:1301.2175](https://arxiv.org/abs/1301.2175)



arXiv:1301.2175

Status: Simplified models and CMS

Most of CMSes SMS results are presented like this:



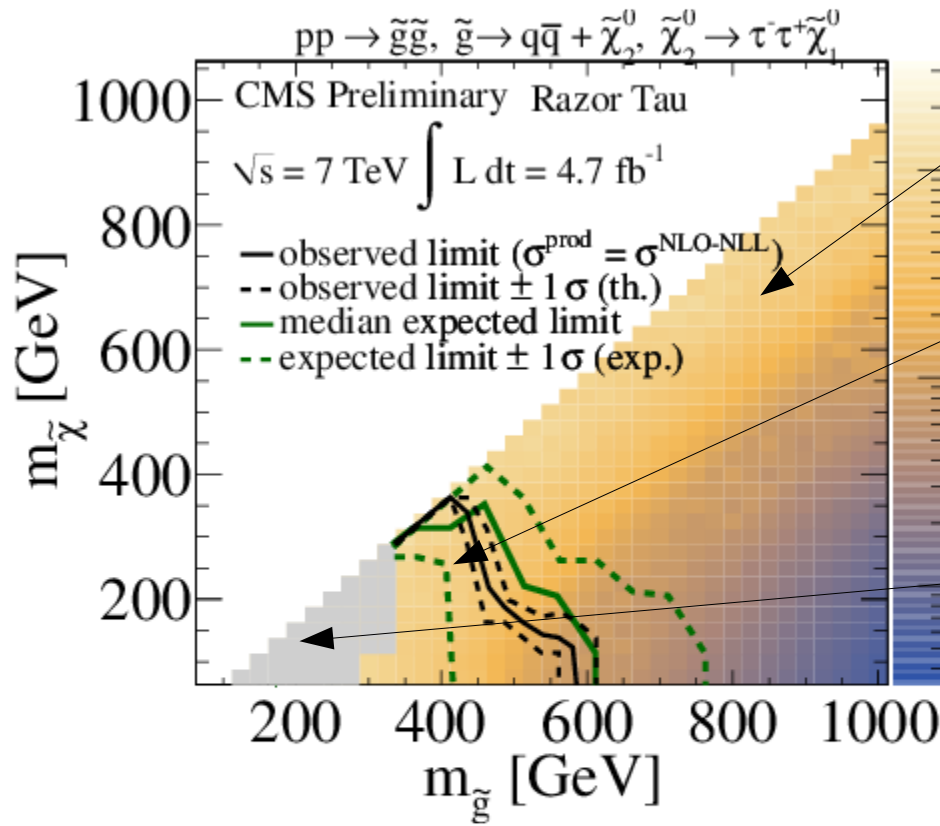
Color represents 95% upper limit on production cross section

Upper limits are compared with reference cross sections (observed/expected, ± 1 sigma)

CMS-SUS-12-023

Status: Simplified models and CMS

Most of CMSes SMS results are presented like this:



Color represents 95% upper limit on production cross section

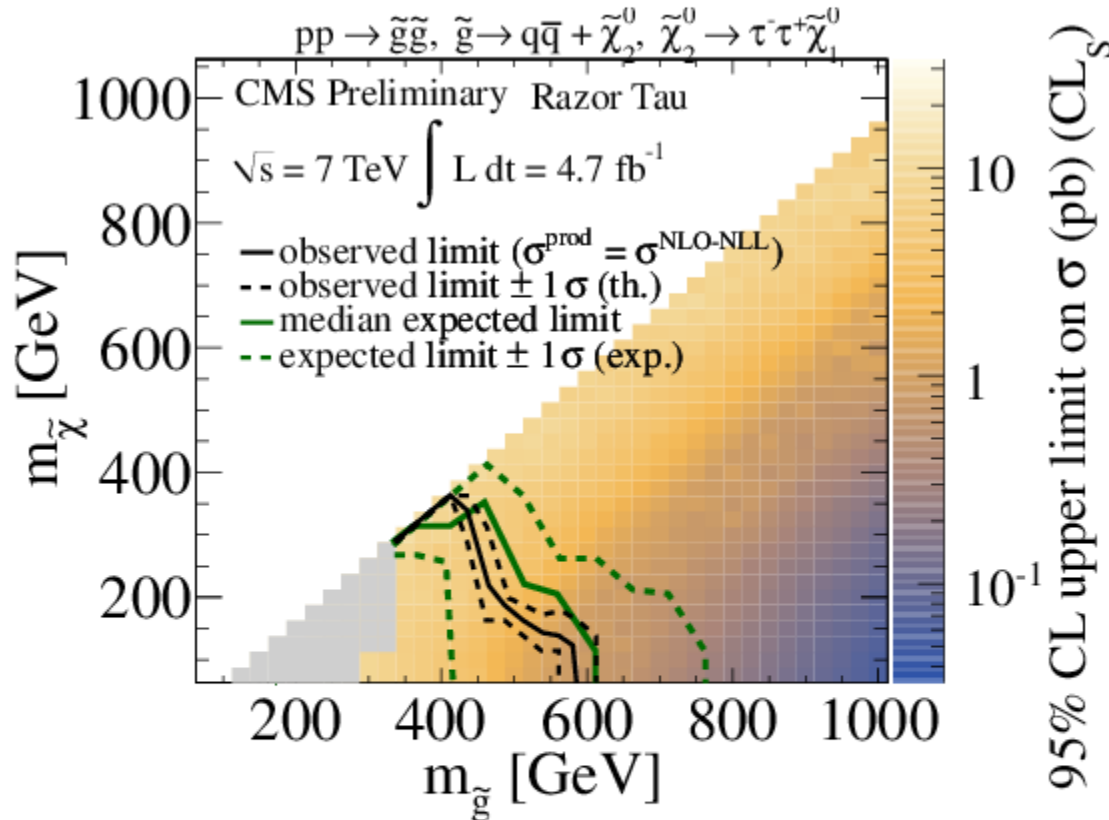
Upper limits are compared with reference cross sections (observed/expected, $\pm 1 \sigma$)

No statements are made in regions with too low statistics or too large (e.g. ISR) uncertainties.

95% CL upper limit on σ (pb) (CL_s)

CMS-SUS-11-029

Status: Simplified models and CMS



CMS-SUS-11-029

What we would like, though, are the full likelihoods of the production cross sections, for each bin in the plot on the left.

Even further, if we were granted a free wish, we would also like all information and meta information about how the likelihood was constructed.

Status: Simplified models and ATLAS

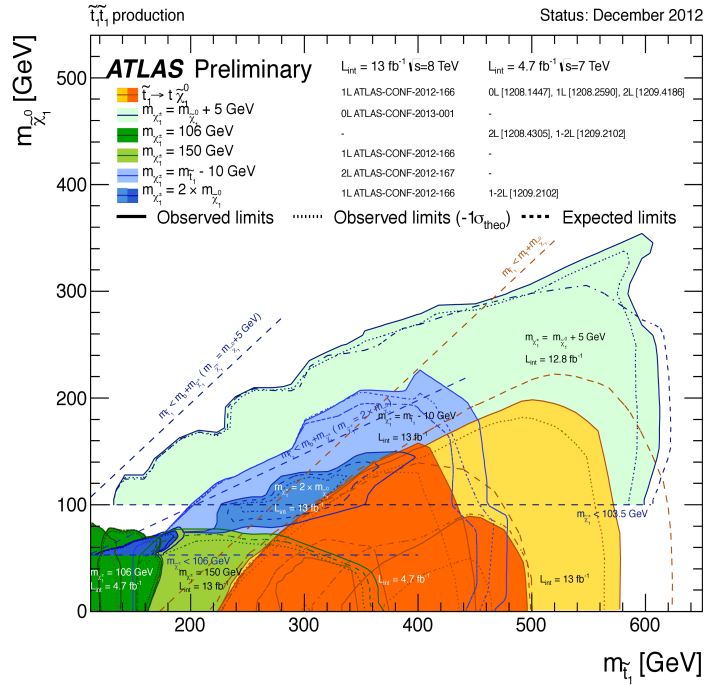
<https://twiki.cern.ch/twiki/bin/view/AtlasPublic/SupersymmetryPublicResults>

ATLAS SUSY Searches* - 95% CL Lower Limits (Status: Dec 2012)		
Inclusive searches	MSUGRA/CMSSM : 0 lep + j's + E _{7,miss} 1.50 TeV $\tilde{q} = \tilde{g}$ mass	
	MSUGRA/CMSSM : 1 lep + j's + E _{7,miss} 1.24 TeV $\tilde{q} = \tilde{g}$ mass	
	Pheno model : 0 lep + j's + E _{7,miss} 1.18 TeV \tilde{g} mass ($m(\tilde{q}) < 2$ TeV, light $\tilde{\chi}_1^0$)	
	Pheno model : 0 lep + j's + E _{7,miss} 1.38 TeV \tilde{q} mass ($m(\tilde{q}) < 2$ TeV, light $\tilde{\chi}_1^0$)	
3rd gen. sq gluino med.	Gluino med. $\tilde{\chi}_1^0$ ($\tilde{g} \rightarrow q\bar{q}\tilde{\chi}_1^0$) : 1 lep + j's + E _{7,miss} 900 GeV \tilde{g} mass ($m(\tilde{\chi}_1^0) < 200$ GeV, $m(\tilde{\chi}_1^0) = \frac{1}{2}(m(\tilde{\chi}_1^0) + m(\tilde{g}))$)	
	GMSB (I NLSP) : 2 lep (OS) + j's + E _{7,miss} 1.24 TeV \tilde{g} mass ($\tan\beta < 15$)	
	GMSB (τ NLSP) : 1-2 τ + 0-1 lep + j's + E _{7,miss} 1.20 TeV \tilde{g} mass ($\tan\beta > 20$)	
	GGM (bino NLSP) : $\gamma\gamma$ + E _{7,miss} 1.07 TeV \tilde{g} mass ($m(\tilde{\chi}_1^0) > 50$ GeV)	
	GGM (wino NLSP) : γ + lep + E _{7,miss} 619 GeV \tilde{g} mass	
	GGM (higgsino-bino NLSP) : γ + b + E _{7,miss} 900 GeV \tilde{g} mass ($m(\tilde{\chi}_1^0) > 220$ GeV)	
	GGM (higgsino NLSP) : Z + jets + E _{7,miss} 690 GeV \tilde{g} mass ($m(\tilde{H}) > 200$ GeV)	
	Gravitino LSP : 'monojet' + E _{7,miss} 645 GeV F ² scale ($m(\tilde{G}) > 10^4$ eV)	
	3rd gen. squarks direct production	$\tilde{g} \rightarrow b\bar{b}\tilde{\chi}_1^0$ (virtual b) : 0 lep + 3 b-jets + E _{7,miss} 1.24 TeV \tilde{g} mass ($m(\tilde{\chi}_1^0) < 200$ GeV)
		$\tilde{g} \rightarrow t\bar{t}\tilde{\chi}_1^0$ (virtual t) : 2 lep (SS) + j's + E _{7,miss} 850 GeV \tilde{g} mass ($m(\tilde{\chi}_1^0) < 300$ GeV)
$\tilde{g} \rightarrow t\bar{t}\tilde{\chi}_1^0$ (virtual t) : 3 lep + j's + E _{7,miss} 860 GeV \tilde{g} mass ($m(\tilde{\chi}_1^0) < 300$ GeV)		
$\tilde{g} \rightarrow t\bar{t}\tilde{\chi}_1^0$ (virtual t) : 0 lep + multi-jets + E _{7,miss} 1.00 TeV \tilde{g} mass ($m(\tilde{\chi}_1^0) < 300$ GeV)		
$\tilde{g} \rightarrow t\bar{t}\tilde{\chi}_1^0$ (virtual t) : 0 lep + 3 b-jets + E _{7,miss} 1.15 TeV \tilde{g} mass ($m(\tilde{\chi}_1^0) < 200$ GeV)		
$bb, b_s \rightarrow b\bar{b}\tilde{\chi}_1^0$: 0 lep + 2-b-jets + E _{7,miss} 620 GeV b mass ($m(\tilde{\chi}_1^0) < 120$ GeV)		
$bb, b_s \rightarrow b\bar{b}\tilde{\chi}_1^0$: 3 lep + j's + E _{7,miss} 405 GeV b mass ($m(\tilde{\chi}_1^0) = 2m(\tilde{\chi}_1^0)$)		
$\tilde{t}\tilde{t}$ (light), $\tilde{t} \rightarrow b\bar{b}\tilde{\chi}_1^0$: 1/2 lep (+ b-jet) + E _{7,miss} 160-350 GeV \tilde{t} mass ($m(\tilde{\chi}_1^0) = 55$ GeV)		
$\tilde{t}\tilde{t}$ (medium), $\tilde{t} \rightarrow b\bar{b}\tilde{\chi}_1^0$: 1 lep + b-jet + E _{7,miss} 160-350 GeV \tilde{t} mass ($m(\tilde{\chi}_1^0) = 0$ GeV, $m(\tilde{\chi}_1^0) = 150$ GeV)		
$\tilde{t}\tilde{t}$ (medium), $\tilde{t} \rightarrow b\bar{b}\tilde{\chi}_1^0$: 2 lep + E _{7,miss} 100-440 GeV \tilde{t} mass ($m(\tilde{\chi}_1^0) = 0$ GeV, $m(\tilde{H}) - m(\tilde{\chi}_1^0) = 10$ GeV)		
EW direct	$\tilde{t}\tilde{t}$ (medium), $\tilde{t} \rightarrow t\bar{b}\tilde{\chi}_1^0$: 1 lep + b-jet + E _{7,miss} 230-500 GeV \tilde{t} mass ($m(\tilde{\chi}_1^0) = 0$)	
	$\tilde{t}\tilde{t}$ (medium), $\tilde{t} \rightarrow t\bar{b}\tilde{\chi}_1^0$: 2 lep + E _{7,miss} 230-485 GeV \tilde{t} mass ($m(\tilde{\chi}_1^0) = 0$)	
	$\tilde{t}\tilde{t}$ (natural GMSB) : Z(\rightarrow ll) + b-jet + E _{7,miss} 310 GeV \tilde{t} mass ($115 < m(\tilde{\chi}_1^0) < 230$ GeV)	
	$\tilde{t}\tilde{t}$ (natural GMSB) : Z(\rightarrow ll) + E _{7,miss} 85-195 GeV \tilde{t} mass ($m(\tilde{\chi}_1^0) = 0$)	
	$\tilde{\chi}_1^0 \tilde{\chi}_1^0 \rightarrow \nu\bar{\nu}(\nu\bar{\nu}) \rightarrow \nu\bar{\nu}\tilde{\chi}_1^0$: 2 lep + E _{7,miss} 110-340 GeV $\tilde{\chi}_1^0$ mass ($m(\tilde{\chi}_1^0) < 10$ GeV, $m(\tilde{\nu}) = \frac{1}{2}(m(\tilde{\chi}_1^0) + m(\tilde{\nu}))$)	
	$\tilde{\chi}_1^0 \tilde{\chi}_1^0 \rightarrow \nu\bar{\nu}(\nu\bar{\nu}) \rightarrow \nu\bar{\nu}\tilde{\chi}_1^0$: 2 lep + E _{7,miss} 110-340 GeV $\tilde{\chi}_1^0$ mass ($\lambda_{311} = 0.10, \lambda_{322} = 0.05$)	
	$\tilde{\chi}_1^0 \tilde{\chi}_1^0 \rightarrow \nu\bar{\nu}(\nu\bar{\nu}) \rightarrow \nu\bar{\nu}\tilde{\chi}_1^0$: 3 lep + E _{7,miss} 580 GeV $\tilde{\chi}_1^0$ mass ($m(\tilde{\chi}_1^0) = m(\tilde{\chi}_1^0), m(\tilde{\chi}_1^0) = 0, m(\tilde{\nu})$ as above)	
	Direct $\tilde{\chi}_1^0$ pair prod. (AMSB) : long-lived $\tilde{\chi}_1^0$ 140-295 GeV $\tilde{\chi}_1^0$ mass ($m(\tilde{\chi}_1^0) = m(\tilde{\chi}_1^0), m(\tilde{\chi}_1^0) = 0$, sleptons decoupled)	
	Stable \tilde{t} R-hadrons : low $\beta, \beta\gamma$ (full detector) 985 GeV \tilde{g} mass	
	Stable \tilde{t} R-hadrons : low $\beta, \beta\gamma$ (full detector) 683 GeV \tilde{t} mass	
Long-lived particles	GMSB : stable $\tilde{\tau}$ 300 GeV $\tilde{\tau}$ mass ($5 < \tan\beta < 20$)	
	$\tilde{\chi}_1^0 \rightarrow q\bar{q}$ (RPV) : μ + heavy displaced vertex 700 GeV \tilde{q} mass ($0.3 \times 10^{-5} < \lambda_{211} < 1.5 \times 10^{-5}, 1 \text{ mm} < ct < 1 \text{ m}, \tilde{g}$ decoupled)	
	LFV : $pp \rightarrow \tilde{\nu} + X, \tilde{\nu} \rightarrow e\mu$ resonance 1.61 TeV $\tilde{\nu}$ mass ($\lambda_{211} = 0.10, \lambda_{222} = 0.05$)	
	LFV : $pp \rightarrow \tilde{\nu} + X, \tilde{\nu} \rightarrow e(\mu) + \text{resonance}$ 1.10 TeV $\tilde{\nu}$ mass ($\lambda_{211} = 0.10, \lambda_{222} = 0.05$)	
	Bilinear RPV CMSSM : 1 lep + 7 j's + E _{7,miss} 1.2 TeV $\tilde{q} = \tilde{g}$ mass ($c\tau_{1,2,3} < 1 \text{ mm}$)	
	$\tilde{\chi}_1^0 \tilde{\chi}_1^0 \rightarrow W\tilde{\chi}_1^0 \tilde{\chi}_1^0 \rightarrow e\bar{\nu}_e \nu_e \nu_e$: 4 lep + E _{7,miss} 700 GeV $\tilde{\chi}_1^0$ mass ($m(\tilde{\chi}_1^0) > 300$ GeV, λ_{121} or $\lambda_{122} > 0$)	
	$\tilde{\chi}_1^0 \tilde{\chi}_1^0 \rightarrow W\tilde{\chi}_1^0 \tilde{\chi}_1^0 \rightarrow e\bar{\nu}_e \nu_e \nu_e$: 4 lep + E _{7,miss} 430 GeV \tilde{t} mass ($m(\tilde{\chi}_1^0) > 100$ GeV, $m(\tilde{u}_L) = m(\tilde{u}_R) = m(\tilde{d}_L) = m(\tilde{d}_R) > 0$)	
	$\tilde{g} \rightarrow q\bar{q}$: 3-jet resonance pair 666 GeV \tilde{g} mass	
	Scalar gluon : 2-jet resonance pair 100-287 GeV sgluon mass (incl. limit from 110.2693)	
	WIMP interaction (D5, Dirac $\tilde{\chi}_1^0$) : 'monojet' + E _{7,miss} 704 GeV M ² scale ($m_{\tilde{\chi}_1^0} < 80$ GeV, limit of < 687 GeV for D8)	

ATLAS Preliminary

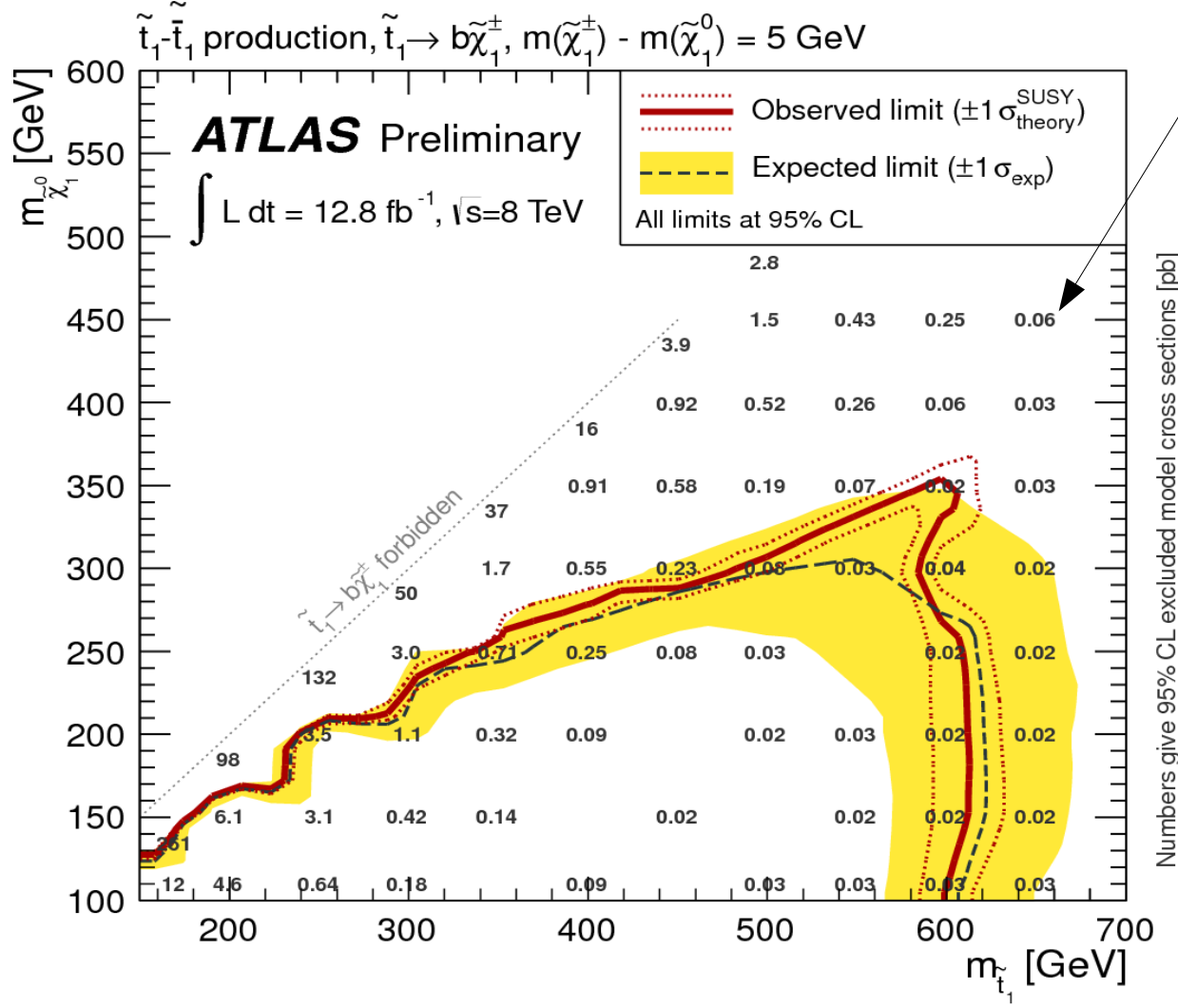
$\int L dt = (2.1 - 13.0) \text{ fb}^{-1}$

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



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

Status: Simplified models and ATLAS



Most recent results now also show upper limits on production cross sections

(previous iterations had 1-CLs values instead. We want the full likelihoods. If not the likelihoods, we want the upper limits)

Status: Simplified models and ATLAS

2011 data (7 TeV)

Short Title of the Paper	Date	\sqrt{s} (TeV)	L (fb ⁻¹)	Document	Plots+Aux. Material	Journal
0-2 leptons + 0-1 b-jets multichannel (razor)	12/2012	7	4.7	1212.6149	Link	Submitted to EPJC
Heavy resonance to $e\mu$, $e\tau$, $\mu\tau$ [RPV-LFV] NEW	12/2012	7	4.6	1212.1272	Link	Submitted to PLB
Long-lived particles [R-hadrons, slepton] NEW	11/2012	7	4.7	1211.1597	Link	Submitted to PLB
1 photon + ≥ 1 b-jet + Etmis [GGM, higgsino NLSP] NEW	11/2012	7	4.7	1211.1167	Link	Accepted by PLB
Muon + displaced vertex [RPV]	10/2012	7	4.7	1210.7451	Link	Accepted by PLB
Pair of 2-jet resonance [N=1/2 scalar gluon]	10/2012	7	4.6	1210.4826	Link	Accepted by EPJC
Pair of 3-jet resonance [RPV]	10/2012	7	4.6	1210.4813	Link	JHEP 12 (2012) 086
≥ 4 leptons + Etmis [RPV]	10/2012	7	4.7	1210.4457	Link (+ data)	JHEP 12 (2012) 124
Monojet + Etmis [WIMP]	10/2012	7	4.7	1210.4491	Link	Submitted to JHEP
Disappearing track + jets + Etmis [Direct long-lived charginos - AMSB]	10/2012	7	4.7	1210.2852	Link	Accepted by JHEP
1-2 taus + 0-1 leptons + jets + Etmis [GMSB]	10/2012	7	4.7	1210.1314	Link	EPJC 72 (2012) 2215
Monophoton [ADD, WIMP]	09/2012	7	4.7	1209.4625	Link	PRL 110 (2013) 011802
2 leptons + jets + Etmis [Medium stop]	09/2012	7	4.7	1209.4186	Link (+ data)	JHEP 11 (2012) 094
1-2 b-jets + 1-2 leptons + jets + Etmis [Light Stop]	09/2012	7	4.7	1209.2102	Link	Accepted by PLB
2 photons + Etmis [GGM, bino NLSP]	09/2012	7	4.7	1209.0753	Link (+ data)	PLB 718 (2012) 411

<https://twiki.cern.ch/twiki/bin/view/AtlasPublic/SupersymmetryPublicResults>

Status: Simplified models and ATLAS

And some results already appeared on hepdata:

<http://hepdata.cedar.ac.uk/view/ins1190891>

The Durham HepData Project



REACTION DATABASE • DATA REVIEWS • PARTON DISTRIBUTION FUNCTION SERVER • OTHER HEP RESOURCES

Reaction Database Full Record Display

View [short record](#) or as: [plain text](#), [AIDA](#), [PyROOT](#), [YODA](#), [ROOT](#), [mpl](#) or [jhepwork](#)

AAD 2012 — Search for R-parity-violating supersymmetry in events with four or more leptons in $\sqrt{s}=7$ with the ATLAS detector

Experiment: [CERN-LHC-ATLAS \(ATLAS\)](#)

Preprinted as [CERN-PH-EP-2012-276](#)

Archived as: [ARXIV:1210.4457](#)

Record in: [INSPIRE](#)

CERN-LHC. Measurement of final states with four or more leptons (electrons or muons) produced in proton-proton collisions at a centre-of-mass energy of 7 TeV. The data sample has a total integrated luminosity of 4.7 fb⁻¹. Comparisons with the Standard Model are made in two signal regions: one that requires moderate values of missing transverse momentum and the other that requires large effective mass. The data are interpreted in a simplified model of R-parity-violating supersymmetry and in an R-parity-violating MSUGRA/CMSSM model. There is a link below to the SLHA files of the analyses

Baseline: Four or more leptons (e,mu) + Veto Z candidates

SR1: Baseline+Missing ET > 50 GeV

SR2: Baseline+Effective mass > 300 GeV (=scalar sum of missing ET, lepton PT and jet PT for jets PT>40GeV).

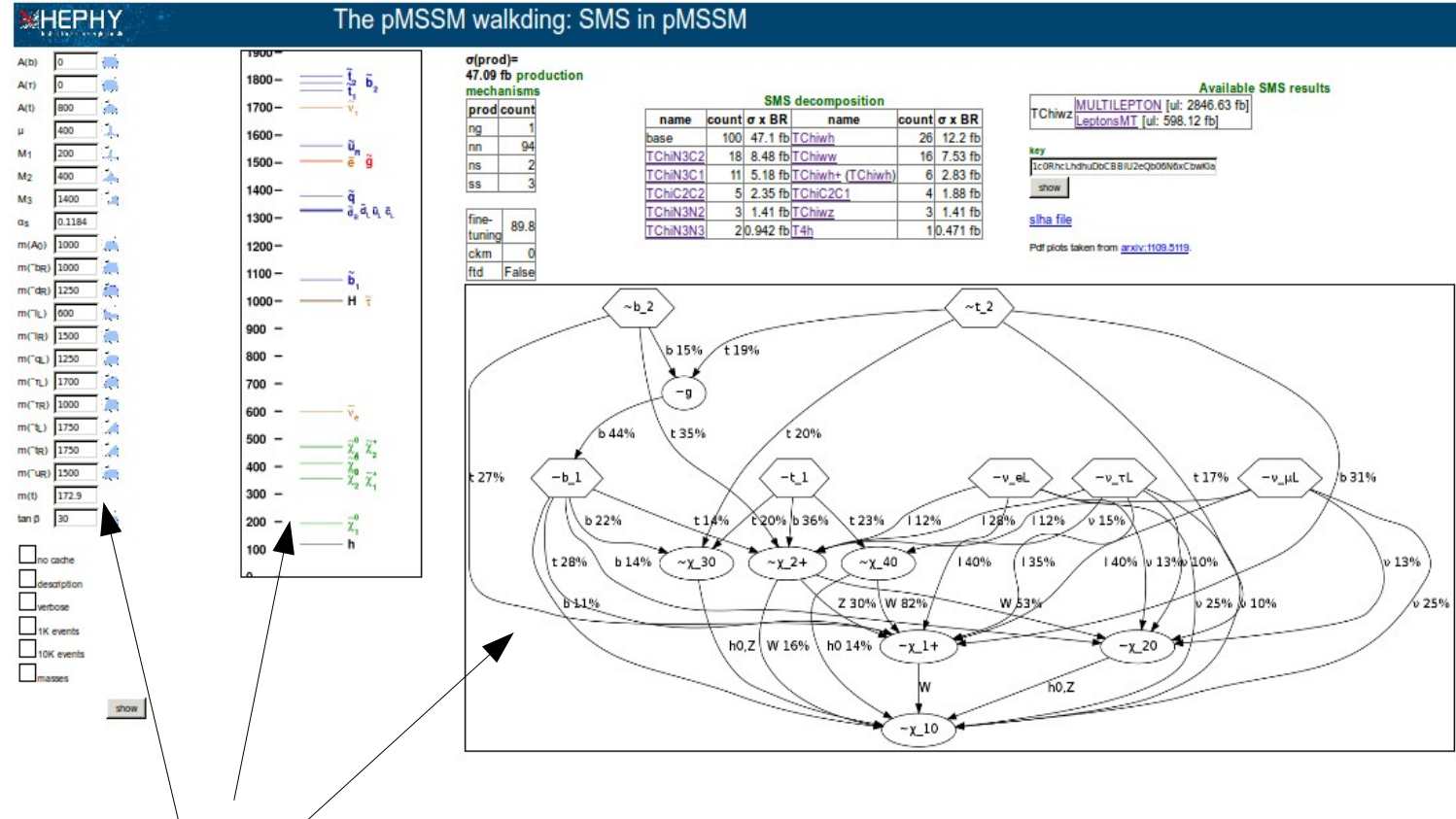
[Link to the SLHA files](#)

[View list of currently selected plots](#)

Wishes from the experimental collaborations

- We would like full bin-by-bin **likelihoods** also for SMS results
- Please publish using **hepdata**
- Ultimate vision: e.g. **Histfactory + hepdata** may make it possible for us to produce all sorts of combined likelihoods, across analyses, across results

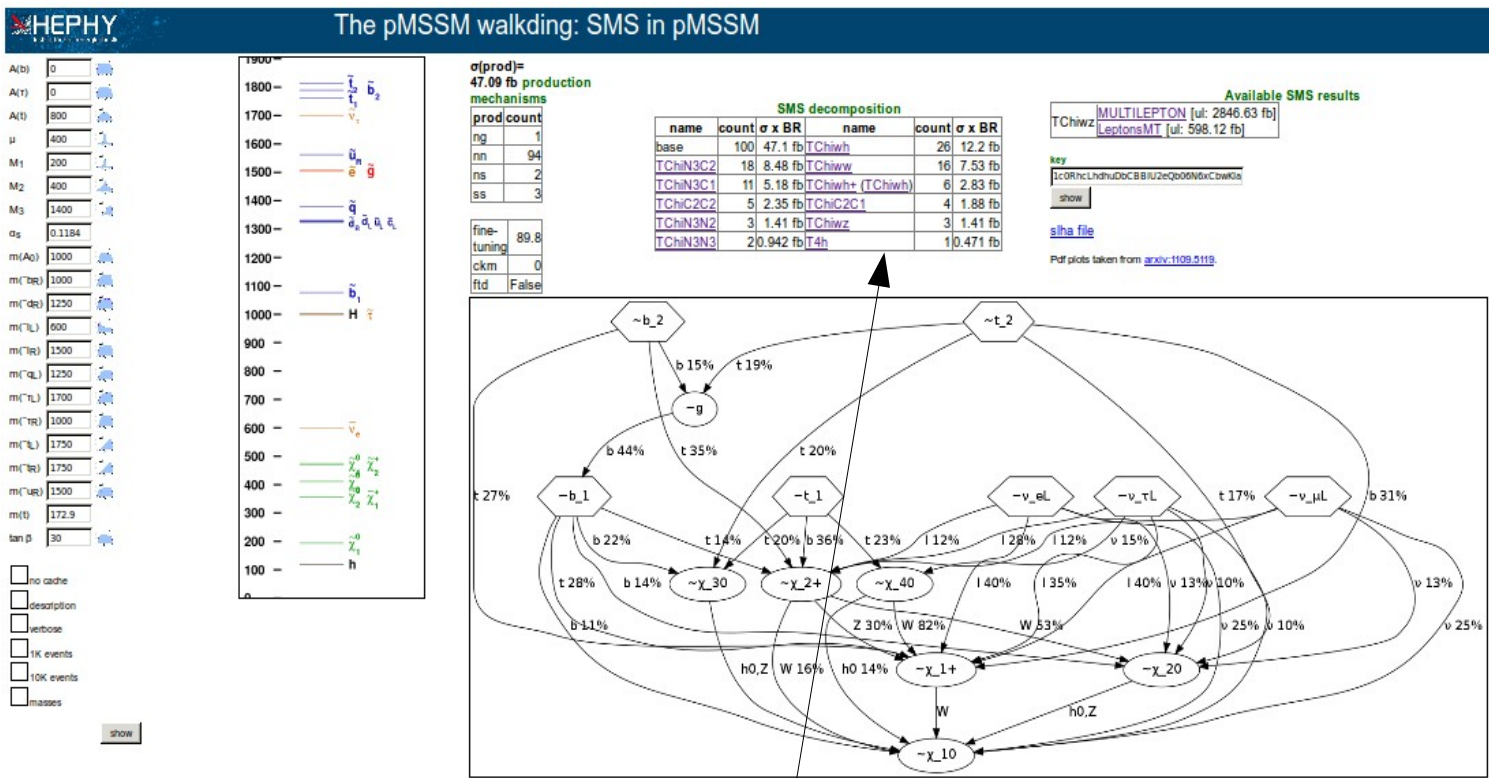
<http://www.hephy.at/user/walten/cgi-bin/pmssm.py>,
<http://www.hephy.at/user/walten/cgi-bin/pnmssm.py>



Our ultimate vision looks like this:

- take a specific parameter point of a model (e.g. via an MCMC walk)

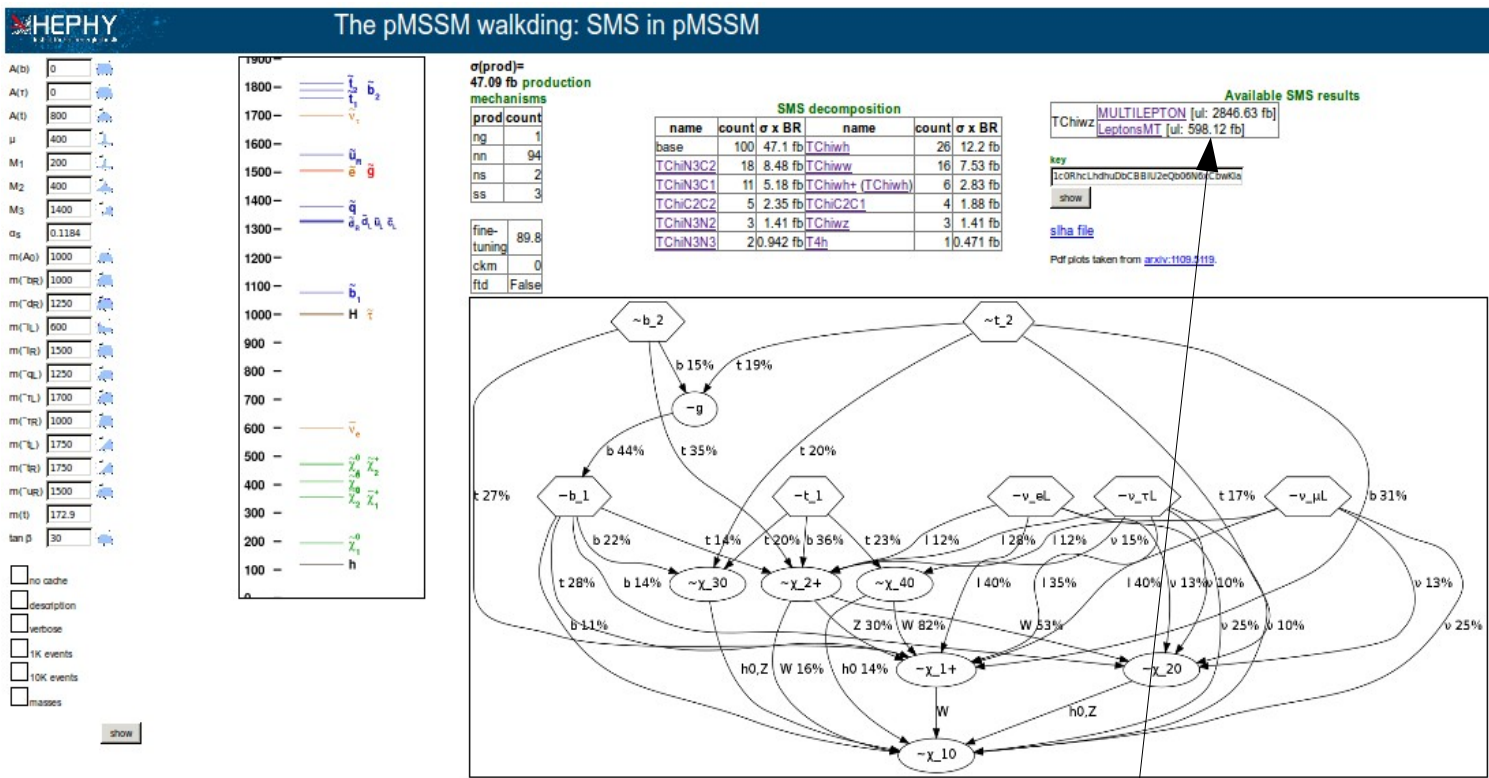
<http://www.hephy.at/user/walten/cgi-bin/pmssm.py>



Our ultimate vision looks like this:

- take a specific parameter point of a model (e.g. via an MCMC walk)
- decompose it into its SMS spectrum

<http://www.hephy.at/user/walten/cgi-bin/pmssm.py>



Our ultimate vision looks like this:

- take a specific parameter point of a model (e.g. via an MCMC walk)
- decompose it into its SMS spectrum
- check the latest and greatest ATLAS / CMS / non-LHC results for the various topologies

then **mix it, cook it, serve it!**

- **closure tests** between direct exclusions in full models and the “combined SMS way”, possibly outside the experiments
- **side-by-side comparisons** between CMS and ATLAS results
- why not mix/combine the best of two worlds?
- simply update to newer results when theyre published
- add non-LHC results to the mix
- have it all searchable and available via inspire → hepdata → histfactory
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