α_T analysis: T2tt-4bd approval

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Introduction

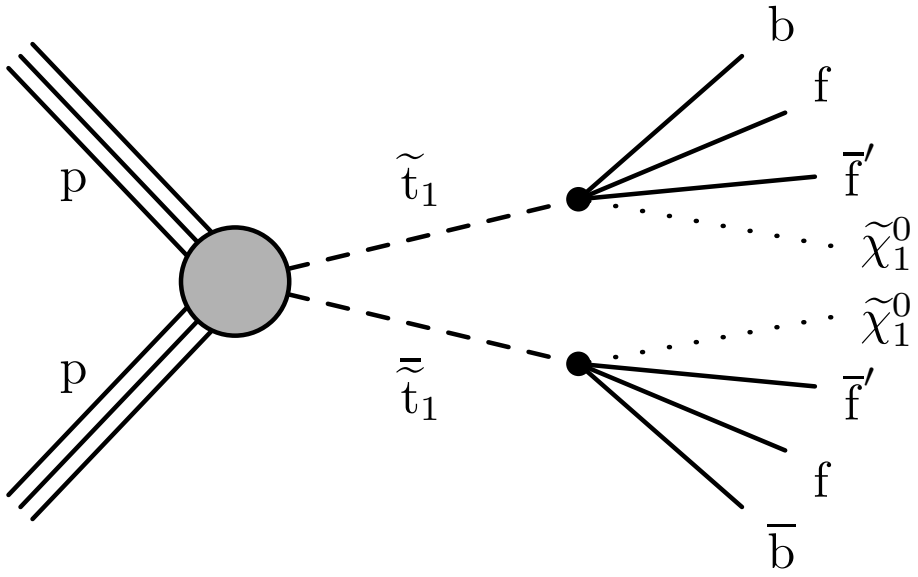
- Presenting on behalf of α_{T} analysis (jet + MET search for natural and split SUSY)
- We bin in H_{T}, $H_{\mathrm{T}}^{\mathrm{miss}}$, n_{jet}, n_{b}
- Seeking approval for analysis of T2tt-4bd (previously T2-4bd) simplified model
- Due to constraints and deadlines, did not have time to include in SUS-16-038 paper (available at arXiv, CADI)
- Intention is to add to Supplementary Material and public webpage

Event selection and binning

Baseline event selection		
All-jet final state	Veto events containing photons, electrons, muons, and SITs within acceptance	
$p_{\mathrm{T}}^{\mathrm{miss}}$ quality	Veto events based on filters related to beam and instrumental effects	
Jet quality	Veto events containing jets that fail identification criteria or $0.1 < f_{\mathrm{h}^{\pm}}^{\mathrm{j1}} < 0.95$	
Jet energy and sums	$p_{\mathrm{T}}^{\mathrm{j1}} > 100\,\mathrm{GeV}$, $H_{\mathrm{T}} > 200\,\mathrm{GeV}$, $H_{\mathrm{T}}^{\mathrm{miss}} > 200\,\mathrm{GeV}$	
Jets outside acceptance	$H_{\mathrm{T}}^{\mathrm{miss}} / p_{\mathrm{T}}^{\mathrm{miss}} < 1.25$, veto events containing jets with $p_{\mathrm{T}} > 40\,\mathrm{GeV}$ and $\lvert\eta\rvert > 2.4$	
Signal region	Baseline selection +	
α_{T} threshold (H_{T} range)	0.65 (200–250 GeV), 0.60 (250–300), 0.55 (300–350), 0.53 (350–400), 0.52 (400–900)	
$\Delta\phi^{*}_{\mathrm{min}}$ threshold	$\Delta\phi^{*}_{\mathrm{min}} > 0.5$ ($n_{\mathrm{jet}} \geq 2$), $\Delta\phi^{*}_{\mathrm{min}}{}^{25} > 0.5$ ($n_{\mathrm{jet}} = 1$)	
Nominal categorization schema		
n_{jet}	1	(monojet)
	$\geq 2a$	(a denotes asymmetric, $40 < p_{\mathrm{T}}^{\mathrm{j2}} < 100\,\mathrm{GeV}$)
	2, 3, 4, 5, ≥ 6	(symmetric, $p_{\mathrm{T}}^{\mathrm{j2}} > 100\,\mathrm{GeV}$)
n_{b}	0, 1, 2, 3, ≥ 4	(can be dropped/merged vs. n_{jet})
H_{T} boundaries	200, 400, 600, 900, 1200 GeV	(can be dropped/merged vs. n_{jet}, n_{b})
$H_{\mathrm{T}}^{\mathrm{miss}}$ boundaries	200, 400, 600, 900 GeV	(can be dropped/merged vs. n_{jet}, n_{b}, H_{T})
Simplified categorization schema		
Topology (n_{jet}, n_{b})	Monojet-like	$(1 \cap \geq 2a, 0)$, $(1 \cap \geq 2a, \geq 1)$
	Low n_{jet}	$(2 \cap 3, 0 \cap 1)$, $(2 \cap 3, \geq 2)$
	Medium n_{jet}	$(4 \cap 5, 0 \cap 1)$, $(4 \cap 5, \geq 2)$
	High n_{jet}	$(\geq 6, 0 \cap 1)$, $(\geq 6, \geq 2)$
H_{T} boundaries	$H_{\mathrm{T}} > 200\,\mathrm{GeV}$ ($n_{\mathrm{jet}} \leq 3$), $H_{\mathrm{T}} > 400\,\mathrm{GeV}$ ($n_{\mathrm{jet}} \geq 4$)	
$H_{\mathrm{T}}^{\mathrm{miss}}$ boundaries	200, 400, 600, 900 GeV	

The model

◎ T2tt model, 4-body decay: $pp \rightarrow \tilde{t}\bar{\tilde{t}},\ \tilde{t} \rightarrow bf\bar{f}\tilde{\chi}_1^0$



◎ Mass points generated from $m_{\text{Stop}} = 250$ to 800 GeV, with mass splittings ($m_{\text{Stop}} - m_{\text{LSP}}$) from 10 to 80 GeV for each value of m_{Stop}

◎ Using the $m_{\text{Stop}} = 450$ GeV, $m_{\text{LSP}} = 400$ GeV benchmark model

Systematic uncertainties

To add to Supplementary Material

Model	$(m_{\text{Susy}}, m_{\text{LSP}})$	Luminosity	ISR	JEC	PU
T2tt-4bd	(450, 400)	2.6%	4-20%	5-12%	7-12%

b-tag (Fullsim)	Mistag (Fullsim)	b-tag (Fastsim)	c-tag (Fastsim)	light-tag (Fastsim)	Trigger	MC stat.
2-4%	2-3%	2-5%	2-5%	1-7%	2-3%	6-21%

Table 25: Representative range taken from the 16% and 84% percentiles of the uncertainty across the analysis bins for each source of signal systematic. One benchmark point is chosen for this model, corresponding to the "compressed" scenario, i.e. with small mass splitting between the mother particle and the LSP.

Cross section limits

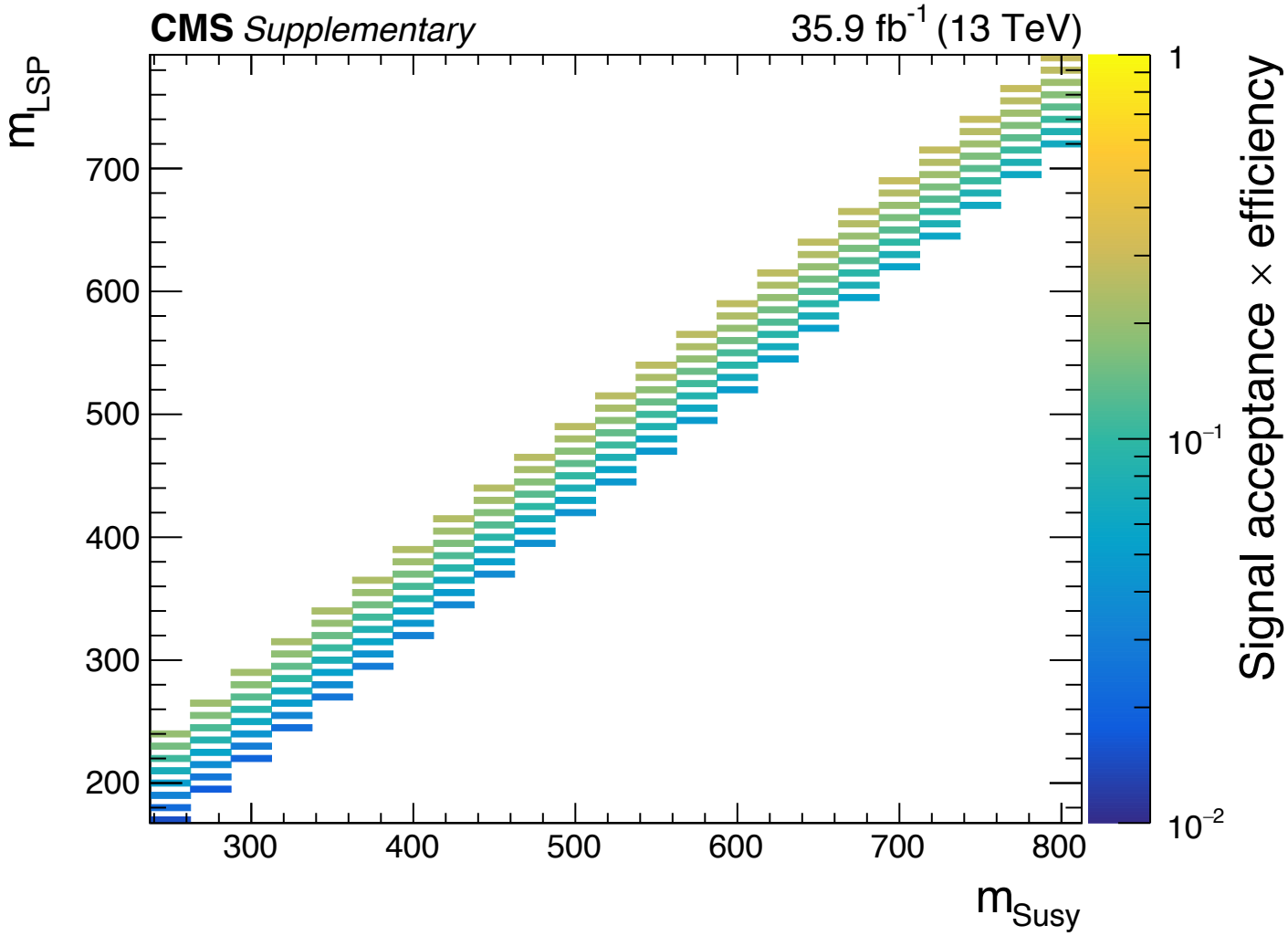
To add to Supplementary Material

Benchmark models		Nominal		Simplified	
$(m_{\text{SUSY}}, m_{\text{LSP}})$ [GeV]		μ_{exp}	μ_{obs}	μ_{exp}	μ_{obs}
T2tt-4bd	(450, 400)	0.94	1.89	2.16	3.49

Table 26: Expected (μ_{exp}) and observed (μ_{obs}) upper limits on the production cross section, expressed in terms of the signal strength parameter, obtained using both the nominal and simplified binning schema.

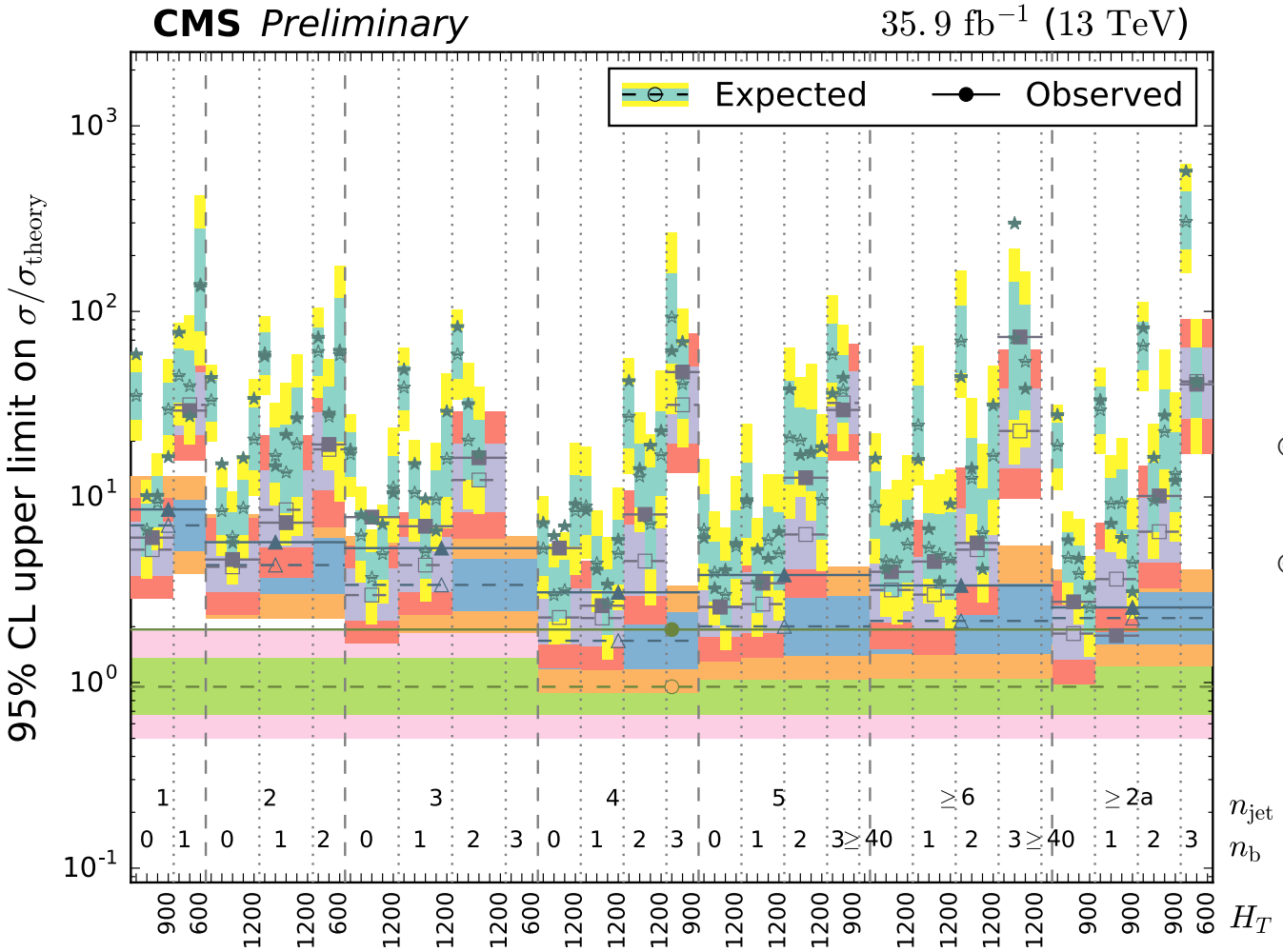
Signal acceptance x efficiency

To add to Supplementary Material



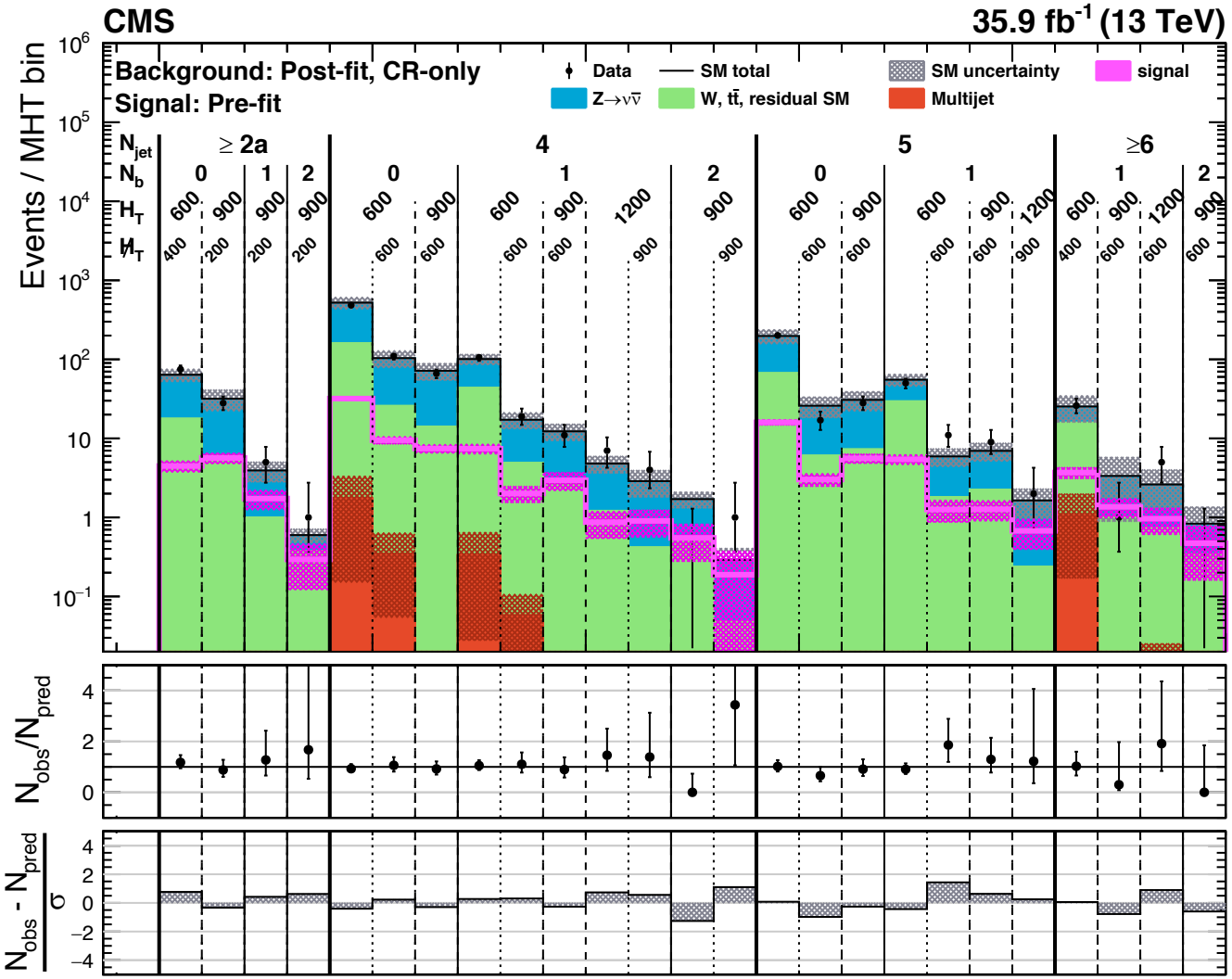
◎ 9.4 % for (450, 400) benchmark point

Limit per bin (benchmark model)



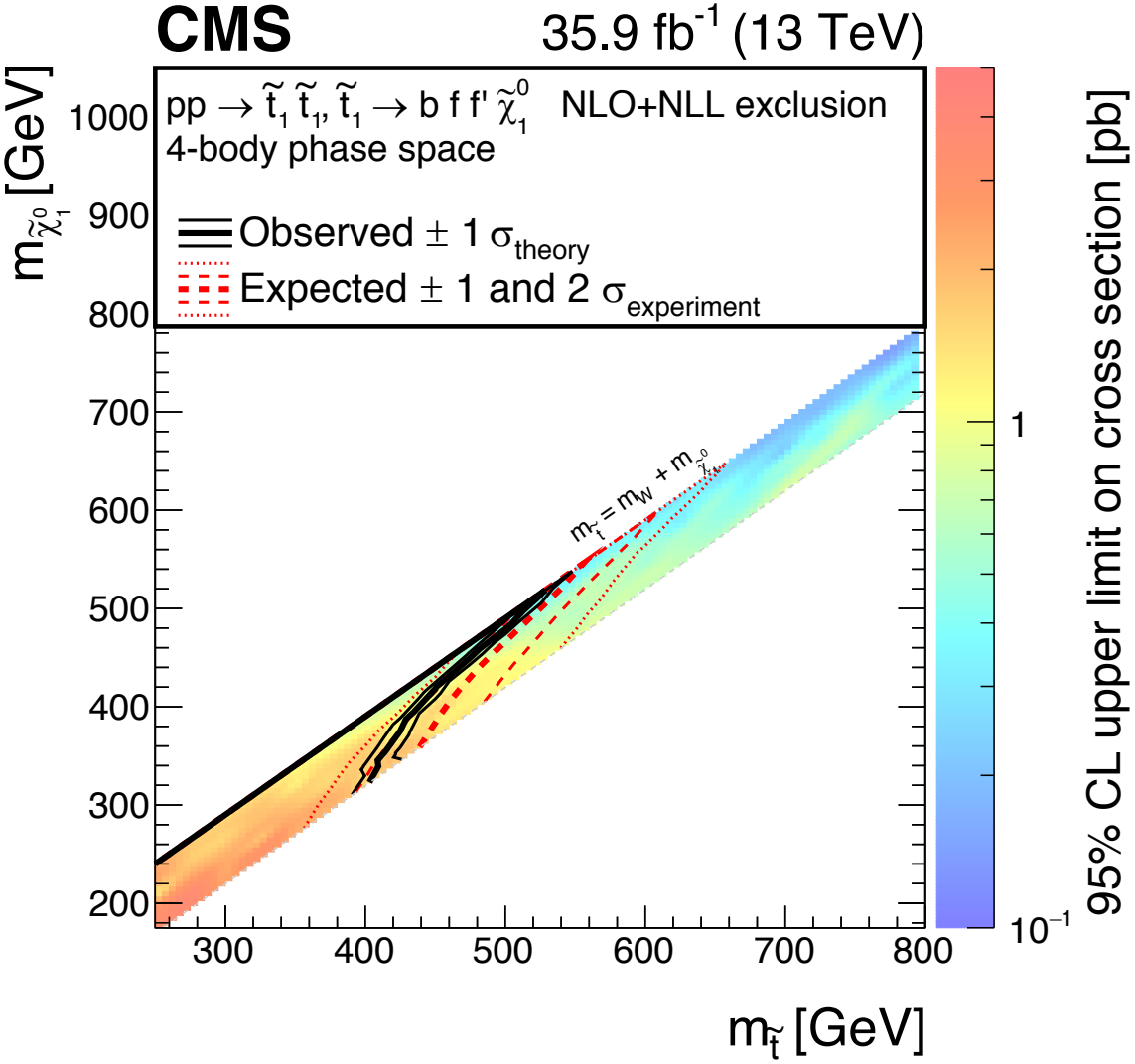
- Inclusive in MHT
- Internal plot

Most sensitive bins (benchmark model)

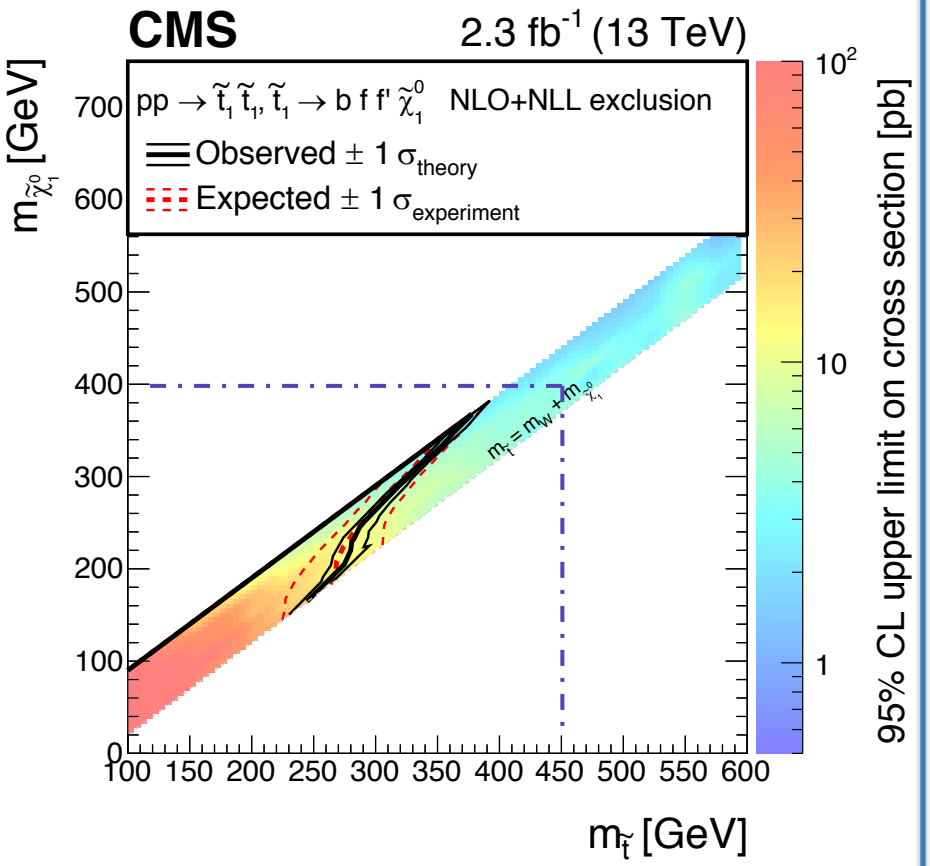


Limit plot

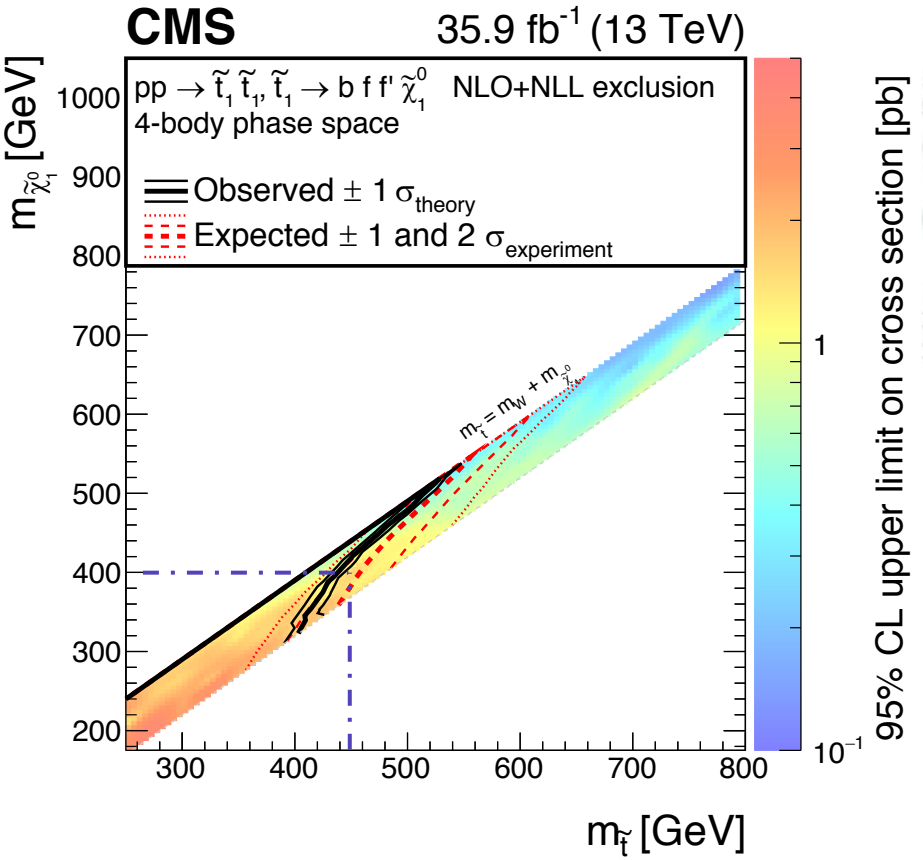
To add to Supplementary Material



Comparison with previous limit



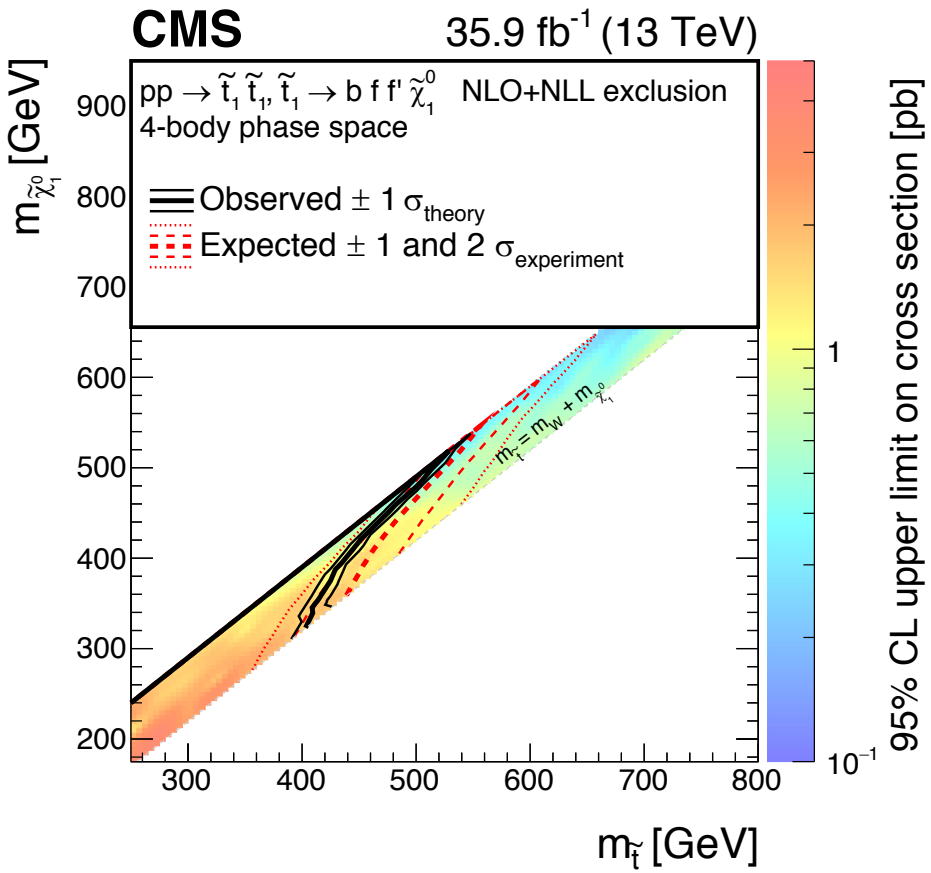
2015 result



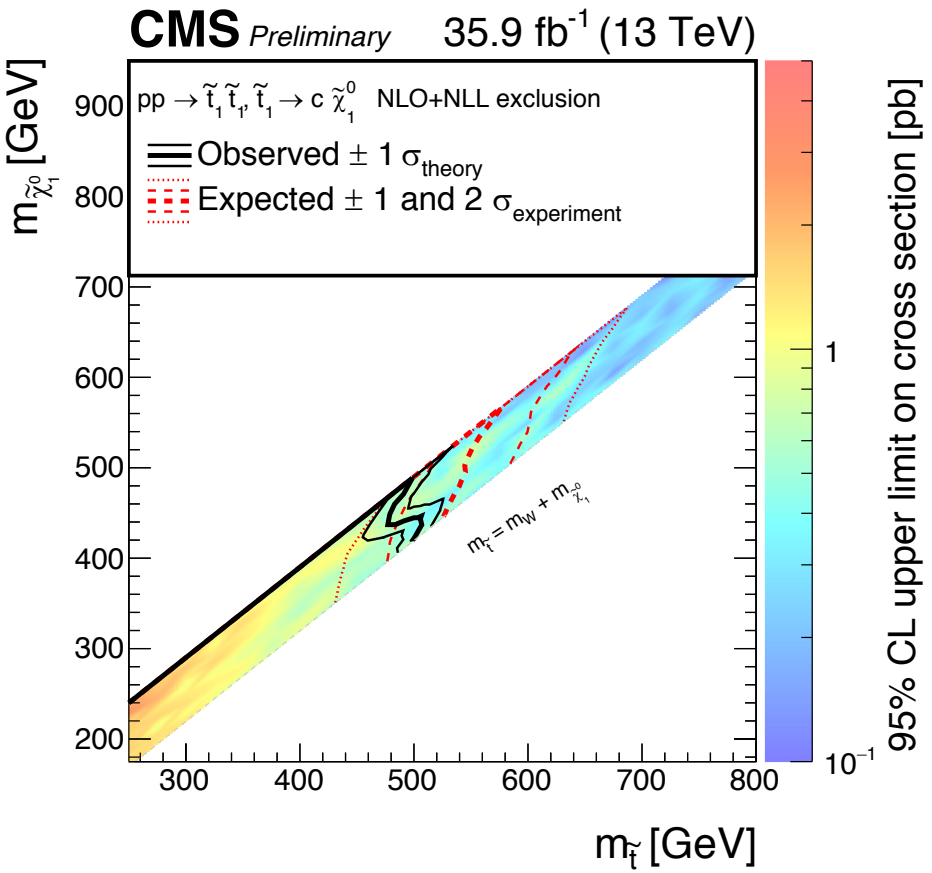
2016 result

◎ Purple lines are for reference to benchmark point only (will not be in final plot)

Limit plot (comparison with T2cc)



T2tt-4bd



T2cc

Summary and next steps

◎ Seeking approval for analysis of T2tt-4bd model as we were unable to include it in paper

◎ Cut flow table for this, and other models, in progress

◎ Intention is to add the following to Supplementary Material and public webpage:

- Table of systematics
- Table of cross section limits
- Plot of signal acceptance x efficiency
- Limit plane
- Cut flow table

Backup

Most sensitive n_{jet} categories