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T2tt-4bd analysis: complete

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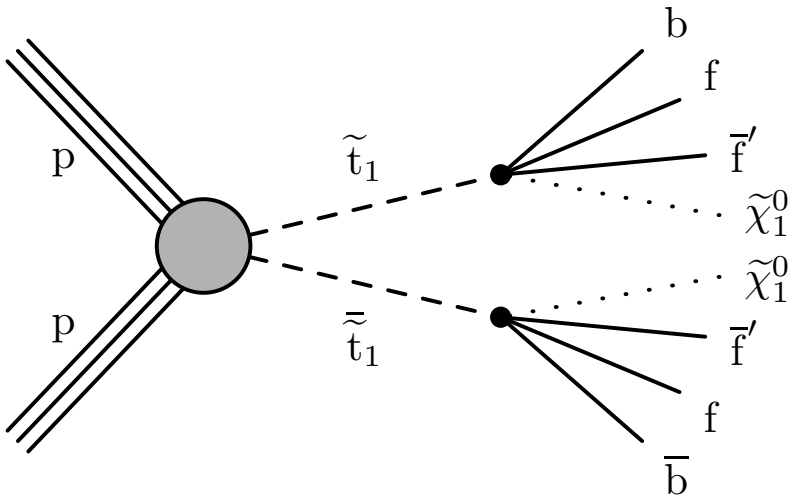
CMS

The model

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



- 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 model

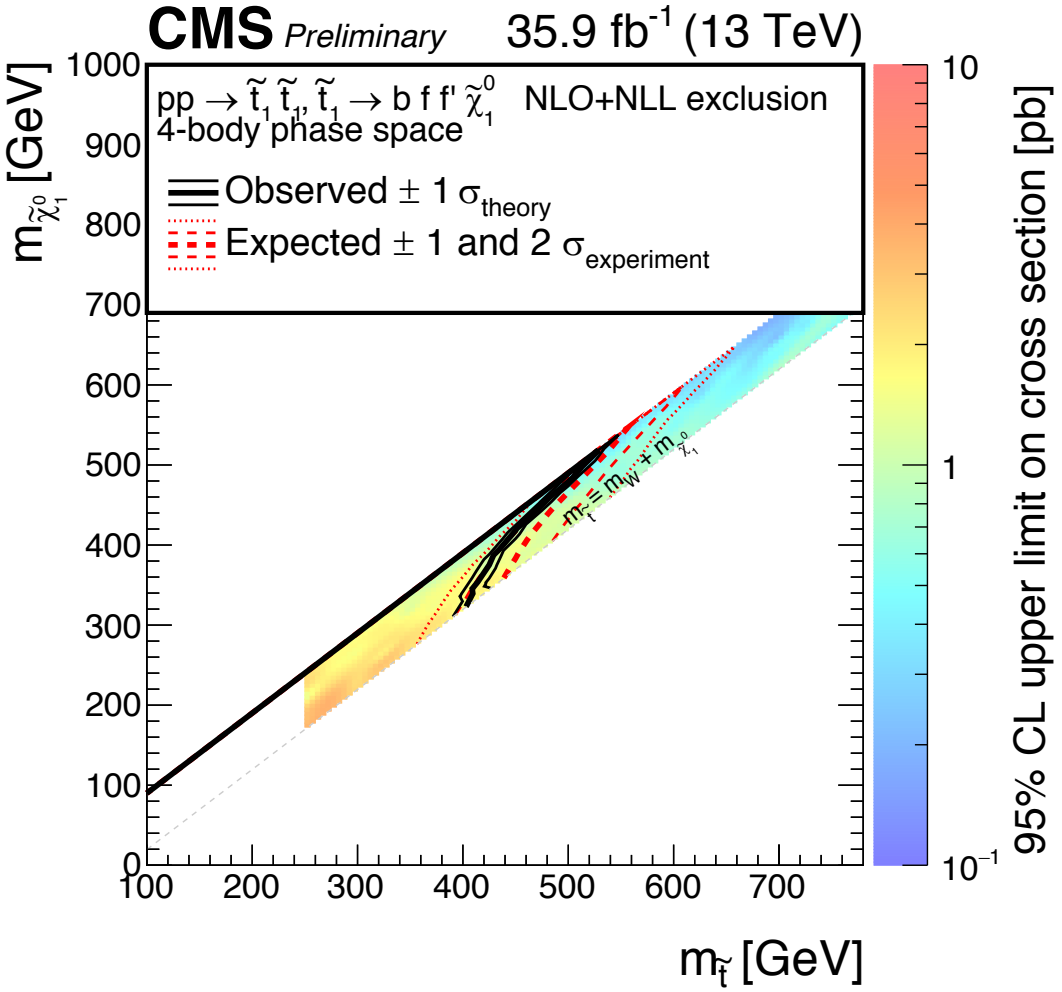
Tree production and analysis

- Trees produced with Heppy, using CRAB rather than Imperial/Bristol batch
- Using (450, 400) benchmark model
- All analysis components (as far as I know) completed:

  - Limit plot | Feynman diagram | systematics | cross section limit table | signal acceptance x efficiency plot | most sensitive n_{jet} categories plot | significance scan | limits per bin plot | mountain range plot | cut flow table

Limit plot

- Includes signal contamination. Makes marginal difference to plot
- No mass point failures



Systematics and cross section limits

- Taken from my lab book using AN as template:

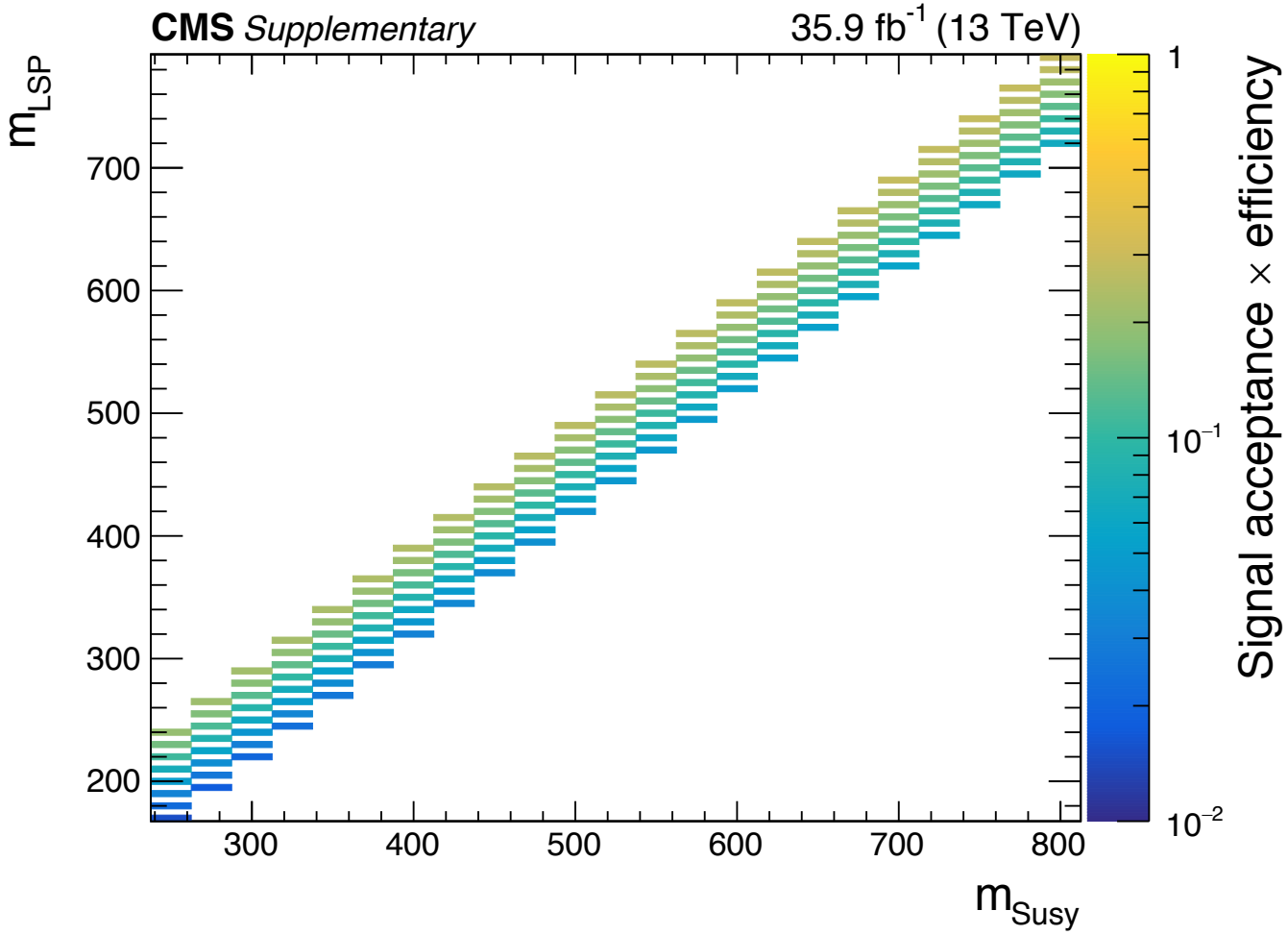
Model	$(m_{\text{Susy}}, m_{\text{LSP}})$	Luminosity	ISR	JEC	PU	b-tag (Fullsim)	Mistag (Fullsim)	b-tag (Fastsim)	c-tag (Fastsim)	light-tag (Fastsim)	Trigger	MC stat.
T2tt-4bd	(450, 400)	2.6%	4-20%	5-12%	7-12%	2-4%	2-3%	2-5%	2-5%	1-7%	2-3%	6-21%

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.

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

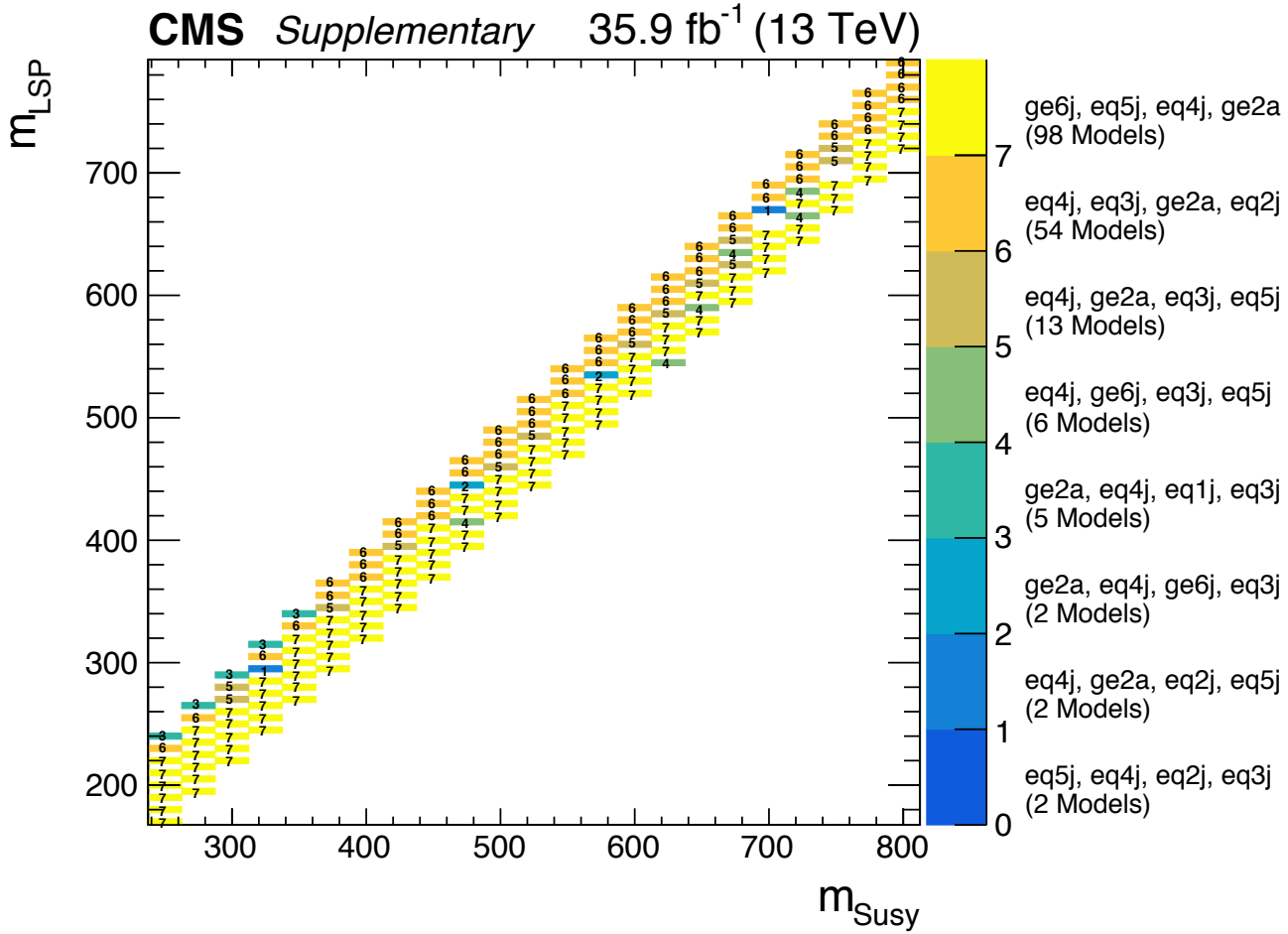
Table 26: Expected (μ_{exp}) and observed (μ_{obs}) upper limits on the production cross section, expressed in terms of the signal strength parameter, obtained using both the nominal and simplified binning schema.

Signal acceptance x efficiency

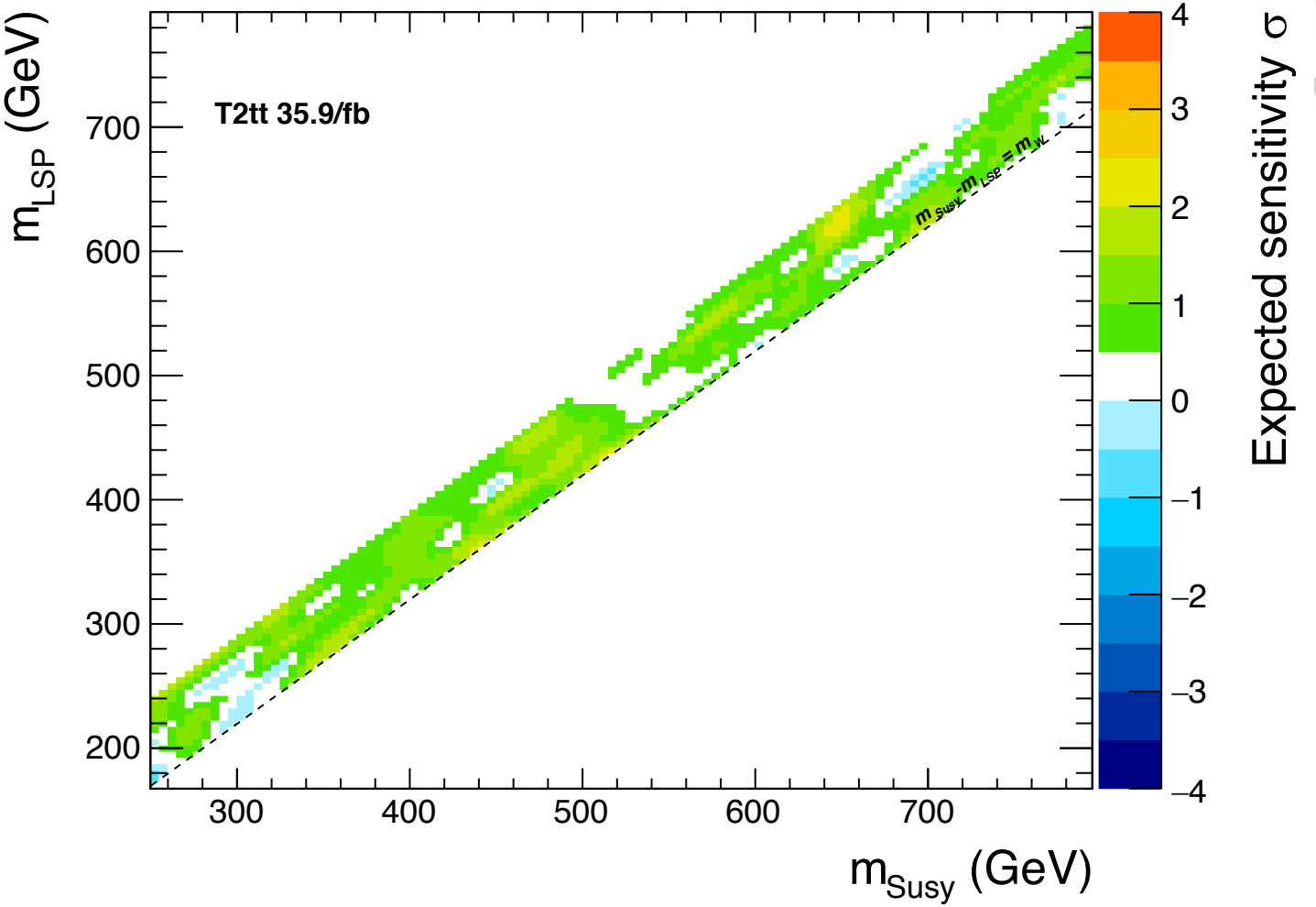


- 9.4 % for (450, 400) benchmark

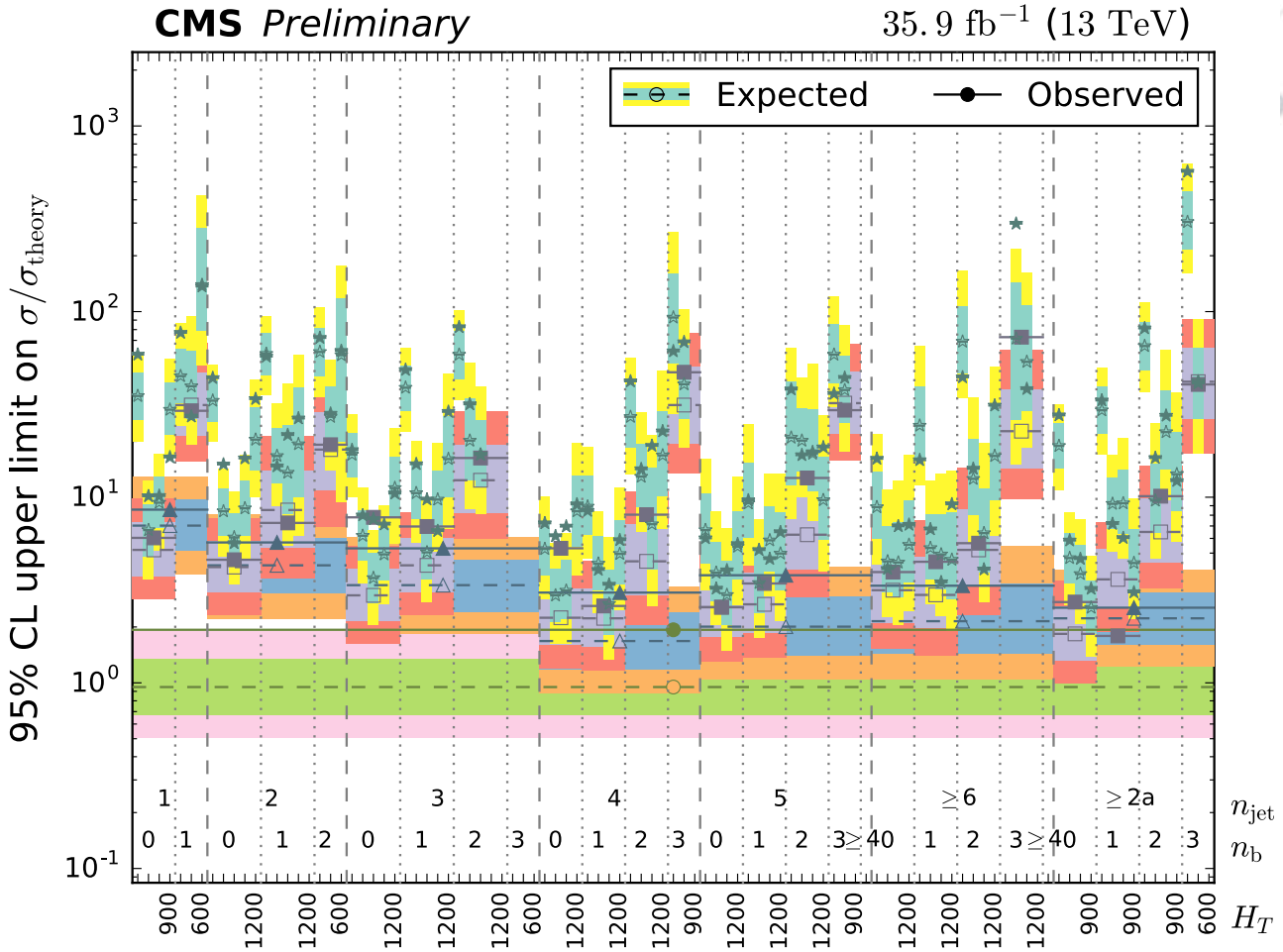
Most sensitive n_{jet} categories



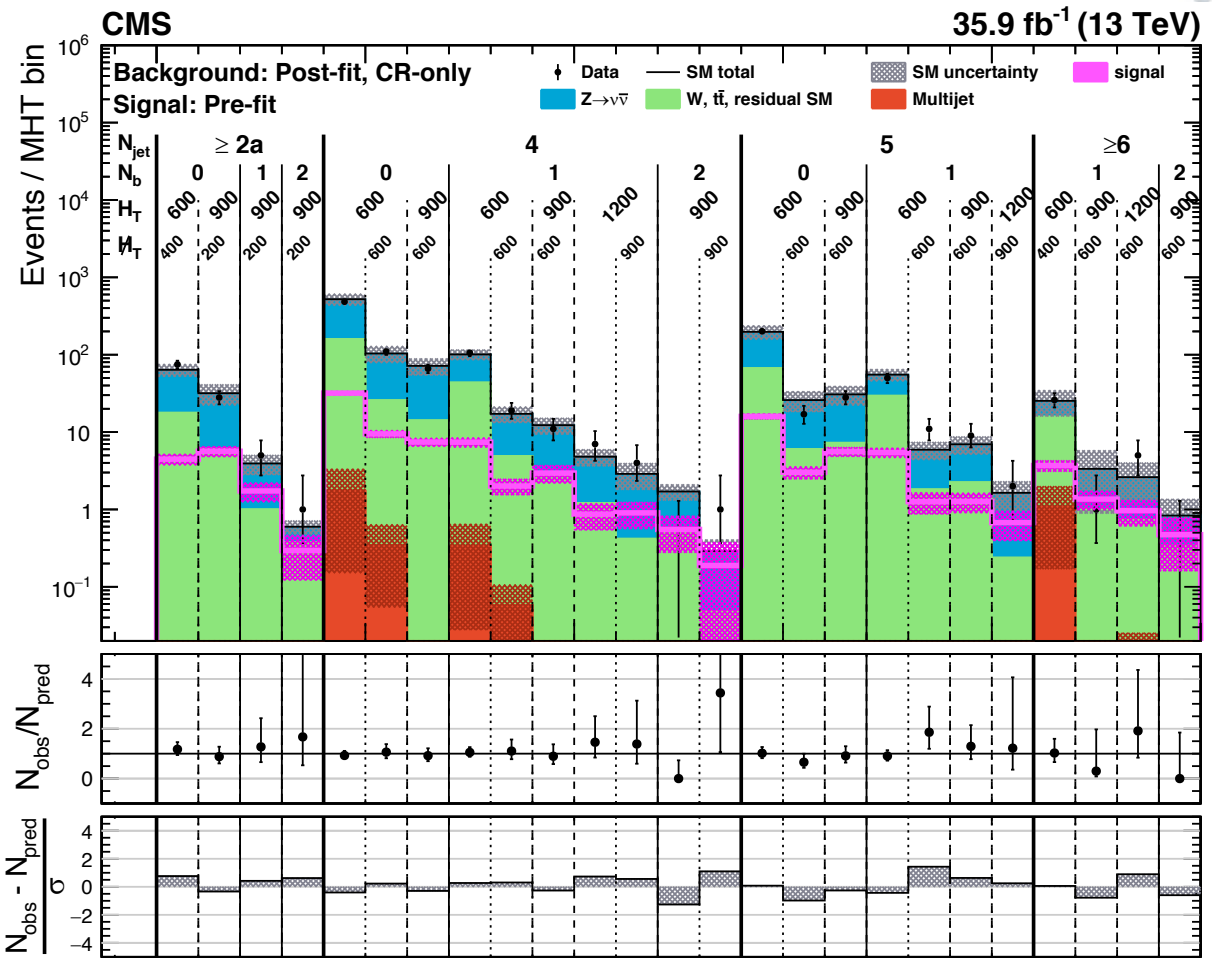
Significance scan



Limit per bin



Mountain range



Cut flow table

Table 28: Cut flow table for `T2tt-4bd` model.

Event selection	Benchmark model (m_{SUSY}, m_{LSP})
	T2tt-4bd
	(450, 400)
Before selection	100
Event veto for muons and electrons	79
Event veto for single isolated tracks	71
Event veto for photons	71
Event veto for jets failing ID	71
$n_{\text{jet}} \geq 2$	55
$0.1 < \text{CHF}^{\text{j}_1} < 0.95$	50
$p_{\text{T}}^{\text{j}_1} > 100\,\text{GeV}$	41
$H_{\text{T}} > 200\,\text{GeV}$	37
$H_{\text{T}}^{\text{miss}} > 200\,\text{GeV}$	26
Event veto for forward jets ($\lvert\eta\rvert > 2.4$)	22
$H_{\text{T}}^{\text{miss}}/E_{\text{T}}^{\text{miss}} < 1.25$	20
H_{T}-dependent α_{T} requirements ($H_{\text{T}} < 900\,\text{GeV}$)	11
$\Delta\phi_{\text{min}}^{*} > 0.5$	8.3

Consolidating the material

- Everything added to AN in relevant places
- Plots and text are included, and linked to properly (I think)
- Only missing the reference to the previous mass limit in the table listing the simplified models
- PR made to master branch of CMSRA1/AlphaTDR2
- Big thanks to Shane and Ben for helping me out and pointing me to the code/instructions for all of these components