Wishlist from phenomenologists
Material needed for proper reinterpretations of LHC results

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Implementing a new analysis in a recasting tool

✦ Picking up an experimental publication
- ✤ Reading
- ✤ Understanding

✅ **Relatively easy**

✦ Writing the analysis code in the tool internal language

✅ **Relatively easy**

✦ Getting the information missing from the publication for a proper validation
- ✤ Efficiencies (trigger, electrons, muons, b-tagging, JES, *etc.*)
  - ★ Including p_T and/or η dependence
  - ★ Accurate information
- ✤ Detailed cutflows for some well-defined benchmark scenarios
  - ★ Exact definition of the benchmarks (SLHA spectra)
  - ★ Event generation information (cards, tunes, LHE files if possible)
- ✤ Expected number of events in each region and cross sections
- ✤ Digitized histograms (e.g., on HEPDATA)

⚠ **Essential**
✗ **Often difficult!**

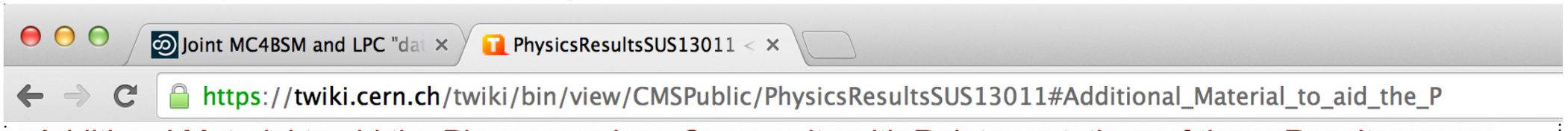
✦ Comparing tools and real life

Example 1: CMS-SUS-13-11 (stops with one lepton)

✦ Missing information for the validation
- ✤ Efficiencies
- ✤ Cutflows and Monte Carlo information for given benchmarks

✅ Discussions with CMS needed

✦ All missing information was provided



Additional Material to aid the Phenomenology Community with Reinterpretations of these Results

Hide Details

Summary of yields for the $\tilde{t} \to t\tilde{\chi}_1^0$ model with $m_{\tilde{t}} = 650$ GeV and $m_{\tilde{\chi}_1^0} = 50$ GeV. No trigger efficiency or ISR reweighting is applied. In the first block of the table, the first row shows the yield after requiring at least one analysis lepton, at least 4 jets, and MET > 50 GeV. In each subsequent row, the preselection requirements are added one at a time. In the second block of the table the low-mass (LM) signal region yields are indicated. In the third block the high-mass (HM) signal region yields are indicated. The number after LM or HM indicates the MET requirement. The latter results may be compared to the signal yields in Table 4 of http://arxiv.org/pdf/1308.1586.pdf but they are slightly higher ($\sim 10-20\%$) because the trigger and ISR weights are not applied. All uncertainties are statistical only. The bold entry indicates the signal region with the best sensitivity, i.e., the signal region used for limit-setting.

$\ell + \geq 4$ jets + MET>50	31.6 ± 0.3
+ MET>100	29.7 ± 0.3

✅ Update of the analysis wiki page
✅ Shared LHE files and PYTHIA cards

Additional Table 1: Cut flow table for the t̃ → tχ̃0 decay mode, mstop=650 GeV, mLSP=50 GeV.

Example 2: ATLAS-EXO-2014-04 (monophotons)

✦ Missing information

✤ Crack in the detector: no photons in the [1.37-1.52] η-range

✤ Tight photon requirements

✅ Discussions with ATLAS needed

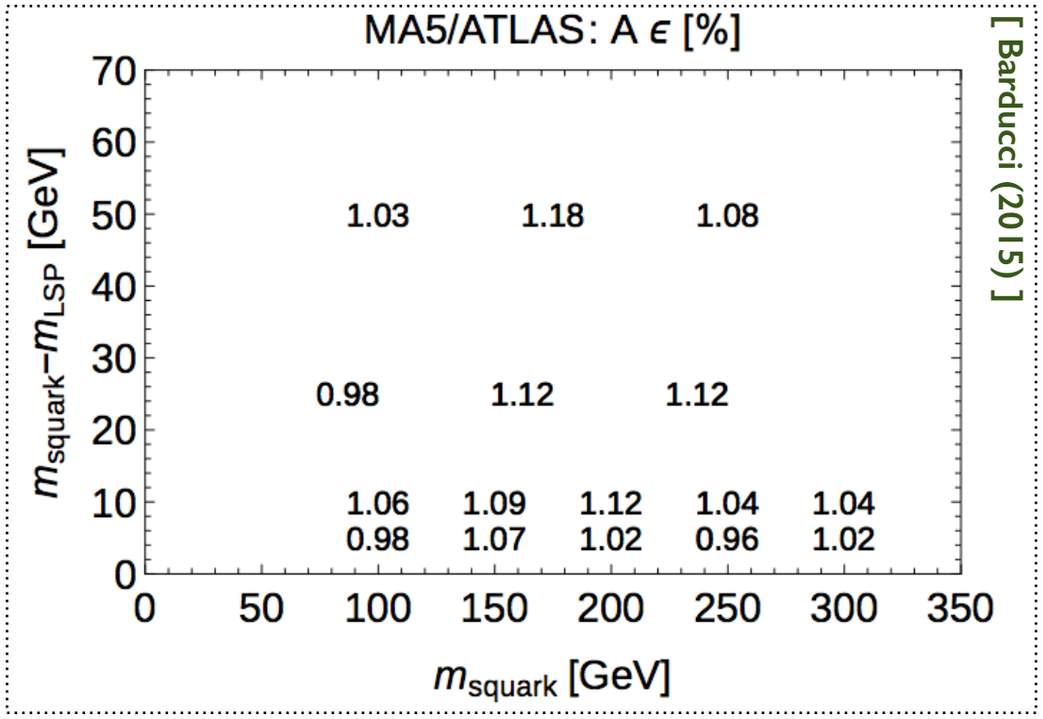
✅ In ATLAS-COM-PHYS-2014-542

✦ Event generation for the test benchmarks

✤ Monte Carlo information (cards, tunes, *etc.*)

✅ Kindly provided by ATLAS

Very good results
(ratio of efficiencies)

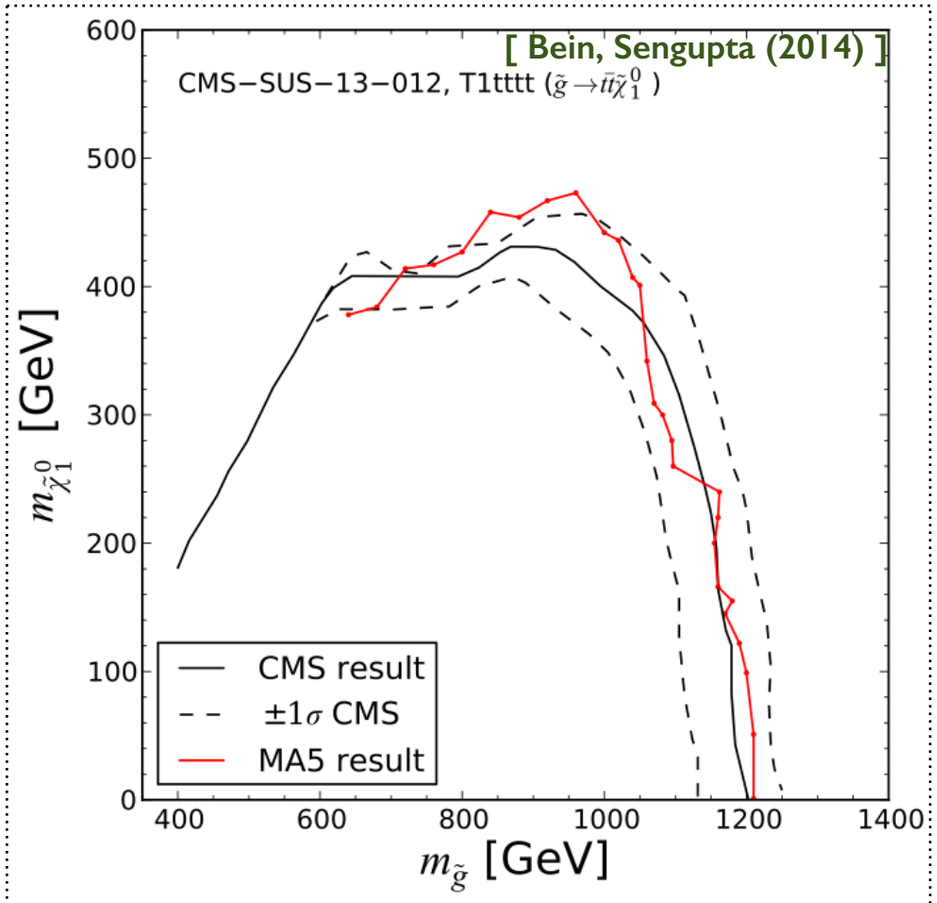


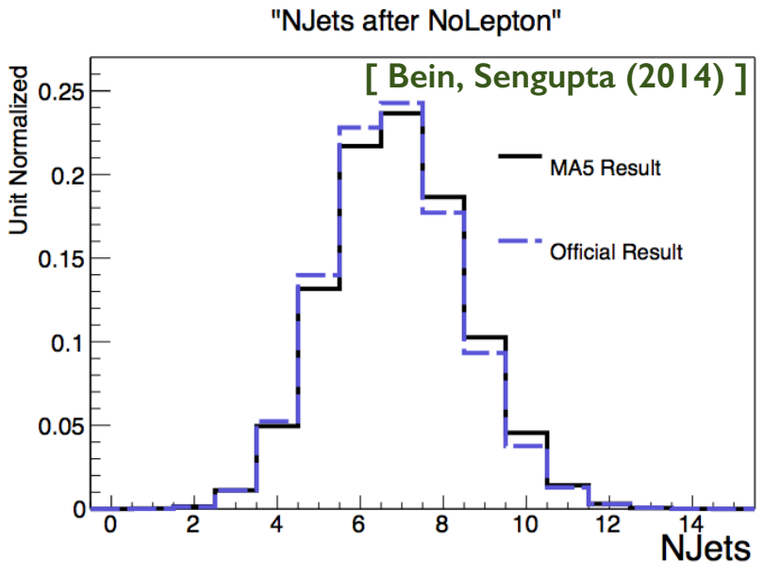
Example 3: CMS-SUS-13-12 (susy with jets and MET)

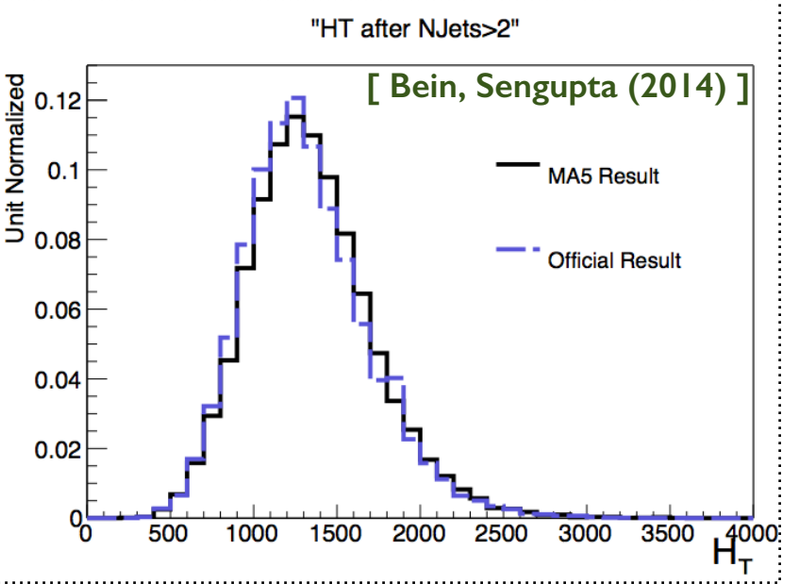
✦ Implementation by a CMS person who took part to the CMS analysis

✅ **Easy implementation & validation**

Very good results







Better limits: need for the statistical model used by CMS to combine all 36 signal regions

Example 4: When things are borderline… (1/2)

✦ Large differences are found

✤ ATLAS-CONF-2013-047 (multijet + missing energy)

★ Large differences for one or two signal regions (out of 8)

★ The reinterpretation cannot be totally wrong as 6 regions are fine

★ Issues related to the jets (smearing, Monte Carlo details)

⚠ **Monte Carlo info is desirable**

⚠ **Jet smearing info is desirable**

#	Cut Name	ϵ_{ATLAS}	ϵ_{Atom} ± Stat	$\epsilon_{Atom}/\epsilon_{ATLAS}$
1	base: pTj1 > 130	100.	100. ±	
2	base: pTj2 > 60	99.37	99.94 ± 1.44	1.01
3	pTj3 > 60	79.02	95.88 ± 1.41	1.21
4	B base: dphi_min_23 > 0.4	69.1	79.96 ± 1.28	1.16
5	BT: MET/meff_3j > 0.4	33.19	26.14 ± 0.73	0.79
6	BT: meff_inc > 1800	23.8	19.09 ± 0.63	0.8

#	Cut Name	ϵ_{ATLAS}	ϵ_{Atom} ± Stat	$\epsilon_{Atom}/\epsilon_{ATLAS}$
1	base: pTj1 > 130	100.	100. ±	
2	base: pTj2 > 60	94.5	93.96 ± 1.08	0.99
3	pTj3 > 60	44.12	35.26 ± 0.66	0.8
4	pTj4 > 60	14.38	8.87 ± 0.33	0.62
5	C base: dphi_min_23 > 0.4	12.62	7.82 ± 0.31	0.62
6	C base: dphi_min_inc > 0.2	11.63	7.39 ± 0.3	0.64
7	CM: MET/meff_4j > 0.25	9.	5.86 ± 0.27	0.65
8	CM: meff_inc > 1200	3.75	2.55 ± 0.18	0.68

Example 5: When things are borderline… (2/2)

- ATLAS-EXOT-2014-04 (monophotons)
  - Effects non-reproducible with DELPHES (cleaning cuts, triggers, good vertexing)
- ATLAS-SUS-2013-09 (stops in the dilepton channel)
  - Information on effects non-reproducible with DELPHES lost (student has quit physics)

⚠ **Efficiencies computed by hand**
Maybe model-dependent

Very good results
(for a SUSY benchmark)

Signal region	H160: 2 b-jets, 2 SF leptons	
Process	$\tilde{t} \to b\tilde{\chi}_1^{\pm} \to bW^{(*)}\tilde{\chi}_1^0$	
Point	$m(\tilde{t}) = 300$ GeV, $m(\tilde{\chi}_1^{\pm}) = 150$ GeV, $m(\tilde{\chi}_1^0) = 50$ GeV	
Source	ATLAS	CheckMATE
Generated events	157106.0	50000.0
Total Events	157106 ± 0	-
Generator Filter*	100000 ± 190	-
Cleaning Cuts*	990930 ± 0	-
Trigger*	49660 ± 180	-
Two 10 GeV SF leptons	3668.1 ± 60	3670 ± 18
Isolation	2844.6 ± 53	3270 ± 18
opposite sign	2805.2 ± 52	3270 ± 18
$m_{\ell\ell} > 20$ GeV	2744.7 ± 52	3150 ± 18
Trigger lepton p_T requirements	2613.5 ± 51	2980 ± 18
2 b-jets	1074.1 ± 33	1190 ± 13
$m_{T2}^{\text{b-jet}} \geq 160$ GeV	151.9 ± 12	182 ± 5.4
$m_{T2} \leq 90$ GeV	147.6 ± 12	175 ± 5.3
leading lepton $p_T < 60$ GeV	75.3 ± 8.7	60.3 ± 3.1

? [Kim (2015)]

Example 6: some of the not so good guys…

✦ Missing or incomplete validation information

✤ CMS-SUS-12-028 (α_T)

★ No cutflows; no answers from CMS to requests

❌ Dead end!

✤ CMS-SUS-13-007 (1 lepton+b-jets+met)

★ Semi-official validation material provided (that cannot be used in the public validation)

★ No cutflows

★ Messy definition of the benchmark points

⚠️ We'll do our best…

✦ Missing or incomplete analysis information

⚠️ Too vague!

✤ ATLAS-EXOT-2013-10 (monolepton)

★ The average trigger efficiency is 80%–90% in the muon channel"

★ 80% of the muons are reconstructed with most of the loss coming from…

★ No precise information on signal event generation

★ No signal distributions on HEPDATA

Unfortunately: many more examples!

The wishlist - part I

✦ Analysis description

✤ Clear description of the selections, including their sequence
- ★ A tabulated form would be appreciable (possibly on the analysis wiki pages)

✤ Efficiencies for physics (electrons, muons, jets, taus, b-tagging, mistagging rates, *etc.*)
- ★ Including p_T and η dependence
- ★ Or a reference with the information

✤ Efficiencies for triggers, event cleaning, *etc.*
- ★ Effects that cannot be modeled in our fast simulation

✤ Digitized figures
- ★ Missing in particular the performance results (reading off log-scale histograms…)
- ★ ROOT format, text format, *etc.*

✤ Special variables (*e.g.*, the CMS razor)
- ★ Providing snippets of code would be highly appreciated
- ★ Some variables have different definitions in different analyses (*e.g.*, asymmetric M_{T2})

The wishlist - part 2

✦ Validation material ➢ quality of the reinterpretation

✤ Benchmark scenarios
- ★ Spectra and decay tables (under an SLHA-form)
- ★ Several scenarios are appreciable
- ★ Publicly available on the wiki pages or HEPDATA

✤ Monte Carlo tools configuration
- ★ Cards, tunes, merging information, *etc*.
- ★ Better, the CMS way: LHE files with shower inputs (no new source of discrepancies)
- ★ Publicly available on the wiki pages or HEPDATA

✤ Detailed cutflows for the benchmarks, with the correct selection ordering
- ★ Including each step of the (pre)selection
- ★ For several benchmarks
- ★ The more steps are available, the better (even the preselection, the cleaning, *etc*.)
  (pin-down the differences in our machinery, in the fastsim *vs*. CMS-ATLAS simulation)

✤ Kinematical distributions at different steps of the selection
- ★ Extra cross-check of our machinery

The wishlist: summary

✦ Analysis description

- ✤ Clear description of the selections, including their sequence
- ✤ Efficiencies for physics
- ✤ Efficiencies for triggers, event cleaning, *etc.*
- ✤ Digitized figures
- ✤ Special variables

✦ Validation material

- ✤ Benchmark scenarios
- ✤ Monte Carlo tools configuration
- ✤ Detailed cutflows
- ✤ Kinematical distributions

Reproducibility is the ability of an entire experiment
to be reproduced, possibly by an independent (pheno) study