VALIDATION OF RECASTED ANALYSIS AND WRITE-UP OF THE VALIDATION NOTE

Guillaume CHALONS

LPT Orsay

MA5 workshop on LHC recatsing KOREA

OUTLINE

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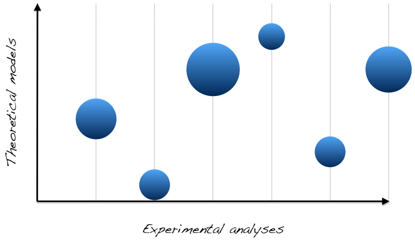
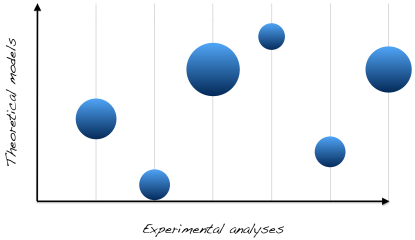
☞ Only specific/constrained models



RATIONALE FOR PUBLIC ANALYSIS VALIDATION

- ☞ Only specific/constrained models
- ☞ # Theo. Models. $\gg$ # Exp. Analyses



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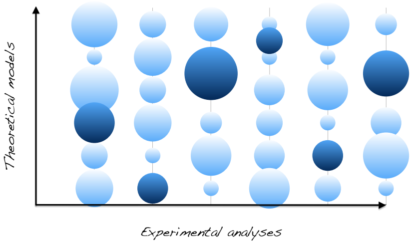
- Constrain any model not covered with already existing analyses



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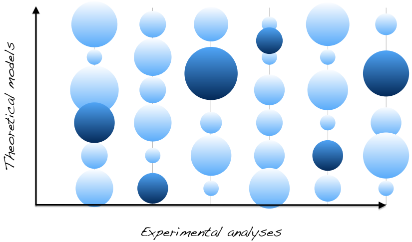
- Constrain any model not covered with already existing analyses
- Huge manpower and ressources



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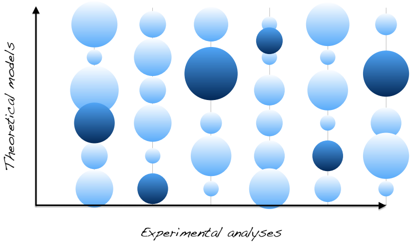

Theorists must step in to fill the gaps ⇒ **RECASTING**

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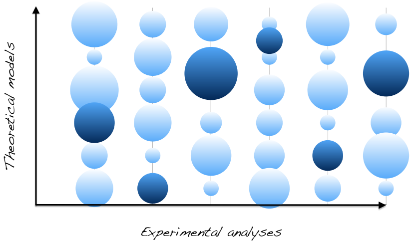

Theorists must step in to fill the gaps $\Rightarrow$ **RECASTING**

Experiment $\Longleftrightarrow$ Theory

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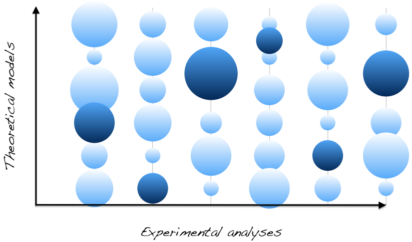

Theorists must step in to fill the gaps ⇒ **RECASTING**

Experiment ⟺ Theory

- Improve the documentation
- Preserve the data
- Identify coverage of the existing analyses
- Elaborate new search strategies

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- LHC data is collected with significant human and financial effort
- Exploit the full potential of the LHC (test as many ideas as possible)

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CASE FOR ACCURATE VALIDATION NOTES

- LHC data is collected with significant human and financial effort
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- Some analyses are very complex
- Large turnover in the young HEP community
- Some crucial information may be lost

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- HEP evolves fast
- In the pheno community softwares are regularly updated
- Also new tools appear which may replace the older ones (also new programming languages, ...)

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Validation note helps to keep track of all the necessary details to maintain the usefulness of the analyses and their further use

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Choose the analysis which is relevant for your physics purpose

RECASTING

1) Read & understand the experimental paper
2) Write the C++ analysis code
3) Get missing info from collab
   - Efficiencies (trigger, leptons, b-tagging, JES): crucial for preselection!
   - MC config
   - benchmark points
   - cutflows
   - Exp. final # events in each SR and XS
4) Digitize histograms (if not on HEPData, Twiki)
5) Produce your own cutflows/histos, compare with official ones,discuss with collab., iterate until reasonable agreement
6) **Write the validation note and submit your analysis code + note to the PAD database**

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OUTLINE

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From now on and in the following I assume the analysis has been implemented and can be executed w/o errors

- Go to the website of the analysis (from the ATLAS/CMS Twiki's)

Search for pair-produced third-generation squarks decaying via charm quarks or in compressed supersymmetric scenarios in pp collisions at $\sqrt{s}$ = 8 TeV with the ATLAS detector.

Phys. Rev. D. 90, 052008 (2014)

1 July 2014

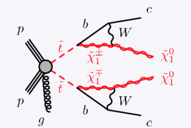
Contact: ATLAS Supersymmetry conveners

Content	Preview
e-print arXiv:1407.0608	pdf from arXiv
Inspire record	-
Data points	-
Figures and Auxiliary Material	-

Figures

Figure 1a:
Diagrams for the pair production of top squarks with the decay modes $t_1 \to c + \chi^0{}_1$ or $t_1 \to b + ff' + \chi^0{}_1$, and the pair production of sbottom squarks with the decay mode $b_1 \to b + \chi^0{}_1$. In one case, the presence of a jet from initial-state radiation is also indicated for illustration purposes.

png (18kB), eps (7kB), pdf (5kB)



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VALIDATION STEP I: GETTING THE MATERIAL

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AAD 2014 — Search for squarks and gluinos with the ATLAS detector in final states with jets and missing transverse momentum using sqrt(s) = 8 TeV proton-proton collision data

Experiment: **CERN-LHC-ATLAS (ATLAS)**
Preprinted as **CERN-PH-EP-2014-093**
Archived as: **ARXIV:1405.7875**
Auxiliary Material: https://atlas.web.cern.ch/Atlas/GROUPS/PHYSICS/PAPERS/SUSY-2013-02/
Record in: **INSPIRE**
Record in: **CERN Document Server**
Record in: **HEPData** (new site in development)

CERN-LHC. A search for squarks and gluinos in final states containing high-pT jets, missing transverse momentum and no electrons or muons is presented. The data were recorded in 2012 by the ATLAS experiment in sqrt(s) = 8 TeV proton-proton collisions at the Large Hadron Collider, with a total integrated luminosity of 20.3 fb^{-1}. No significant excess above the Standard Model expectation is observed. Results are interpreted in a variety of simplified and specific supersymmetry-breaking models assuming that R-parity is conserved and that the lightest neutralino is the lightest supersymmetric particle. An exclusion limit at the 95% confidence level on the mass of the gluino is set at 1330 GeV for a simplified model incorporating only a gluino and the lightest neutralino. For a simplified model involving the strong production of first- and second-generation squarks, squark masses below 850 GeV (440 GeV) are excluded for a massless lightest neutralino, assuming mass degenerate (single light-flavour) squarks. In mSUGRA/CMSSM models with tan(beta) = 30, A0 = -2m0 and mu> 0, squarks and gluinos of equal mass are excluded for masses below 1700 GeV. Additional limits are set for non-universal Higgs mass models with gaugino mediation and for simplified models involving the pair production of gluinos, each decaying to a top squark and a top quark, with the top squark decaying to a charm quark and a neutralino. These limits extend the region of supersymmetric parameter space excluded by previous searches with the ATLAS detector.

Link to SLHA/ directory containing all .slha files provided by ATLAS experiment

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Table 27 (Figure 8a.) HIDE DATA or as: input, plain text, AIDA, PyROOT, YODA, ROOT, mpl, DMelt, MarcXML or YAML
Measured E_T^{miss} distribution for the C1 selection before the cut in the variable shown is applied. The data are compared to the SM predictions. For illust purposes, the distribution of two different SUSY scenarios are included.

reaction keywords: [P P --> STOP STOP X]
observable keywords: [N]

RE	P P --> STOP STOP X			
SQRT(S)	8000.0 GeV			
	Data	Background	Sig-200-125	Sig-200-195
E_T^{miss} IN GEV	Events			
150.0 – 200.0	305 +-17.0,+18.0	331.9	44.3	1.7
200.0 – 250.0	138 +-11.3,+12.3	139.0	63.4	2.3
250.0 – 300.0	87 +-9.3,+10.4	81.1	50.7	2.3
300.0 – 350.0	50 +-7.0,+8.1	54.5	36.5	4.6
350.0 – 400.0	26 +-5.1,+6.2	28.5	24.6	3.2
400.0 – 450.0	20 +-4.4,+5.5	17.5	16.0	1.9
450.0 – 500.0	8 +-2.8,+3.9	10.1	9.3	2.6
500.0 – 550.0	12 +-3.4,+4.6	8.0	4.2	0.8
550.0 – 600.0	1 +-0.8,+2.3	4.7	2.5	1.2
600.0 – 650.0	0 +-0.0,+0.0	2.1	1.8	1.4
650.0 – 700.0	1 +-0.8,+2.3	1.1	0.6	0.3
700.0 – 750.0	1 +-0.8,+2.3	1.0	0.6	0.5
750.0 – 800.0	1 +-0.8,+2.3	1.1	0.5	0.3
800.0 – 850.0	0 +-0.0,+0.0	0.2	0.1	0.0
850.0 – 900.0	1 +-0.8,+2.3	0.1	0.1	0.0

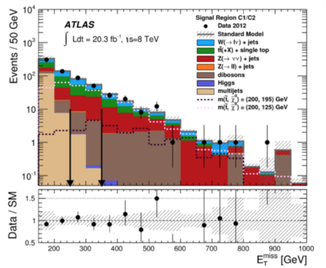

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Figure 47:
Cut flow for different stop signals for the monojet-like selection. Three different SUSY scenarios for top squark pair production with $t_1 \rightarrow c + \chi^0_1$ are presented. The number of signal events corresponds to the expectations for a total integrated luminosity of 20.3 fb_{-11}. Please note the 'All' row is after the application of a generator-level filter applying a MET>80 GeV requirement at truth level.

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SR	Cut	$m_{\tilde{t}_1}$ [GeV], $m_{\tilde{\chi}^0_1}$ [GeV] 200, 125		200, 195		250, 245	
Pre-Selection	All	181902	100%	103191	100%	48103	100%
	Preselected (E_T^{miss} > 100 GeV)	97217	53.4%	64652	62.7%	23416	48.7%
	Trigger	82686	45.5%	57948	56.2%	21149	44.0%
	Event cleaning	82514	45.4%	57849	56.1%	21115	43.9%
	Bad jet veto	82131	45.2%	57566	55.8%	21023	43.7%
	Electron veto	81961	45.1%	57487	55.7%	20994	43.6%
	Muon veto	81855	45.0%	57455	55.7%	20986	43.6%
	$N_{jets} \leq 3$	59315	32.6%	52491	50.9%	18985	39.5%
	$\Delta\phi(E_T^{miss}, \text{jets}) > 0.4$	54295	29.8%	49216	47.7%	17843	37.1%
	Leading jet cleaning	52904	29.1%	47137	45.7%	17147	35.6%
	Leading jet p_T > 150 GeV	14220	7.8%	20910	20.3%	8183	17.0%
	E_T^{miss} > 150 GeV	9468	5.2%	18297	17.7%	7290	15.2%
M1	Leading jet p_T > 280 GeV	1627	0.9%	3854	3.7%	1748	3.6%
	E_T^{miss} > 220 GeV	1276	0.7%	3722	3.6%	1694	3.5%
M2	Leading jet p_T > 340 GeV	721	0.4%	1897	1.8%	882	1.8%
	E_T^{miss} > 340 GeV	282	0.16%	1518	1.5%	736	1.5%
M3	Leading jet p_T > 450 GeV	169	0.09%	527	0.5%	279	0.6%
	E_T^{miss} > 450 GeV	64	0.035%	415	0.40%	230	0.48%

Figure 48:
Cut flow for different stop signals for the c-tagged selection. Three different SUSY scenarios for top squark pair production with $t_1 \rightarrow c + \chi^0_1$ are presented. The number of signal events corresponds to the expectations for a total integrated luminosity of 20.3 fb_{-11}. Please note the 'All' row is after the application of a generator-level filter applying a MET>80 GeV requirement at truth level.

png 330kB, eps 1789kB, pdf 64kB

SR	Cut	$m_{\tilde{t}_1}$ [GeV], $m_{\tilde{\chi}^0_1}$ [GeV] 200, 125		200, 195		250, 245	
Pre-Selection	All	181902	100%	103191	100%	48103	100%
	Trigger	123479	67.9%	74486	72.2%	38851	80.8%
	Primary Vertex	123420	67.8%	74456	72.2%	38837	80.7%
	Electron veto	123200	67.7%	74390	72.1%	38802	80.7%
	Muon veto	123128	67.7%	74372	72.1%	38789	80.6%
	Bad jet veto	123077	67.7%	74331	72%	38765	80.6%
	Njets ≥ 2	61280	33.7%	16042	15.5%	10579	22%
	$\Delta\phi(E_T^{miss}, \text{jets}) > 0.4$	49911	27.4%	13711	13.3%	9131	19%
	E_T^{miss} > 150 GeV	18603	10.2%	8602	8.34%	7340	15.3%
	Leading jet p_T > 150 GeV	9866	5.42%	4769	4.62%	4790	9.96%
Tagging	N loose tags = 4	4420	2.43%	1445	1.4%	1534	3.19%
	N medium tags ≥ 1	1355	0.745%	87	0.084%	88	0.18%
	Leading jet p_T > 290 GeV	324	0.178%	22	0.022%	31	0.064%
C1	E_T^{miss} > 250 GeV	189	0.104%	20	0.019%	28	0.058%
C2	E_T^{miss} > 350 GeV	74	0.041%	12	0.012%	22	0.046%

ATLAS EXPERIMENT

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From now on and in the following I assume the analysis has been implemented and can be executed w/o errors

- Go to the website of the analysis (from the ATLAS/CMS Twiki's)

Figure 9a:
Exclusion plane at 95% CL as a function of stop and neutralino masses from the monojet-like analysis. The observed (red line) and expected (blue line) upper limits from this analysis are compared to previous results from Tevatron experiments, and from LEP experiments at CERN with squark mixing angle $\theta=0^{o}$. The dotted lines around the observed limit indicate the range of observed limits corresponding to $\pm 1\sigma$ variations on the NLO SUSY cross section predictions. The shaded area around the expected limit indicates the expected $\pm 1\sigma$ ranges of limits in the absence of a signal. A band for $m_{t_1} - m_{\chi^0_1} < 2$ GeV indicates the region in the phase space for which the stop can become long-lived. The labels M1-M3 on the left figure indicate which of the monojet-like selections gives the best 95% CL expected limit in each point of the stop-neutralino plane.

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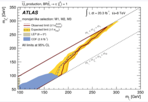

Figure 9b:
Exclusion plane at 95% CL as a function of stop and neutralino masses from the c-tagged analysis. The observed (red line) and expected (blue line) upper limits from this analysis are compared to previous results from Tevatron experiments, and from LEP experiments at CERN with squark mixing angle $\theta=0^{o}$. The dotted lines around the observed limit indicate the range of observed limits corresponding to $\pm 1\sigma$ variations on the NLO SUSY cross section predictions. The shaded area around the expected limit indicates the expected $\pm 1\sigma$ ranges of limits in the absence of a signal. A band for $m_{t_1} - m_{\chi^0_1} < 2$ GeV indicates the region in the phase space for which the stop can become long-lived. The labels C1-C2 on the left figure indicate which of the c-tagged selections gives the best 95% CL expected limit in each point of the stop-neutralino plane.

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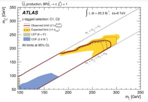

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VALIDATION STEP I: GETTING THE MATERIAL

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- Go to the website of the analysis (from the ATLAS/CMS Twiki's)

- If validation material is missing, **contact** the respective conveners *ASAP*
- In passing, also ask for details about the MC configuration for generating the signal
  - Best: LHE files or equivalent
  - If not given, MC version and settings
  - SLHA files (parameters, particle spectrum) if present
  - If generated with MadGraph: MadGraph cards
  - ...

See Dipan's Lecture for more details about histograms

- For histograms, make sure you have all declared them in the `Initialize function`

```
  //Declaration of Histograms
  Manager()->AddHisto("MET presel",17.,150.,1000.); // figaux_09
//   Manager()->AddHisto("MET > 80 GeV",20.,0.,1020.); // figaux_01a
//   Manager()->AddHisto("MET > 80 + pT(jet1) > 290 GeV",20.,0,1020.); // figaux_01b

  Manager()->AddHisto("NJets",5.,-0.5,4.5,"M1"); //figaux_08a
  Manager()->AddHisto("j1 eta",20.,-5.0,5.0,"M1"); // figaux_08b
  Manager()->AddHisto("DeltaPhi(MET,jet1)",25.,0.0,3.2,"M1"); // figaux_08c
```

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VALIDATION STEP II: MODIFYING YOUR ANALYSIS CODE

See Dipan's Lecture for more details about histograms

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  Manager()->AddHisto("DeltaPhi(MET,jet1)",25.,0.0,3.2,"M1"); // figaux_08c
```

- Make sure you fill them at the right moment

```
   if(!Manager()->ApplyCut((SignalJets[0]->pt() > 150),"Leading jet pT > 150 GeV"))
   return true;

   if(!Manager()->ApplyCut((MET > 150),"MET > 150 GeV"))
   return true;

   Manager()->FillHisto("MET presel",MET);
// Signal Region specific cuts
// SRM1
if(!Manager()->ApplyCut((SignalJets[0]->pt() > 280),"pT(j1) > 280 GeV"))
   return true;
```

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  Manager()->AddHisto("DeltaPhi(MET,jet1)",25.,0.0,3.2,"M1"); // figaux_08c
```

- Make sure you fill them at the right moment

- Sometimes you may also have to change the order of the cuts to reproduce the cutflows (or even add new ones)

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VALIDATION STEP III: GENERATING THE SIGNAL SAMPLES

- To validate your analysis you must first reproduce the official cutflows, distributions and maybe also exclusion limit plots
- For the first two, they were realized for specific benchmark points

- Most optimistic case: generated signal sample is available, you just need to run it through `DELPHES` and your `MA5` analysis on it.
- More probable: you have to generate it by yourself. It is crucial you use **as much as possible** the very same MC configuration (cards, tunes,SLHA spectra)
- Contact the conveners of the respective Physics group to get the needed missing information
- If information obtained not using the official channels, cannot appear in the public validation.

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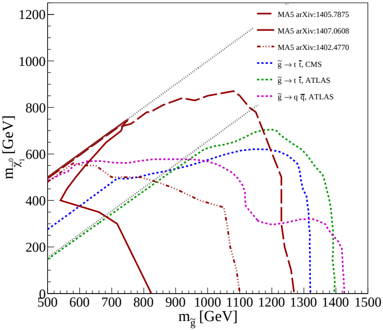
MA5 arXiv:1405.7875
MA5 arXiv:1407.0608
MA5 arXiv:1402.4770
g̃ → t t̄, CMS
g̃ → t t̄, ATLAS
g̃ → q q̄, ATLAS
m_χ̃⁰₁ [GeV]
m_g̃ [GeV]
0
200
400
600
800
1000
1200
500
600
700
800
900
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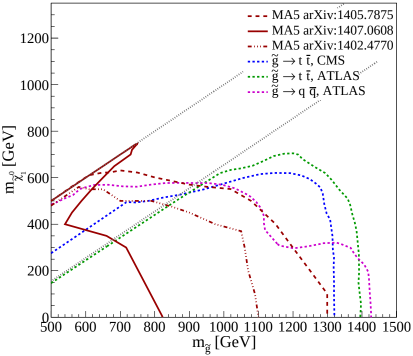
1100
1200
1300
1400
1500


MA5 arXiv:1405.7875
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MA5 arXiv:1402.4770
g̃ → t t̄, CMS
g̃ → t t̄, ATLAS
g̃ → q q̄, ATLAS
m_χ̃⁰₁ [GeV]
m_g̃ [GeV]
0
200
400
600
800
1000
1200
500
600
700
800
900
1000
1100
1200
1300
1400
1500

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- To reproduce accurately the detector response, one has to make sure that DELPHES is correctly tuned
  - Leptons efficiencies
  - $b/c/\tau$-tagging
  - ...
- One has to look also not only on the physics groups but also the performance groups results.
- Some of the detector tunings can be done directly at the MA5 level and/or at the DELPHES level. First solution, if possible, to be preferred (save CPU time)

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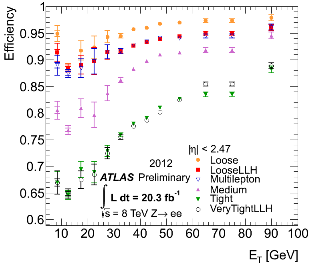

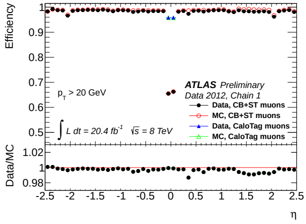

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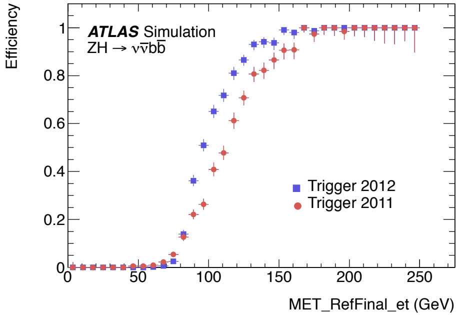
VALIDATION STEP IV: TUNING THE DETECTOR

- To reproduce accurately the detector response, one has to make sure that DELPHES is correctly tuned
  - Leptons efficiencies
  - $b/c/\tau$-tagging
  - ...
- One has to look also not only on the physics groups but also the performance groups results.
- Some of the detector tunings can be done directly at the MA5 level and/or at the DELPHES level. First solution, if possible, to be preferred (save CPU time)

```
#####################
# Electron efficiency
#####################

module Efficiency ElectronEfficiency {
  set InputArray ElectronEnergySmearing/electrons
  set OutputArray electrons

  # set EfficiencyFormula {efficiency formula as a function of eta and pt}

  # efficiency formula for "medium" electrons
  set EfficiencyFormula {                                            (pt <= 7.0) * (0.000)             + \
       (abs(eta) <= 2.47)                   *  (pt > 7.0 && pt <= 25.0) * (0.800)              + \
       (abs(eta) <= 2.47)                   * (pt > 25.0 && pt <= 50.0) * (0.670 + pt*4.8e-3) + \
       (abs(eta) <= 2.47)                   * (pt > 50.0 && pt <= 75.0) * (0.910)              + \
       (abs(eta) <= 2.47)                   * (pt > 75.0 && pt <= 90.0) * (0.810 + pt*1.5e-3) + \
       (abs(eta) <= 2.47)                   *                (pt > 90) * (0.945)              + \
       (abs(eta) > 2.47)                                                * (0.000)}
}
```

VALIDATION STEP IV: TUNING THE DETECTOR

- To reproduce accurately the detector response, one has to make sure that DELPHES is correctly tuned
  - Leptons efficiencies
  - $b/c/\tau$-tagging
  - ...
- One has to look also not only on the physics groups but also the performance groups results.
- Some of the detector tunings can be done directly at the MA5 level and/or at the DELPHES level. First solution, if possible, to be preferred (save CPU time)



- To reproduce accurately the detector response, one has to make sure that DELPHES is correctly tuned
  - Leptons efficiencies
  - $b/c/\tau$-tagging
  - ...
- One has to look also not only on the physics groups but also the performance groups results.
- Some of the detector tunings can be done directly at the MA5 level and/or at the DELPHES level. First solution, if possible, to be preferred (save CPU time)

```
    double new_MET = sqrt(pow(MET_x+smear_x,2)+pow(MET_y+smear_y,2));
    pTmiss.SetPxPyPzE(MET_x+smear_x,MET_y+smear_y,0.,new_MET);
    double MET = pTmiss.Pt();
//     std::cout << " MET_old = " << MET_old << " | " << "MET_new = " << MET << std::endl;
//=========Met weight=============
if (MET<60.)  myEventWeight*=0.;
else if(MET > 60. && MET < 115.)
myEventWeight*=(-133.502 + 8.24539*MET -0.200154*pow(MET,2)   + 0.00238408*pow(MET,3) - 1.3928E-5*pow(MET,4) + 3.198
//  else myEventWeight*=1;
else if(MET > 115. && MET < 250.)
   myEventWeight*=(-11.9738 + 0.321823*MET -0.0032124*pow(MET,2)   + 1.60901E-5*pow(MET,3) - 4.03489E-8*pow(MET,4) +
else  myEventWeight*=1.;
```

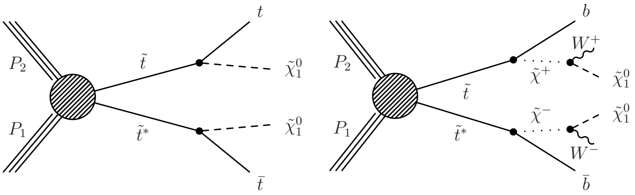
VALIDATION STEP V: GENERATE THE CUTFLOWS AND THE HISTOGRAMS

- Run your analysis within MA5 on your signal sample (in `ROOT` format)
- All information regarding the cutflow & Histograms is contained in the `.saf` file that can be found in `Analysis_name/signal_sample/Analysis_name_run/`
- At present you have to write your own script (in the expert mode) to read and produce plots and cutflows (ongoing work on a report generator)
- To compare with the official validation material take care if the number of events is rescaled (to $\sigma \times \mathcal{L}$ for example).
- Compare !
- Be critical and use your physics knowledge !
- Do not hesitate to come back to the ATLAS/CMS physics group conveners if stuck !

OUTLINE

LPT Orsay

- CMS search for $\tilde{t}$ in the $\ell + \not{E}_T$ final state pp collisions at 8 TeV with full $\mathcal{L}$.
- Targets $\tilde{t}_1 \to t\tilde{\chi}_1^0$ & $\tilde{t}_1 \to b\tilde{\chi}_1^\pm$



- Two sets of SRS defined, sensitive to each topology
- Each set further divided into "Low ΔM" & "High ΔM" and then sub-divided according to $\neq \not{E}_T$ thresholds.
- Two specific variables to reduce the dilepton $t\bar{t}$ bckg.
  - a χ^2 resulting from the full reconstruction of the had. top (straightforward: available on the `Twiki` page)
  - a variant of M_{T2}, M_{T2}^W implemented following *JHEP* **1207** (2012) 110.

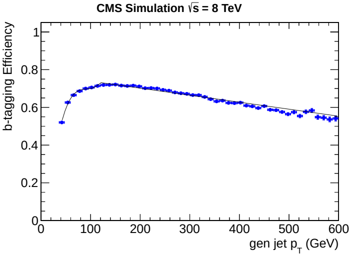
LPT Orsay

- Analysis very well documented (lots of distribution of variables available)
- Detailed trigger efficiencies and ID-only efficiencies for $e^{\pm}$ and $\mu^{\pm}$ missing but provided kindly by CMS upon request

- Approved tables and plots (*click on plot to get larger version*)
  - (pseudo) Feynman diagrams
  - Results: yields vs. background prediction, kinematical distributions of (near-)final event sample
  - Interpretation: SUSY summary plots
  - Interpretation: limits on SUSY parameters
  - Kinematical quantities used in the event selection
  - Signal Region definitions
  - Sample BDT outputs at the preselection stage
  - Control region studies
  - Systematic uncertainties on the background prediction
  - Additional MT and BDT output distributions
  - Monte Carlo modeling of initial state radiation
  - Signal Regions used for limit extraction
  - Acceptance maps, not in paper
  - Additional plots, not in paper
- Code
- Electronic material
- Additional Material to aid the Phenomenology Community with Reinterpretations of these Results

LPT Orsay

- Analysis very well documented (lots of distribution of variables available)
- Detailed trigger efficiencies and ID-only efficiencies for $e^\pm$ and $\mu^\pm$ missing but provided kindly by CMS upon request



Parameter	Value
A	$(1.55 \pm 0.05) \times 10^{-6}$
B	$(-4.26 \pm 0.12) \times 10^{-4}$
C	0.0391 ± 0.0008
D	-0.496 ± 0.020
E	$(-3.26 \pm 0.01) \times 10^{-4}$
F	0.7681 ± 0.0016

$$Fit = Ax^3 + Bx^2 + Cx + D \text{ for } p_T < 120 \text{ GeV, linear } Ex + F \text{ above}$$

- b-tagging efficiency in function of p_T missing but taken from *JHEP* **1401** (2014) 163
- Analysis isolation criteria difficult: relies on so-called PF particles p_T in a cone of given size ΔR.
- Only tracks from the inner detector used for isolation

CMS-SUS-13-011: CUTFLOWS

- Use of the 11 benchmark points in the physics paper (7 "T2bW" & 4 "T2tt")
- LHE files (partonic event samples) provided by CMS (extremely useful)
- Passed through PYTHIA6 & modified DELPHES 3 (no MC generation)

benchmark point	CMS result	MA 5 result
$\tilde{t} \to b\tilde{\chi}_1^{\pm}$, low ΔM, $E_T^{\rm miss} > 150$ GeV		
(250/50/0.5)	157 ± 9.9	193.7
(250/50/0.75)	399 ± 18	533.1
$\tilde{t} \to b\tilde{\chi}_1^{\pm}$, high ΔM, $E_T^{\rm miss} > 150$ GeV		
(450/50/0.25)	23 ± 2.3	27.5
$\tilde{t} \to b\tilde{\chi}_1^{\pm}$, high ΔM, $E_T^{\rm miss} > 250$ GeV		
(600/100/0.5)	6.1 ± 0.5	6.0
(650/50/0.5)	6.7 ± 0.4	6.6
(650/50/0.75)	6.3 ± 0.4	6.2

benchmark point	CMS result	MA 5 result
$\tilde{t} \to t\tilde{\chi}_1^0$, low ΔM, $E_T^{\rm miss} > 150$ GeV		
(250/50)	108 ± 3.7	131.7
$\tilde{t} \to t\tilde{\chi}_1^0$, high ΔM, $E_T^{\rm miss} > 300$ GeV		
(650/50)	3.7 ± 0.1	4.5

- $m_{\tilde{\chi}_1^+} = x \cdot m_{\tilde{t}_1} + (1-x) m_{\tilde{\chi}_1^0}$.

Very good agreement for $m_{\tilde{t}_1} > 600$ GeV, discrepancies of 20-30% for lighter $\tilde{t}_1$ low ΔM

- Upon our request the CMS SUSY group provided additional tables

LPT Orsay

- Use of the 11 benchmark points in the physics paper (7 "T2bW" & 4 "T2tt")
- LHE files (partonic event samples) provided by CMS (extremely useful)
- Passed through PYTHIA6 & modified DELPHES 3 (no MC generation)

↓ Monte Carlo modeling of initial state radiation
↓ Signal Regions used for limit extraction
↓ Acceptance maps, not in paper
↓ Additional plots, not in paper
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- LHE files (partonic event samples) provided by CMS (extremely useful)
- Passed through PYTHIA6 & modified DELPHES 3 (no MC generation)

cut	$m_{\tilde{t}_1} = 650$ GeV CMS	$m_{\tilde{t}_1} = 650$ GeV MA 5	$m_{\tilde{t}_1} = 250$ GeV CMS	$m_{\tilde{t}_1} = 250$ GeV MA 5
$1\ell + \geq 4\text{jets} + \not{E}_T > 50$	31.6 ± 0.3	33.3	8033.0 ± 38.7	8871.4
$+ \not{E}_T > 100$ GeV	29.7 ± 0.3	31.4	4059.2 ± 27.5	4634.5
$+ n_b \geq 1$	25.2 ± 0.2	27.1	3380.1 ± 25.1	3930.5
+ iso-track veto	21.0 ± 0.2	22.5	2770.0 ± 22.7	3229.9
+ tau veto	20.6 ± 0.2	22.0	2683.1 ± 22.4	3153.5
$+ \Delta\phi_{\min} > 0.8$	17.8 ± 0.2	18.9	2019.1 ± 19.4	2509.4
+ hadronic $\chi^2 < 5$	11.9 ± 0.2	12.7	1375.9 ± 16.0	1553.1
$+ M_T > 120$ GeV	9.6 ± 0.1	10.4	355.1 ± 8.1	406.8
high ΔM, $\not{E}_T > 300$ GeV	4.2 ± 0.1	5.1	—	—
low ΔM, $\not{E}_T > 150$ GeV	—	—	124.0 ± 4.8	152.3

- Upon our request the CMS SUSY group provided additional tables

- For validation cutflows are valuable information
- Track step-by-step the analysis

- Use of the 11 benchmark points in the physics paper (7 "T2bW" & 4 "T2tt")
- LHE files (partonic event samples) provided by CMS (extremely useful)
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cut	$m_{\tilde{t}_1} = 650$ GeV CMS	$m_{\tilde{t}_1} = 650$ GeV MA 5	$m_{\tilde{t}_1} = 250$ GeV CMS	$m_{\tilde{t}_1} = 250$ GeV MA 5
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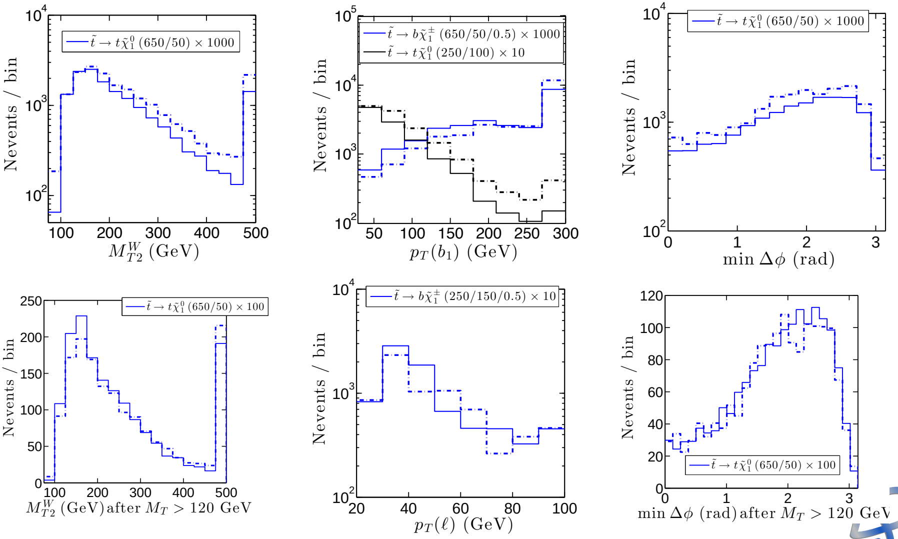
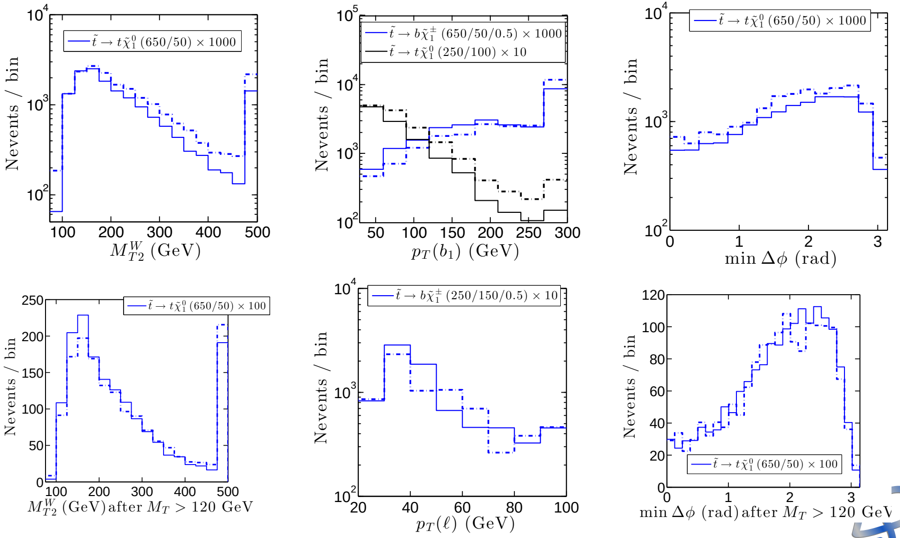
low ΔM, $\not{E}_T > 150$ GeV	—	—	124.0 ± 4.8	152.3

- Upon our request the CMS SUSY group provided additional tables

- For validation cutflows are valuable information
- Track step-by-step the analysis
- As isolation difficult → we applied a weighting factor to correct our track-only isolation method (could be model dependent)
- CMS results reproduced within 20%


$\tilde{t} \to t\tilde{\chi}_1^0$ (650/50) × 1000
Nevents / bin
M_{T2}^W (GeV)
$\tilde{t} \to b\tilde{\chi}_1^\pm$ (650/50/0.5) × 1000
$\tilde{t} \to t\tilde{\chi}_1^0$ (250/100) × 10
$p_T(b_1)$ (GeV)
$\tilde{t} \to t\tilde{\chi}_1^0$ (650/50) × 1000
min $\Delta\phi$ (rad)
$\tilde{t} \to t\tilde{\chi}_1^0$ (650/50) × 100
M_{T2}^W (GeV) after $M_T > 120$ GeV
$\tilde{t} \to b\tilde{\chi}_1^\pm$ (250/150/0.5) × 10
$p_T(\ell)$ (GeV)
$\tilde{t} \to t\tilde{\chi}_1^0$ (650/50) × 100
min $\Delta\phi$ (rad) after $M_T > 120$ GeV

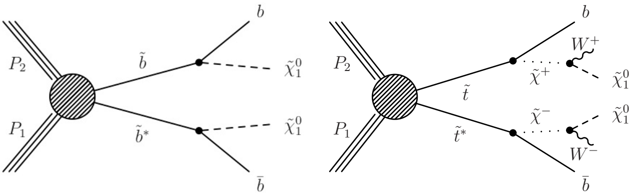
LPT Orsay



✓ Reasonable agreement for a fastsim

LPT Orsay

- Search for 3[rd] gen. squarks in the $0\ell + 2b + \not{E}_T$ final state pp collisions at 8 TeV
- Targets $\tilde{b}_1 \to b\tilde{\chi}_1^0$ & $\tilde{t}_1 \to b\tilde{\chi}_1^\pm$

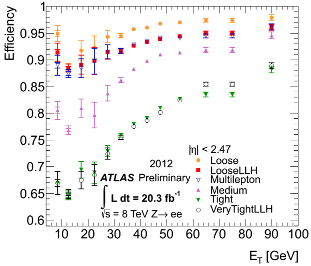


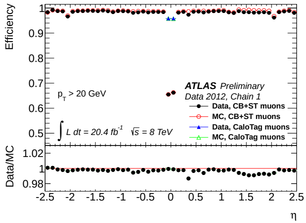
- Two SR defined
  - SRA: large mass splitting $\Delta m = m_{\tilde{\chi}_1^\pm} - m_{\tilde{\chi}_1^0}$
  - SRB: small Δm
- SRB selects a high-p_T coming from ISR to increase sensitivity for small Δm.
- Specific kin variable used: contransverse mass M_{CT} (with ISR boost factor included)

- Similarly to M_{T2}, M_{CT} designed to measure masses of pair-produced particles decaying invisibly

- Analysis very well documented for physics (CLs, $\mathcal{A} \times \varepsilon$ plots)
- Analysis less documented for reimplementation/validation purposes (only final distributions, no CF)
- M_{CT} variable implemented using code available from `http://mctlib.hepforge.org/`

- At the detector simulation level we updated the ATLAS card for the $e^{\pm}$ and $\mu^{\pm}$ efficiency





- light-jets, c-jets, τ, b-jets rejection factor taken from physics paper

- After communication with ATLAS, cutflow tables were made available

- No LHE input files were provided by the ATLAS collab.
- Simulate the signal sample through MadGraph5_v1.4.8+PYTHIA6 then passed to DELPHES modified version using generic official SLHA files

- For SRA two benchmark point are given for validation
  - $(m_{\tilde{b}_1}, m_{\tilde{\chi}_1^0}) = (500, 1)$ GeV
  - $(m_{\tilde{t}_1}, m_{\tilde{\chi}_1^\pm}, m_{\tilde{\chi}_1^0}) = (500, 105, 100)$ GeV

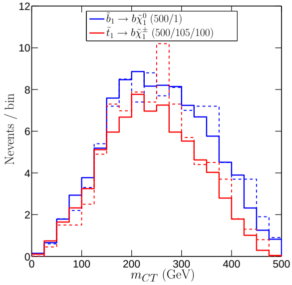
cut	$m_{\tilde{b}_1} = 500$ GeV ATLAS result	$m_{\tilde{b}_1} = 500$ GeV MA 5 result	$m_{\tilde{t}_1} = 500$ GeV ATLAS result	$m_{\tilde{t}_1} = 500$ GeV MA5 result
$E_T^{\text{miss}} > 80$ GeV filter	1606.0	1627.9	1632.0	1582.2
+ Lepton veto	1505.0	1592.6	1061.0	1140.8
+ $E_T^{\text{miss}} > 150$ GeV	1323.0	1370.3	859.0	910.8
+ Jet Selection	119.0	122.2	39.0	39.6
+ $M_{bb} > 200$ GeV	96.0	99.3	32.0	31.9
+ $M_{CT} > 150$ GeV	82.0	83.5	26.8	25.9
+ $M_{CT} > 200$ GeV	67.0	68.3	20.2	19.6
+ $M_{CT} > 250$ GeV	51.0	50.5	13.2	12.6
+ $M_{CT} > 300$ GeV	35.0	33.4	7.7	6.9

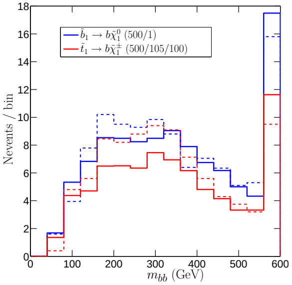
LPT Orsay

- After communication with ATLAS, cutflow tables were made available

- No LHE input files were provided by the ATLAS collab.
- Simulate the signal sample through `MadGraph5_v1.4.8+PYTHIA6` then passed to `DELPHES` modified version using generic official `SLHA` files

- For SRA two benchmark point are given for validation
  - $(m_{\tilde{b}_1}, m_{\tilde{\chi}_1^0}) = (500, 1)$ GeV
  - $(m_{\tilde{t}_1}, m_{\tilde{\chi}_1^\pm}, m_{\tilde{\chi}_1^0}) = (500, 105, 100)$ GeV





- After communication with ATLAS, cutflow tables were made available

- No LHE input files were provided by the ATLAS collab.
- Simulate the signal sample through MadGraph5_v1.4.8+PYTHIA6 then passed to DELPHES modified version using generic official SLHA files

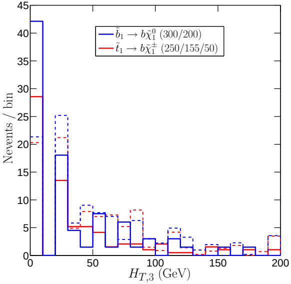
- For SRB two benchmark point are given for validation
  - $(m_{\tilde{b}_1}, m_{\tilde{\chi}_1^0}) = (300, 200)$ GeV
  - $(m_{\tilde{t}_1}, m_{\tilde{\chi}_1^\pm}, m_{\tilde{\chi}_1^0}) = (250, 155, 150)$ GeV

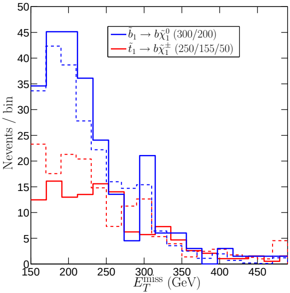
cut	$m_{\tilde{b}_1} = 350$ GeV ATLAS result	$m_{\tilde{b}_1} = 350$ GeV MA 5 result	$m_{\tilde{t}_1} = 500$ GeV ATLAS result	$m_{\tilde{t}_1} = 500$ GeV MA5 result
$E_T^{\rm miss} > 80$ GeV filter	6221.0	5990.6	1329.0	1109.9
+ Lepton veto	4069.0	4773.4	669.0	816.5
+ $E_T^{\rm miss} > 250$ GeV	798.3	790.5	93.0	102.6
+ Jet Selection	7.9	7.2	6.2	4.7
+ $H_{T,3} < 50$ GeV	5.2	6.0	3.0	3.3

- After communication with ATLAS, cutflow tables were made available

- No LHE input files were provided by the ATLAS collab.
- Simulate the signal sample through MadGraph5_v1.4.8+PYTHIA6 then passed to DELPHES modified version using generic official SLHA files

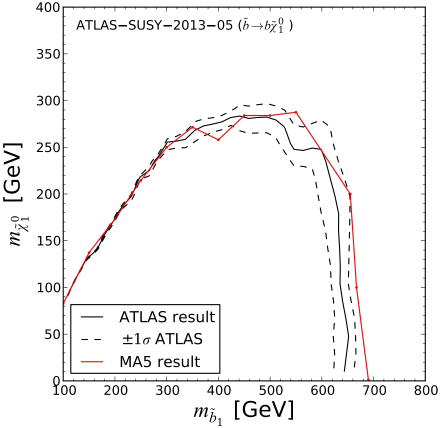
- For SRB two benchmark point are given for validation
  - $(m_{\tilde{b}_1}, m_{\tilde{\chi}_1^0}) = (300, 200)$ GeV
  - $(m_{\tilde{t}_1}, m_{\tilde{\chi}_1^\pm}, m_{\tilde{\chi}_1^0}) = (250, 155, 150)$ GeV





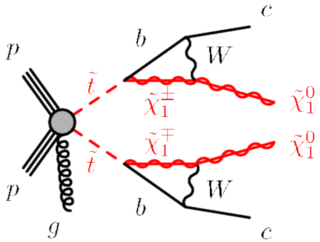
LPT Orsay

- Edit the `Analysis_name.info` file
- Need $\mathcal{L}$, definition of the SRs and for each n_{obs}, n_{bckg} and Δn_{bckg}.
- Execute the `exclusion_CLs.py` script
  `./exclusion_CLs.py analysis_name benchmark_point [run number] [cross section in pb]`



A VALIDATED ANALYSIS: ATLAS-SUSY-2013-21

- This analysis targets direct $\tilde{t}_1$ pair production in compressed spectra scenarios
- In particular it is optimised for $\tilde{t}_1 \to c + \tilde{\chi}_1^0$ using a monojet and c-tagged search strategies



- We only implemented the monojet search since
  - It can be reinterpreted in DM or other compressed spectra scenarios
  - We do not have access to the needed charm-tagging information
- SLHA cards available on HEPDATA, no run card available, provided after contact with ATLAS conveners.

cut	$\tilde{t} \longrightarrow c\tilde{\chi}_1^0$ (200/125) cutflow # events (scaled to σ and $\mathcal{L}$)	# events (official)	$\tilde{t} \longrightarrow c\tilde{\chi}_1^0$ (200/195) cutflow # events (scaled to σ and $\mathcal{L}$)	# events (official)
Initial # of events	376047.3		376047.3	
ALL		181902.0		103191.0

cut	$\tilde{t} \to c\tilde{\chi}_1^0$ (200/125) cutflow # events (scaled to σ and $\mathcal{L}$)	# events (official)	$\tilde{t} \to c\tilde{\chi}_1^0$ (200/195) cutflow # events (scaled to σ and $\mathcal{L}$)	# events (official)
Initial # of events	376047.3		376047.3	
$\not{E}_T > 80$ GeV Filter	192812.8 (-48.7%)	181902.0	104577.6 (-72.2%)	103191.0
$\not{E}_T > 100$ GeV	136257.1 (-29.3%)	97217.0	82619.0 (-21.0%)	64652.0 (-37.3%)

cut	$\tilde{t} \to c\tilde{\chi}_1^0$ (200/125) cutflow # events (scaled to σ and $\mathcal{L}$)	# events (official)	$\tilde{t} \to c\tilde{\chi}_1^0$ (200/195) cutflow # events (scaled to σ and $\mathcal{L}$)	# events (official)
Initial # of events	376047.3		376047.3	
$\not{E}_T > 80$ GeV Filter	192812.8 (-48.7%)	181902.0	104577.6 (-72.2%)	103191.0
$\not{E}_T > 100$ GeV	136257.1 (-29.3%)	97217.0	82619.0 (-21.0%)	64652.0 (-37.3%)
Trigger, ...	-	82131.0 (-15.5%)	-	57566.0 (-30.3%)

cut	$\tilde{t} \rightarrow c\tilde{\chi}_1^0$ (200/125) cutflow # events (scaled to σ and $\mathcal{L}$)	# events (official)	$\tilde{t} \rightarrow c\tilde{\chi}_1^0$ (200/195) cutflow # events (scaled to σ and $\mathcal{L}$)	# events (official)
Initial # of events	376047.3		376047.3	
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$\not{E}_T > 100$ GeV	136257.1 (−29.3%)	97217.0	82619.0 (−21.0%)	64652.0 (−37.3%)
Trigger, ...	-	82131.0 (−15.5%)	-	57566.0 (−30.3%)
Lepton veto	134894.2 (−1.0%)	81855.0 (−15.8%)	82493.9 (−0.2%)	57455.0 (−11.1%)
$N_{\rm jets} \leq 3$	101653.7 (−24.6%)	59315.0 (−27.5%)	75391.5 (−8.6%)	52491.0 (−8.6%)
$\Delta\phi(\not{E}_T, \rm jets) > 0.4$	95568.8 (−2.1%)	54295.0 (−8.5%)	70888.1 (−1.2%)	49216.0 (−6.2%)
$p_T(j_1) > 150$ GeV	17282.8 (−81.9%)	14220.0 (−73.8%)	25552.0 (−64.0%)	20910.0 (−57.5%)
$\not{E}_T > 150$ GeV	10987.8 (−36.4%)	9468.0 (−33.4%)	21569.1 (−15.6%)	18297.0(−12.5%)
M1 Signal Region				

cut	$\tilde{t} \rightarrow c\tilde{\chi}_1^0$ (200/125) cutflow # events (scaled to σ and $\mathcal{L}$)	# events (official)	$\tilde{t} \rightarrow c\tilde{\chi}_1^0$ (200/195) cutflow # events (scaled to σ and $\mathcal{L}$)	# events (official)
Initial # of events	376047.3		376047.3	
$\not{E}_T > 80$ GeV Filter	192812.8 (-48.7%)	181902.0	104577.6 (-72.2%)	103191.0
$\not{E}_T > 100$ GeV	136257.1 (-29.3%)	97217.0	82619.0 (-21.0%)	64652.0 (-37.3%)
Trigger, ...	-	82131.0 (-15.5%)	-	57566.0 (-30.3%)
Lepton veto	134894.2 (-1.0%)	81855.0 (-15.8%)	82493.9 (-0.2%)	57455.0 (-11.1%)
$N_{\rm jets} \leq 3$	101653.7 (-24.6%)	59315.0 (-27.5%)	75391.5 (-8.6%)	52491.0 (-8.6%)
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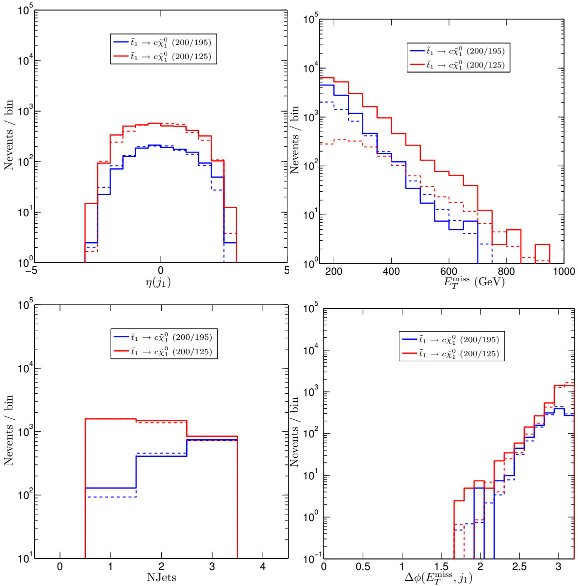
$\not{E}_T > 150$ GeV	10987.8 (-36.4%)	9468.0 (-33.4%)	21569.1 (-15.6%)	18297.0(-12.5%)
M1 Signal Region				
$p_T(j_1) > 280$ GeV	2031.2 (-81.5%)	1627.0 (-82.8%)	4922.0 (-77.2%)	3854.0 (-78.9%)
$\not{E}_T > 220$ GeV	1517.6 (-25.3%)	1276.0 (-21.6%)	4628.4 (-6.0%)	3722.0 (-3.4%)
M2 Signal Region				
$p_T(j_1) > 340$ GeV	858.0 (-92.2%)	721.0 (-92.4%)	2509.0 (-88.4%)	1897.0 (-89.6%)
$\not{E}_T > 340$ GeV	344.4 (-59.9%)	282.0 (-60.9%)	1758.9 (-29.9%)	1518.0 (-20.0%)
M3 Signal Region				
$p_T(j_1) > 450$ GeV	204.3 (-98.1%)	169.0 (-98.2%)	773.3 (-96.4%)	527.0 (-97.1%)
$\not{E}_T > 450$ GeV	61.3 (-70.0%)	64.0 (-62.1%)	476.8 (-38.3%)	415.0 (-21.3%)


$\tilde{t}_1 \to c\tilde{\chi}_1^0$ (200/195)
$\tilde{t}_1 \to c\tilde{\chi}_1^0$ (200/125)
Nevents / bin
$\eta(j_1)$
E_T^{miss} (GeV)
NJets
$\Delta\phi(E_T^{\mathrm{miss}}, j_1)$

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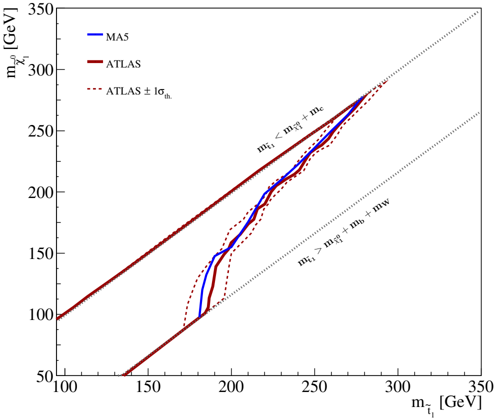
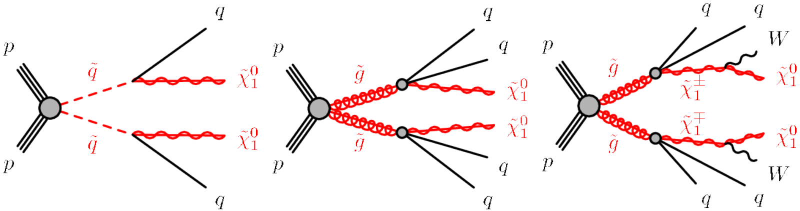


- We aim at a precision of order 20-30% on the limit setting

- Search for squarks & gluinos in final states with jets and MET.
- Targets $\tilde{q} \to q\tilde{\chi}_1^0$, $\tilde{g} \to q\bar{q}\tilde{\chi}_1^0$ & $\tilde{g} \to qq\tilde{\chi}_1^\pm \to qqW^\pm\tilde{\chi}_1^0$



- Analysis performed with $\sqrt{s} = 13$ TeV & $\mathcal{L} = 3.2\,\text{fb}^{-1}$.
- 7 inclusive SR covering $n_{\text{jets}} = 2 - 6$ with $p_T > 50$ GeV.and MET > 200 GeV.

- Aplanarity variable (event shape variable) implemented thanks to communication with ATLAS
- 3 benchmarks provided by ATLAS after contacting them
- Long communication with ATLAS to properly match the generated signal sample and its hadronization with PYTHIA8.
- Some selection criteria on jets ignored with respect to the official analysis which have a negligible impact on the # of events.

- For each cut, the relative efficiency is computed as

$$\epsilon_i = \frac{n_i}{n_{i-1}}$$

Selections	benchmark # 1		benchmark # 2		benchmark # 3	
	MA5	Official	MA5	Official	MA5	Official
Preselection, $E_T^{\rm miss} > 200$ GeV, $p_T(\text{jet}_1) > 200$ GeV	0.92	0.90	0.63	0.58	0.86	0.85
Jet multiplicity	1.00	1.00	1.00	1.00	0.98	0.99
$\min\Delta\phi(E_T^{\rm miss}, \text{jet})$ cut	0.61	0.61	0.71	0.71	0.79	0.79
$p_T(\text{jet}_2)$ cut	0.99	0.99	0.49	0.52	0.76	0.75
$E_T^{\rm miss}/\sqrt{H_T}$ cut	0.31	0.31	0.11	0.11	0.39	0.40
$m_{\rm eff}$(incl.) cut	0.96	0.96	0.21	0.20	0.21	0.19

TABLE III: Cut flows, expressed in terms of efficiencies, for three signal samples in signal region `SR2jt`.

Selections	benchmark # 1		benchmark # 2		benchmark # 3	
	MA5	Official	MA5	Official	MA5	Official
Preselection, $E_T^{\rm miss} > 200$ GeV, $p_T(\text{jet}_1) > 200$ GeV	0.92	0.90	0.63	0.58	0.86	0.85
Jet multiplicity	0.95	0.95	0.76	0.79	0.36	0.35
$\min\Delta\phi(E_T^{\rm miss}, \text{jet})$ cut	0.69	0.70	0.78	0.78	0.82	0.81
$p_T(\text{jet}_2)$ cut	1.00	1.00	0.98	0.98	0.99	0.98
$p_T(\text{jet}_4)$ cut	0.88	0.88	0.44	0.43	0.37	0.36
Aplanarity cut	0.68	0.68	0.67	0.68	0.60	0.57
$E_T^{\rm miss}/m_{\rm eff}(\text{Nj})$ cut	0.71	0.71	0.95	0.93	0.86	0.89
$m_{\rm eff}$(incl.) cut	0.85	0.85	0.04	0.04	0.25	0.23

TABLE IV: Cut flows, expressed in terms of efficiencies, for three signal samples in signal region `SR4jt`.

- Agreement better than 80% for all cuts and signal regions

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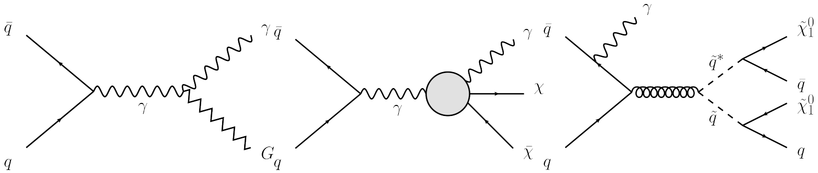
- Search for NP in events with a photon and MET
- Targets DM, X-DIM, SUSY



- Analysis performed with $\sqrt{s} = 8$ TeV & $\mathcal{L} = 20.3\,\text{fb}^{-1}$.
- Analysis looks for one isolated hard photon with $p_T > 125$ GeV, MET > 150 GeV, no leptons and not more than one jet.

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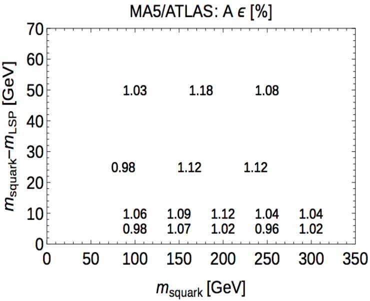
ATLAS-EXOT-2014-06: VALIDATION

- Already provided by ATLAS
  - a cutflow for one benchmark
  - Acceptance, Efficiencies & production XS for more benchmarks
- MC production cards provided after contact with ATLAS.

- In addition a crack in the detector has been implemented for $1.37 < |\eta_\gamma| < 1.52$ which makes photons undetectable (after discussion with ATLAS)
- Effect not reproducible with fast sim (good vertex and cleaning cuts) by applying a scaling on the # of events
- Scaling factor to account the efficiency reconstruction for a tight photon with $p_T > 125$ GeV (discussion with ATLAS which pointed to a performance paper).

Cut	ATLAS	Rel. decr.	MA5 (u1 u1~)	Rel. decr.
Nominal	9989		9989	
a. Trigger	8582			
b. Good Vertex	8574			
c. Cleaning cuts	8213			
0. $E_T^{miss} > 150$ GeV	4131		4384	
1. 1 loose γ, $p_T > 125$ GeV, $\|\eta\| < 2.37$	2645	−36.0	2637	−39.8
2. Tight leading γ with $\|\eta\| < 1.37$	2068	−21.8	2052	−22.2
3. Isolated leading γ	1898	−8.2	1856	−9.6
4. $\Delta\phi(\gamma^{leading}, E_T^{miss}) > 0.4$	1887	−0.6	1840	−0.8
5. $N_{jet} \leq 1$ and $\Delta\phi(jet, E_T^{miss}) > 0.4$	1219	−35.4	1234	−33.0
6. Lepton veto	1188	−2.5	1233	−0.1



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- In the previous examples, the validation was successul (*i.e* a reasonable agreement was found)
- However, sometimes it is much more difficult if not impossible

- Missing or incomplete analysis information
  - ATLAS-SUS-2013-09 (stops in the dilepton channel): Information on effects non-reproducible with DELPHES lost (student has quit physics)
  - ATLAS-EXOT-2013-10 (monolepton): No info on signal distributions, on event generation, imprecise statements about efficiencies
  - CMS-SUS-16-036: Use pseudo-jets, what is documented is not what has been implemented, communication very slow

- Missing or incomplete validation information
  - CMS-SUS-12-028: No cutflows and answers from CMS to requests
  - CMS-SUS-13-007 (1 lepton+b-jets+met): No cutflows, messy info about benchmarks, semi-official validation material provided (that cannot be used in the public validation note)
  - CMS-SUS-16-033: Cutflow does not correspond to actual selection used for the analysis

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OUTLINE

1. RATIONALE FOR PUBLIC ANALYSIS VALIDATION
2. PROCEDURE TO VALIDATE AN ANALYSIS
3. SOME EXAMPLES OF VALIDATED ANALYSES
4. **HOW TO WRITE THE VALIDATION NOTE**
5. SUMMARY

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VALIDATION NOTE CONTENT

- The validation note should
  - Be Concise
  - Be Clear and Understandable
  - Contain references where additional information has been picked up

- It should describe
  - A short description of the analysis
  - If a new specific variable was used, a short description of its implementation and links to references.
  - Any information sourcing from the official channels which is not included in the analysis paper
  - A description of the benchmarks used for the validation and how they were obtained
  - How the signal sample was generated (tools, version, MC tunings)
  - A description of tunings/scalings used to mimick non-reproducible effects at the detector level
  - A comparison between your results and the official ones (comparison of cutflows, distributions, possibly limit plots)
  - A fair account on the quality of the validation

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OUTLINE

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SUMMARY

- The quality of the reinterpretation strongly depends on the quality of the validation material available
- As soon as you have chosen an analysis to recast, contact the conveners for missing information (communication takes time)

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SUMMARY

- ☞ The quality of the reinterpretation strongly depends on the quality of the validation material available
- ☞ As soon as you have chosen an analysis to recast, contact the conveners for missing information (communication takes time)

- At the analysis level make sure
  - ☞ have clearly defined the physics objects
  - ☞ you have clearly understood the description of the selection
  - ☞ Have the efficiencies for objects,triggers etc... at hand (crucial for detector sim)
  - ☞ have the means to handle special variables (which are not alreayd included in MA5)

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- At the validation level make sure you have
  - Info about benchmarks: spectra,decays
  - MC tools config: version, tunings, merging info, generation (best is LHE: no need to even generate the events).
  - Detailed cutflows
  - Kinematical distributions.

LPT Orsay

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  - Detailed cutflows
  - Kinematical distributions.

- Reaching a 20-30% agreement with the official results is acceptable
- Level 0 of validation is the cutflow, enable to track step by step the validation
- The more discreprancy you get, the more you need to dig/work (also plot distributions and limit plot)

Orsay