CheckMATE

Checkmating your favorite BSM model

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Before the LHC

- It was expected that if SUSY was realized in nature, it would be discovered soon
- If squarks/gluinos were roughly 1 TeV, ten thousands of events would be expected per year
- Two main objectives:
 - discover SUSY through excess
 - extract sparticle masses, couplings and spin







However...

... no excess above SM expectation has been found so far

- 1./2. generation squark and gluino masses below
 1.7 TeV are excluded (for degenerate squarks/ gluinos)
- This is somewhat worrisome if one believes in supersymmetry in order to stabilize the EW scale
- However, if higgsinos and third generation sparticles are light, SUSY is still natural





But even the limits for third generation sparticles becomes pretty strict

But SUSY could be hidden...

- A compressed spectrum is difficult to probe
- RPV can significantly reduce MET
- Extended particle content can modify the collider signature
- In Split SUSY, many sparticles are not accessible at the LHC



ATLAS SUSY Searches* - 95% CL Lower Limits

Status: ICHEP 2014

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		Model	e, μ, τ, γ	Jets	E _T miss	∫£ dr[ft	>-1]	Mass limit		Reference
	Inclusive Searches	$\begin{array}{l} \text{MSUGRA/CMSSM} \\ \text{MSUGRA/CMSSM} \\ \text{MSUGRA/CMSSM} \\ \tilde{q}\bar{q}, \tilde{q} \rightarrow q \tilde{\xi}_{1}^{0} \\ \tilde{g}\bar{x}, \tilde{x} \rightarrow q \tilde{q} \tilde{\xi}_{1}^{0} \\ \tilde{g}\bar{x}, \tilde{x} \rightarrow q \tilde{q} \tilde{\xi}_{1}^{0} \\ \tilde{g}\bar{x}, \tilde{x} \rightarrow q q \tilde{\xi}_{1}^{1} \rightarrow q q W^{+} \tilde{\chi}_{3}^{0} \\ \tilde{g}\bar{x}, \tilde{x} \rightarrow q q (\ell \ell / \ell r / t r r) \tilde{\chi}_{1}^{0} \\ \text{GMSB} (\ell \text{ NLSP}) \\ \text{GMSB } (\tilde{r} \text{ NLSP}) \\ \text{GGM (bino NLSP)} \\ \text{GGM (bino NLSP)} \\ \text{GGM (higgsino-bino NLSP)} \\ \text{GGM (higgsino NLSP)} \\ \text{Gravitino LSP} \end{array}$	$\begin{array}{c} 0 \\ 1 e, \mu \\ 0 \\ 0 \\ 1 e, \mu \\ 2 e, \mu \\ 2 e, \mu \\ 1 \cdot 2 \tau + 0 \cdot 1 \ell \\ 2 \gamma \\ 1 e, \mu + \gamma \\ \gamma \\ 2 e, \mu (Z) \\ 0 \end{array}$	2-6 jets 3-6 jets 7-10 jets 2-6 jets 3-6 jets 0-3 jets 0-3 jets mono-jet	Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes	20.3 20.3 20.3 20.3 20.3 20.3 20.3 4.7 20.3 4.7 20.3 4.8 4.8 5.8 10.5	\$\vee\$	1.7 T 1.2 TeV 1.1 TeV 850 GeV 1.33 TeV 1.33 TeV 1.33 TeV 1.33 TeV 1.18 TeV 1.12 TeV 1.24 TeV 1.24 TeV 1.5 Te 1.28 TeV 619 GeV 900 GeV 690 GeV 645 GeV	 m(i)=m(i) any m(i) any m(i) m(i²)→0 GeV, m(1[∞] gen. i)=m(2^{∞1} gen. i) m(i²)→0 GeV m(i²)=0 GeV taryt<15 taryt<15 taryt<15 taryt<20 GeV m(i²)>50 GeV m(i²)>50 GeV m(i²)>50 GeV m(i²)>50 GeV m(i²)>200 GeV m(i²)>200 GeV m(i²)>200 GeV m(i²)>10⁻¹ eV 	1405.7875 ATLAS-CONF-2013-062 1308.1841 1405.7875 ATLAS-CONF-2013-062 ATLAS-CONF-2013-069 1208.4688 1407.0600 ATLAS-CONF-2014-001 ATLAS-CONF-2014-01 ATLAS-CONF-2014-01 ATLAS-CONF-2012-144 1211.1167
and Jus	g med.	$\tilde{s} \rightarrow b \tilde{b} \tilde{t}_{1}^{0}$ $\tilde{s} \rightarrow b \tilde{t}_{1}^{0}$ $\tilde{s} \rightarrow b \tilde{t} \tilde{t}_{1}^{0}$	0 0 0-1 e.μ 0-1 e.μ	3 b 7-10 jets 3 b 3 b	Yes Yes Yes Yes	20.1 20.3 20.1 20.1	2 2 2 2 2	1.25 TeV 1.1 TeV 1.34 TeV 1.3 TeV	m(t ²)<400 GeV m(t ²)<350 GeV m(t ²)<400 GeV m(t ²)<400 GeV	1407.0600 1308.1841 1407.0600 1407.0600
and nan souther	direct production	$ \begin{array}{l} \tilde{b}_1 \tilde{b}_1, \tilde{b}_1 {\rightarrow} b \tilde{t}_1^0 \\ \tilde{b}_1 \tilde{b}_1, \tilde{b}_1 {\rightarrow} b \tilde{t}_1^0 \\ \tilde{b}_1 \tilde{b}_1, \tilde{b}_1 {\rightarrow} b \tilde{t}_1^\pi \\ \tilde{t}_1 \tilde{t}_1 (light), \tilde{t}_1 {\rightarrow} b \tilde{t}_1^\pi \\ \tilde{t}_1 \tilde{t}_1 (\text{inght}), \tilde{t}_1 {\rightarrow} W \tilde{b} \tilde{t}_1^0 \\ \tilde{t}_1 \tilde{t}_1 (\text{medium}), \tilde{t}_1 {\rightarrow} b \tilde{t}_1^n \\ \tilde{t}_1 \tilde{t}_1 (\text{medium}), \tilde{t}_1 {\rightarrow} b \tilde{t}_1^n \\ \tilde{t}_1 \tilde{t}_1 (\text{neavy}), \tilde{t}_1 {\rightarrow} t \tilde{t}_1^0 \\ \tilde{t}_1 \tilde{t}_1 (\text{neavy}), \tilde{t}_1 {\rightarrow} t \tilde{t}_1^0 \\ \tilde{t}_1 \tilde{t}_1 (\text{neavy}), \tilde{t}_1 {\rightarrow} t \tilde{t}_1^0 \\ \tilde{t}_1 \tilde{t}_1 (\text{neavel}), \tilde{t}_1 {\rightarrow} t \tilde{t}_1^0 \\ \tilde{t}_1 \tilde{t}_1 (\text{neavel} \text{GMSB}) \\ \tilde{t}_2 \tilde{t}_2, \tilde{t}_2 {\rightarrow} \tilde{t}_1 + Z \end{array} $	0 $2 e, \mu$ (SS) $1-2 e, \mu$ $2 e, \mu$ $2 e, \mu$ 0 $1 e, \mu$ 0 0 $2 e, \mu (Z)$ $3 e, \mu (Z)$	2 b 0-3 b 1-2 b 0-2 jets 2 jets 2 b 1 b 2 b tono-jet/c-1 1 b 1 b	Yes Yes Yes Yes Yes Yes Yes Yes Yes Yes	20.1 20.3 4.7 20.3 20.3 20.1 20 20.1 20.3 20.3 20.3 20.3		100-620 GeV 275-440 GeV 110 <mark>-167 GeV</mark> 130-210 GeV 215-530 GeV 210-640 GeV 260-640 GeV 90-240 GeV 150-580 GeV 290-600 GeV	$\begin{split} &m(\tilde{\tau}_{1}^{0}){<}90\text{GeV} \\ &m(\tilde{\tau}_{1}^{0}){=}2m(\tilde{t}_{1}^{0}) \\ &m(\tilde{\tau}_{1}^{0}){=}55\text{GeV} \\ &m(\tilde{\tau}_{1}^{0}){=}55\text{GeV} \\ &m(\tilde{\tau}_{1}^{0}){=}m(\tilde{y}){=}50\text{GeV}, \\ &m(\tilde{\tau}_{1}^{0}){=}0\text{GeV} \\ &m(\tilde{\tau}_{1}^{0}){=}0\text{GeV} \\ &m(\tilde{\tau}_{1}^{0}){=}0\text{GeV} \\ &m(\tilde{\tau}_{1}^{0}){=}0\text{GeV} \\ &m(\tilde{\tau}_{1}^{0}){=}150\text{GeV} \\ &m(\tilde{\tau}_{1}^{0}){=}150\text{GeV} \\ &m(\tilde{\tau}_{1}^{0}){=}150\text{GeV} \\ &m(\tilde{\tau}_{1}^{0}){=}150\text{GeV} \\ &m(\tilde{\tau}_{1}^{0}){=}250\text{GeV} \end{split}$	1308.2631 1404.2500 1208.4305, 1209.2102 1403.4853 1408.4853 1308.2631 1407.0583 1406.1122 1407.0608 1403.5222 1403.5222
μ	direct	$\begin{array}{c} \tilde{t}_{1,R} \tilde{t}_{1,R}, \tilde{t} \rightarrow l \tilde{\chi}_{1}^{0} \\ \tilde{\chi}_{1}^{+} \tilde{\chi}_{1}^{-}, \tilde{\chi}_{1}^{-} \rightarrow l \nu (l \bar{\nu}) \\ \tilde{\chi}_{1}^{+} \tilde{\chi}_{1}^{-}, \tilde{\chi}_{1}^{+} \rightarrow \bar{\tau} \nu (r \bar{\nu}) \\ \tilde{\chi}_{1}^{+} \tilde{\chi}_{2}^{0} \rightarrow \tilde{\ell}_{1} r \tilde{t}_{1} l (l \bar{\nu}), l \bar{\eta} \tilde{t}_{1} l (\bar{\nu}) \\ \tilde{\chi}_{1}^{+} \tilde{\chi}_{2}^{0} \rightarrow W \tilde{\chi}_{1}^{0} Z \tilde{\chi}_{1}^{0} \\ \tilde{\chi}_{2}^{+} \tilde{\chi}_{2}^{0} \rightarrow W \tilde{\chi}_{1}^{0} h \tilde{\chi}_{1}^{0} \\ \tilde{\chi}_{2}^{+} \tilde{\chi}_{2}^{0} \rightarrow W \tilde{\chi}_{1}^{0} h \tilde{\chi}_{1}^{0} \\ \tilde{\chi}_{2}^{+} \tilde{\chi}_{2}^{0} \rightarrow W \tilde{\chi}_{2}^{0} h \tilde{\chi}_{2}^{0} \\ \tilde{\chi}_{2}^{+} \tilde{\chi}_{2}^{0} \rightarrow W \tilde{\chi}_{1}^{0} h \tilde{\chi}_{1}^{0} \end{array}$	2 e.µ 2 e.µ 2 e.µ 2-3 e.µ 1 e.µ 4 e.µ	0 - 0 2 b 0	Yes Yes Yes Yes Yes Yes	20.3 20.3 20.3 20.3 20.3 20.3 20.3 20.3	$\tilde{t}_{\tilde{x}_{11}}^{\tilde{x}_{11}}$	90-325 GeV 140-465 GeV 100-350 GeV 700 GeV 420 GeV 620 GeV m($\begin{array}{l} m(\tilde{t}_{1}^{0})=0~GeV\\ m(\tilde{t}_{1}^{0})=0~GeV,~m(\tilde{t},~\tilde{r})=0.5(m(\tilde{t}_{1}^{0})+m(\tilde{t}_{1}^{0}))\\ m(\tilde{t}_{1}^{0})=0~GeV,~m(\tilde{t},~\tilde{r})=0.5(m(\tilde{t}_{1}^{0})+m(\tilde{t}_{1}^{0}))\\ \tilde{t}_{1}^{0})=m(\tilde{t}_{2}^{0}),~m(\tilde{t}_{1}^{0})=0,~m(\tilde{t},~\tilde{r})=0.5(m(\tilde{t}_{1}^{0})+m(\tilde{t}_{1}^{0}))\\ m(\tilde{t}_{1}^{0})=m(\tilde{t}_{2}^{0}),~m(\tilde{t}_{1}^{0})=0,~sleptons~decoupled\\ m(\tilde{t}_{1}^{0})=m(\tilde{t}_{2}^{0}),~m(\tilde{t}_{1}^{0})=0,~sleptons~decoupled\\ \tilde{t}_{2}^{0}=m(\tilde{t}_{1}^{0}),~m(\tilde{t}_{1}^{0})=0,~m(\tilde{t},~\tilde{r})=0.5(m(\tilde{t}_{2}^{0})+m(\tilde{t}_{1}^{0})) \end{array}$	1403.5294 1403.5294 1407.0350 1402.7029 1403.5294, 1402.7029 ATLAS-CONF-2013.093 1405.5086
Long-lived	particles	Direct $\hat{x}_{1}^{+}\hat{x}_{1}^{-}$ prod., long-lived \hat{x}_{1}^{+} Stable, stopped \hat{g} R-hadron GMSB, stable $\hat{\tau}, \hat{x}_{1}^{0} \rightarrow \hat{\tau}(\hat{\tau}, \hat{\mu}) + \tau(\epsilon,$ GMSB, $\hat{x}_{1}^{0} \rightarrow \gamma \hat{G}$, long-lived \hat{x}_{1}^{0} $\hat{q}\hat{q}, \hat{x}_{1}^{0} \rightarrow qg\mu$ (RPV)	Disapp. trk 0 .μ) 1-2 μ 2 γ 1 μ, displ. vtx	1 jet 1-5 jets - -	Yes Yes Yes	20.3 27.9 15.9 4.7 20.3	χ [*] 2 χ [*] 2 2	270 GeV 832 GeV 475 GeV 230 GeV 1.0 TeV	$\begin{array}{l} m(\tilde{r}_{1}^{2})\!=\!m(\tilde{k}_{1}^{2})\!=\!160 \; MeV,\; r(\tilde{k}_{1}^{2})\!=\!0.2\; ns \\ m(\tilde{r}_{1}^{2})\!=\!100\; GeV,\; 10\; \mu s\!<\! r(\tilde{g})\!<\!1000\; s \\ 10\!<\!tan\! f^{2}\!<\!50 \\ 0.4\!<\! r(\tilde{k}_{1}^{2})\!<\!2\; ns \\ 1.5\;<\! r\!<\!156\; mm,\; BR(\mu)\!=\!1,\; m(\tilde{k}_{1}^{2})\!=\!108\; GeV \end{array}$	ATLAS-CONF-2013-069 1310.6584 ATLAS-CONF-2013-058 1304.6310 ATLAS-CONF-2013-092
	RPV	$ \begin{array}{l} LFV pp \rightarrow \tilde{v}_r + X, \tilde{v}_r \rightarrow e + \mu \\ LFV pp \rightarrow \tilde{v}_r + X, \tilde{v}_r \rightarrow e(\mu) + \tau \\ Biinear RPV CMSSM \\ \tilde{x}_1^+ \tilde{x}_1^-, \tilde{x}_1^+ \rightarrow W \tilde{x}_1^0, \tilde{x}_1^0 \rightarrow e e \tilde{v}_{\mu}, e \mu \tilde{v}_e \\ \tilde{x}_1^+ \tilde{x}_1^-, \tilde{x}_1^+ \rightarrow W \tilde{x}_1^0, \tilde{x}_1^0 \rightarrow e e \tilde{v}_{\mu}, e \mu \tilde{v}_e \\ \tilde{x}_1^+ \tilde{x}_1^-, \tilde{x}_1^+ \rightarrow W \tilde{x}_1^0, \tilde{x}_1^0 \rightarrow e e \tilde{v}_e, e \tau \tilde{v}_e \\ \tilde{g} \rightarrow q o q \\ \tilde{g} \rightarrow \tilde{t}_1 t, \tilde{t}_1 \rightarrow b s \end{array} $	$\begin{array}{c} 2 e, \mu \\ 1 e, \mu + \tau \\ 2 e, \mu (\text{SS}) \\ 4 e, \mu \\ 3 e, \mu + \tau \\ 0 \\ 2 e, \mu (\text{SS}) \end{array}$	- 0-3 b - - 6-7 jets 0-3 b	- Yes Yes Yes - Yes	4.6 4.6 20.3 20.3 20.3 20.3 20.3	P, P, \$-\$ \$\vec{x}_1^* \$\vec{x}	1.61 Te 1.1 TeV 1.35 TeV 750 GeV 450 GeV 916 GeV 850 GeV	$\begin{array}{c} \lambda_{j+1}^{\prime}=0.10, \lambda_{152}=0.05\\ \lambda_{j+1}^{\prime}=0.10, \lambda_{16203}=0.05\\ m(\dot{q})=m(\dot{q}), x_{1237}=<1 \mbox{ mm}\\ m(\ddot{t}_{1}^{\prime})>0.2\times m(\ddot{t}_{1}^{\prime}), \lambda_{153}=0\\ m(\ddot{t}_{1}^{\prime})>0.2\times m(\ddot{t}_{1}^{\prime}), \lambda_{153}=0\\ BR(t)=BR(t)=BR(t)=0\% \end{array}$	1212.1272 1212.1272 1404.2500 1405.5086 1405.5086 ATLAS-CONF-2013.091 1404.250
	Other	Scalar gluon pair, sgluon $\rightarrow q\bar{q}$ Scalar gluon pair, sgluon $\rightarrow t\bar{t}$ WIMP interaction (D5, Dirac χ)	0 2 e,µ (SS) 0	4 jets 2 b mono-jet	Yes Yes	4.6 14.3 10.5	sgluon sgluon M" scale	100-287 GeV 350-800 GeV 704 GeV	incl. limit from 1110.2993 m(χ)<80 GeV, limit of <587 GeV for D8	1210.4826 ATLAS-CONF-2013-051 ATLAS-CONF-2012-147
		full data p	vs = 8 TeV artial data	Vs = full	data			10 ⁻¹ 1	Mass scale [TeV]	

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

ATLAS/CMS have looked in many final state signatures and have derived limits on simplified models

ATLAS Preliminary $\sqrt{s} = 7.8 \text{ TeV}$

Drawbacks...

- However, many simplified models are *unrealistic*
- Limits would be heavily modified if one changes the assumptions on the sparticle spectrum and couplings
- E.g., softer jets/leptons, reduced MET, BR <1
- How can we constrain all kinds of models (even non-SUSY) by experimental data?

Recast experimental limits I

- SModels (arXiv:1312.4175) decomposes the signal into simplified topologies and compare their rates with experimental limits
- FastLim (arXiv:1402.0492) calculates limits based on simplified models by providing pre-calculated efficiency tables for each simplified topology
- Both are very fast but the topology must be very simple

Recast experimental limits II

- Generate MC events with Pythia, Herwig, Sherpa,...
- Simulate the detector response with Delphes/PGS
- Code up the relevant experimental study
- Validate the detector simulation and the analysis code
- This is very time consuming

Our Idea







Detector simulation

- We heavily rely on the fast detector simulation Delphes 3
- However, we have modified the default Delphes
 - Many studies require multiple "types" of the same final state
 - The need of several isolation criteria for the same object
 - Retune of the detector response for many final state objects

Retune of Delphes



Id efficiency for "medium" electrons



B tagging efficiency of jets containing light quarks



Signal efficiencies for 3 prong taus

Validation plots





Analyses

- CheckMATE uses a C++ framework to process Delphes' results
- All analyses are written in the same structural form
- We have implemented kinematical functions and methods for object removal
- A typical analysis consists of
 - choosing final state objects
 - trigger efficiencies/vetoing events
 - define signal/control regions
 - count number of events in each SR

#include "example.h"

```
void Example::initialize() {
   setAnalysinName("example");
   setInformation(""
        "@#Example Analysis\n"
   "");
   setLuminosity(10*units::INVFB);
   ignore("towers");
   ignore("tracks");
   bookSignalRegions("jets;jets_plus_e;jets_plus_m");
   bookCutflowRegions("singlelep;twojets");
}
```

void Example::analyze() {
 electronsMedium = filterPhaseSpace(electronsMedium, 20, -2.5, 2.5, true)

std::vector<Electron*> isoElecs = filterIsolation(electronsMedium);

muonsCombined = filterPhaseSpace(muonsCombined, 25, -2.0, 2.0); std::vector<Muon*> isoMuons = filterIsolation(muonsCombined); missingET->addMuons(isoMuons);

jets = filterPhaseSpace(jets, 50); jets = overlapRemoval(jets, electronsMedium, 0.2);

if (isoElecs.size() + isoMuons.size() == 1)
return;
countCutflowEvent("singlelep");

if (jets.size() < 2)
 return;
countCutflowEvent("twojets");</pre>

double E_tot = 0; for(int j = 0; j < jets.size(); j++) E_tot += jets[j]->PT;

```
if (E_tot >= 150) {
   countSignalEvent("jets");
   if ((isoElecs.size() == 1)&&
      (fabs(isoElecs[0]->P4().DeltaPhi(missingET->P4())) < 0.3))
   countSignalEvent("jets_plus_e");</pre>
```

```
else if ((isoMuons.size() == 1)&&
    (fabs(isoElecs[0]->P4().DeltaPhi(missingET->P4())) < 0.15))
    countSignalEvent("jets_plus_m");
```

```
} '
```

```
void Example::finalize() {
}
```

Analyses

Name	NSR	Description	Lumi
atlas_1403_4853	12	ATLAS, 2 leptons + etmiss (direct stop)	20.3
atlas_1308_2631	6	ATLAS, 0 leptons + 2 b-jets + etmiss	20.1
atlas_1404_2500	5	ATLAS, Same sign dilepton or 3l	20.3
atlas_1407_0583	27	ATLAS, 1 lepton + (b–)jets + etmiss (stop)	20.3
atlas_1407_0600	9	ATLAS, 3 b-jets + 0-1 lepton + etmiss	20.1
atlas_conf_2012_104	2	ATLAS, 1 lepton + >= 4 jets + etmiss	5.8
atlas_conf_2012_147	4	ATLAS, Monojet + etmiss	10.0
atlas_conf_2013_024	3	ATLAS, 0 leptons + 6 (2 b–)jets + etmiss	20.5
atlas_conf_2013_036	5	ATLAS: 4 leptons + etmiss	20.7
atlas_conf_2013_037	6	ATLAS, 1 lepton + (b–)jets + etmiss (stop)	20.7
atlas_conf_2013_047	10	ATLAS, 0 leptons + 2–6 jets + etmiss	20.3
atlas_conf_2013_049	9	ATLAS, 2 leptons + etmiss	20.3
atlas_conf_2013_061	9	ATLAS, 0–1 leptons + >= 3 b-jets + etmiss	20.1
atlas_conf_2013_089	12	ATLAS, 2 leptons (razor)	20.3
atlas_conf_2014_014	1	ATLAS, 2 leptons + b-jets (stop)	20.3
cms_1303_2985	59	CMS, alpha_T + b-jets	11.7



Setting limits

- Directly compare S to 95% upper limit on signal S95
- Calculate the ratio r=S/S95. If r>1: Excluded!
- Choose signal region with strongest expected exclusion
- Use its observed result to state "excluded" or "allowed"
- Alternatively, calculate CL. If CL < 0.05: Excluded!

Demonstration

Input

General Options
[Mandatory Parameters]
Name: My_New_Run
Analyses: atlas_conf_2013_047

[Optional Parameters]

Process Information (Each new process 'X' must start with [X])
[gluinogluino]
XSect: 3.53*FB
XSectErr: 1e-5*PB
Events: testfile.hep

Demonstration

Input

General Options
[Mandatory Parameters]
Name: My_New_Run
Analyses: atlas_conf_2013_047

[Optional Parameters]

Process Information (Each new process 'X' must start with [X])
[gluinogluino]
XSect: 3.53*FB
XSectErr: 1e-5*PB
Events: testfile.hep

Output

SR	S	dS_stat	dS_sys	dS_tot	S95_obs	S95_exp	r^c_obs	r^c_exp
AL	37.41	0.43	4.10	4.12	1341.20	1135.00	0.02	0.03
AM	5.37	0.15	0.56	0.58	51.30	42.70	0.08	0.10
BM	7.33	0.18	0.76	0.78	14.90	17.00	0.39	0.34
BT	0.84	0.05	0.10	0.11	6.70	5.80	0.09	0.11
CM	18.22	0.30	2.04	2.07	81.20	72.90	0.17	0.19
CT	2.32	0.08	0.27	0.28	2.40	3.30	0.74	0.54
D	12.15	0.24	1.29	1.32	15.50	13.60	0.62	0.70
EL	21.56	0.33	2.38	2.41	92.40	57.30	0.18	0.29
EM	16.08	0.29	1.79	1.81	28.60	21.40	0.44	0.59
ET	8.10	0.20	0.89	0.91	8.30	6.50	0.76	0.97

Demonstration

Input

General Options
[Mandatory Parameters]
Name: My_New_Run
Analyses: atlas_conf_2013_047

[Optional Parameters]

Process Information (Each new process 'X' must start with [X])
[gluinogluino]
XSect: 3.53*FB
XSectErr: 1e-5*PB
Events: testfile.hep

Output

SR	S	dS_stat	dS_sys	dS_tot	S95_obs	S95_exp	r^c_obs	r^c_exp
AL	37.41	0.43	4.10	4.12	1341.20	1135.00	0.02	0.03
AM	5.37	0.15	0.56	0.58	51.30	42.70	0.08	0.10
BM	7.33	0.18	0.76	0.78	14.90	17.00	0.39	0.34
BT	0.84	0.05	0.10	0.11	6.70	5.80	0.09	0.11
CM	18.22	0.30	2.04	2.07	81.20	72.90	0.17	0.19
CT	2.32	0.08	0.27	0.28	2.40	3.30	0.74	0.54
D	12.15	0.24	1.29	1.32	15.50	13.60	0.62	0.70
EL	21.56	0.33	2.38	2.41	92.40	57.30	0.18	0.29
EM	16.08	0.29	1.79	1.81	28.60	21.40	0.44	0.59
ET	8.10	0.20	0.89	0.91	8.30	6.50	0.76	0.97

Result

analysis	bestSR	r_obs^c	r_exp^c	CLs_obs	dCLs_obs	CLs_exp	dCLs_exp	[]
atlas_conf_2013_047	ET	0.76	0.97	0.0609	0.0027	0.0077	0.0013	[]

Numerical Results



Conclusion

- CheckMATE test any event + cross section combination against current LHC results
- ... is very easy to use (for the lazy physicist)
- ...is transparent in its functionality (for the curious physicist)
- ... it is simple to extend (for the talented physicist)