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CheckMATE とは?

任意の signal process について、LHC 実験で制限されている か否か (95%CL) を調べるツール

コアは、LHC 実験の detector 効果 (smearing, ID efficiency) がなるべく再現できるように tune した Simulator (Delphes) を、 イベント解析環境も含めてパッケージにしたもの。

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- 1. CheckMATE を使って model の生死が調 べられる
- 2. CheckMATE が何をやっているのかが大 体分かる



CheckMATE の使い方 CheckMATE について まとめ

今日の話の内容は基本的にはマニュアルに書いてあります。 参考資料:

CheckMATE manual (arXiv: 1312.2591)

CheckMATE talk slides

https://indico.fnal.gov/getFile.py/access?

contribId=11&sessionId=4&resId=0&materialId=slides&confId=9361

https://lpsc.in2p3.fr/Indico/getFile.py/access? contribId=1&resId=0&materialId=slides&confId=1085

ChekMATE の使い方

Installation

Mac OSX (Yosemite & EL Captain) You should use "clang" instead of "gcc". See the installation note: Hep_Tools_install.pdf (Thanks to Endo-san, Ishikawa-kun and Hamaguchi-san)

Linux

Just follow the CheckMATE Installation-Tutorial page. (at least on Ubuntu14.4 & CentOS7)

Example Case

- CheckMATE を具体的に使ってみる
- ATLAS 2-6 jets +MET 解析 (ATLAS-CONF-2013-047) にある mSUGRA への制限を CheckMATE でやるとどうなるか



Example Case: Signal Regions

 $m_{\text{eff}}(\text{incl.}) = E_T^{\text{miss}} + \sum p_T^i \quad (p_T^i > 40 \,\text{GeV})$

ATLAS 2-6 jets +MET 解析の Signal Region (SR) Jet multiplicity, MET, jet pT, meff などで分類

| | | | <i>l</i> | | | | | | | |
|---|------------|-------------|-------------------------|-------------|--|------|------------|-----------------------------------|------|------|
| Requirement | A (2-jets) | | B (3-jets) | | C (4-jets) | | D (5-jets) | E (6-jets) | | |
| | L | Μ | Μ | Т | Μ | Т | _ | L | Μ | Т |
| $E_{\rm T}^{\rm miss}$ [GeV] > | | 160 | | | | | | | | |
| $p_{\rm T}(j_1)$ [GeV] > | | 130 | | | | | | | | |
| $p_{\rm T}(j_2)$ [GeV] > | | 60 | | | | | | | | |
| $p_{\rm T}(j_3)$ [GeV] > | - | - | | 60 | 60 | | 60 | 60 | | |
| $p_{\mathrm{T}}(j_4)$ [GeV] > | - | - | | _ | 60 | | 60 | 60 | | |
| $p_{\rm T}(j_5)$ [GeV] > | - | - | | _ | _ | | 60 | 60 | | |
| $p_{\rm T}(j_6)$ [GeV] > | - | - | | _ | - | | _ | 60 | | |
| $\Delta \phi(\text{jet}_i, \mathbf{E}_{\mathrm{T}}^{\mathrm{miss}})_{\mathrm{min}} >$ | 0.4 (i = | = {1, 2, (3 | B if $p_{\rm T}(j_3)$ | > 40 GeV)}) | $0.4 (i = \{1, 2, 3\}), 0.2 (i = \{1, 2, 3\})$ | | | $p_{\rm T} > 40 \text{ GeV jets}$ | | |
| $E_{\rm T}^{\rm miss}/m_{\rm eff}(Nj) >$ | 0.2 | _a | 0.3 | 0.4 | 0.25 | 0.25 | 0.2 | 0.15 | 0.2 | 0.25 |
| $m_{\rm eff}({\rm incl.}) [{\rm GeV}] >$ | 1000 | 1600 | 1800 | 2200 | 1200 | 2200 | 1600 | 1000 | 1200 | 1500 |

(a) For SR A-medium the cut on $E_{\rm T}^{\rm miss}/m_{\rm eff}(Nj)$ is replaced by a requirement $E_{\rm T}^{\rm miss}/\sqrt{H_{\rm T}} > 15 \ {\rm GeV}^{1/2}$.

CheckMATE を使う準備

調べたい model point で、解析の Cut を生き残るような衝突反応の event を生成して、.hepmc/.hep ファイルを作っておく

今回は jets +MET 解析なので pp > q~q~, g~g~, q~g~ といった colored プロセスを作った (Cross Section の大きいもの)。 SUSYHIT(Suspect), MadGraph5+Pythia6

Cross Section は Prospino2 で計算したNLO での値を後で CheckMATE に教える。

CheckMATE の動かし方1

cd CheckMATE-1.2.2

touch param.dat

CheckMATEの動かし方1

param.dat: CheckMATE のパラメーターを指定する

General Options
[Mandatory Parameters]
Name: mSUGRA_2800_450
Analyses: atlas_conf_2013_047

[Optional Parameters] OutputDirectory: results

Process Information (Each new process 'X' must start with [X])
[gluino-pair]
XSect: 3.20*FB
XSectErr: 0*FB
Events: pp_gogo/Events/mSUGRA_2800_450_1/tag_1_pythia_events.hep

[stop1-pair]
XSect: 4.93*FB
XSectErr: 0*FB
Events: pp_t1t1~/Events/mSUGRA_2800_450/tag_1_pythia_events.hep

```
./bin/CheckMATE param.dat
```

CheckMATE の動かし方1 param.dat: CheckMATE のパラメーターを指定する

General Options [Mandatory Parameters] Name: My_Run Analyses: atlas_conf_2013_047, atlas_1405_7875, cms_1303_2985 [Optional Parameters] OutputDirectory: results ## Process Information (Each new process 'X' must start with [X]) [gluino-pair] XSect: 3.20*FB XSectErr: 0*FB Events: pp_gogo/Events/mSUGRA_2800_450_1/tag_1_pythia_events.hep, pp_gogo/Events/mSUGRA_2800_450_2/tag_1_pythia_events.hep

Analysis, Event file は コンマ で区切れば複数指定可能

CheckMATE Options

| Input File | Comma | and Line | Definition |
|------------------------|-------|------------------|---|
| FullCL | -cl, | -full-cl | Calculates CL_S explicitly for each signal region and uses it for the exclusion |
| | | | statement. |
| RandomSeed | -rs, | -random-seed | Defines a fixed seed for the random number generator. |
| OutputDirectory | -od, | -outdir | This defines the path to the directory into which all CheckMATE output should |
| | | | be saved. Both absolute and relative paths are allowed. If not set, CheckMATE |
| | | | will create and use a results / directory within its main folder. |
| OutputExists | -oe, | -output-exists | If there are already output files with the same run name in the same output |
| | | | directory as the current run, CheckMATE can deal with this in different ways: |
| | | | $\verb overwrite $ will delete the old output and restart with a new run. add will consider |
| | | | the current run as an addendum to the previous run and will add the current |
| | | | results to the old ones. overwrite will always ask the user via prompt. |
| ${\tt SkipParamCheck}$ | -sp, | -skip-paramcheck | Skip startup parameter check. |
| SkipDelphes | -sd, | -skip-delphes | Only works if the output directory already exists and has Delphes ROOT files. |
| | | | Delphes won't run and the given ROOT files in the output directory are re- |
| | | | processed by the given analyses. This is only useful in case the user changed |
| | | | parts of the analysis and wants to test with the same input. |
| SkipEvaluation | -se, | -skip-evaluation | The input files are only processed by the detector simulation and the chosen |
| | | | analyses, but the analysis result will not be further evaluated and compared to |
| | | | experimental data. It should be used when doing a control region analysis or for |
| | | | debugging purposes. |
| QuietMode | -q,c | quiet | No output will be print on screen. |
| VerboseMode | -v,v | verbose | All Delphes and analysis output will be printed to the standard output. |
| TempMode | -t,t | temporary | All Delphes ROOT files will be deleted after the analysis step to save hard disk |
| | | | space. |

Ref: manual

Type "./bin/CheckMATE -h" to see all the options currently available.

CheckMATE の動かし方2

コマンドラインで引数を与える

./bin/CheckMATE -n MyRun -a atlas_conf_2013_047
-p "gluino-pair; stop1-pair" —xs "3.20*FB; 4.93*FB"
—xse "1e-5*PB; 0*FB" eventfile1.hep eventfile2.hep

このやり方でも Event file を複数指定することができるが、 その場合は process, xsec, xsec_error をイベントファイルの数 だけ セミコロン で区切って指定する必要あり。

オプションも指定可能(前の表参照)。

パソコンで demo

SR: atlas_1503_03290 - SR-Z

CheckMATE を動かすと こんな結果が出力される

Model point は生きている (Allowed) 他の部分は後で 解説します

```
_____(___| <| | | |/ ____ \| | | |____
_|\___|\___|_|\_\_| |_/_/ ___\_\_| |
The following settings are used:
Eventfiles: 1
      /Users/yoshi/projects/talk@collider_school/events6.hep (process: squark-pair
Analyses:
      atlas_1503_03290 (2 leptons + jets + missingET)
Output Directories:
      results/Demo_Model5
Additional Settings:
Is this correct? (y/n) y
   ****** DELPHES + ANALYSES
*****
* Processing file '/Users/yoshi/projects/talk@collider_school/events6.hep'
** - Delphes
#####################<u>| (100.00%)</u>
** - Analysis
    -atlas_1503_03290
******
******
           EVALUATION
********
Test: Calculation of r = signal/(95\%CL \ limit \ on \ signal)
Warning: Error is dominated by Monte Carlo statistics!
Result: Allowed
Result for r: r_max = 0.02460
```

My Results (m0 = 2800 GeV)



CheckMATE validation



CheckMATE について

CheckMATE は何をしてるのか

- コマンドを実行すると…
- 1..hep / .hepmc ファイルの受け取り
- 2. Delphes で detector simulation -> root file で出力
- 3. root file を読み込んで解析プログラムを走らせる
- 4. 一番 sensitive な signal region を選び、それを 使って モデルが exclude されているかどうかを判 定する

実行結果

- result_dir (出力ファイル)
 - delphes
 - xxx_delphes.root (event file after detector simulation)
 - log.delphes.dat (Delphes log)
 - merged.tcl (settings of detector simulation)
 - analysis
 - xxx_cutflow.dat (event nubmers & acceptances after each cuts)
 - xxx_signal.dat (final event numbers & acceptances for SRs)
 - log_analysis.txt (log of analsysis phase)
 - evaluation
 - xxx_cl_limits.txt (CLs values for each SRs)
 - xxx_event_numbers.txt (final event numbers and errors)
 - xxx_r_limits.txt (S95 & r values for each SRs)
 - best_signal_regions.txt (summary of the best SR)

実行結果

- result_dir (出力ファイル)
 - delphes
 - xxx_delphes.root (event file after detector simulation)
 - log.delphes.dat (Delphes log)
 - merged.tcl (settings of detector simulation)
 - analysis
 - xxx_cutflow.dat (event nubmers & acceptances after each cuts)
 - xxx_signal.dat (final event numbers & acceptances for SRs)
 - log_analysis.txt (log of analsysis phase)

- 最終的な 制限の 結果は ここに 纏まってる
- evaluation
 - xxx_event_numbers.txt (final event numbers and errors)
 - xxx_r_limits.txt (S95 & r values for each SRs)
 - best_signal_regions.txt (summary of the best SR)
 - xxx_cl_limits.txt (CLs values for each SRs; When FullCL = T)

1. 用語と意味

evaluation/xxx_r_limits.txt

| SR | S | dS_stat | dS_sys | dS_tot | S95_obs | S95_exp | r^c_obs r^c_exp |
|----|--------|---------|--------|--------|----------|----------|-------------------|
| AL | 30.884 | 0.559 | 0.000 | 0.559 | 1341.200 | 1135.000 | 0.022(CS10.026L1) |

S: signal event number after cuts

dS: error of S

stat: statistical MC error

sys: calculated from cross-section errors given by users
tot: total error

S95_obs(exp): observed (expected) 95%CL upper bound of signal

実際の実験解析の論文から引用

$$r_X^c = \frac{S - 1.96 \, dS_{\rm tot}}{S_X^{95}}$$

Combination to get $S \pm \Delta S$



Combine within each process *p* with given σ^{p} , $\Delta \sigma^{p}$

- A Determine \sum weights over all input files for *p*
- & Normalise w.r.t $\mathcal{L}\sigma^{p}$ for S^{p}
- ^A Determine normalised $\sqrt{\sum \text{weights}^2}$ for ΔS_{stat}^p
- \triangle Use $\mathcal{L}\Delta\sigma^{p}$ for ΔS_{sys}^{p}

MC event numbers for unweighted events

Combine different processes

Daniel Schmeier — The Inner Workings of Checkmate

2. 制限に使う signal region の選び方

evaluation/xxx_r_limits.txt

| SR | S | dS_stat | dS_sys | dS_tot | S95_obs | S95_exp | r^c_obs | r^c_exp |
|----|--------|---------|--------|--------|----------|----------|---------|---------|
| AL | 30.884 | 0.559 | 0.000 | 0.559 | 1341.200 | 1135.000 | 0.022 | 0.026 |
| AM | 5.277 | 0.231 | 0.000 | 0.231 | 51.300 | 42.700 | 0.094 | 0.113 |
| BM | 6.915 | 0.264 | 0.000 | 0.264 | 14.900 | 17.000 | 0.429 | 0.376 |
| BT | 0.728 | ~ 0.086 | 0.000 | 0.086 | 6.700 | 5.800 | 0.084 | 0.097 |
| СМ | 16.741 | 0.411 | 0.000 | 0.411 | 81.200 | 72.900 | 0.196 | 0.219 |
| СТ | 1.749 | 0.133 | 0.000 | 0.133 | 2.400 | 3.300 | 0.620 | 0.451 |
| D | 10.938 | 0.333 | 0.000 | 0.333 | 15.500 | 13.600 | 0.664 | 0.756 |
| EL | 18.682 | 0.435 | 0.000 | 0.435 | 92.400 | 57.300 | 0.193 | 0.311 |
| EM | 14.760 | 0.386 | 0.000 | 0.386 | 28.600 | 21.400 | 0.490 | 0.654 |
| ET | 8.502 | 0.293 | 0.000 | 0.293 | 8.300 | 6.500 | 0.955 | 1.220 |
| | | | | 40 | | | | |

$$r_{
m exp}^{c} = rac{S - 1.96 \, dS_{
m tot}}{S_{
m exp}^{95}}$$
が一番大きな SR を、制限をつけるのに使う

3. Allowed/Excluded の判定

evaluation/xxx_r_limits.txt

| _ | | | | | SmartA | | PAZ P | x - y = y |
|----|--------|---------|--------|--------|----------|----------|---------|-----------|
| SR | S | dS_stat | dS_sys | dS_tot | S95_obs | S95_exp | r^c_obs | r^c_exp |
| AL | 30.884 | 0.559 | 0.000 | 0.559 | 1341.200 | 1135.000 | 0.022 | 0.026 |
| AM | 5.277 | 0.231 | 0.000 | 0.231 | 51.300 | 42.700 | 0.094 | 0.113 |
| BM | 6.915 | 0.264 | 0.000 | 0.264 | 14.900 | 17.000 | 0.429 | 0.376 |
| BT | 0.728 | 0.086 | 0.000 | 0.086 | 6.700 | 5.800 | 0.084 | 0.097 |
| СМ | 16.741 | 0.411 - | 0.000 | 0.411 | 81.200 | 72.900 | 0.196 | 0.219 |
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| D | 10.938 | 0.333 | 0.000 | 0.333 | 15.500 | 13.600 | 0.664 | 0.756 |
| EL | 18.682 | 0.435 | 0.000 | 0.435 | 92.400 | 57.300 | 0.193 | 0.311 |
| EM | 14.760 | 0.386 | 0.000 | 0.386 | 28.600 | 21.400 | 0.490 | 0.654 |
| ET | 8.502 | 0.293 | 0.000 | 0.293 | 8.300 | 6.500 | 0.955 | 1.220 |
| | | | | | | | | |

Allowed

$$r_{
m obs}^c = rac{S-1.96\,dS_{
m tot}}{S_{
m obs}^{95}} \geq 1$$
なら 95%CL で Excluded と判定

evaluation/best_signal_regions.txt

| analysis | bestSR | r_obs^c | r_exp^c | CLs_0 | bs dCl | Ls_obs | CLs_exp | dCLs_exp |
|---------------------|---------|---------|---------|-------|--------|--------|---------|----------|
| atlas_conf_2013_047 | ET | 0.955 | 1.220 | 0.048 | 0 0.0 | 0024 | 0.0028 | 0.0008 |
| S | dS_stat | dS_sys | dS_tot | B | dB | 0 | S95_obs | S95_exp |
| 8.502 | 0.293 | 0.000 | 0.293 | 2.900 | 1.800 | 5.000 | 8.300 | 6.500 |

生死の判定に使った Signal region の情報がまとまっている

解析ライブラリについて

CheckMATE で制限をだすには、適用したい 解析を CheckMATE 用にコーディングすることが必要。

> 有志(主に開発者)が作成した解析コードがいくつか パッケージに入っている(解析ライブラリ)。 各解析の説明 & validation note は HP メニューの "List of Analysis" に書いてある。

解析ライブラリについて

- Home
- Downloads
- Documentation
- Installation Tutorial
- CheckMATE Tutorial
- Overview of Analyses
- List of Analyses
- Unvalidated Analyses
- F.A.Q.
- Doxygen documentation
- Questions/Comments/Bugs
- Contact

Validated List of Analyses

The analyses list below have been validated and are 'certified' for use. Please click on 'validation' to find the accompanying pdf.

atlas_1308_1841 validation

Collaboration: ATLAS Signal: >= 6 jets + Etmiss Luminosity: 20.3 fb^(-1) Authors: Junjie Cao, Liangliang Shang, Jin Min Yang and Yang Zhang If you use this analysis in your study please cite: arXiv:1504.07869 NOTE: Large radius jet signal regions NOT included

atlas_1308_2631 validation

Collaboration: ATLAS Signal: 0 leptons + 2 b-jets + Etmiss Luminosity: 20.1 fb⁽⁻¹⁾

atlas_1402_7029 validation

Collaboration: ATLAS Signal: 3 leptons + Etmiss Luminosity: 20.3 fb⁽⁻¹⁾

atlas_1403_4853 validation

Collaboration: ATLAS Signal: Stop search with 2 leptons Luminosity: 20.3 fb⁽⁻¹⁾

解析ライブラリ: validation

| | $m_{	ilde{g}}=1000 GeV,\mu=700 GeV$ | | | | | | | | | |
|-------------------------------------|-------------------------------------|---|------|------------------|------------------|------|--|--|--|--|
| | | $N_{raw}^{EXP} = 100000, N_{raw}^{OUR} = 50000$ | | | | | | | | |
| | E | XP | (| DUR | DIFF | I | | | | |
| No cuts | 71.8 | 3 ± 0.0 | 71. | $.8{\pm}0.0$ | | | | | | |
| At least 2 leptons | 33.8 | ± 0.12 | 26.' | $7{\pm}0.16$ | -21% | | | | | |
| | | ee | | | $\mu\mu$ | | | | | |
| | EXP | OUR | DIFF | EXP | OUR | DIFF | | | | |
| Lepton flavour | 14.3 ± 0.09 | 11.48 ± 0.12 | -20% | $9.3{\pm}0.07$ | $10.04{\pm}0.11$ | 8% | | | | |
| PromptLeptons | 14.0 ± 0.09 | $11.47{\pm}0.12$ | -18% | $9.3{\pm}0.07$ | $10.04{\pm}0.11$ | 8% | | | | |
| Opposite charged leptons | $13.3 {\pm} 0.09$ | $11.27{\pm}0.12$ | -15% | $8.8 {\pm} 0.07$ | $9.94{\pm}0.11$ | 13% | | | | |
| > 1 jet | 12.8 ± 0.09 | 10.48 ± 0.11 | -18% | $8.4{\pm}0.07$ | $9.07{\pm}0.11$ | 8% | | | | |
| $m_{ll} > 15$ | $12.0{\pm}0.09$ | 10.48 ± 0.11 | -13% | $8.3 {\pm} 0.07$ | $9.04{\pm}0.11$ | 9% | | | | |
| $\Delta\phi(j_1, E_T^{miss}) > 0.4$ | 11.3 ± 0.09 | $9.84{\pm}0.11$ | -13% | $8.0{\pm}0.07$ | $8.47{\pm}0.10$ | 6% | | | | |
| $\Delta\phi(j_2, E_T^{miss}) > 0.4$ | $10.3{\pm}0.08$ | $8.82{\pm}0.11$ | -14% | $7.2{\pm}0.07$ | $7.66{\pm}0.10$ | 6% | | | | |
| $81 GeV < m_{ll} < 101 GeV$ | $8.8{\pm}0.08$ | 8.1 ± 0.10 | -8% | $5.9{\pm}0.06$ | $6.38{\pm}0.09$ | 8% | | | | |
| $H_T > 600 GeV$ | $8.4{\pm}0.08$ | 6.94 ± 0.09 | -17% | $5.6{\pm}0.06$ | $5.52{\pm}0.09$ | -1% | | | | |
| $E_T^{miss} > 225 GeV$ | $6.7 {\pm} 0.07$ | 5.44 ± 0.08 | -19% | 4.4 ± 0.06 | $4.28{\pm}0.08$ | -3% | | | | |



自分で解析コードを作るには

CheckMATEに用意されている解析コードは まだ少ない

欲しい解析コードがない場合、、、 自分で作って CheckMATE に入れたい。

解析コードの雛形を用意するお助けツールを使う

Analysis Manager で雛形作り

cd CheckMATE-1.2.2 make AnalysisManager ./bin/AnalysisManager

Analysis Manager が起動するので、あとは質問にいろいろ 答えながら、実装したい実験解析の情報を入れていく。

The set of information you entered is valid. You now have to add the numbers for each of the given signal regions. Note that while you enter more numbers, the corresponding model independent 95\% confidence limits for the items you have already entered are calculated in the background. on-Z obs: 29 bkg: 10.6 bkg_err: 3.2 S95obs and S95exp values are calculated internally (progress: 0 / 2) 3. Settings for Detector Simulation 3.1: Miscellaneous To which experiment does the analysis correspond? [(A)TLAS, (C)MS]

Analysis Manager で雛形作り

- Variable values saved in /Users/yoshi/packages/checkmate_v1.2.1_2/data/test_analysis_var.j
- Created source file /Users/yoshi/packages/checkmate_v1.2.1_2/tools/analysis/src/analyses/test_analysis.cc
- Created header file /Users/yoshi/packages/checkmate_v1.2.1_2/tools/analysis/include/analyses/test_analysis.h
- Updated Makefile
- Updated main source main.cc
- Reference file created
- List of analyses updated

Analysis test_analysis has been added successfully! Run 'autoreconf; ./configure {parameters}; make' to compile the new sources.

入力が完了したら、

CheckMATE-1.2.2/tools/analysis/src/analysis 以下に C++ の スケルトン解析コードができてるので、ROOTで解析コードを 書くように、必要な Cut 等を加えていけばいいと思われる。 (未経験なのでここまで)

Analysis library リスト

ちなみに、Analysis Manager を起動した画面で "I" を入力すると、 現在使える解析リストが見れる

| *************************************** | | | | | | | | | | |
|---|-----|---|------|-----|---|--|--|--|--|--|
| # #Name | NSR | Description | Lumi | CR? | # | | | | | |
| # atlas_1210_2979 | 1 | ATLAS, WW measurement with 2 leptons (7TeV) | 4.6 | no | # | | | | | |
| # atlas_1308_2631 | 6 | ATLAS, 0 leptons + 2 b-jets + etmiss | 20.1 | yes | # | | | | | |
| # atlas_1402_7029 | 20 | ATLAS, 3 leptons + etmiss (chargino+neutralino) | 20.3 | no | # | | | | | |
| # atlas_1403_4853 | 12 | ATLAS, 2 leptons + etmiss (direct stop) | 20.3 | no | # | | | | | |
| # atlas_1403_5294 | 13 | ATLAS, 2 leptons + etmiss, (SUSY electroweak) | 20.3 | yes | # | | | | | |
| <pre># atlas_1403_5294_CR</pre> | 4 | ATLAS, 2 leptons + etmiss CR, (SUSY electroweak) | 20.3 | yes | # | | | | | |
| # atlas_1404_2500 | 5 | ATLAS, Same sign dilepton or 3l | 20.3 | no | # | | | | | |
| # atlas_1407_0583 | 27 | ATLAS, 1 lepton + (b-)jets + etmiss (stop) | 20.3 | no | # | | | | | |
| # atlas_1407_0600 | 9 | ATLAS, 3 b-jets + 0-1 lepton + etmiss | 20.1 | no | # | | | | | |
| # atlas_1407_0608 | 3 | ATLAS, Monojet or charm jet (stop) | 20.3 | no | # | | | | | |
| # atlas_1502_01518 | 9 | ATLAS, Monojet plus missing energy | 20.3 | no | # | | | | | |
| # atlas_conf_2012_104 | 2 | ATLAS, 1 lepton + >= 4 jets + etmiss | 5.8 | yes | # | | | | | |
| # atlas_conf_2012_147 | 4 | ATLAS, Monojet + etmiss | 10.0 | yes | # | | | | | |
| # atlas_conf_2013_021 | 4 | ATLAS, WZ standard model (3 leptons + etmiss) | 13.0 | no | # | | | | | |
| # atlas_conf_2013_024 | 3 | ATLAS, 0 leptons + 6 (2 b-)jets + etmiss | 20.5 | yes | # | | | | | |
| # atlas_conf_2013_031 | 2 | ATLAS: Higgs spin measurement (WW) | 20.7 | no | # | | | | | |
| # atlas_conf_2013_036 | 5 | ATLAS: 4 leptons + etmiss | 20.7 | no | # | | | | | |
| # atlas_conf_2013_047 | 10 | ATLAS, 0 leptons + 2–6 jets + etmiss | 20.3 | yes | # | | | | | |
| # atlas_conf_2013_049 | 9 | ATLAS, 2 leptons + etmiss | 20.3 | yes | # | | | | | |
| # atlas_conf_2013_061 | 9 | ATLAS, 0-1 leptons + >= 3 b-jets + etmiss | 20.1 | yes | # | | | | | |
| # atlas_conf_2013_062 | 19 | ATLAS: 1–2 leptons + 3–6 jets + etmiss | 20.1 | yes | # | | | | | |
| # atlas_conf_2013_089 | 12 | ATLAS, 2 leptons (razor) | 20.3 | yes | # | | | | | |
| # atlas_conf_2014_014 | 1 | ATLAS, 2 leptons + b-jets (stop) | 20.3 | yes | # | | | | | |
| # atlas_conf_2014_033 | 3 | ATLAS, WW standard model measurement | 20.3 | yes | # | | | | | |
| # atlas_conf_2014_056 | 1 | ATLAS, ttbar spin correlation measurement | 20.3 | yes | # | | | | | |
| # cms_1303_2985 | 59 | CMS, alpha_T + b-jets | 11.7 | yes | # | | | | | |
| # cms_1301_4698_WW | 1 | CMS, WW standard model measurement | 3.5 | no | # | | | | | |
| # cms_1306_1126_WW | 1 | CMS, WW standard model measurement (7TeV) | 4.9 | no | # | | | | | |
| # cms_1405_7570 | 57 | CMS, Various chargino and neutralino | 19.5 | no | # | | | | | |
| # cms_smp_12_006 | 4 | CMS, WZ standard model (3 leptons + etmiss) | 19.6 | no | # | | | | | |
| # cms_sus_12_019 | 4 | CMS, 2 leptons, >= 2 jets + etmiss (dilep edge) | 19.4 | no | # | | | | | |
| # cms_sus_13_016 | 1 | CMS, OS lep 3+ b-tags | 19.5 | no | # | | | | | |
| # # Superseded analyses | # | | | | | | | | | |
| # #atlas conf 2013 035 | 6 | ATLAS, Superseded by atlas 1402 7029 | 20.7 | no | # | | | | | |
| # #atlas_conf_2013_037 | 6 | ATLAS, Superseded by atlas 1407 0583 | 20.7 | no | # | | | | | |
| # #atlas_conf_2013_048 | 4 | ATLAS, Superseded by atlas_1403_4853 | 20.0 | no | # | | | | | |
| # # User added analyses | # | | | | | | | | | |
| # # | | | | | | | | | | |
| # atlas 1411 1559 | 1 | Search for new phenomena in events with a photon and missing transverse momentum in pp collisions | 20.3 | no | # | | | | | |

Delphes for CheckMATE

- CheckMATE を使って ATLAS, CMS の解析をある程度
 再現できるようにいろいろ tune してある
 (a few% ~ 10% くらいの精度で再現)
- CheckMATEの開発者によって専門的に

メインテナンスされており、基本的にブラックボックス として使う

Detector Simulation



Delphes 3.0.10 Standard

- A Simulates track reconstruction
- A Determines energy deposits of all particles
- Applies identification efficiencies for photons and leptons
- ^Å Clusters jets
- A Performs energy/momentum smearings of all reconstructed objects
- A Evaluates total missing energy
- A Checks isolation conditions for photons and leptons
- Applies b-/ tau-tag on jets



Delphes tuning



B tagging efficiency of jets containing light quarks

Signal efficiencies for 3 prong taus

Delphes for CheckMATE Validation plots

CheckMATE で tune されている Delphes を使う



CheckMATE 2

そのうちメジャー update があるようです

- CheckMATE 2 will be public soon
- A Pythia module is added to CheckMATE
- The user can select a process (a number of supersymmetric processes are implemented)
- MC events can be directly interfaced with Delphes (without writing hepmc files)
- Delphes events are interfaced to CheckMATE (no root file is generated)
- CheckMATE can be used with the most recent Delphes version soon
- Implemented tools two combine SR

まとめ

今日の話の確認

CheckMate の使い方の説明 > CheckMate を使ってモデルポイントの生死が調べられ る

CheckMate の補足 > CheckMate が何を やっているのかが大体分かる

好きなモデルの生死を調べてみましょう