

CheckMATE 実習

Yoshitaro Takaesu
U. Tokyo

**CheckMATE を使って、
先週配布した
sample point の event を
解析してみる**

SUSY Analyses in CheckMATE

特徴的 かつ simple なやつをいくつか

atlas_1405_7875

2-6 jets +ET_miss

- $p_{T_j1} > 130$ GeV
- $p_{T_j2-6} > 60$ or 40 GeV
- $ET_miss > 160$ GeV
- $ET_miss / \sqrt{H_T}$ or ET_miss / m_{eff} cut

hard jet の数と m_{eff} によって signal region を分類

Requirement	Signal Region					
	2jl	2jm	2jt	2jW	3j	4jW
$m_{eff}(\text{incl.}) [\text{GeV}] >$	800	1200	1600	1800	2200	1100

Requirement	4jl-	4jl	4jm	4jt	5j	6jl	6jm	6jt	6jt+
$m_{eff}(\text{incl.}) [\text{GeV}] >$	700	1000	1300	2200	1200	900	1200	1500	1700

atlas_conf_2013_024

$t\bar{t}$ (all hadronic) +ET_miss

- $N_{\text{lepton}} = 0$
- $N_{\text{jet}} \geq 6$
- $pT_{j1,2} > 80 \text{ GeV}$
- $pT_{j3-6} > 35 \text{ GeV}$
- $N_{\text{bjet}} \geq 2$
- $80 \text{ GeV} < M_{\text{jjj}} < 270 \text{ GeV}$
- $mT(\text{bjet}, \text{ET}_{\text{miss}}) > 175$
- $\text{ET}_{\text{miss}} > 200 \text{ GeV}$ (**SR1**)
300 GeV (**SR2**)
350 GeV (**SR3**)

← Require $t\bar{t}$ like final state with hadronic decay

atlas_1402_7029

3 leptons +ET_miss

- N_lepton = 3
- N_bjet = 0 ← Reduce top BG

tau の数 と lepton charge によって signal region を分類

Signal region	SR0 τ a	SR0 τ b	SR1 τ	SR2 τ a	SR2 τ b
Flavour/sign	l^+l^-l, l^+l^-l'	$l^\pm l^\pm l'^\mp$	$\tau^\pm l^\mp l'^\mp, \tau^\pm l^\mp l'^\mp$	$\tau\tau l$	$\tau^+\tau^-l$
b-tagged jet	veto	veto	veto	veto	veto
E_T^{miss}	binned	> 50	> 50	> 50	> 60
Other	m_{SFOS} binned m_T binned	$p_T^{3\text{rd } l} > 20$ $\Delta\phi_{ll'}^{\text{min}} \leq 1.0$	$p_T^{2\text{nd } l} > 30$ $\sum p_T^l > 70$ $m_{\ell\tau} < 120$ $m_{ee} Z$ veto	$m_{T2}^{\text{max}} > 100$	$\sum p_T^\tau > 110$ $70 < m_{\tau\tau} < 120$
Target model	\tilde{l}, WZ -mediated	Wh -mediated	Wh -mediated	$\tilde{\tau}_L$ -mediated	Wh -mediated

atlas_1402_7029

**SR0tau a is
Further divided
into 20 binned
regions**

SR0 τ a bin	m_{SFOS}	m_{T}	$E_{\text{T}}^{\text{miss}}$	3 ℓ Z veto
1	12–40	0–80	50–90	no
2	12–40	0–80	> 90	no
3	12–40	> 80	50–75	no
4	12–40	> 80	> 75	no
5	40–60	0–80	50–75	yes
6	40–60	0–80	> 75	no
7	40–60	> 80	50–135	no
8	40–60	> 80	> 135	no
9	60–81.2	0–80	50–75	yes
10	60–81.2	> 80	50–75	no
11	60–81.2	0–110	> 75	no
12	60–81.2	> 110	> 75	no
13	81.2–101.2	0–110	50–90	yes
14	81.2–101.2	0–110	> 90	no
15	81.2–101.2	> 110	50–135	no
16	81.2–101.2	> 110	> 135	no
17	> 101.2	0–180	50–210	no
18	> 101.2	> 180	50–210	no
19	> 101.2	0–120	> 210	no
20	> 101.2	> 120	> 210	no

$$m_{\text{T}}(\vec{p}_{\text{T}}^{\ell}, \vec{p}_{\text{T}}^{\text{miss}}) = \sqrt{2p_{\text{T}}^{\ell} E_{\text{T}}^{\text{miss}} - 2\vec{p}_{\text{T}}^{\ell} \cdot \vec{p}_{\text{T}}^{\text{miss}}}$$

やってみよう

(第1回目の復習)

Sample point の Cross section

先週配布した Sample point の hepmc file を CheckMATE に渡す時は、以下の NLO Cross section を使ってください

- **Point1** Cross section: 6.78 ± 0.018 fb
- **Point2** Cross section: 768 ± 0.29 fb
- **Point3** Cross section: 30 ± 0.016 fb
- **Point4** Cross section: 190 ± 0.93 fb

By Prospino2

How to run CheckMATE

1. Go to CheckMATE_dir/bin

How to run CheckMATE

1. Go to CheckMATE_dir/bin
2. make params.dat

```
[Mandatory Parameters]
```

```
Name: demo
```

```
Analyses: atlas_1405_7875,  
          atlas_conf_2013_024,  
          atlas_1402_7029
```

```
[Optional Parameters]
```

```
OutputDirectory: results
```

```
[point1]
```

```
XSect: 6.78*FB
```

```
XSectErr: 0.018*FB
```

```
Events: hepmcs/point1.hepmc
```

How to run CheckMATE

1. Go to CheckMATE_dir/bin
2. make params.dat
3. ./CheckMATE param.dat

How to run CheckMATE

1. Go to CheckMATE_dir/bin
2. make params.dat
3. ./CheckMATE param.dat

```
*****
***** DELPHES + ANALYSES *****
*****
* Processing file '/Users/yoshi/projects/NojiriColliderSchool/TalkData/hepmcs/po
int1.hepmc'
** - Delphes
** [#####] (100.00%)
** - Analysis
    -atlas_1405_7875
    -atlas_conf_2013_024
    -atlas_1402_7029
```

```
*****
***** EVALUATION *****
*****
```

```
Test: Calculation of  $r = \text{signal}/(95\%CL \text{ limit on signal})$ 
Warning: Error is dominated by Monte Carlo statistics!
Result: Excluded
Result for r: r_max = 1.36231
SR: atlas_1405_7875 - SR05_d.6jt+
```

How to run CheckMATE

1. Go to CheckMATE_dir/bin
2. make params.dat
3. ./CheckMATE param.dat
4. Check evaluation dir in the CheckMATE results dir

results/demo/evaluation/best_signal_regions.txt

analysis	bestSR	r_obs ^c	r_exp ^c	S	dS_stat	dS_sys	dS_tot	S95_obs	S95_exp
atlas_1405_7875	SR05_d.6jt+	1.362	1.631	12.041	0.652	0.032	0.653	7.900	6.600
atlas_conf_2013_024	SR2	0.110	0.074	1.430	0.528	0.004	0.528	3.600	5.300
atlas_1402_7029	SR0taua20	0.000	0.000	0.000	0.014	0.000	0.014	2.900	2.900

Jets +MET

tt~ +MET

3lepton +MET