

# The LaTeX report

---

Generated by elijahsheridan on 29 March 2020, 03:57:14

This report has been generated automatically by MADANALYSIS 5.

Please cite:

**E. Conte, B. Fuks and G. Serret,**  
*MadAnalysis 5, A User-Friendly Framework for Collider Phenomenology,*  
Comput. Phys. Commun. **184** (2013) 222-256,  
arXiv:1206.1599 [hep-ph].

To contact us:

<http://madanalysis.irmp.ucl.ac.be>  
[ma5team@iphc.cnrs.fr](mailto:ma5team@iphc.cnrs.fr)

---

## Contents

<b>1</b>	<b>Setup</b>	<b>2</b>
1.1	Command history	2
1.2	Configuration	3
<b>2</b>	<b>Datasets</b>	<b>4</b>
2.1	signal	4
2.2	bg_vbf_0_100	4
2.3	bg_vbf_100_200	4
2.4	bg_vbf_200_400	5
2.5	bg_vbf_400_600	5
2.6	bg_vbf_600_800	6
2.7	bg_vbf_800_1200	6
2.8	bg_vbf_1200_1600	7
2.9	bg_vbf_1600_inf	7
2.10	bg_dip_0_100	7
2.11	bg_dip_100_200	8
2.12	bg_dip_200_400	8
2.13	bg_dip_400_600	9
2.14	bg_dip_600_800	9
2.15	bg_dip_800_1200	9
2.16	bg_dip_1200_1600	10
2.17	bg_dip_1600_inf	10
<b>3</b>	<b>Histos and cuts</b>	<b>11</b>
3.1	Cut 1	11
3.2	Cut 2	12
<b>4</b>	<b>Summary</b>	<b>13</b>
4.1	Cut-flow charts	13

---

# 1 Setup

## 1.1 Command history

```
ma5># set directory where running "./bin/ma5"; set lumi; define the signal significance
ma5>set main.currentdir = /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno # need to
change this directory path -> exit and type "pwd" to get the path
ma5>set main.lumi = 40.0
ma5># import samples -> change the path to the LHE file
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/madgraph_data/axion_signal/-
axion_signal_gurrola_cuts_1MeV.lhe.gz as signal
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/madgraph_data/vbf_diphoton_background_
merged_lhe/vbf_diphoton_background_ht_0_100_merged.lhe.gz as bg_vbf_0_100
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/madgraph_data/vbf_diphoton_background_
merged_lhe/vbf_diphoton_background_ht_100_200_merged.lhe.gz as bg_vbf_100_200
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/madgraph_data/vbf_diphoton_background_
merged_lhe/vbf_diphoton_background_ht_200_400_merged.lhe.gz as bg_vbf_200_400
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/madgraph_data/vbf_diphoton_background_
merged_lhe/vbf_diphoton_background_ht_400_600_merged.lhe.gz as bg_vbf_400_600
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/madgraph_data/vbf_diphoton_background_
merged_lhe/vbf_diphoton_background_ht_600_800_merged.lhe.gz as bg_vbf_600_800
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/madgraph_data/vbf_diphoton_background_
merged_lhe/vbf_diphoton_background_ht_800_1200_merged.lhe.gz as bg_vbf_800_1200
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/madgraph_data/vbf_diphoton_background_
merged_lhe/vbf_diphoton_background_ht_1200_1600_merged.lhe.gz as bg_vbf_1200_1600
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/madgraph_data/vbf_diphoton_background_
merged_lhe/vbf_diphoton_background_ht_1600_inf_merged.lhe.gz as bg_vbf_1600_inf
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/madgraph_data/diphoton_double_isr_back
merged_lhe/diphoton_double_isr_background_ht_0_100_merged.lhe.gz as bg_dip_0_100
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/madgraph_data/diphoton_double_isr_back
merged_lhe/diphoton_double_isr_background_ht_100_200_merged.lhe.gz as bg_dip_100_200
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/madgraph_data/diphoton_double_isr_back
merged_lhe/diphoton_double_isr_background_ht_200_400_merged.lhe.gz as bg_dip_200_400
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/madgraph_data/diphoton_double_isr_back
merged_lhe/diphoton_double_isr_background_ht_400_600_merged.lhe.gz as bg_dip_400_600
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/madgraph_data/diphoton_double_isr_back
merged_lhe/diphoton_double_isr_background_ht_600_800_merged.lhe.gz as bg_dip_600_800
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/madgraph_data/diphoton_double_isr_back
merged_lhe/diphoton_double_isr_background_ht_800_1200_merged.lhe.gz as bg_dip_800_1200
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/madgraph_data/diphoton_double_isr_back
merged_lhe/diphoton_double_isr_background_ht_1200_1600_merged.lhe.gz as bg_dip_1200_1600
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/madgraph_data/diphoton_double_isr_back
merged_lhe/diphoton_double_isr_background_ht_1600_inf_merged.lhe.gz as bg_dip_1600_inf
ma5># define bg and signal samples
ma5>set signal.type = signal
ma5>set bg_vbf_0_100.type = background
ma5>set bg_vbf_100_200.type = background
ma5>set bg_vbf_200_400.type = background
ma5>set bg_vbf_400_600.type = background
ma5>set bg_vbf_600_800.type = background
```

```

ma5>set bg_vbf_800_1200.type = background
ma5>set bg_vbf_1200_1600.type = background
ma5>set bg_vbf_1600_inf.type = background
ma5>set bg_dip_0_100.type = background
ma5>set bg_dip_100_200.type = background
ma5>set bg_dip_200_400.type = background
ma5>set bg_dip_400_600.type = background
ma5>set bg_dip_600_800.type = background
ma5>set bg_dip_800_1200.type = background
ma5>set bg_dip_1200_1600.type = background
ma5>set bg_dip_1600_inf.type = background
ma5># define weights for the samples
ma5>#set sample_1.weight = 1
ma5>#set sample_2.weight = 1
ma5># a jet can be from a light quark or b quark
ma5>define jets = j
ma5>define e = e+ e-
ma5>define mu = mu+ mu-
ma5>define ta = ta+ ta-
ma5>define lept = e mu ta
ma5>define ax = 9000005
ma5># selections
ma5>select (sdETA(jets[1] jets[2]) > 3.6 or sdETA(jets[1] jets[2]) < -3.6) and M(jets[1]
jets[2]) > 1250
ma5>select PT(a[1]) > 450 and M(a[1] a[2]) > 400
ma5>submit analysis_tight_pta450_maa400

```

## 1.2 Configuration

- MadAnalysis version 1.6.33 (2017/11/20).
- Histograms given for an integrated luminosity of  $40.0\text{fb}^{-1}$ .

## 2 Datasets

### 2.1 signal

- Samples stored in the directory: [/Users/elijahsheridan/MG5\\_aMC\\_v2\\_6\\_5/axion\\_pheno/-optimization](#) .
- Sample consisting of: [signal](#) events.
- Generated events: [1000000](#) events.
- Normalization to the luminosity: [4094+/- 2](#) events.
- Ratio (event weight): [0.0041](#) .

Path to the event file	Nr. of events	Cross section (pb)	Negative wgts (%)
/Users/elijahsheridan/-MG5_aMC_v2_6_5/-axion_pheno/-madgraph_data/axion_signal/-axion_signal_gurrola_cuts_1MeV.lh	1000000	0.102 @ 0.028%	0.0

### 2.2 bg\_vbf\_0\_100

- Samples stored in the directory: [/Users/elijahsheridan/MG5\\_aMC\\_v2\\_6\\_5/axion\\_pheno/-optimization](#) .
- Sample consisting of: [background](#) events.
- Generated events: [1000000](#) events.
- Normalization to the luminosity: [12150+/- 24](#) events.
- Ratio (event weight): [0.012](#) .

Path to the event file	Nr. of events	Cross section (pb)	Negative wgts (%)
/Users/elijahsheridan/-MG5_aMC_v2_6_5/-axion_pheno/madgraph_data/-vbf_diphoton_background_data/-merged_lhe/-vbf_diphoton_background_ht_0_100	1000000	0.304 @ 0.19%	0.0

### 2.3 bg\_vbf\_100\_200

- Samples stored in the directory: [/Users/elijahsheridan/MG5\\_aMC\\_v2\\_6\\_5/axion\\_pheno/-optimization](#) .
- Sample consisting of: [background](#) events.
- Generated events: [965662](#) events.

- Normalization to the luminosity: 9695 $\pm$ 17 events.
- Ratio (event weight): 0.01 .

Path to the event file	Nr. of events	Cross section (pb)	Negative wgts (%)
/Users/elijahsheridan/- MG5_aMC_v2_6_5/- axion_pheno/madgraph_data/- vbf_diphoton_background_data/- merged_lhe/- vbf_diphoton_background_ht_100_	965662	0.242 @ 0.17%	0.0

#### 2.4 bg\_vbf\_200\_400

- Samples stored in the directory: /Users/elijahsheridan/MG5\_aMC\_v2\_6\_5/axion\_pheno/-  
optimization .
- Sample consisting of: background events.
- Generated events: 984165 events.
- Normalization to the luminosity: 5413 $\pm$ 11 events.
- Ratio (event weight): 0.0055 .

Path to the event file	Nr. of events	Cross section (pb)	Negative wgts (%)
/Users/elijahsheridan/- MG5_aMC_v2_6_5/- axion_pheno/madgraph_data/- vbf_diphoton_background_data/- merged_lhe/- vbf_diphoton_background_ht_200_	984165	0.135 @ 0.2%	0.0

#### 2.5 bg\_vbf\_400\_600

- Samples stored in the directory: /Users/elijahsheridan/MG5\_aMC\_v2\_6\_5/axion\_pheno/-  
optimization .
- Sample consisting of: background events.
- Generated events: 1000000 events.
- Normalization to the luminosity: 986 $\pm$ 2 events.
- Ratio (event weight): 0.00099 .

Path to the event file	Nr. of events	Cross section (pb)	Negative wgts (%)
/Users/elijahsheridan/- MG5_aMC_v2_6_5/- axion_pheno/madgraph_data/- vbf_diphoton_background_data/- merged_lhe/- vbf_diphoton_background_ht_400_	1000000	0.0247 @ 0.14%	0.0

## 2.6 bg\_vbf\_600\_800

- Samples stored in the directory: [/Users/elijahsheridan/MG5\\_aMC\\_v2\\_6\\_5/axion\\_pheno/-optimization](#) .
- Sample consisting of: [background](#) events.
- Generated events: [1000000](#) events.
- Normalization to the luminosity: [252+/- 1](#) events.
- Ratio (event weight): [0.00025](#) .

Path to the event file	Nr. of events	Cross section (pb)	Negative wgts (%)
/Users/elijahsheridan/- MG5_aMC_v2_6_5/- axion_pheno/madgraph_data/- vbf_diphoton_background_data/- merged_lhe/- vbf_diphoton_background_ht_600_	1000000	0.0063 @ 0.13%	0.0

## 2.7 bg\_vbf\_800\_1200

- Samples stored in the directory: [/Users/elijahsheridan/MG5\\_aMC\\_v2\\_6\\_5/axion\\_pheno/-optimization](#) .
- Sample consisting of: [background](#) events.
- Generated events: [400839](#) events.
- Normalization to the luminosity: [114+/- 1](#) events.
- Ratio (event weight): [0.00028](#) .

Path to the event file	Nr. of events	Cross section (pb)	Negative wgts (%)
/Users/elijahsheridan/- MG5_aMC_v2_6_5/- axion_pheno/madgraph_data/- vbf_diphoton_background_data/- merged_lhe/- vbf_diphoton_background_ht_800_	400839	0.00287 @ 0.16%	0.0

## 2.8 bg\_vbf\_1200\_1600

- Samples stored in the directory: [/Users/elijahsheridan/MG5\\_aMC\\_v2\\_6\\_5/axion\\_pheno/-optimization](#) .
- Sample consisting of: [background](#) events.
- Generated events: [953803](#) events.
- Normalization to the luminosity: [20+/- 1](#) events.
- Ratio (event weight): [2.1e-05](#) .

Path to the event file	Nr. of events	Cross section (pb)	Negative wgts (%)
<a href="#">/Users/elijahsheridan/-MG5_aMC_v2_6_5/-axion_pheno/madgraph_data/-vbf_diphoton_background_data/-merged_lhe/-vbf_diphoton_background_ht_1200</a>	953803	0.000515 @ 0.16%	0.0

## 2.9 bg\_vbf\_1600\_inf

- Samples stored in the directory: [/Users/elijahsheridan/MG5\\_aMC\\_v2\\_6\\_5/axion\\_pheno/-optimization](#) .
- Sample consisting of: [background](#) events.
- Generated events: [270148](#) events.
- Normalization to the luminosity: [7+/- 1](#) events.
- Ratio (event weight): [2.6e-05](#) .

Path to the event file	Nr. of events	Cross section (pb)	Negative wgts (%)
<a href="#">/Users/elijahsheridan/-MG5_aMC_v2_6_5/-axion_pheno/madgraph_data/-vbf_diphoton_background_data/-merged_lhe/-vbf_diphoton_background_ht_1600</a>	270148	0.000191 @ 0.11%	0.0

## 2.10 bg\_dip\_0\_100

- Samples stored in the directory: [/Users/elijahsheridan/MG5\\_aMC\\_v2\\_6\\_5/axion\\_pheno/-optimization](#) .
- Sample consisting of: [background](#) events.
- Generated events: [1040000](#) events.
- Normalization to the luminosity: [2710847+/- 4614](#) events.



- **Ratio (event weight): 2.6 - warning: please generate more events (weight larger than 1)!**

Path to the event file	Nr. of events	Cross section (pb)	Negative wgts (%)
/Users/elijahsheridan/- MG5_aMC_v2_6_5/- axion_pheno/madgraph_data/- diphoton_double_isr_background_c merged_lhe/- diphoton_double_isr_background_l	1040000	67.8 @ 0.17%	0.0

### 2.11 bg\_dip\_100\_200

- Samples stored in the directory: [/Users/elijahsheridan/MG5\\_aMC\\_v2\\_6\\_5/axion\\_pheno/-optimization](#) .
- Sample consisting of: [background](#) events.
- Generated events: [1040000](#) events.
- Normalization to the luminosity: [1095362+/- 1528](#) events.
- **Ratio (event weight): 1.1 - warning: please generate more events (weight larger than 1)!**

Path to the event file	Nr. of events	Cross section (pb)	Negative wgts (%)
/Users/elijahsheridan/- MG5_aMC_v2_6_5/- axion_pheno/madgraph_data/- diphoton_double_isr_background_c merged_lhe/- diphoton_double_isr_background_l	1040000	27.4 @ 0.14%	0.0

### 2.12 bg\_dip\_200\_400

- Samples stored in the directory: [/Users/elijahsheridan/MG5\\_aMC\\_v2\\_6\\_5/axion\\_pheno/-optimization](#) .
- Sample consisting of: [background](#) events.
- Generated events: [1040000](#) events.
- Normalization to the luminosity: [239548+/- 414](#) events.
- **Ratio (event weight): 0.23** .

Path to the event file	Nr. of events	Cross section (pb)	Negative wgts (%)
/Users/elijahsheridan/- MG5_aMC_v2_6_5/- axion_pheno/madgraph_data/- diphoton_double_isr_background_c merged_lhe/- diphoton_double_isr_background_l	1040000	5.99 @ 0.17%	0.0

### 2.13 bg\_dip\_400\_600

- Samples stored in the directory: [/Users/elijahsheridan/MG5\\_aMC\\_v2\\_6\\_5/axion\\_pheno/-optimization](#) .
- Sample consisting of: [background](#) events.
- Generated events: [1040000](#) events.
- Normalization to the luminosity: [28798+/- 53](#) events.
- Ratio (event weight): [0.028](#) .

Path to the event file	Nr. of events	Cross section (pb)	Negative wgts (%)
<a href="#">/Users/elijahsheridan/-MG5_aMC_v2_6_5/-axion_pheno/madgraph_data/-diphoton_double_isr_background_cmerged_lhe/-diphoton_double_isr_background_l</a>	1040000	0.72 @ 0.18%	0.0

### 2.14 bg\_dip\_600\_800

- Samples stored in the directory: [/Users/elijahsheridan/MG5\\_aMC\\_v2\\_6\\_5/axion\\_pheno/-optimization](#) .
- Sample consisting of: [background](#) events.
- Generated events: [662009](#) events.
- Normalization to the luminosity: [6674+/- 28](#) events.
- Ratio (event weight): [0.01](#) .

Path to the event file	Nr. of events	Cross section (pb)	Negative wgts (%)
<a href="#">/Users/elijahsheridan/-MG5_aMC_v2_6_5/-axion_pheno/madgraph_data/-diphoton_double_isr_background_cmerged_lhe/-diphoton_double_isr_background_l</a>	662009	0.167 @ 0.41%	0.0

### 2.15 bg\_dip\_800\_1200

- Samples stored in the directory: [/Users/elijahsheridan/MG5\\_aMC\\_v2\\_6\\_5/axion\\_pheno/-optimization](#) .
- Sample consisting of: [background](#) events.
- Generated events: [1040000](#) events.
- Normalization to the luminosity: [2942+/- 6](#) events.

- Ratio (event weight): 0.0028 .

Path to the event file	Nr. of events	Cross section (pb)	Negative wgts (%)
/Users/elijahsheridan/- MG5_aMC_v2_6_5/- axion_pheno/madgraph_data/- diphoton_double_isr_background_c merged_lhe/- diphoton_double_isr_background_l	1040000	0.0736 @ 0.17%	0.0

## 2.16 bg\_dip\_1200\_1600

- Samples stored in the directory: /Users/elijahsheridan/MG5\_aMC\_v2\_6\_5/axion\_pheno/-optimization .
- Sample consisting of: background events.
- Generated events: 337115 events.
- Normalization to the luminosity: 513+/- 3 events.
- Ratio (event weight): 0.0015 .

Path to the event file	Nr. of events	Cross section (pb)	Negative wgts (%)
/Users/elijahsheridan/- MG5_aMC_v2_6_5/- axion_pheno/madgraph_data/- diphoton_double_isr_background_c merged_lhe/- diphoton_double_isr_background_l	337115	0.0128 @ 0.51%	0.0

## 2.17 bg\_dip\_1600\_inf

- Samples stored in the directory: /Users/elijahsheridan/MG5\_aMC\_v2\_6\_5/axion\_pheno/-optimization .
- Sample consisting of: background events.
- Generated events: 1040000 events.
- Normalization to the luminosity: 187+/- 1 events.
- Ratio (event weight): 0.00018 .

Path to the event file	Nr. of events	Cross section (pb)	Negative wgts (%)
/Users/elijahsheridan/- MG5_aMC_v2_6_5/- axion_pheno/madgraph_data/- diphoton_double_isr_background_c merged_lhe/- diphoton_double_isr_background_l	1040000	0.00469 @ 0.15%	0.0

### 3 Histos and cuts

#### 3.1 Cut 1

\* Cut: select ( sdETA ( jets[1] jets[2] ) > 3.6 or sdETA ( jets[1] jets[2] ) < -3.6 ) and M ( jets[1] jets[2] ) > 1250.0

Dataset	Events kept: K	Rejected events: R	Efficiency: K / (K + R)	Cumul. efficiency: K / Initial
signal	814.6 +/- 25.5	3279.5 +/- 25.6	0.19896 +/- 0.00624	0.19896 +/- 0.00624
bg_vbf_0_10	204.2 +/- 14.2	11946.1 +/- 26.8	0.01681 +/- 0.00117	0.01681 +/- 0.00117
bg_vbf_100_	950.9 +/- 29.3	8744.4 +/- 32.9	0.09808 +/- 0.00302	0.09808 +/- 0.00302
bg_vbf_200_	1147.9 +/- 30.2	4265.4 +/- 31.3	0.21205 +/- 0.00556	0.21205 +/- 0.00556
bg_vbf_400_	273.7 +/- 14.1	713.1 +/- 14.1	0.2774 +/- 0.0143	0.2774 +/- 0.0143
bg_vbf_600_	47.78 +/- 6.22	204.30 +/- 6.23	0.1895 +/- 0.0247	0.1895 +/- 0.0247
bg_vbf_800_	12.06 +/- 3.29	102.70 +/- 3.29	0.1051 +/- 0.0286	0.1051 +/- 0.0286
bg_vbf_1200	0.678 +/- 0.810	19.92 +/- 0.81	0.0329 +/- 0.0393	0.0329 +/- 0.0393
bg_vbf_1600	0.0483 +/- 0.2191	7.610 +/- 0.219	0.00631 +/- 0.02860	0.00631 +/- 0.02860
bg_dip_0_10	229.4 +/- 15.1	2710617 +/- 4612	8.46e-05 +/- 5.59e-06	8.46e-05 +/- 5.59e-06
bg_dip_100_	990.1 +/- 31.5	1094372 +/- 1526	9.04e-04 +/- 2.87e-05	9.04e-04 +/- 2.87e-05
bg_dip_200_	1641.8 +/- 40.5	237907 +/- 412	0.006854 +/- 0.000169	0.006854 +/- 0.000169
bg_dip_400_	593.2 +/- 24.1	28205.5 +/- 56.5	0.020599 +/- 0.000837	0.020599 +/- 0.000837
bg_dip_600_	88.41 +/- 9.35	6585.9 +/- 28.8	0.0132 +/- 0.0014	0.0132 +/- 0.0014
bg_dip_800_	22.00 +/- 4.67	2920.34 +/- 6.86	0.00748 +/- 0.00159	0.00748 +/- 0.00159
bg_dip_1200	1.34 +/- 1.16	512.16 +/- 2.87	0.00261 +/- 0.00225	0.00261 +/- 0.00225
bg_dip_1600	0.0921 +/- 0.3034	187.691 +/- 0.412	0.00049 +/- 0.00162	0.00049 +/- 0.00162

### 3.2 Cut 2

\* Cut: select PT ( a[1] ) > 450.0 and M ( a[1] a[2] ) > 400.0

Dataset	Events kept: K	Rejected events: R	Efficiency: K / (K + R)	Cumul. efficiency: K / Initial
signal	446.5 +/- 19.9	368.1 +/- 18.3	0.5481 +/- 0.0174	0.10905 +/- 0.00487
bg_vbf_0_10	0.0 +/- 0.0	204.2 +/- 14.2	0.0 +/- 0.0	0.0 +/- 0.0
bg_vbf_100_	0.0904 +/- 0.3007	950.8 +/- 29.3	9.51e-05 +/- 3.16e-04	9.33e-06 +/- 3.10e-05
bg_vbf_200_	0.666 +/- 0.816	1147.2 +/- 30.2	0.00058 +/- 0.00071	0.000123 +/- 0.000151
bg_vbf_400_	1.92 +/- 1.38	271.8 +/- 14.0	0.00700 +/- 0.00504	0.0019 +/- 0.0014
bg_vbf_600_	1.38 +/- 1.17	46.40 +/- 6.15	0.0290 +/- 0.0243	0.00549 +/- 0.00465
bg_vbf_800_	0.704 +/- 0.836	11.4 +/- 3.2	0.0584 +/- 0.0675	0.00613 +/- 0.00729
bg_vbf_1200_	0.0625 +/- 0.2495	0.615 +/- 0.773	0.0921 +/- 0.3513	0.00303 +/- 0.01212
bg_vbf_1600_	0.00676 +/- 0.08217	0.0415 +/- 0.2032	0.14 +/- 1.58	0.000882 +/- 0.010729
bg_dip_0_10	0.0 +/- 0.0	229.4 +/- 15.1	0.0 +/- 0.0	0.0 +/- 0.0
bg_dip_100_	0.0 +/- 0.0	990.1 +/- 31.5	0.0 +/- 0.0	0.0 +/- 0.0
bg_dip_200_	1.38 +/- 1.18	1640.4 +/- 40.5	0.000841 +/- 0.000716	5.77e-06 +/- 4.91e-06
bg_dip_400_	4.68 +/- 2.16	588.5 +/- 24.0	0.00789 +/- 0.00363	1.62e-04 +/- 7.51e-05
bg_dip_600_	2.81 +/- 1.68	85.6 +/- 9.2	0.0318 +/- 0.0187	0.000421 +/- 0.000251
bg_dip_800_	1.34 +/- 1.16	20.66 +/- 4.53	0.061 +/- 0.051	0.000455 +/- 0.000393
bg_dip_1200_	0.11 +/- 0.33	1.23 +/- 1.11	0.0817 +/- 0.2365	0.000213 +/- 0.000645
bg_dip_1600_	0.011 +/- 0.105	0.0811 +/- 0.2846	0.12 +/- 1.07	5.87e-05 +/- 5.59e-04

## 4 Summary

### 4.1 Cut-flow charts

- How to compare signal (S) and background (B):  $S/\sqrt{S+B}$  .
- Object definition selections are indicated in cyan.
- Reject and select are indicated by 'REJ' and 'SEL' respectively

Cuts	Signal (S)	Background (B)	S vs B
Initial (no cut)	4094.08 +/- 1.13	4113516 +/- 4877	2.01760 +/- 0.00132
SEL: ( sdETA ( jets[1] jets[2] ) > 3.6 or sdETA (	814.6 +/- 25.5	6203.5 +/- 76.0	9.723 +/- 0.292
SEL: PT ( a[1] ) > 450.0 and M ( a[1] a[2] ) > 400	446.5 +/- 19.9	15.16 +/- 3.89	20.780 +/- 0.487