

The LaTeX report

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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]) > 2.6 or sdETA(jets[1] jets[2]) < -2.6) and M(jets[1]
jets[2]) > 1250
ma5>select PT(a[1]) > 500 and M(a[1] a[2]) > 200
ma5>submit analysis_loose_pta500_maa200

```

1.2 Configuration

- MadAnalysis version 1.6.33 (2017/11/20).
- Histograms given for an integrated luminosity of 40.0fb^{-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 (%) |
|---|---------------|--------------------|-------------------|
| /Users/elijahsheridan/- MG5_aMC_v2_6_5/- axion_pheno/madgraph_data/- vbf_diphoton_background_data/- merged_lhe/- vbf_diphoton_background_ht_1200 | 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 (%) |
|---|---------------|--------------------|-------------------|
| /Users/elijahsheridan/- MG5_aMC_v2_6_5/- axion_pheno/madgraph_data/- vbf_diphoton_background_data/- merged_lhe/- vbf_diphoton_background_ht_1600 | 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 (%) |
|--|---------------|--------------------|-------------------|
| /Users/elijahsheridan/-MG5_aMC_v2_6_5/-axion_pheno/madgraph_data/-diphoton_double_isr_background_cmerged_lhe/-diphoton_double_isr_background_l | 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 (%) |
|--|---------------|--------------------|-------------------|
| /Users/elijahsheridan/-MG5_aMC_v2_6_5/-axion_pheno/madgraph_data/-diphoton_double_isr_background_cmerged_lhe/-diphoton_double_isr_background_l | 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]) > 2.6 or sdETA (jets[1] jets[2]) < -2.6) and M (jets[1] jets[2]) > 1250.0

| Dataset | Events kept: K | Rejected events: R | Efficiency: K / (K + R) | Cumul. efficiency: K / Initial |
|-------------|-----------------|--------------------|-------------------------|--------------------------------|
| signal | 1711.8 +/- 31.6 | 2382.3 +/- 31.6 | 0.41812 +/- 0.00771 | 0.41812 +/- 0.00771 |
| 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_ | 349.4 +/- 15.0 | 637.5 +/- 15.0 | 0.3540 +/- 0.0152 | 0.3540 +/- 0.0152 |
| bg_vbf_600_ | 111.21 +/- 7.88 | 140.87 +/- 7.89 | 0.4412 +/- 0.0313 | 0.4412 +/- 0.0313 |
| bg_vbf_800_ | 40.31 +/- 5.11 | 74.45 +/- 5.12 | 0.3513 +/- 0.0446 | 0.3513 +/- 0.0446 |
| bg_vbf_1200 | 4.49 +/- 1.87 | 16.10 +/- 1.87 | 0.218 +/- 0.091 | 0.218 +/- 0.091 |
| bg_vbf_1600 | 0.784 +/- 0.839 | 6.874 +/- 0.839 | 0.102 +/- 0.110 | 0.102 +/- 0.110 |
| 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_ | 1066.5 +/- 32.1 | 27732.1 +/- 59.6 | 0.03703 +/- 0.00111 | 0.03703 +/- 0.00111 |
| bg_dip_600_ | 531.3 +/- 22.2 | 6143.1 +/- 33.7 | 0.07960 +/- 0.00331 | 0.07960 +/- 0.00331 |
| bg_dip_800_ | 193.3 +/- 13.4 | 2749.1 +/- 14.2 | 0.06568 +/- 0.00457 | 0.06568 +/- 0.00457 |
| bg_dip_1200 | 21.80 +/- 4.57 | 491.71 +/- 5.22 | 0.0424 +/- 0.0089 | 0.0424 +/- 0.0089 |
| bg_dip_1600 | 4.1 +/- 2.0 | 183.71 +/- 2.01 | 0.0217 +/- 0.0106 | 0.0217 +/- 0.0106 |

3.2 Cut 2

* Cut: select PT (a[1]) > 500.0 and M (a[1] a[2]) > 200.0

| Dataset | Events kept: K | Rejected events: R | Efficiency: K / (K + R) | Cumul. efficiency: K / Initial |
|-------------|-------------------|--------------------|-------------------------|--------------------------------|
| signal | 1014.2 +/- 27.6 | 697.6 +/- 24.1 | 0.5925 +/- 0.0119 | 0.24772 +/- 0.00675 |
| bg_vbf_0_10 | 0.0 +/- 0.0 | 204.2 +/- 14.2 | 0.0 +/- 0.0 | 0.0 +/- 0.0 |
| bg_vbf_100_ | 0.0503 +/- 0.2242 | 950.8 +/- 29.3 | 5.29e-05 +/- 2.36e-04 | 5.18e-06 +/- 2.31e-05 |
| bg_vbf_200_ | 0.33 +/- 0.57 | 1147.5 +/- 30.2 | 0.000287 +/- 0.000500 | 6.10e-05 +/- 1.06e-04 |
| bg_vbf_400_ | 2.05 +/- 1.43 | 347.3 +/- 15.0 | 0.00588 +/- 0.00409 | 0.00208 +/- 0.00145 |
| bg_vbf_600_ | 3.42 +/- 1.84 | 107.78 +/- 7.86 | 0.0308 +/- 0.0164 | 0.01359 +/- 0.00729 |
| bg_vbf_800_ | 2.70 +/- 1.62 | 37.62 +/- 5.03 | 0.0669 +/- 0.0393 | 0.0235 +/- 0.0141 |
| bg_vbf_1200 | 0.41 +/- 0.63 | 4.08 +/- 1.81 | 0.0912 +/- 0.1358 | 0.0199 +/- 0.0308 |
| bg_vbf_1600 | 0.0727 +/- 0.2683 | 0.711 +/- 0.803 | 0.0927 +/- 0.3275 | 0.00949 +/- 0.03504 |
| 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_ | 0.691 +/- 0.831 | 1641.1 +/- 40.5 | 0.000421 +/- 0.000506 | 2.88e-06 +/- 3.47e-06 |
| bg_dip_400_ | 6.73 +/- 2.59 | 1059.8 +/- 32.0 | 0.00631 +/- 0.00242 | 2.34e-04 +/- 9.01e-05 |
| bg_dip_600_ | 9.33 +/- 3.05 | 522.0 +/- 22.0 | 0.0176 +/- 0.0057 | 0.001397 +/- 0.000457 |
| bg_dip_800_ | 7.55 +/- 2.74 | 185.7 +/- 13.2 | 0.0391 +/- 0.0139 | 0.002565 +/- 0.000933 |
| bg_dip_1200 | 1.02 +/- 1.01 | 20.78 +/- 4.47 | 0.0469 +/- 0.0453 | 0.00199 +/- 0.00197 |
| bg_dip_1600 | 0.149 +/- 0.386 | 3.92 +/- 1.96 | 0.0367 +/- 0.0932 | 0.000795 +/- 0.002057 |

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]) > 2.6 or sdETA (| 1711.8 +/- 31.6 | 7487.3 +/- 82.9 | 17.848 +/- 0.309 |
| SEL: PT (a[1]) > 500.0 and M (a[1] a[2]) > 200 | 1014.2 +/- 27.6 | 34.50 +/- 5.86 | 31.318 +/- 0.449 |