The LaTeX report

Generated by elijahsheridan on 12 September 2020, 15:13:40

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**

Contents

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/madgraph_data
# need to change this directory path -> exit and type "pwd" to get the path
ma5>set main.lumi = 40
ma5>set main.fom.formula = 5
ma5>set main.fom.x = 0.25
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/-
on_discovery_contour/ma100MeV_L1pt8TeV_deta2.lhe.gz as signal_1pt8TeVL
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/madgraph_data/axion_signal/-
on_discovery_contour/ma100MeV_L2TeV_deta2.lhe as signal_2TeVL
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/madgraph_data/axion_signal/-
on_discovery_contour/ma100MeV_L2pt2TeV_deta2.lhe.gz as signal_2pt2TeVL
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/madgraph_data/axion_signal/-
on_discovery_contour/ma100MeV_L2pt4TeV_deta2.lhe.gz as signal_2pt4TeVL
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>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># define bg and signal samples
ma5>set signal_1pt8TeVL.type = signal
ma5>set signal_2TeVL.type = signal
ma5>set signal_2pt2TeVL.type = signal
ma5>set signal_2pt4TeVL.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># 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># cuts
ma5>select ((sdETA(jets[1] jets[2]) > 2.6 or sdETA(jets[1] jets[2]) < -2.6) and M(jets[1]
jets[2]) > 750) and (PT(a[1]) > 300 and M(a[1] a[2]) > 500)
ma5># define which plots to make
ma5>plot PT(jets[1])
ma5>plot ETA(jets[1])
ma5>plot PHI(jets[1])
ma5>plot PT(jets[2])
ma5>plot ETA(jets[2])
ma5>plot PHI(jets[2])
ma5>plot DELTAR(jets[1], jets[2])
ma5>plot M(jets[1] jets[2])
ma5>plot sdETA(jets[1] jets[2])
ma5>plot M(a[1] a[2])
ma5>plot PT(a[1])
ma5>plot PT(a[2])
ma5>plot THT
ma5>plot MET
ma5>plot TET
ma5>#set the plot/graph parameters
```

```
ma5>set selection[2].xmin = 0
ma5>set selection[2].xmax = 2000
ma5>set selection[2].nbins = 200
ma5>set selection[2].rank = PTordering
ma5>set selection[2].titleX = "p_{T}[j_{1}] (GeV)"
ma5>set selection[3].xmin = -8
ma5>set selection[3].xmax = 8
ma5>set selection[3].nbins = 160
ma5>set selection[3].rank = PTordering
ma5>set selection[3].titleX = "#eta[j_{1}]"
ma5>set selection[4].xmin = -3.2
ma5>set selection[4].xmax = 3.2
ma5>set selection[4].nbins = 64
ma5>set selection[4].rank = PTordering
ma5>set selection[4].titleX = "#phi[j_{1}]"
ma5>set selection[5].xmin = 0
ma5>set selection[5].xmax = 1000
ma5>set selection[5].nbins = 100
ma5>set selection[5].rank = PTordering
ma5>set selection[5].titleX = "p_{T}[j_{2}] (GeV)"
ma5>set selection[6].xmin = -8
ma5>set selection[6].xmax = 8
ma5>set selection[6].nbins = 160
ma5>set selection[6].rank = PTordering
ma5>set selection[6].titleX = "#eta[j_{2}]"
ma5>set selection[7].xmin = -3.2
ma5>set selection[7].xmax = 3.2
ma5>set selection[7].nbins = 64
ma5>set selection[7].rank = PTordering
ma5>set selection[7].titleX = "#phi[j_{2}]"
ma5>set selection[8].xmin = 0
ma5>set selection[8].xmax = 15
ma5>set selection[8].nbins = 75
ma5>set selection[8].rank = PTordering
ma5>set selection[8].titleX = "#DeltaR[j_{1},j_{2}]"
ma5>set selection[9].xmin = 750
ma5>set selection[9].xmax = 8000
ma5>set selection[9].nbins = 160
ma5>set selection[9].rank = PTordering
ma5>set selection[9].titleX = "M[j_{1},j_{2}] (GeV)"
ma5>set selection[10].xmin = 2.6
ma5>set selection[10].xmax = 15
ma5>set selection[10].titleX = "#Delta#eta(j_{1},j_{2})"
ma5>set selection[11].xmin = 500
ma5>set selection[11].xmax = 4000
ma5>set selection[11].nbins = 400
ma5>set selection[11].rank = PTordering
ma5>set selection[11].titleX = "M[a_{1},a_{2}] (GeV)"
ma5>set selection[12].xmin = 300
```

```
ma5>set selection[12].xmax = 2000
ma5>set selection[12].nbins = 80
ma5>set selection[12].rank = PTordering
ma5>set selection[12].titleX = "p_{T}[a_{1}]"
ma5>set selection[13].xmin = 0
ma5>set selection[13].xmax = 2000
ma5>set selection[13].nbins = 400
ma5>set selection[13].rank = PTordering
ma5>set selection[13].titleX = "p_{T}[a_{2}] (GeV)"
ma5>set selection[14].xmin = 0
ma5>set selection[14].xmax = 4000
ma5>set selection[14].nbins = 80
ma5>set selection[14].rank = PTordering
ma5>set selection[14].titleX = "THT"
ma5>set selection[15].xmin = 0
ma5>set selection[15].xmax = 1000
ma5>set selection[15].nbins = 200
ma5>set selection[15].rank = PTordering
ma5>set selection[15].titleX = "MET"
ma5>set selection[16].xmin = 0
ma5>set selection[16].xmax = 8000
ma5>set selection[16].nbins = 80
ma5>set selection[16].rank = PTordering
ma5>set selection[16].titleX = "TET"
ma5>submit ma100MeV_L1pt8-2pt4TeV_deta2pt6s
```

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_1pt8tevl

- Samples stored in the directory: /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/-post_optimization_studies/mad_analyses .
- Sample consisting of: signal events.
- Generated events: 100000 events.
- Normalization to the luminosity: 176+/- 1 events.
- Ratio (event weight): 0.0018 .

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/-on_discovery_contour/-ma100MeV_L1pt8TeV_deta2.lhe.gz	100000	0.00442 @ 0.095%	0.0

2.2 signal_2tevl

- Samples stored in the directory: /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/-post_optimization_studies/mad_analyses .
- Sample consisting of: signal events.
- Generated events: 100000 events.
- Normalization to the luminosity: 106+/- 1 events.
- Ratio (event weight): 0.0011 .

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/-on_discovery_contour/-ma100MeV_L2TeV_deta2.lhe	100000	0.00267 @ 0.14%	0.0

2.3 signal_2pt2tevl

- Samples stored in the directory: /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/-post_optimization_studies/mad_analyses .
- Sample consisting of: signal events.
- Generated events: 100000 events.

- Normalization to the luminosity: 69+/- 1 events.
- Ratio (event weight): 0.00069 .

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/-on_discovery_contour/-ma100MeV_L2pt2TeV_deta2.lhe.gz	100000	0.00174 @ 0.094%	0.0

2.4 signal_2pt4tevl

- Samples stored in the directory: /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/-post_optimization_studies/mad_analyses .
- Sample consisting of: signal events.
- Generated events: 100000 events.
- Normalization to the luminosity: 47+/- 1 events.
- Ratio (event weight): 0.00047 .

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/-on_discovery_contour/-ma100MeV_L2pt4TeV_deta2.lhe.gz	100000	0.00119 @ 0.097%	0.0

2.5 bg_dip_0_100

- Samples stored in the directory: /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/-post_optimization_studies/mad_analyses .
- 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_ merged_lhe/- diphoton_double_isr_background_l	1040000	67.8 @ 0.17%	0.0

2.6 bg_dip_100_200

- Samples stored in the directory: /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/-post_optimization_studies/mad_analyses .
- 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_ merged_lhe/- diphoton_double_isr_background_l	1040000	27.4 @ 0.14%	0.0

2.7 bg_dip_200_400

- Samples stored in the directory: /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/-post_optimization_studies/mad_analyses .
- 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_ merged_lhe/- diphoton_double_isr_background_l	1040000	5.99 @ 0.17%	0.0

2.8 bg_dip_400_600

- Samples stored in the directory: /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/-post_optimization_studies/mad_analyses .
- 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_c merged_lhe/-diphoton_double_isr_background_l	1040000	0.72 @ 0.18%	0.0

2.9 bg_dip_600_800

- Samples stored in the directory: /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/-post_optimization_studies/mad_analyses .
- 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_c merged_lhe/-diphoton_double_isr_background_l	662009	0.167 @ 0.41%	0.0

2.10 bg_dip_800_1200

- Samples stored in the directory: /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/-post_optimization_studies/mad_analyses .
- 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_merged_lhe/-diphoton_double_isr_background_l	1040000	0.0736 @ 0.17%	0.0

2.11 bg_dip_1200_1600

- Samples stored in the directory: /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/-post_optimization_studies/mad_analyses .
- 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_merged_lhe/-diphoton_double_isr_background_l	337115	0.0128 @ 0.51%	0.0

2.12 bg_dip_1600_inf

- Samples stored in the directory: /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/-post_optimization_studies/mad_analyses .
- 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_merged_lhe/-diphoton_double_isr_background_l	1040000	0.00469 @ 0.15%	0.0

2.13 bg_vbf_0_100

- Samples stored in the directory: /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/-post_optimization_studies/mad_analyses .
- 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_1(	1000000	0.304 @ 0.19%	0.0

2.14 bg_vbf_100_200

- Samples stored in the directory: /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/-post_optimization_studies/mad_analyses .
- Sample consisting of: background events.
- Generated events: 965662 events.
- Normalization to the luminosity: 9695+/- 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

2.15 bg_vbf_200_400

- Samples stored in the directory: /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/-post_optimization_studies/mad_analyses .
- Sample consisting of: background events.
- Generated events: 984165 events.
- Normalization to the luminosity: 5413+/- 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

2.16 bg_vbf_400_600

- Samples stored in the directory: /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/-post_optimization_studies/mad_analyses .
- Sample consisting of: background events.
- Generated events: 1000000 events.
- Normalization to the luminosity: 986+/- 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

2.17 bg_vbf_600_800

- Samples stored in the directory: /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/-post_optimization_studies/mad_analyses .
- 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

2.18 bg_vbf_800_1200

- Samples stored in the directory: /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/-post_optimization_studies/mad_analyses .
- 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

2.19 bg_vbf_1200_1600

- Samples stored in the directory: /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/-post_optimization_studies/mad_analyses .
- 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

2.20 bg_vbf_1600_inf

- Samples stored in the directory: /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/-post_optimization_studies/mad_analyses .
- 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

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]) > 750.0) and (PT (a[1]) > 300.0 and M (a[1] a[2]) > 500.0)**

Dataset	Events kept: K	Rejected events: R	Efficiency: K / (K + R)	Cumul. efficiency: K / Initial
signal_1pt8tev	71.44 +/- 6.53	105.47 +/- 6.53	0.4038 +/- 0.0369	0.4038 +/- 0.0369
signal_2tevl	44.6 +/- 5.1	62.3 +/- 5.1	0.4169 +/- 0.0477	0.4169 +/- 0.0477
signal_2pt2tev	29.50 +/- 4.12	39.95 +/- 4.12	0.4247 +/- 0.0593	0.4247 +/- 0.0593
signal_2pt4tev	20.34 +/- 3.41	27.07 +/- 3.41	0.4290 +/- 0.0719	0.4290 +/- 0.0719
bg_dip_0_10	0.0 +/- 0.0	2710847 +/- 4613	0.0 +/- 0.0	0.0 +/- 0.0
bg_dip_100_	3.16 +/- 1.78	1095359 +/- 1527	2.89e-06 +/- 1.62e-06	2.89e-06 +/- 1.62e-06
bg_dip_200_	25.80 +/- 5.08	239523 +/- 413	1.08e-04 +/- 2.12e-05	1.08e-04 +/- 2.12e-05
bg_dip_400_	29.41 +/- 5.42	28769.3 +/- 52.4	0.001021 +/- 0.000188	0.001021 +/- 0.000188
bg_dip_600_	11.87 +/- 3.44	6662.5 +/- 27.8	0.001778 +/- 0.000516	0.001778 +/- 0.000516
bg_dip_800_	6.14 +/- 2.47	2936.20 +/- 5.62	0.002086 +/- 0.000841	0.002086 +/- 0.000841
bg_dip_1200_	0.83 +/- 0.91	512.68 +/- 2.78	0.00162 +/- 0.00177	0.00162 +/- 0.00177
bg_dip_1600_	0.132 +/- 0.363	187.652 +/- 0.457	0.000701 +/- 0.001931	0.000701 +/- 0.001931
bg_vbf_0_10	0.0486 +/- 0.2204	12150.3 +/- 23.1	4.00e-06 +/- 1.81e-05	4.00e-06 +/- 1.81e-05
bg_vbf_100_	1.16 +/- 1.08	9694.2 +/- 16.6	0.000120 +/- 0.000111	0.000120 +/- 0.000111
bg_vbf_200_	6.68 +/- 2.58	5406.6 +/- 11.2	0.001235 +/- 0.000477	0.001235 +/- 0.000477
bg_vbf_400_	6.68 +/- 2.58	980.17 +/- 2.91	0.00677 +/- 0.00261	0.00677 +/- 0.00261
bg_vbf_600_	3.03 +/- 1.73	249.05 +/- 1.76	0.01203 +/- 0.00687	0.01203 +/- 0.00687
bg_vbf_800_	1.58 +/- 1.25	113.18 +/- 1.26	0.0138 +/- 0.0109	0.0138 +/- 0.0109
bg_vbf_1200_	0.236 +/- 0.483	20.360 +/- 0.484	0.0114 +/- 0.0234	0.0114 +/- 0.0234
bg_vbf_1600_	0.0435 +/- 0.2081	7.615 +/- 0.208	0.00569 +/- 0.02717	0.00569 +/- 0.02717

3.2 Histogram 1

*** Plot: PT (jets[1])**

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal_1pt8tevl	71.6	1.0	396.62	298.8	0.0	0.131
signal_2tevl	44.7	1.0	385.588	291.8	0.0	0.09079
signal_2pt2tevl	29.7	1.0	379.343	290.4	0.0	0.1358
signal_2pt4tevl	20.5	1.0	373.314	287.0	0.0	0.1156
bg_dip_0_100	0.0 +/- 0.0	0.	0.0	0.0	0.0	0.0
bg_dip_100_20	3.16	1.0	98.8303	32.52	0.0	0.0
bg_dip_200_40	25.8	1.0	242.467	53.8	0.0	0.0
bg_dip_400_60	29.4	1.0	381.126	79.78	0.0	0.0
bg_dip_600_80	11.9	1.0	542.936	100.3	0.0	0.0
bg_dip_800_12	6.14	1.0	742.239	154.9	0.0	0.0
bg_dip_1200_1	0.83	1.0	1023.42	228.6	0.0	0.0
bg_dip_1600_i	0.132	1.0	1300.11	327.6	0.0	2.469
bg_vbf_0_100	0.0486	1.0	42.7818	7.815	0.0	0.0
bg_vbf_100_20	1.16	1.0	109.408	25.35	0.0	0.0
bg_vbf_200_40	6.68	1.0	216.071	56.72	0.0	0.0
bg_vbf_400_60	6.68	1.0	356.234	74.01	0.0	0.0
bg_vbf_600_80	3.03	1.0	504.253	94.41	0.0	0.0
bg_vbf_800_12	1.58	1.0	693.712	143.6	0.0	0.0
bg_vbf_1200_1	0.236	1.0	974.535	204.1	0.0	0.0
bg_vbf_1600_i	0.0444	1.0	1295.18	311.7	0.0	2.294

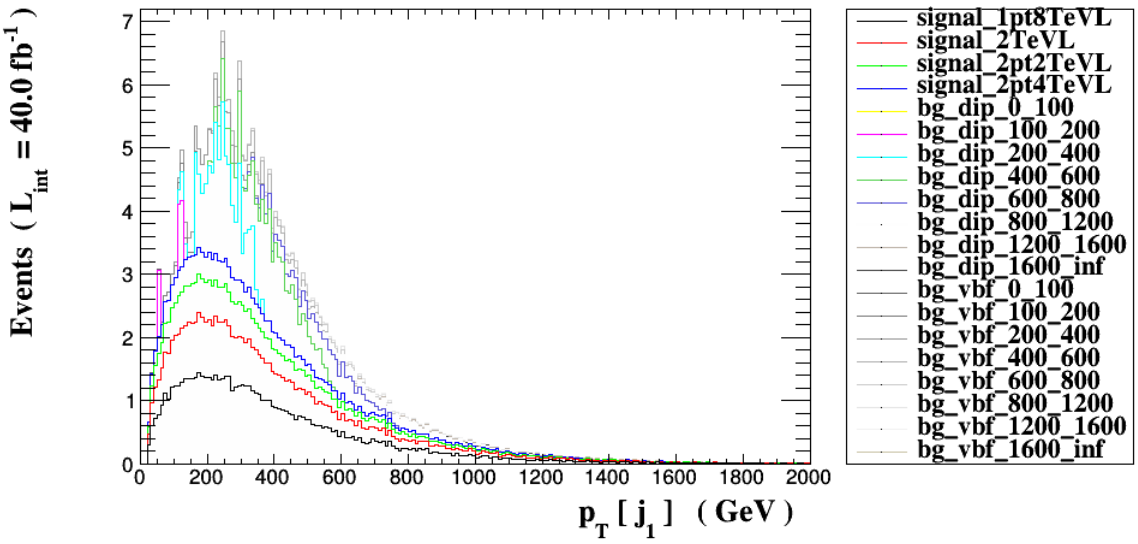

Figure 1.

3.3 Histogram 2

*** Plot: ETA (jets[1])**

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal_1pt8tevl	71.6	1.0	-0.00482515	1.974	0.0	0.0
signal_2tevl	44.7	1.0	-0.00826326	2.002	0.0	0.0
signal_2pt2tevl	29.7	1.0	-0.0199017	2.031	0.0	0.0
signal_2pt4tevl	20.5	1.0	-0.00273609	2.04	0.0	0.0
bg_dip_0_100	0.0 +/- 0.0	0.	0.0	0.0	0.0	0.0
bg_dip_100_20	3.16	1.0	1.65038	2.73	0.0	0.0
bg_dip_200_40	25.8	1.0	0.0327822	1.622	0.0	0.0
bg_dip_400_60	29.4	1.0	0.0285181	1.387	0.0	0.0
bg_dip_600_80	11.9	1.0	-0.0527389	1.256	0.0	0.0
bg_dip_800_12	6.14	1.0	0.00530536	1.183	0.0	0.0
bg_dip_1200_1	0.83	1.0	-0.0573518	1.162	0.0	0.0
bg_dip_1600_i	0.132	1.0	0.0325828	1.171	0.0	0.0
bg_vbf_0_100	0.0486	1.0	0.873486	2.934	0.0	0.0
bg_vbf_100_20	1.16	1.0	0.133336	2.773	0.0	0.0
bg_vbf_200_40	6.68	1.0	0.0158882	2.195	0.0	0.0
bg_vbf_400_60	6.68	1.0	-0.0253292	1.796	0.0	0.0
bg_vbf_600_80	3.03	1.0	-0.000919668	1.589	0.0	0.0
bg_vbf_800_12	1.58	1.0	-0.0271121	1.423	0.0	0.0
bg_vbf_1200_1	0.236	1.0	-0.0196162	1.285	0.0	0.0
bg_vbf_1600_i	0.0444	1.0	0.0503087	1.194	0.0	0.0

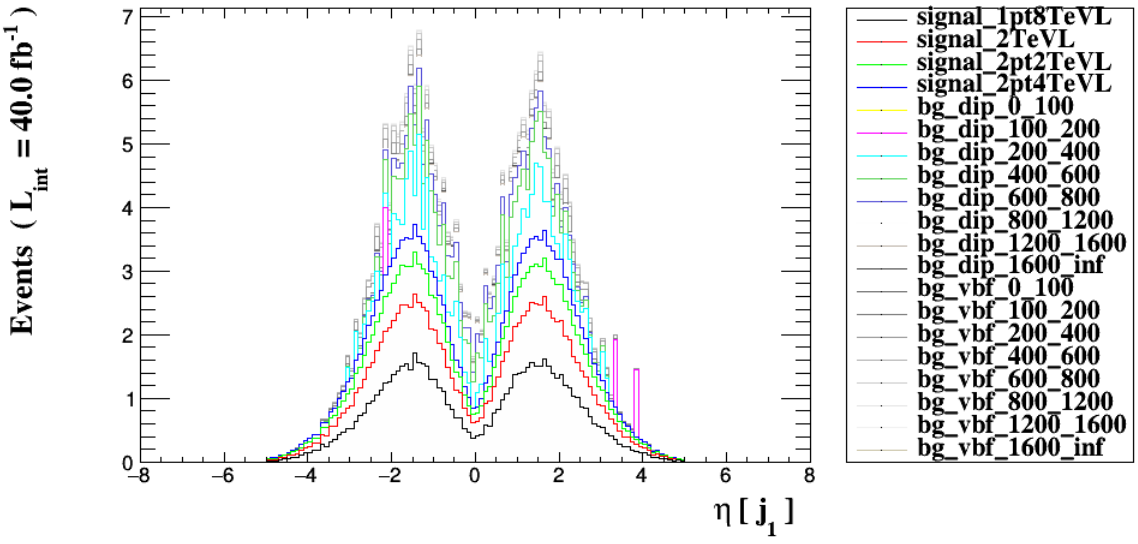
Events (L_{int} = 40.0 fb^{-1})
η [j_1]
signal_1pt8TeVL
signal_2TeVL
signal_2pt2TeVL
signal_2pt4TeVL
bg_dip_0_100
bg_dip_100_200
bg_dip_200_400
bg_dip_400_600
bg_dip_600_800
bg_dip_800_1200
bg_dip_1200_1600
bg_dip_1600_inf
bg_vbf_0_100
bg_vbf_100_200
bg_vbf_200_400
bg_vbf_400_600
bg_vbf_600_800
bg_vbf_800_1200
bg_vbf_1200_1600
bg_vbf_1600_inf

Figure 2.

3.4 Histogram 3

*** Plot: PHI (jets[1])**

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal_1pt8tevl	71.6	1.0	0.00430839	1.812	0.0	0.0
signal_2tevl	44.7	1.0	-0.000657404	1.827	0.0	0.0
signal_2pt2tevl	29.7	1.0	0.0120395	1.816	0.0	0.0
signal_2pt4tevl	20.5	1.0	-0.0272324	1.818	0.0	0.0
bg_dip_0_100	0.0 +/- 0.0	0.	0.0	0.0	0.0	0.0
bg_dip_100_20	3.16	1.0	0.466209	0.3607	0.0	0.0
bg_dip_200_40	25.8	1.0	-0.0184691	1.809	0.0	0.0
bg_dip_400_60	29.4	1.0	-0.0145545	1.833	0.0	0.0
bg_dip_600_80	11.9	1.0	-0.0166173	1.856	0.0	0.0
bg_dip_800_12	6.14	1.0	-6.42725e-05	1.794	0.0	0.0
bg_dip_1200_1	0.83	1.0	-0.00691131	1.856	0.0	0.0
bg_dip_1600_i	0.132	1.0	0.0937289	1.81	0.0	0.0
bg_vbf_0_100	0.0486	1.0	-0.168141	1.997	0.0	0.0
bg_vbf_100_20	1.16	1.0	-0.0767497	1.778	0.0	0.0
bg_vbf_200_40	6.68	1.0	-0.0861787	1.817	0.0	0.0
bg_vbf_400_60	6.68	1.0	0.0190635	1.803	0.0	0.0
bg_vbf_600_80	3.03	1.0	-0.00814006	1.804	0.0	0.0
bg_vbf_800_12	1.58	1.0	0.0406637	1.81	0.0	0.0
bg_vbf_1200_1	0.236	1.0	0.0203858	1.807	0.0	0.0
bg_vbf_1600_i	0.0444	1.0	0.0571332	1.824	0.0	0.0

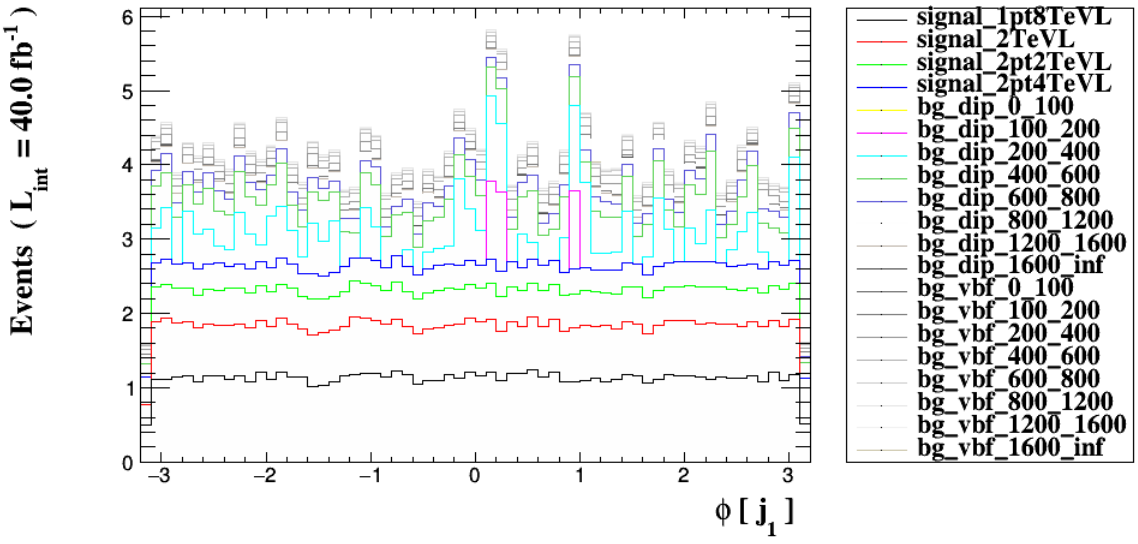
Events (L_{int} = 40.0 fb^{-1})
ϕ [j_1]
signal_1pt8TeVL
signal_2TeVL
signal_2pt2TeVL
signal_2pt4TeVL
bg_dip_0_100
bg_dip_100_200
bg_dip_200_400
bg_dip_400_600
bg_dip_600_800
bg_dip_800_1200
bg_dip_1200_1600
bg_dip_1600_inf
bg_vbf_0_100
bg_vbf_100_200
bg_vbf_200_400
bg_vbf_400_600
bg_vbf_600_800
bg_vbf_800_1200
bg_vbf_1200_1600
bg_vbf_1600_inf

Figure 3.

3.5 Histogram 4

*** Plot: PT (jets[2])**

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal_1pt8tevl	71.6	1.0	126.672	102.5	0.0	0.004942
signal_2tevl	44.7	1.0	122.114	98.76	0.0	0.004778
signal_2pt2tevl	29.7	1.0	119.452	96.18	0.0	0.002341
signal_2pt4tevl	20.5	1.0	117.516	94.67	0.0	0.006934
bg_dip_0_100	0.0 +/- 0.0	0.	0.0	0.0	0.0	0.0
bg_dip_100_20	3.16	1.0	49.3379	16.83	0.0	0.0
bg_dip_200_40	25.8	1.0	80.1038	38.82	0.0	0.0
bg_dip_400_60	29.4	1.0	109.934	61.83	0.0	0.0
bg_dip_600_80	11.9	1.0	141.464	92.51	0.0	0.0
bg_dip_800_12	6.14	1.0	192.947	137.0	0.0	0.0
bg_dip_1200_1	0.83	1.0	316.424	222.2	0.0	0.0
bg_dip_1600_i	0.132	1.0	538.488	322.1	0.0	4.526
bg_vbf_0_100	0.0486	1.0	31.916	8.29	0.0	0.0
bg_vbf_100_20	1.16	1.0	53.936	17.53	0.0	0.0
bg_vbf_200_40	6.68	1.0	94.1307	38.71	0.0	0.0
bg_vbf_400_60	6.68	1.0	133.026	59.99	0.0	0.0
bg_vbf_600_80	3.03	1.0	180.549	86.09	0.0	0.0
bg_vbf_800_12	1.58	1.0	244.294	127.1	0.0	0.0
bg_vbf_1200_1	0.236	1.0	367.183	193.0	0.0	0.0
bg_vbf_1600_i	0.0444	1.0	520.042	285.6	0.0	2.43

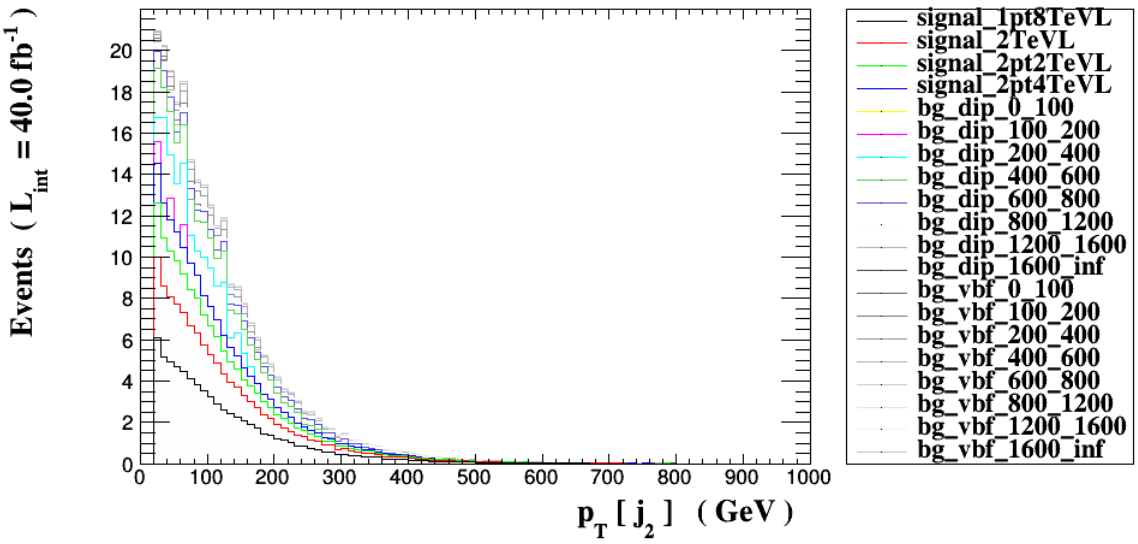

Figure 4.

3.6 Histogram 5

*** Plot: ETA (jets[2])**

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal_1pt8tevl	71.6	1.0	-0.00273279	2.847	0.0	0.0
signal_2tevl	44.7	1.0	-0.00636076	2.886	0.0	0.0
signal_2pt2tevl	29.7	1.0	0.0204261	2.905	0.0	0.0
signal_2pt4tevl	20.5	1.0	0.00378007	2.919	0.0	0.0
bg_dip_0_100	0.0 +/- 0.0	0.	0.0	0.0	0.0	0.0
bg_dip_100_20	3.16	1.0	0.140052	2.918	0.0	0.0
bg_dip_200_40	25.8	1.0	0.341283	2.913	0.0	0.0
bg_dip_400_60	29.4	1.0	0.0011524	2.601	0.0	0.0
bg_dip_600_80	11.9	1.0	0.0476112	2.556	0.0	0.0
bg_dip_800_12	6.14	1.0	-0.0409596	2.481	0.0	0.0
bg_dip_1200_1	0.83	1.0	0.043888	2.297	0.0	0.0
bg_dip_1600_i	0.132	1.0	-0.122585	2.088	0.0	0.0
bg_vbf_0_100	0.0486	1.0	1.04772	3.507	0.0	0.0
bg_vbf_100_20	1.16	1.0	-0.324417	3.174	0.0	0.0
bg_vbf_200_40	6.68	1.0	0.0369757	2.866	0.0	0.0
bg_vbf_400_60	6.68	1.0	0.0499887	2.594	0.0	0.0
bg_vbf_600_80	3.03	1.0	0.00439739	2.453	0.0	0.0
bg_vbf_800_12	1.58	1.0	0.0359424	2.343	0.0	0.0
bg_vbf_1200_1	0.236	1.0	0.0450563	2.208	0.0	0.0
bg_vbf_1600_i	0.0444	1.0	-0.0663344	2.114	0.0	0.0

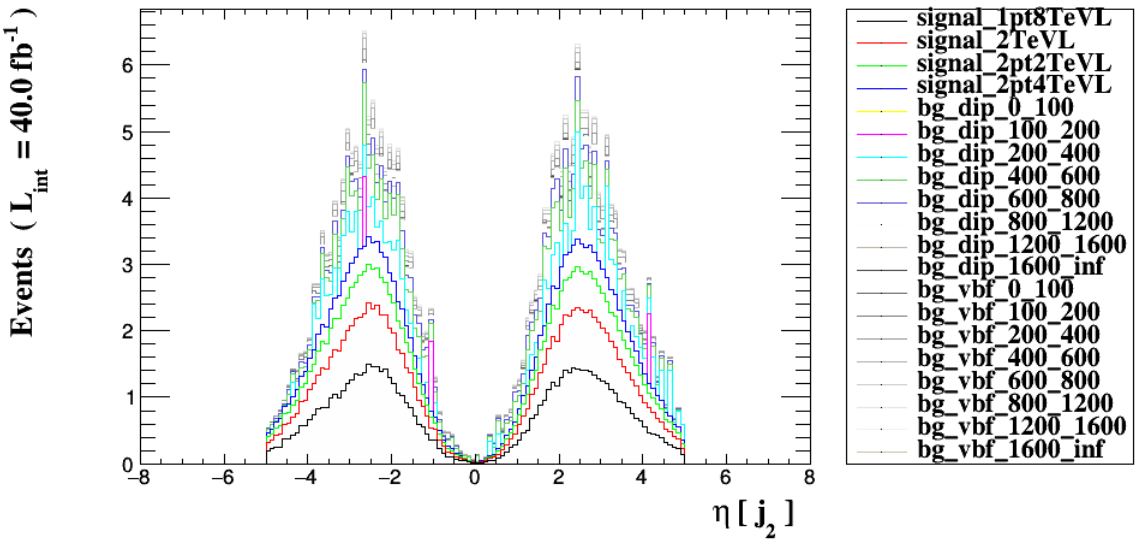

Figure 5.

3.7 Histogram 6

*** Plot: PHI (jets[2])**

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal_1pt8tevl	71.6	1.0	-0.00551197	1.813	0.0	0.0
signal_2tevl	44.7	1.0	-0.00629482	1.815	0.0	0.0
signal_2pt2tevl	29.7	1.0	0.00123806	1.811	0.0	0.0
signal_2pt4tevl	20.5	1.0	-0.00251439	1.808	0.0	0.0
bg_dip_0_100	0.0 +/- 0.0	0.	0.0	0.0	0.0	0.0
bg_dip_100_20	3.16	1.0	1.00733	1.634	0.0	0.0
bg_dip_200_40	25.8	1.0	-0.0150701	1.924	0.0	0.0
bg_dip_400_60	29.4	1.0	-0.020964	1.794	0.0	0.0
bg_dip_600_80	11.9	1.0	0.0543267	1.792	0.0	0.0
bg_dip_800_12	6.14	1.0	0.0379614	1.804	0.0	0.0
bg_dip_1200_1	0.83	1.0	-0.0236384	1.819	0.0	0.0
bg_dip_1600_i	0.132	1.0	-0.168036	1.827	0.0	0.0
bg_vbf_0_100	0.0486	1.0	0.0859607	1.498	0.0	0.0
bg_vbf_100_20	1.16	1.0	0.17327	1.879	0.0	0.0
bg_vbf_200_40	6.68	1.0	-0.0623337	1.832	0.0	0.0
bg_vbf_400_60	6.68	1.0	-0.0452271	1.825	0.0	0.0
bg_vbf_600_80	3.03	1.0	-0.00796522	1.816	0.0	0.0
bg_vbf_800_12	1.58	1.0	-0.0301573	1.811	0.0	0.0
bg_vbf_1200_1	0.236	1.0	-0.0222433	1.824	0.0	0.0
bg_vbf_1600_i	0.0444	1.0	0.0549082	1.783	0.0	0.0

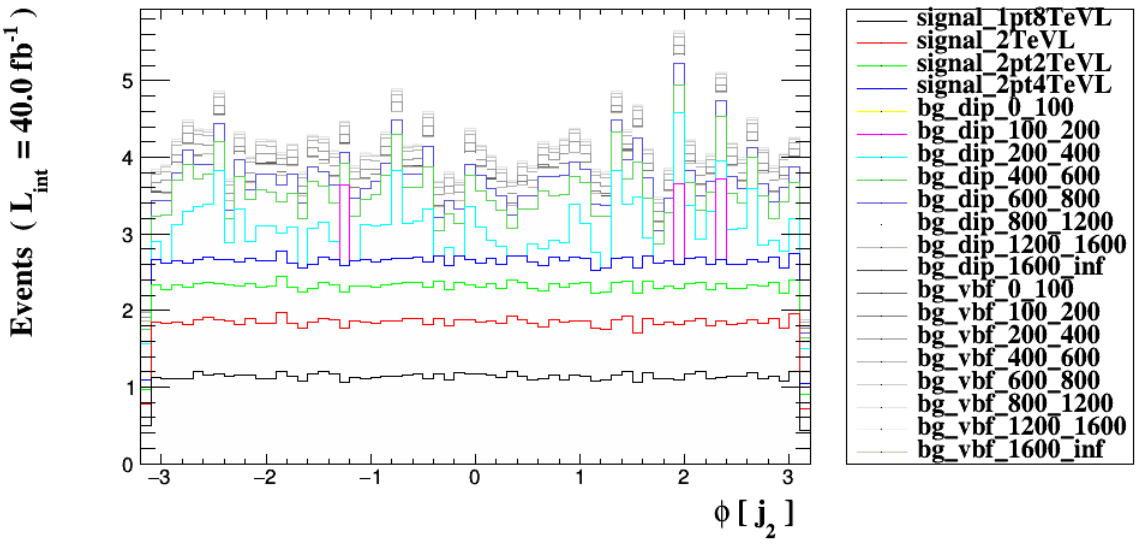

Figure 6.

3.8 Histogram 7

*** Plot: DELTAR (jets[1] , jets[2])**

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal_1pt8tevl	71.6	1.0	4.7913	1.264	0.0	0.0
signal_2tevl	44.7	1.0	4.85016	1.269	0.0	0.0
signal_2pt2tevl	29.7	1.0	4.89784	1.272	0.0	0.0
signal_2pt4tevl	20.5	1.0	4.91461	1.273	0.0	0.0
bg_dip_0_100	0.0 +/- 0.0	0.	0.0	0.0	0.0	0.0
bg_dip_100_20	3.16	1.0	5.99929	0.4811	0.0	0.0
bg_dip_200_40	25.8	1.0	4.61504	0.7198	0.0	0.0
bg_dip_400_60	29.4	1.0	4.09991	0.7051	0.0	0.0
bg_dip_600_80	11.9	1.0	4.02528	0.6393	0.0	0.0
bg_dip_800_12	6.14	1.0	4.00152	0.5757	0.0	0.0
bg_dip_1200_1	0.83	1.0	3.9588	0.4793	0.0	0.0
bg_dip_1600_i	0.132	1.0	3.95712	0.4082	0.0	0.0
bg_vbf_0_100	0.0486	1.0	6.62263	0.3293	0.0	0.0
bg_vbf_100_20	1.16	1.0	5.99091	0.8146	0.0	0.0
bg_vbf_200_40	6.68	1.0	5.10685	0.9126	0.0	0.0
bg_vbf_400_60	6.68	1.0	4.54901	0.8616	0.0	0.0
bg_vbf_600_80	3.03	1.0	4.35037	0.747	0.0	0.0
bg_vbf_800_12	1.58	1.0	4.19332	0.6452	0.0	0.0
bg_vbf_1200_1	0.236	1.0	4.06782	0.544	0.0	0.0
bg_vbf_1600_i	0.0444	1.0	4.00588	0.4638	0.0	0.0

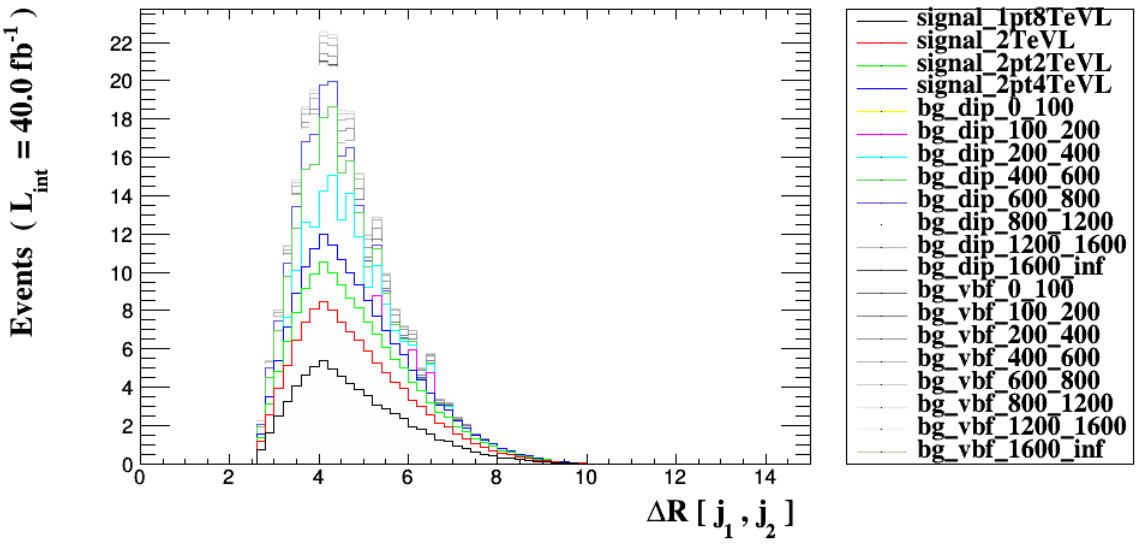

Figure 7.

3.9 Histogram 8

*** Plot: M (jets[1] jets[2])**

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal_1pt8tevl	71.6	1.0	1700.42	795.4	0.0	0.0
signal_2tevl	44.7	1.0	1709.83	805.3	0.0	0.002392
signal_2pt2tevl	29.7	1.0	1719.88	809.2	0.0	0.0
signal_2pt4tevl	20.5	1.0	1712.18	806.6	0.0	0.0
bg_dip_0_100	0.0 +/- 0.0	0.	0.0	0.0	0.0	0.0
bg_dip_100_20	3.16	1.0	1172.68	166.8	0.0	0.0
bg_dip_200_40	25.8	1.0	1086.69	339.7	0.0	0.0
bg_dip_400_60	29.4	1.0	1156.39	374.9	0.0	0.0
bg_dip_600_80	11.9	1.0	1406.66	476.3	0.0	0.0
bg_dip_800_12	6.14	1.0	1771.18	664.8	0.0	0.0
bg_dip_1200_1	0.83	1.0	2404.2	931.2	0.0	0.0
bg_dip_1600_i	0.132	1.0	3359.93	1180	0.0	0.0
bg_vbf_0_100	0.0486	1.0	886.102	84.95	0.0	0.0
bg_vbf_100_20	1.16	1.0	1373.99	562.4	0.0	0.0
bg_vbf_200_40	6.68	1.0	1609.96	785.9	0.0	0.0
bg_vbf_400_60	6.68	1.0	1735.16	826.3	0.0	0.0
bg_vbf_600_80	3.03	1.0	2009.65	841.1	0.0	0.0
bg_vbf_800_12	1.58	1.0	2347.3	869.7	0.0	0.0
bg_vbf_1200_1	0.236	1.0	2943.94	918.6	0.0	0.009153
bg_vbf_1600_i	0.0444	1.0	3625.32	1061	0.0	0.06398

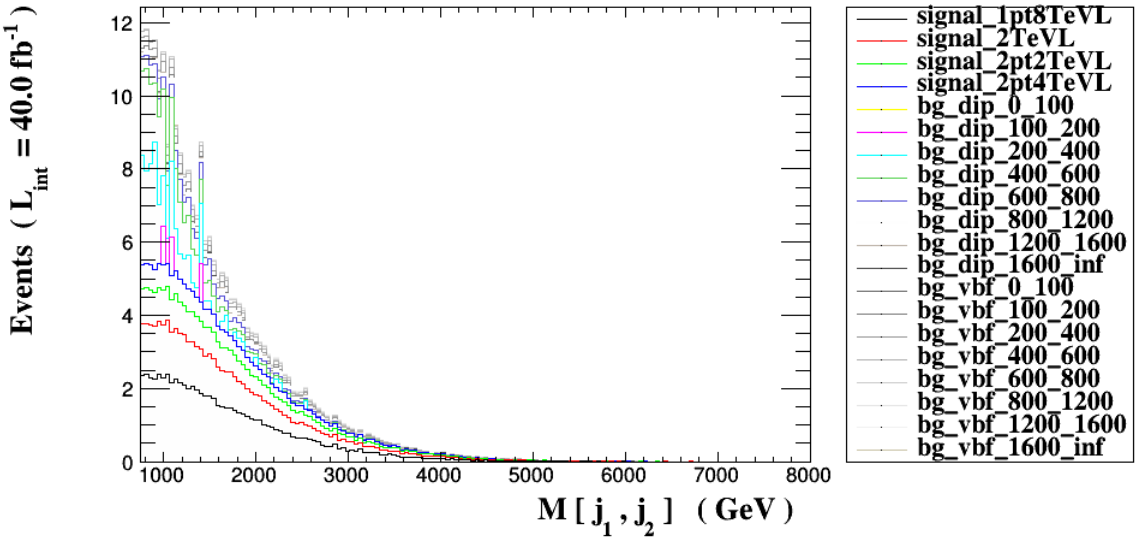

Figure 8.

3.10 Histogram 9

*** Plot: sdETA (jets[1] jets[2])**

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal_1pt8tevl	71.6	1.0	-0.00209236	4.622	50.06	0.0
signal_2tevl	44.7	1.0	-0.0019025	4.69	50.04	0.0
signal_2pt2tevl	29.7	1.0	-0.0403278	4.739	50.38	0.0
signal_2pt4tevl	20.5	1.0	-0.00651616	4.76	50.09	0.0
bg_dip_0_100	0.0 +/- 0.0	0.	0.0	0.0	0.0	0.0
bg_dip_100_20	3.16	1.0	1.51032	5.585	33.38	0.0
bg_dip_200_40	25.8	1.0	-0.308501	4.231	54.46	0.0
bg_dip_400_60	29.4	1.0	0.0273657	3.639	50.0	0.0
bg_dip_600_80	11.9	1.0	-0.10035	3.454	51.48	0.0
bg_dip_800_12	6.14	1.0	0.0462649	3.324	49.19	0.0
bg_dip_1200_1	0.83	1.0	-0.10124	3.147	51.92	0.0
bg_dip_1600_i	0.132	1.0	0.155168	3.003	47.46	0.0
bg_vbf_0_100	0.0486	1.0	-0.174236	6.403	50.0	0.0
bg_vbf_100_20	1.16	1.0	0.457753	5.752	46.55	0.0
bg_vbf_200_40	6.68	1.0	-0.0210876	4.873	50.04	0.0
bg_vbf_400_60	6.68	1.0	-0.0753178	4.189	50.97	0.0
bg_vbf_600_80	3.03	1.0	-0.00531706	3.854	50.13	0.0
bg_vbf_800_12	1.58	1.0	-0.0630546	3.582	50.81	0.0
bg_vbf_1200_1	0.236	1.0	-0.0646725	3.319	50.8	0.0
bg_vbf_1600_i	0.0444	1.0	0.116643	3.131	48.21	0.0

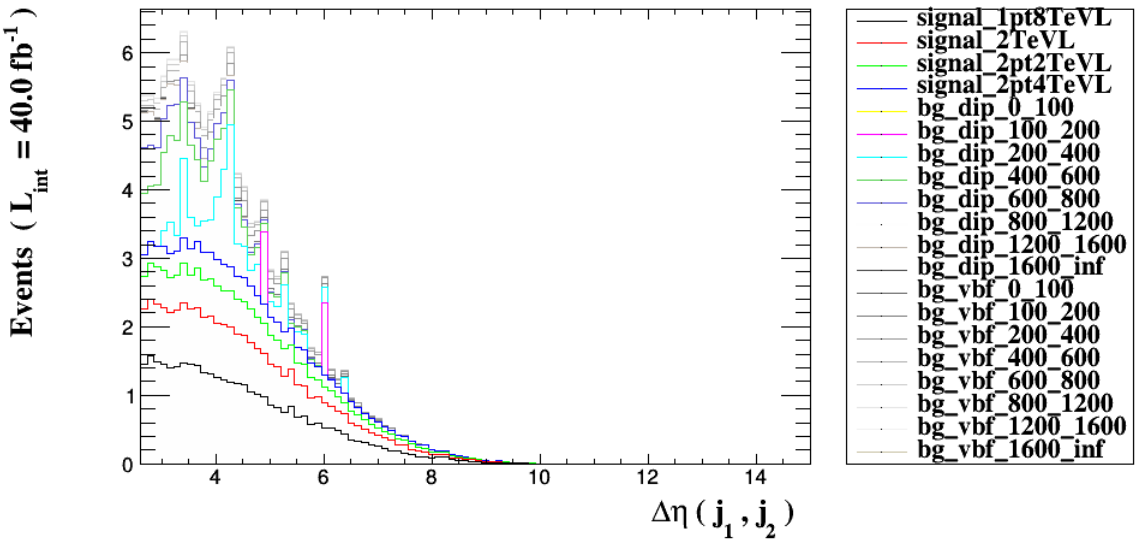

Figure 9.

3.11 Histogram 10

*** Plot: M (a[1] a[2])**

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal_1pt8tevl	71.6	1.0	1440.41	804.8	0.0	1.282
signal_2tevl	44.7	1.0	1452.91	814.5	0.0	1.3
signal_2pt2tevl	29.7	1.0	1458.99	818.6	0.0	1.395
signal_2pt4tevl	20.5	1.0	1467.75	823.2	0.0	1.422
bg_dip_0_100	0.0 +/- 0.0	0.	0.0	0.0	0.0	0.0
bg_dip_100_20	3.16	1.0	674.287	36.08	0.0	0.0
bg_dip_200_40	25.8	1.0	806.444	369.4	0.0	0.0
bg_dip_400_60	29.4	1.0	757.536	302.7	0.0	0.0
bg_dip_600_80	11.9	1.0	794.656	340.2	0.0	0.0
bg_dip_800_12	6.14	1.0	817.407	345.6	0.0	0.0
bg_dip_1200_1	0.83	1.0	857.308	368.7	0.0	0.0
bg_dip_1600_i	0.132	1.0	894.427	438.3	0.0	0.0
bg_vbf_0_100	0.0486	1.0	999.408	375.3	0.0	0.0
bg_vbf_100_20	1.16	1.0	847.835	279.9	0.0	0.0
bg_vbf_200_40	6.68	1.0	801.713	329.2	0.0	0.0
bg_vbf_400_60	6.68	1.0	752.011	284.8	0.0	0.0
bg_vbf_600_80	3.03	1.0	766.09	289.0	0.0	0.0
bg_vbf_800_12	1.58	1.0	787.04	304.8	0.0	0.0
bg_vbf_1200_1	0.236	1.0	805.651	327.2	0.0	0.009129
bg_vbf_1600_i	0.0444	1.0	833.17	363.6	0.0	0.06398

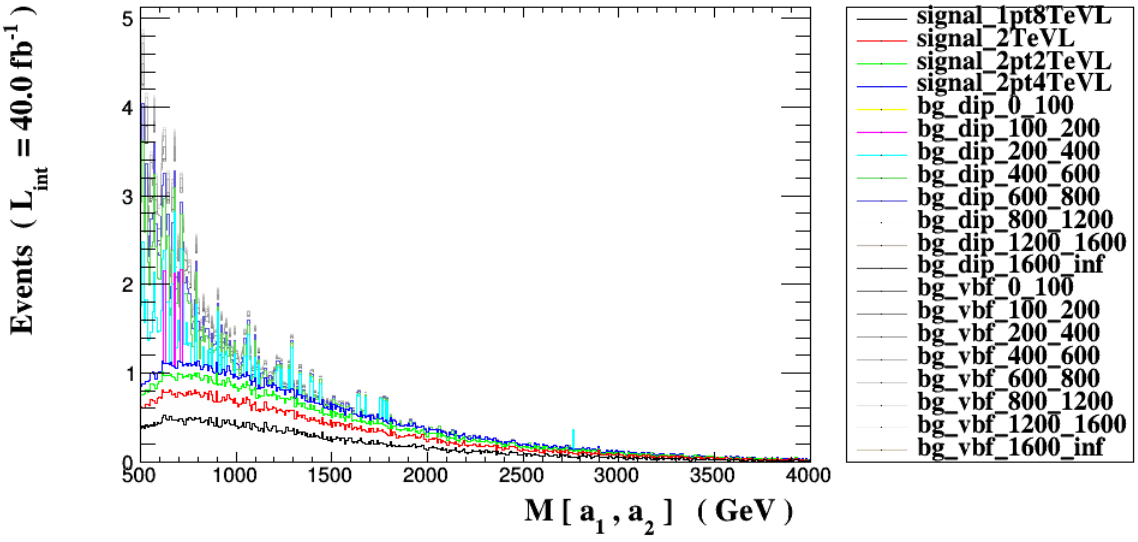

Figure 10.

3.12 Histogram 11

*** Plot: PT (a[1])**

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal_1pt8tevl	71.6	1.0	759.899	377.4	0.0	1.082
signal_2tevl	44.7	1.0	760.681	378.3	0.0	1.008
signal_2pt2tevl	29.7	1.0	759.161	380.0	0.0	1.093
signal_2pt4tevl	20.5	1.0	758.578	383.3	0.0	1.123
bg_dip_0_100	0.0 +/- 0.0	0.	0.0	0.0	0.0	0.0
bg_dip_100_20	3.16	1.0	327.174	7.434	0.0	0.0
bg_dip_200_40	25.8	1.0	400.151	82.89	0.0	0.0
bg_dip_400_60	29.4	1.0	453.621	116.0	0.0	0.0
bg_dip_600_80	11.9	1.0	556.513	168.6	0.0	0.0
bg_dip_800_12	6.14	1.0	681.169	251.5	0.0	0.04611
bg_dip_1200_1	0.83	1.0	836.694	405.5	0.0	0.0
bg_dip_1600_i	0.132	1.0	896.187	576.0	0.0	3.979
bg_vbf_0_100	0.0486	1.0	379.899	64.59	0.0	0.0
bg_vbf_100_20	1.16	1.0	373.902	77.67	0.0	0.0
bg_vbf_200_40	6.68	1.0	392.202	92.25	0.0	0.0
bg_vbf_400_60	6.68	1.0	437.392	113.3	0.0	0.0
bg_vbf_600_80	3.03	1.0	511.989	149.4	0.0	0.0
bg_vbf_800_12	1.58	1.0	630.881	223.5	0.0	0.0
bg_vbf_1200_1	0.236	1.0	793.987	347.0	0.0	0.03651
bg_vbf_1600_i	0.0444	1.0	957.485	518.9	0.0	2.106

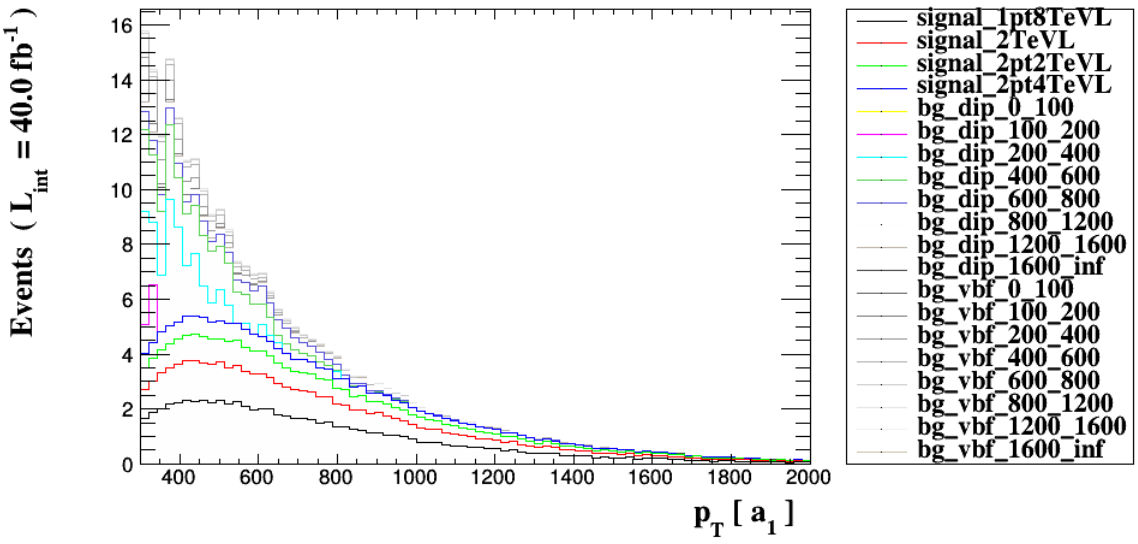

Figure 11.

3.13 Histogram 12

*** Plot: PT (a[2])**

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal_1pt8tevl	71.6	1.0	513.442	347.0	0.0	0.4596
signal_2tevl	44.7	1.0	518.547	351.9	0.0	0.4301
signal_2pt2tevl	29.7	1.0	520.349	352.1	0.0	0.4284
signal_2pt4tevl	20.5	1.0	521.952	355.0	0.0	0.4715
bg_dip_0_100	0.0 +/- 0.0	0.	0.0	0.0	0.0	0.0
bg_dip_100_20	3.16	1.0	253.391	44.39	0.0	0.0
bg_dip_200_40	25.8	1.0	191.937	101.6	0.0	0.0
bg_dip_400_60	29.4	1.0	141.385	100.6	0.0	0.0
bg_dip_600_80	11.9	1.0	138.099	111.8	0.0	0.0
bg_dip_800_12	6.14	1.0	133.82	114.3	0.0	0.0
bg_dip_1200_1	0.83	1.0	124.476	117.4	0.0	0.0
bg_dip_1600_i	0.132	1.0	133.187	137.3	0.0	0.0
bg_vbf_0_100	0.0486	1.0	359.837	74.21	0.0	0.0
bg_vbf_100_20	1.16	1.0	285.217	94.57	0.0	0.0
bg_vbf_200_40	6.68	1.0	209.279	119.1	0.0	0.0
bg_vbf_400_60	6.68	1.0	163.048	118.3	0.0	0.0
bg_vbf_600_80	3.03	1.0	160.555	112.8	0.0	0.0
bg_vbf_800_12	1.58	1.0	166.84	124.1	0.0	0.0
bg_vbf_1200_1	0.236	1.0	171.935	136.6	0.0	0.0
bg_vbf_1600_i	0.0444	1.0	183.125	156.6	0.0	0.0

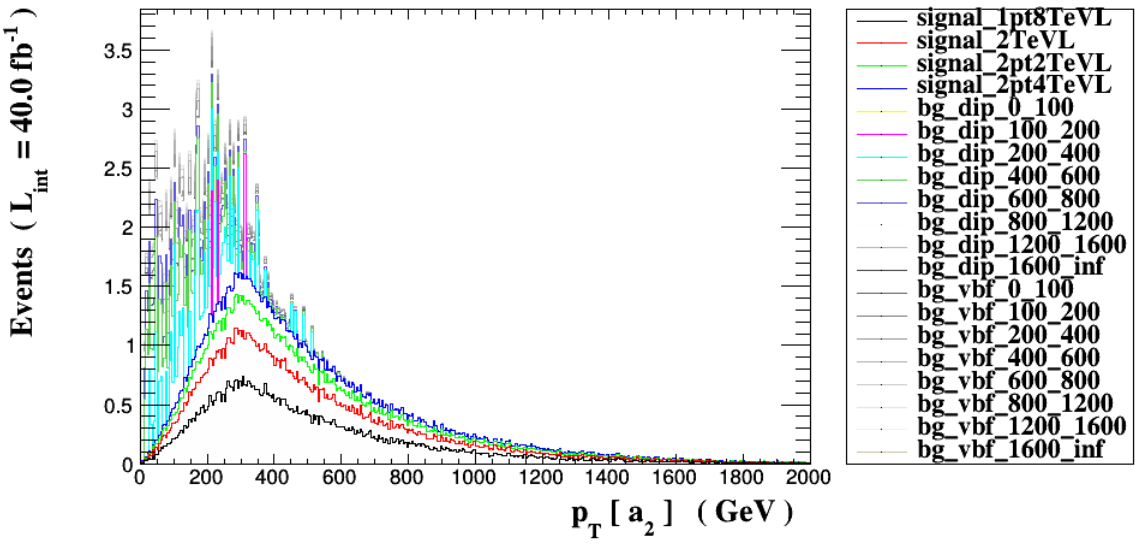

Figure 12.

3.14 Histogram 13

*** Plot: THT**

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal_1pt8tevl	71.6	1.0	523.292	343.8	0.0	0.0
signal_2tevl	44.7	1.0	507.702	334.1	0.0	0.0
signal_2pt2tevl	29.7	1.0	498.796	330.9	0.0	0.0
signal_2pt4tevl	20.5	1.0	490.831	326.9	0.0	0.0
bg_dip_0_100	0.0 +/- 0.0	0.	0.0	0.0	0.0	0.0
bg_dip_100_20	3.16	1.0	148.168	37.58	0.0	0.0
bg_dip_200_40	25.8	1.0	322.57	51.94	0.0	0.0
bg_dip_400_60	29.4	1.0	491.06	56.32	0.0	0.0
bg_dip_600_80	11.9	1.0	684.399	55.83	0.0	0.0
bg_dip_800_12	6.14	1.0	935.186	105.9	0.0	0.0
bg_dip_1200_1	0.83	1.0	1339.85	106.6	0.0	0.0
bg_dip_1600_i	0.132	1.0	1838.6	235.7	0.0	0.0
bg_vbf_0_100	0.0486	1.0	74.6978	15.53	0.0	0.0
bg_vbf_100_20	1.16	1.0	163.344	25.73	0.0	0.0
bg_vbf_200_40	6.68	1.0	310.201	55.23	0.0	0.0
bg_vbf_400_60	6.68	1.0	489.26	55.92	0.0	0.0
bg_vbf_600_80	3.03	1.0	684.802	56.45	0.0	0.0
bg_vbf_800_12	1.58	1.0	938.007	105.1	0.0	0.0
bg_vbf_1200_1	0.236	1.0	1341.72	107.1	0.0	0.0
bg_vbf_1600_i	0.0444	1.0	1815.22	215.1	0.0	0.0

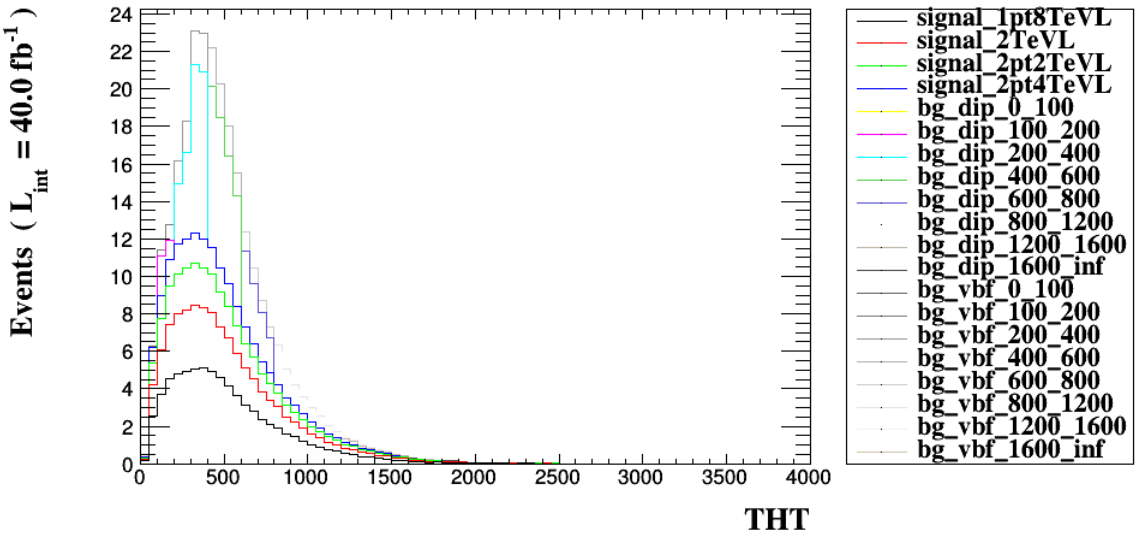

Figure 13.

3.15 Histogram 14

*** Plot: MET**

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal_1pt8tevl	71.6	1.0	1.01393e-08	1.315e-08	0.0	0.0
signal_2tevl	44.7	1.0	1.00902e-08	1.305e-08	0.0	0.0
signal_2pt2tevl	29.7	1.0	1.01543e-08	1.319e-08	0.0	0.0
signal_2pt4tevl	20.5	1.0	1.01718e-08	1.327e-08	0.0	0.0
bg_dip_0_100	0.0 +/- 0.0	0.	0.0	0.0	0.0	0.0
bg_dip_100_20	3.16	1.0	2.6048e-09	5.584e-10	0.0	0.0
bg_dip_200_40	25.8	1.0	5.18557e-09	2.976e-09	0.0	0.0
bg_dip_400_60	29.4	1.0	5.42927e-09	2.957e-09	0.0	0.0
bg_dip_600_80	11.9	1.0	5.50533e-09	3.413e-09	0.0	0.0
bg_dip_800_12	6.14	1.0	6.64857e-09	6.914e-09	0.0	0.0
bg_dip_1200_1	0.83	1.0	1.535e-08	1.701e-08	0.0	0.0
bg_dip_1600_i	0.132	1.0	2.25198e-08	2.023e-08	0.0	0.0
bg_vbf_0_100	0.0486	1.0	2.92664e-09	2.061e-09	0.0	0.0
bg_vbf_100_20	1.16	1.0	4.59216e-09	2.634e-09	0.0	0.0
bg_vbf_200_40	6.68	1.0	5.34226e-09	3.094e-09	0.0	0.0
bg_vbf_400_60	6.68	1.0	5.632e-09	3.701e-09	0.0	0.0
bg_vbf_600_80	3.03	1.0	5.74732e-09	3.481e-09	0.0	0.0
bg_vbf_800_12	1.58	1.0	6.62729e-09	5.521e-09	0.0	0.0
bg_vbf_1200_1	0.236	1.0	1.40828e-08	1.624e-08	0.0	0.0
bg_vbf_1600_i	0.0444	1.0	2.27298e-08	2.061e-08	0.0	0.0

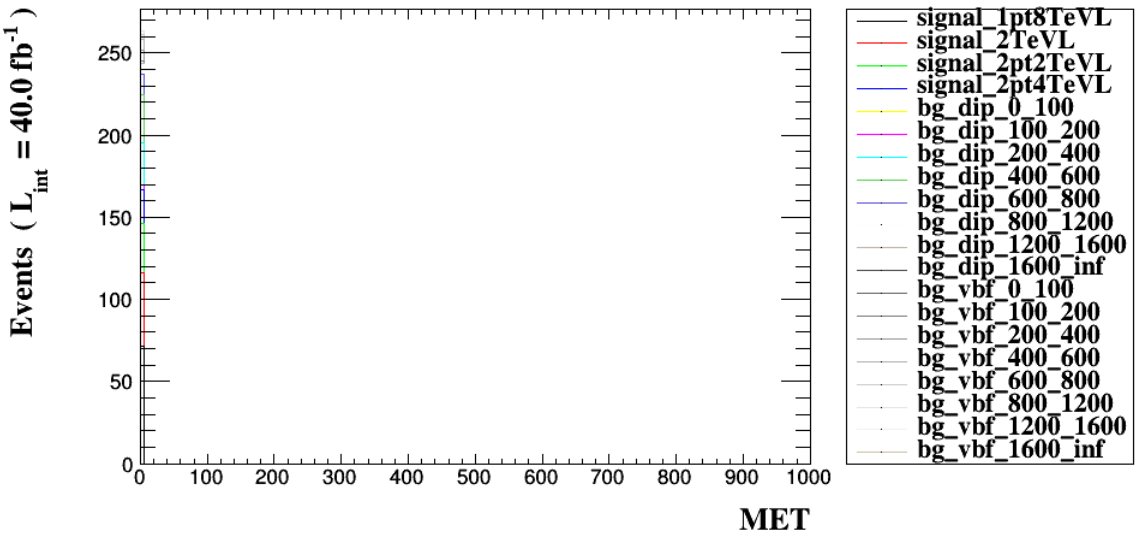

Figure 14.

3.16 Histogram 15

*** Plot: TET**

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal_1pt8tevl	71.6	1.0	1796.63	802.7	0.0	0.0
signal_2tevl	44.7	1.0	1786.93	803.4	0.0	0.002388
signal_2pt2tevl	29.7	1.0	1778.31	807.7	0.0	0.002341
signal_2pt4tevl	20.5	1.0	1771.36	814.1	0.0	0.0
bg_dip_0_100	0.0 +/- 0.0	0.	0.0	0.0	0.0	0.0
bg_dip_100_20	3.16	1.0	728.733	80.65	0.0	0.0
bg_dip_200_40	25.8	1.0	914.659	167.9	0.0	0.0
bg_dip_400_60	29.4	1.0	1086.07	197.0	0.0	0.0
bg_dip_600_80	11.9	1.0	1379.01	239.6	0.0	0.0
bg_dip_800_12	6.14	1.0	1750.17	319.8	0.0	0.0
bg_dip_1200_1	0.83	1.0	2301.02	455.2	0.0	0.0
bg_dip_1600_i	0.132	1.0	2867.98	644.6	0.0	0.0
bg_vbf_0_100	0.0486	1.0	814.434	141.3	0.0	0.0
bg_vbf_100_20	1.16	1.0	822.463	164.7	0.0	0.0
bg_vbf_200_40	6.68	1.0	911.682	196.9	0.0	0.0
bg_vbf_400_60	6.68	1.0	1089.7	208.6	0.0	0.0
bg_vbf_600_80	3.03	1.0	1357.34	214.2	0.0	0.0
bg_vbf_800_12	1.58	1.0	1735.73	292.6	0.0	0.0
bg_vbf_1200_1	0.236	1.0	2307.64	386.5	0.0	0.0
bg_vbf_1600_i	0.0444	1.0	2955.83	592.9	0.0	0.0

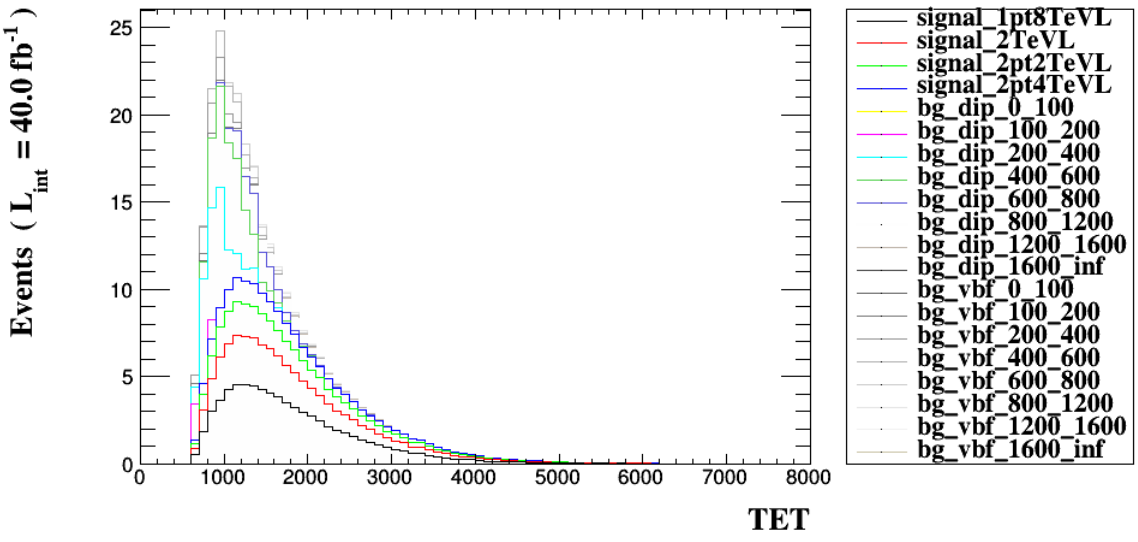

Figure 15.

4 Summary

4.1 Cut-flow charts

- How to compare signal (S) and background (B): S/sqrt(S+B+(xB)**2) .
- 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)	400.622 +/- 0.237	4113516 +/- 4877	3.90e-04 +/- 2.58e-07
SEL: ((sdETA (jets[1] jets[2]) > 2.6 or sdETA	165.82 +/- 9.86	96.80 +/- 9.83	5.694 +/- 0.356