MADAnalysis 5 The LaTeX report

Generated by elijahsheridan on 17 September 2020, 11:19:27

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 main.currentdir = /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/optimization/-
ma_scripts
ma5># set directory where running "./bin/ma5"
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 = 0.0
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># 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 M(a[1] a[2]) > 500
ma5>select PT(a[1]) > 300
ma5>select M(jets[1] jets[2]) > 750
ma5>select sdETA(jets[1] jets[2]) > 3.6 or sdETA(jets[1] jets[2]) < -3.6
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>plot DELTAR(a[1], a[2])
ma5>plot sdETA(a[1] a[2])
ma5>#set the plot/graph parameters
ma5>set selection[5].xmin = 0
ma5>set selection[5].xmax = 2000
ma5>set selection[5].nbins = 200
```

```
ma5>set selection[5].rank = PTordering
ma5>set selection[5].titleX = "p_{T}[j_{1}] (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_{1}]"
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_{1}]"
ma5>set selection[8].xmin = 0
ma5>set selection[8].xmax = 1000
ma5>set selection[8].nbins = 100
ma5>set selection[8].rank = PTordering
ma5>set selection[8].titleX = "p_{T}[j_{2}] (GeV)"
ma5>set selection[9].xmin = -8
ma5>set selection[9].xmax = 8
ma5>set selection[9].nbins = 160
ma5>set selection[9].rank = PTordering
ma5>set selection[9].titleX = "#eta[j_{2}]"
ma5>set selection[10].xmin = -3.2
ma5>set selection[10].xmax = 3.2
ma5>set selection[10].nbins = 64
ma5>set selection[10].rank = PTordering
ma5>set selection[10].titleX = "#phi[j_{2}]"
ma5>set selection[11].xmin = 0
ma5>set selection[11].xmax = 15
ma5>set selection[11].nbins = 75
ma5>set selection[11].rank = PTordering
ma5>set selection[11].titleX = "#DeltaR[j_{1},j_{2}]"
ma5>set selection[12].xmin = 120
ma5>set selection[12].xmax = 2000
ma5>set selection[12].nbins = 160
ma5>set selection[12].rank = PTordering
ma5>set selection[12].titleX = "M[j_{1},j_{2}] (GeV)"
ma5>set selection[13].xmin = 2.4
ma5>set selection[13].xmax = 8
ma5>set selection[13].titleX = "#Delta#eta(j_{1},j_{2})"
ma5>set selection[14].xmin = 0
ma5>set selection[14].xmax = 1000
ma5>set selection[14].nbins = 400
ma5>set selection[14].rank = PTordering
ma5>set selection[14].titleX = "M[a_{1},a_{2}] (GeV)"
ma5>set selection[15].xmin = 0
ma5>set selection[15].xmax = 1000
ma5>set selection[15].nbins = 80
ma5>set selection[15].rank = PTordering
```

```
ma5>set selection[15].titleX = "p_{T}[a_{1}]"
ma5>set selection[16].xmin = 0
ma5>set selection[16].xmax = 2000
ma5>set selection[16].nbins = 400
ma5>set selection[16].rank = PTordering
ma5>set selection[16].titleX = "p_{T}[a_{2}] (GeV)"
ma5>set selection[17].xmin = 0
ma5>set selection[17].xmax = 4000
ma5>set selection[17].nbins = 80
ma5>set selection[17].rank = PTordering
ma5>set selection[17].titleX = "THT"
ma5>set selection[18].xmin = 0
ma5>set selection[18].xmax = 1000
ma5>set selection[18].nbins = 200
ma5>set selection[18].rank = PTordering
ma5>set selection[18].titleX = "MET"
ma5>set selection[19].xmin = 0
ma5>set selection[19].xmax = 8000
ma5>set selection[19].nbins = 80
ma5>set selection[19].rank = PTordering
ma5>set selection[19].titleX = "TET"
ma5>submit four_cuts_eff_flow_chart
```

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/-post_optimization_studies/mad_analyses .
- 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/-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

2.3 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

2.4 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

2.5 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

2.6 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

2.7 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

2.8 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

2.9 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

2.10 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_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/-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_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/-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_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/-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

2.14 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

2.15 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_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/-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_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/-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_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 M (a[1] a[2]) > 500.0**

Dataset	Events kept: K	Rejected events: R	Efficiency: K / (K + R)	Cumul. efficiency: K / Initial
signal	2827.3 +/- 29.6	1266.8 +/- 29.6	0.69057 +/- 0.00722	0.69057 +/- 0.00722
bg_vbf_0_10	5.94 +/- 2.44	12144.4 +/- 23.2	0.000489 +/- 0.000201	0.000489 +/- 0.000201
bg_vbf_100_	25.13 +/- 5.01	9670.2 +/- 17.3	0.002592 +/- 0.000516	0.002592 +/- 0.000516
bg_vbf_200_	44.33 +/- 6.63	5368.9 +/- 12.7	0.00819 +/- 0.00122	0.00819 +/- 0.00122
bg_vbf_400_	18.9 +/- 4.3	967.96 +/- 4.51	0.01914 +/- 0.00436	0.01914 +/- 0.00436
bg_vbf_600_	7.29 +/- 2.66	244.79 +/- 2.68	0.0289 +/- 0.0106	0.0289 +/- 0.0106
bg_vbf_800_	4.24 +/- 2.02	110.52 +/- 2.03	0.0369 +/- 0.0176	0.0369 +/- 0.0176
bg_vbf_1200_	0.925 +/- 0.940	19.67 +/- 0.94	0.0449 +/- 0.0456	0.0449 +/- 0.0456
bg_vbf_1600_	0.363 +/- 0.588	7.296 +/- 0.588	0.0473 +/- 0.0767	0.0473 +/- 0.0767
bg_dip_0_10	495.3 +/- 22.3	2710351 +/- 4612	1.83e-04 +/- 8.21e-06	1.83e-04 +/- 8.21e-06
bg_dip_100_	1178.6 +/- 34.4	1094184 +/- 1525	1.08e-03 +/- 3.13e-05	1.08e-03 +/- 3.13e-05
bg_dip_200_	1106.8 +/- 33.2	238442 +/- 413	0.004620 +/- 0.000139	0.004620 +/- 0.000139
bg_dip_400_	364.0 +/- 19.0	28434.7 +/- 54.9	0.012640 +/- 0.000658	0.012640 +/- 0.000658
bg_dip_600_	131.5 +/- 11.4	6542.9 +/- 29.3	0.0197 +/- 0.0017	0.0197 +/- 0.0017
bg_dip_800_	76.70 +/- 8.64	2865.64 +/- 9.95	0.02607 +/- 0.00294	0.02607 +/- 0.00294
bg_dip_1200_	16.44 +/- 3.99	497.07 +/- 4.73	0.03201 +/- 0.00777	0.03201 +/- 0.00777
bg_dip_1600_	7.09 +/- 2.61	180.69 +/- 2.63	0.0378 +/- 0.0139	0.0378 +/- 0.0139

3.2 Cut 2

*** Cut: select PT (a[1]) > 300.0**

Dataset	Events kept: K	Rejected events: R	Efficiency: K / (K + R)	Cumul. efficiency: K / Initial
signal	2603.7 +/- 30.8	223.6 +/- 14.5	0.92093 +/- 0.00508	0.63597 +/- 0.00752
bg_vbf_0_10	0.753 +/- 0.868	5.19 +/- 2.28	0.127 +/- 0.136	6.20e-05 +/- 7.14e-05
bg_vbf_100_	4.46 +/- 2.11	20.67 +/- 4.54	0.1774 +/- 0.0762	0.000460 +/- 0.000218
bg_vbf_200_	13.66 +/- 3.69	30.66 +/- 5.52	0.3082 +/- 0.0694	0.002524 +/- 0.000682
bg_vbf_400_	10.39 +/- 3.21	8.5 +/- 2.9	0.550 +/- 0.114	0.01053 +/- 0.00325
bg_vbf_600_	4.98 +/- 2.21	2.31 +/- 1.51	0.684 +/- 0.172	0.01977 +/- 0.00877
bg_vbf_800_	3.20 +/- 1.76	1.04 +/- 1.02	0.754 +/- 0.209	0.0278 +/- 0.0154
bg_vbf_1200_	0.719 +/- 0.833	0.206 +/- 0.452	0.777 +/- 0.433	0.0349 +/- 0.0404
bg_vbf_1600_	0.279 +/- 0.519	0.0833 +/- 0.2870	0.770 +/- 0.699	0.0365 +/- 0.0677
bg_dip_0_10	54.8 +/- 7.4	440.5 +/- 21.0	0.1106 +/- 0.0141	2.02e-05 +/- 2.73e-06
bg_dip_100_	247.5 +/- 15.7	931.0 +/- 30.5	0.2100 +/- 0.0119	2.26e-04 +/- 1.44e-05
bg_dip_200_	444.3 +/- 21.1	662.5 +/- 25.7	0.4015 +/- 0.0147	1.85e-03 +/- 8.79e-05
bg_dip_400_	236.0 +/- 15.3	128.0 +/- 11.3	0.648 +/- 0.025	0.008194 +/- 0.000531
bg_dip_600_	91.95 +/- 9.53	39.53 +/- 6.27	0.70 +/- 0.04	0.01378 +/- 0.00143
bg_dip_800_	53.56 +/- 7.25	23.14 +/- 4.79	0.6983 +/- 0.0524	0.01820 +/- 0.00246
bg_dip_1200_	11.29 +/- 3.32	5.15 +/- 2.26	0.687 +/- 0.114	0.02199 +/- 0.00647
bg_dip_1600_	4.60 +/- 2.12	2.49 +/- 1.57	0.649 +/- 0.179	0.0245 +/- 0.0113

3.3 Cut 3

*** Cut: select M (jets[1] jets[2]) > 750.0**

Dataset	Events kept: K	Rejected events: R	Efficiency: K / (K + R)	Cumul. efficiency: K / Initial
signal	2140.3 +/- 32.0	463.5 +/- 20.3	0.8220 +/- 0.0075	0.52277 +/- 0.00781
bg_vbf_0_10	0.0486 +/- 0.2204	0.705 +/- 0.839	0.0645 +/- 0.2830	4.00e-06 +/- 1.81e-05
bg_vbf_100_	1.16 +/- 1.08	3.29 +/- 1.81	0.261 +/- 0.208	0.000120 +/- 0.000111
bg_vbf_200_	6.68 +/- 2.58	6.98 +/- 2.64	0.489 +/- 0.135	0.001235 +/- 0.000477
bg_vbf_400_	7.13 +/- 2.66	3.3 +/- 1.8	0.686 +/- 0.144	0.0072 +/- 0.0027
bg_vbf_600_	4.01 +/- 1.99	0.979 +/- 0.987	0.804 +/- 0.178	0.01589 +/- 0.00788
bg_vbf_800_	2.93 +/- 1.69	0.27 +/- 0.52	0.916 +/- 0.156	0.0255 +/- 0.0147
bg_vbf_1200_	0.697 +/- 0.820	0.022 +/- 0.148	0.969 +/- 0.203	0.0338 +/- 0.0398
bg_vbf_1600_	0.276 +/- 0.516	0.00281 +/- 0.05298	0.990 +/- 0.189	0.0361 +/- 0.0674
bg_dip_0_10	0.0 +/- 0.0	54.8 +/- 7.4	0.0 +/- 0.0	0.0 +/- 0.0
bg_dip_100_	3.16 +/- 1.78	244.4 +/- 15.6	0.01277 +/- 0.00714	2.89e-06 +/- 1.62e-06
bg_dip_200_	25.80 +/- 5.08	418.5 +/- 20.5	0.0581 +/- 0.0111	1.08e-04 +/- 2.12e-05
bg_dip_400_	35.47 +/- 5.95	200.5 +/- 14.1	0.1503 +/- 0.0233	0.001232 +/- 0.000207
bg_dip_600_	26.86 +/- 5.17	65.09 +/- 8.03	0.2921 +/- 0.0474	0.004024 +/- 0.000775
bg_dip_800_	32.73 +/- 5.69	20.83 +/- 4.55	0.6112 +/- 0.0666	0.01112 +/- 0.00193
bg_dip_1200_	9.49 +/- 3.05	1.80 +/- 1.34	0.841 +/- 0.109	0.01848 +/- 0.00594
bg_dip_1600_	4.41 +/- 2.07	0.191 +/- 0.437	0.9584 +/- 0.0931	0.023 +/- 0.011

3.4 Cut 4

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

Dataset	Events kept: K	Rejected events: R	Efficiency: K / (K + R)	Cumul. efficiency: K / Initial
signal	767.0 +/- 25.0	1373.3 +/- 30.2	0.3584 +/- 0.0104	0.1873 +/- 0.0061
bg_vbf_0_10	0.0486 +/- 0.2204	0.0 +/- 0.0	1.0	4.00e-06 +/- 1.81e-05
bg_vbf_100_	1.16 +/- 1.08	0.0 +/- 0.0	1.0	0.000120 +/- 0.000111
bg_vbf_200_	6.04 +/- 2.46	0.638 +/- 0.799	0.905 +/- 0.114	0.001117 +/- 0.000454
bg_vbf_400_	4.4 +/- 2.1	2.69 +/- 1.64	0.622 +/- 0.182	0.00450 +/- 0.00213
bg_vbf_600_	1.64 +/- 1.28	2.37 +/- 1.53	0.409 +/- 0.246	0.00650 +/- 0.00506
bg_vbf_800_	0.622 +/- 0.787	2.3 +/- 1.5	0.213 +/- 0.239	0.00542 +/- 0.00686
bg_vbf_1200_	0.0548 +/- 0.2337	0.642 +/- 0.789	0.0786 +/- 0.3225	0.00266 +/- 0.01135
bg_vbf_1600_	0.0057 +/- 0.0755	0.271 +/- 0.511	0.0206 +/- 0.2703	0.000744 +/- 0.009856
bg_dip_0_10	0.0 +/- 0.0	0.0 +/- 0.0	0.0 +/- 0.0	0.0 +/- 0.0
bg_dip_100_	3.16 +/- 1.78	0.0 +/- 0.0	1.0	2.89e-06 +/- 1.62e-06
bg_dip_200_	19.12 +/- 4.37	6.68 +/- 2.58	0.7410 +/- 0.0863	7.98e-05 +/- 1.83e-05
bg_dip_400_	12.3 +/- 3.5	23.21 +/- 4.82	0.3458 +/- 0.0799	0.000426 +/- 0.000122
bg_dip_600_	3.6 +/- 1.9	23.26 +/- 4.82	0.1340 +/- 0.0657	0.000539 +/- 0.000284
bg_dip_800_	1.47 +/- 1.21	31.26 +/- 5.56	0.0449 +/- 0.0362	0.000500 +/- 0.000412
bg_dip_1200_	0.105 +/- 0.324	9.38 +/- 3.04	0.0111 +/- 0.0340	0.000205 +/- 0.000631
bg_dip_1600_	0.00975 +/- 0.09875	4.40 +/- 2.07	0.00221 +/- 0.02238	5.19e-05 +/- 5.26e-04

3.5 Histogram 1

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	766	1.0	370.671	277.6	0.0	0.08114
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	6.04	1.0	214.843	58.14	0.0	0.0
bg_vbf_400_60	4.44	1.0	360.116	74.81	0.0	0.0
bg_vbf_600_80	1.64	1.0	512.148	95.26	0.0	0.0
bg_vbf_800_12	0.623	1.0	713.131	144.6	0.0	0.0
bg_vbf_1200_1	0.0549	1.0	1037.47	214.8	0.0	0.0
bg_vbf_1600_i	0.00581	1.0	1488.05	353.5	0.0	7.318
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	19.1	1.0	243.87	57.21	0.0	0.0
bg_dip_400_60	12.3	1.0	405.044	76.84	0.0	0.0
bg_dip_600_80	3.6	1.0	583.265	92.47	0.0	0.0
bg_dip_800_12	1.47	1.0	800.398	151.0	0.0	0.0
bg_dip_1200_1	0.105	1.0	1173.89	227.2	0.0	0.0
bg_dip_1600_i	0.00975	1.0	1675.33	329.4	0.0	11.11

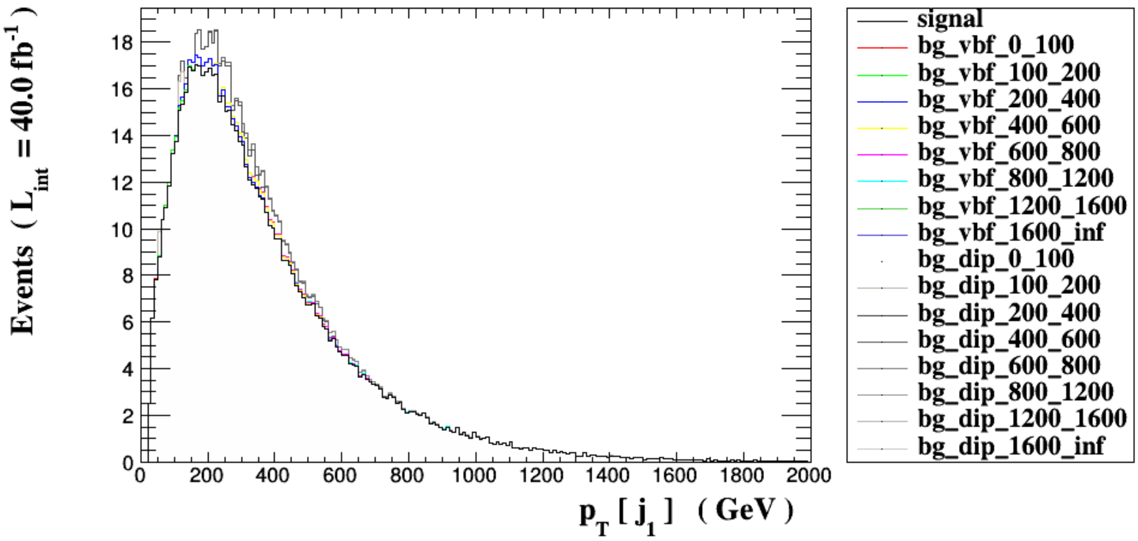

Figure 1.

3.6 Histogram 2

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	766	1.0	-0.00426672	2.037	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	6.04	1.0	-0.006481	2.235	0.0	0.0
bg_vbf_400_60	4.44	1.0	-0.0267496	1.928	0.0	0.0
bg_vbf_600_80	1.64	1.0	0.00605067	1.754	0.0	0.0
bg_vbf_800_12	0.623	1.0	-0.0592612	1.598	0.0	0.0
bg_vbf_1200_1	0.0549	1.0	-0.0746631	1.45	0.0	0.0
bg_vbf_1600_i	0.00581	1.0	0.0871655	1.227	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	19.1	1.0	0.146548	1.676	0.0	0.0
bg_dip_400_60	12.3	1.0	0.1076	1.425	0.0	0.0
bg_dip_600_80	3.6	1.0	-0.0364249	1.3	0.0	0.0
bg_dip_800_12	1.47	1.0	-0.0506134	1.215	0.0	0.0
bg_dip_1200_1	0.105	1.0	0.0264047	1.124	0.0	0.0
bg_dip_1600_i	0.00975	1.0	-0.0490747	0.8389	0.0	0.0

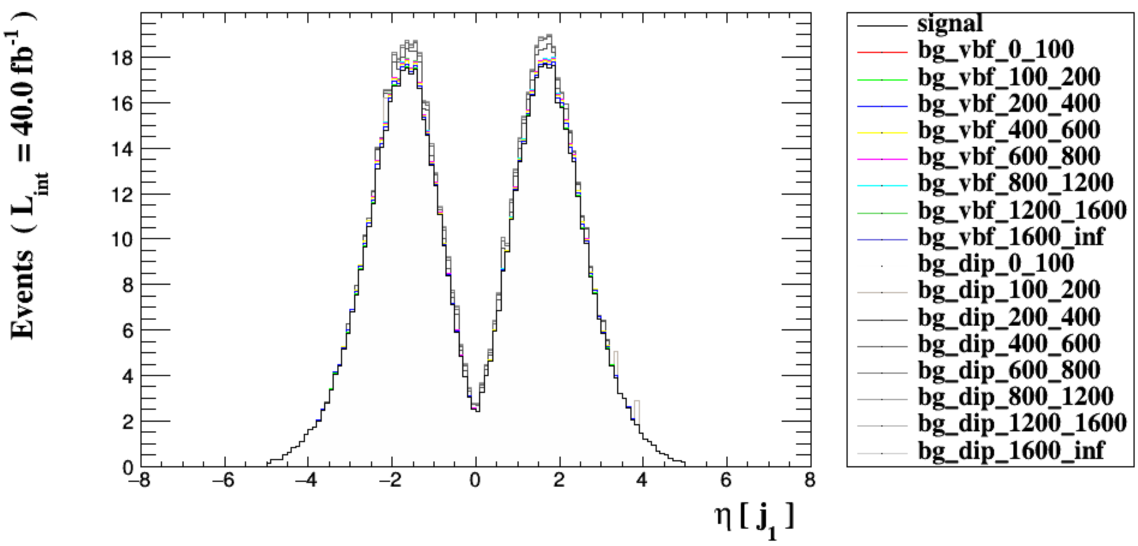

Figure 2.

3.7 Histogram 3

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	766	1.0	0.00274665	1.814	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	6.04	1.0	-0.0816388	1.818	0.0	0.0
bg_vbf_400_60	4.44	1.0	0.0212645	1.801	0.0	0.0
bg_vbf_600_80	1.64	1.0	-0.00569695	1.808	0.0	0.0
bg_vbf_800_12	0.623	1.0	0.0641089	1.814	0.0	0.0
bg_vbf_1200_1	0.0549	1.0	0.0646329	1.787	0.0	0.0
bg_vbf_1600_i	0.00581	1.0	0.217904	1.755	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	19.1	1.0	-0.0522949	1.826	0.0	0.0
bg_dip_400_60	12.3	1.0	-0.125515	1.849	0.0	0.0
bg_dip_600_80	3.6	1.0	-0.113698	1.83	0.0	0.0
bg_dip_800_12	1.47	1.0	0.0576669	1.795	0.0	0.0
bg_dip_1200_1	0.105	1.0	-0.152016	1.941	0.0	0.0
bg_dip_1600_i	0.00975	1.0	-0.0323032	1.815	0.0	0.0

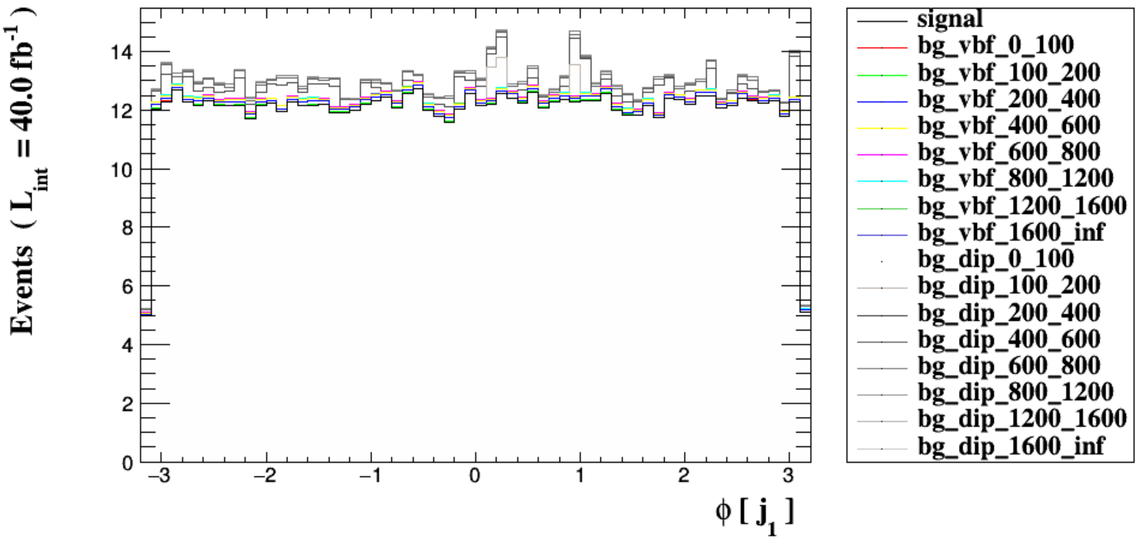

Figure 3.

3.8 Histogram 4

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	766	1.0	102.403	76.9	0.0	0.0
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	6.04	1.0	90.5854	37.67	0.0	0.0
bg_vbf_400_60	4.44	1.0	125.017	60.47	0.0	0.0
bg_vbf_600_80	1.64	1.0	168.787	85.77	0.0	0.0
bg_vbf_800_12	0.623	1.0	215.936	127.0	0.0	0.0
bg_vbf_1200_1	0.0549	1.0	286.77	196.2	0.0	0.0
bg_vbf_1600_i	0.00581	1.0	301.151	261.1	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	49.3379	16.83	0.0	0.0
bg_dip_200_40	19.1	1.0	68.617	36.13	0.0	0.0
bg_dip_400_60	12.3	1.0	78.6224	56.28	0.0	0.0
bg_dip_600_80	3.6	1.0	94.6258	83.07	0.0	0.0
bg_dip_800_12	1.47	1.0	124.553	124.0	0.0	0.0
bg_dip_1200_1	0.105	1.0	176.706	198.4	0.0	0.0
bg_dip_1600_i	0.00975	1.0	138.5	204.7	0.0	0.0

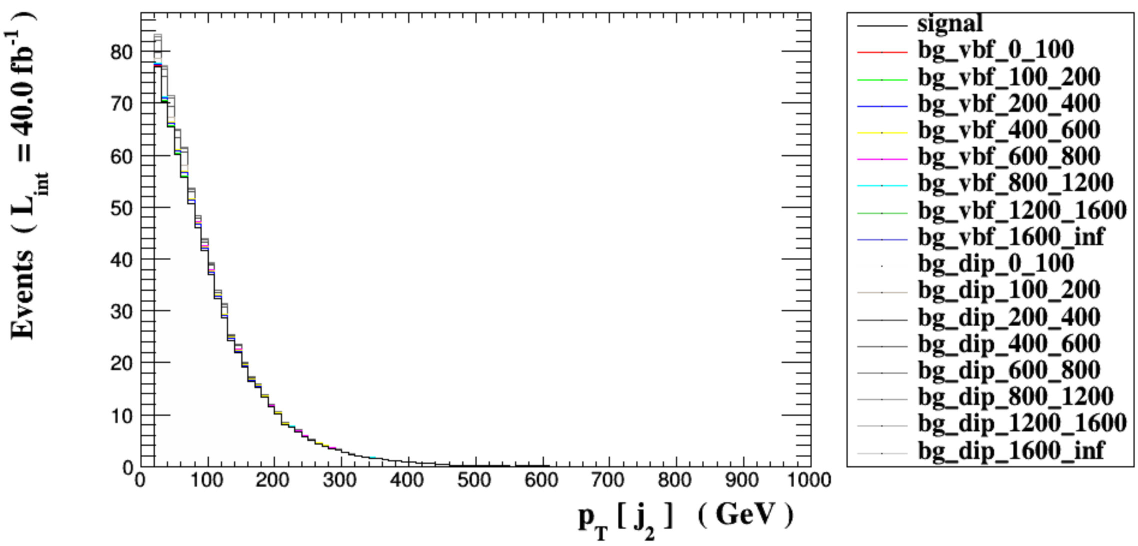

Figure 4.

3.9 Histogram 5

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	766	1.0	0.00824761	3.058	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	6.04	1.0	0.0275519	2.946	0.0	0.0
bg_vbf_400_60	4.44	1.0	0.0664249	2.847	0.0	0.0
bg_vbf_600_80	1.64	1.0	-0.00657983	2.765	0.0	0.0
bg_vbf_800_12	0.623	1.0	0.123933	2.754	0.0	0.0
bg_vbf_1200_1	0.0549	1.0	0.151477	2.787	0.0	0.0
bg_vbf_1600_i	0.00581	1.0	-0.203626	2.95	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	19.1	1.0	0.291332	3.134	0.0	0.0
bg_dip_400_60	12.3	1.0	-0.0693841	3.116	0.0	0.0
bg_dip_600_80	3.6	1.0	0.0792687	3.236	0.0	0.0
bg_dip_800_12	1.47	1.0	0.0158785	3.221	0.0	0.0
bg_dip_1200_1	0.105	1.0	-0.142349	3.23	0.0	0.0
bg_dip_1600_i	0.00975	1.0	-0.328753	3.419	0.0	0.0

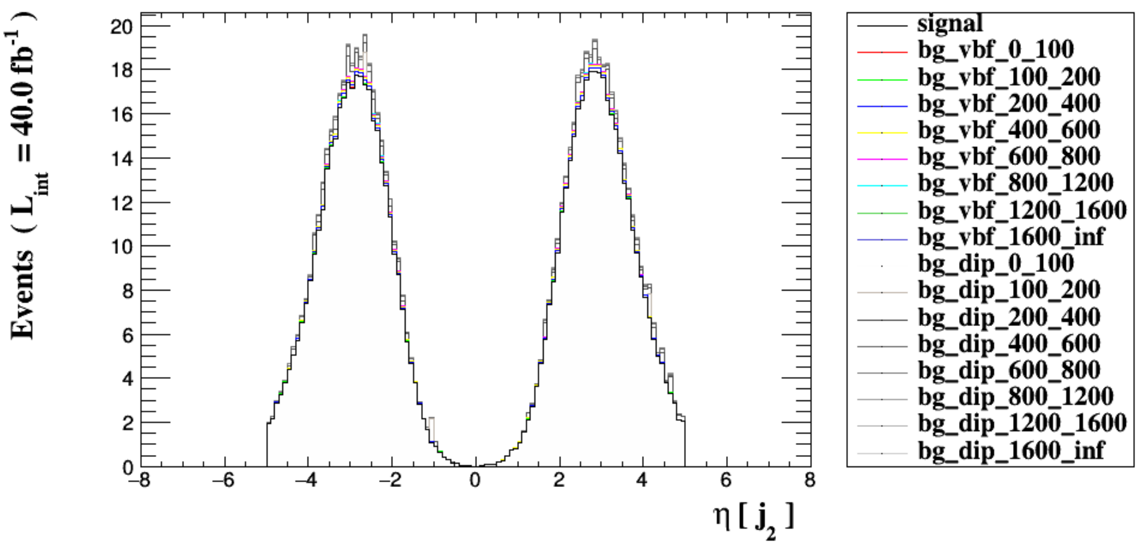

Figure 5.

3.10 Histogram 6

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	766	1.0	-0.00468976	1.813	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	6.04	1.0	-0.0817648	1.828	0.0	0.0
bg_vbf_400_60	4.44	1.0	-0.0599984	1.828	0.0	0.0
bg_vbf_600_80	1.64	1.0	0.0117494	1.812	0.0	0.0
bg_vbf_800_12	0.623	1.0	-0.0684445	1.824	0.0	0.0
bg_vbf_1200_1	0.0549	1.0	-0.0586342	1.806	0.0	0.0
bg_vbf_1600_i	0.00581	1.0	-0.198205	1.858	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	19.1	1.0	-0.0248154	1.887	0.0	0.0
bg_dip_400_60	12.3	1.0	-0.0373808	1.79	0.0	0.0
bg_dip_600_80	3.6	1.0	0.0797356	1.824	0.0	0.0
bg_dip_800_12	1.47	1.0	0.124598	1.781	0.0	0.0
bg_dip_1200_1	0.105	1.0	-0.323666	1.753	0.0	0.0
bg_dip_1600_i	0.00975	1.0	-0.421228	1.806	0.0	0.0

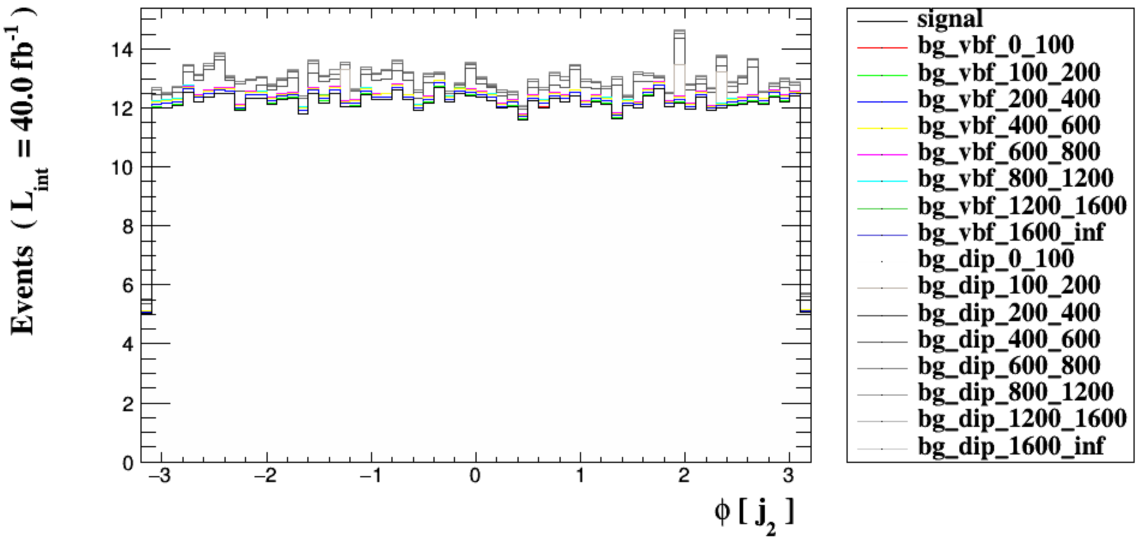

Figure 6.

3.11 Histogram 7

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	766	1.0	5.1046	1.028	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	6.04	1.0	5.24335	0.8413	0.0	0.0
bg_vbf_400_60	4.44	1.0	4.96829	0.7025	0.0	0.0
bg_vbf_600_80	1.64	1.0	4.83273	0.5935	0.0	0.0
bg_vbf_800_12	0.623	1.0	4.73982	0.5158	0.0	0.0
bg_vbf_1200_1	0.0549	1.0	4.67427	0.4511	0.0	0.0
bg_vbf_1600_i	0.00581	1.0	4.62399	0.461	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	19.1	1.0	4.87458	0.6286	0.0	0.0
bg_dip_400_60	12.3	1.0	4.6746	0.5749	0.0	0.0
bg_dip_600_80	3.6	1.0	4.64892	0.5595	0.0	0.0
bg_dip_800_12	1.47	1.0	4.61435	0.495	0.0	0.0
bg_dip_1200_1	0.105	1.0	4.51401	0.442	0.0	0.0
bg_dip_1600_i	0.00975	1.0	4.44387	0.4353	0.0	0.0

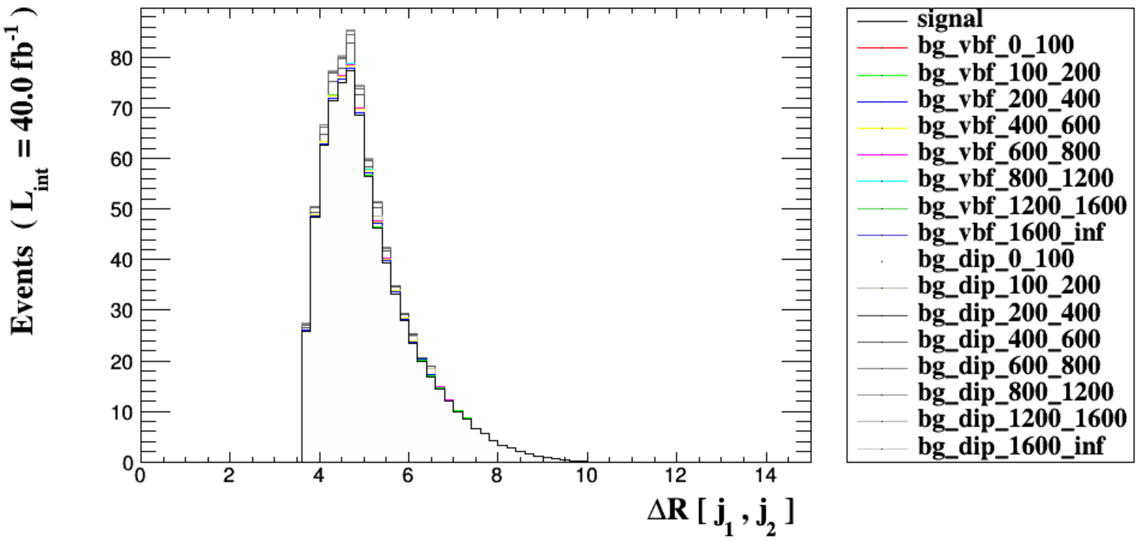

Figure 7.

3.12 Histogram 8

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	766	1.0	1797.17	804.0	0.0	32.54
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	13.79
bg_vbf_200_40	6.04	1.0	1686.56	787.6	0.0	26.93
bg_vbf_400_60	4.44	1.0	2066.12	824.9	0.0	43.08
bg_vbf_600_80	1.64	1.0	2497.1	840.0	0.0	71.38
bg_vbf_800_12	0.623	1.0	2990.13	928.2	0.0	86.9
bg_vbf_1200_1	0.0549	1.0	3719.45	1119	0.0	93.07
bg_vbf_1600_i	0.00581	1.0	4126.54	1410	0.0	92.7
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	19.1	1.0	1168.01	358.4	0.0	4.826
bg_dip_400_60	12.3	1.0	1373.0	458.4	0.0	11.51
bg_dip_600_80	3.6	1.0	1704.65	623.1	0.0	31.09
bg_dip_800_12	1.47	1.0	2097.6	885.2	0.0	47.5
bg_dip_1200_1	0.105	1.0	2709.62	1239	0.0	60.91
bg_dip_1600_i	0.00975	1.0	2721.5	1274	0.0	62.96

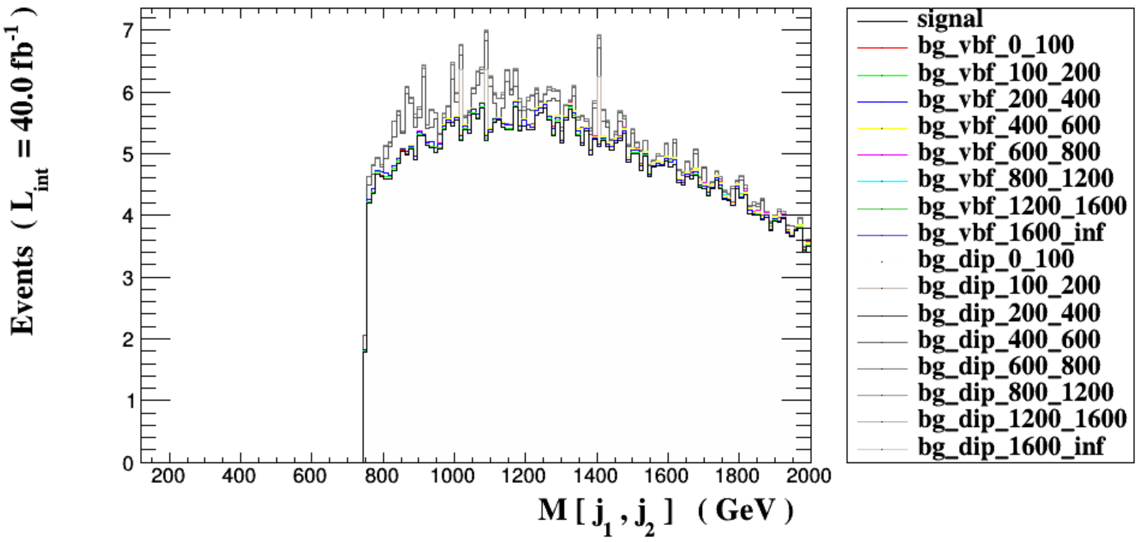

Figure 8.

3.13 Histogram 9

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	766	1.0	-0.0125143	4.892	50.11	0.6048
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	6.04	1.0	-0.0340329	5.008	50.23	0.0
bg_vbf_400_60	4.44	1.0	-0.0931745	4.618	51.09	0.0
bg_vbf_600_80	1.64	1.0	0.0126305	4.376	49.93	0.0
bg_vbf_800_12	0.623	1.0	-0.183195	4.209	52.39	0.0
bg_vbf_1200_1	0.0549	1.0	-0.226141	4.078	52.75	0.0
bg_vbf_1600_i	0.00581	1.0	0.290791	3.996	45.88	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	19.1	1.0	-0.144784	4.518	51.81	0.0
bg_dip_400_60	12.3	1.0	0.176984	4.26	47.85	0.0
bg_dip_600_80	3.6	1.0	-0.115694	4.219	51.54	0.0
bg_dip_800_12	1.47	1.0	-0.0664918	4.119	50.96	0.0
bg_dip_1200_1	0.105	1.0	0.168753	4.051	47.8	0.0
bg_dip_1600_i	0.00975	1.0	0.279678	4.007	46.29	0.0

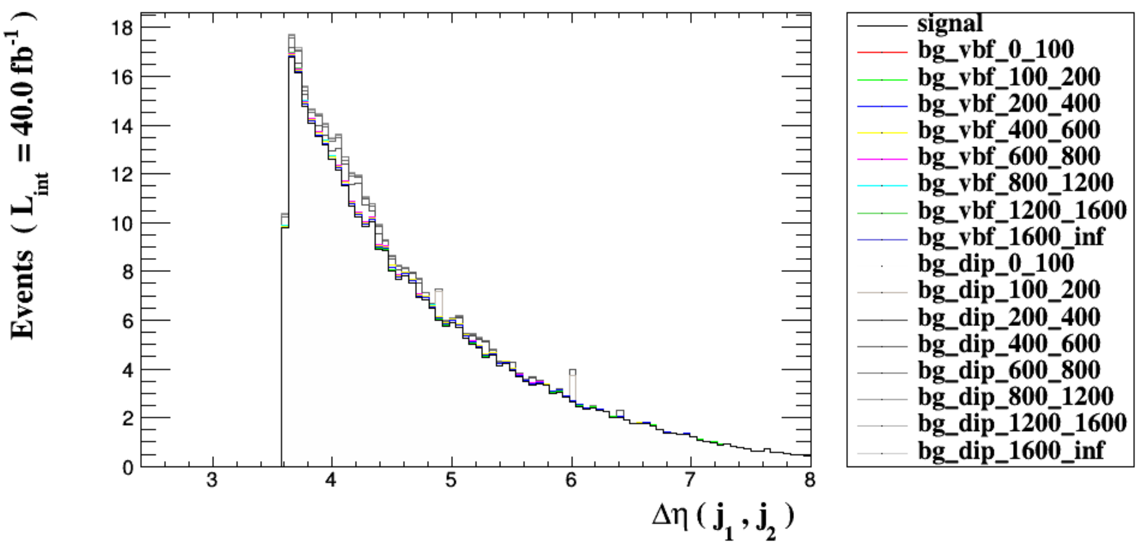

Figure 9.

3.14 Histogram 10

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	766	1.0	1364.91	757.5	0.0	60.26
bg_vbf_0_100	0.0486	1.0	999.408	375.3	0.0	24.96
bg_vbf_100_20	1.16	1.0	847.835	279.9	0.0	25.0
bg_vbf_200_40	6.04	1.0	806.306	333.7	0.0	18.74
bg_vbf_400_60	4.44	1.0	757.771	293.6	0.0	14.41
bg_vbf_600_80	1.64	1.0	774.989	292.6	0.0	16.22
bg_vbf_800_12	0.623	1.0	795.097	304.5	0.0	18.66
bg_vbf_1200_1	0.0549	1.0	827.522	348.5	0.0	22.42
bg_vbf_1600_i	0.00581	1.0	902.86	410.2	0.0	27.83
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	19.1	1.0	785.534	368.8	0.0	16.86
bg_dip_400_60	12.3	1.0	771.771	325.2	0.0	16.48
bg_dip_600_80	3.6	1.0	805.657	366.8	0.0	20.17
bg_dip_800_12	1.47	1.0	805.114	335.3	0.0	19.04
bg_dip_1200_1	0.105	1.0	924.629	435.1	0.0	31.87
bg_dip_1600_i	0.00975	1.0	930.522	452.3	0.0	25.91

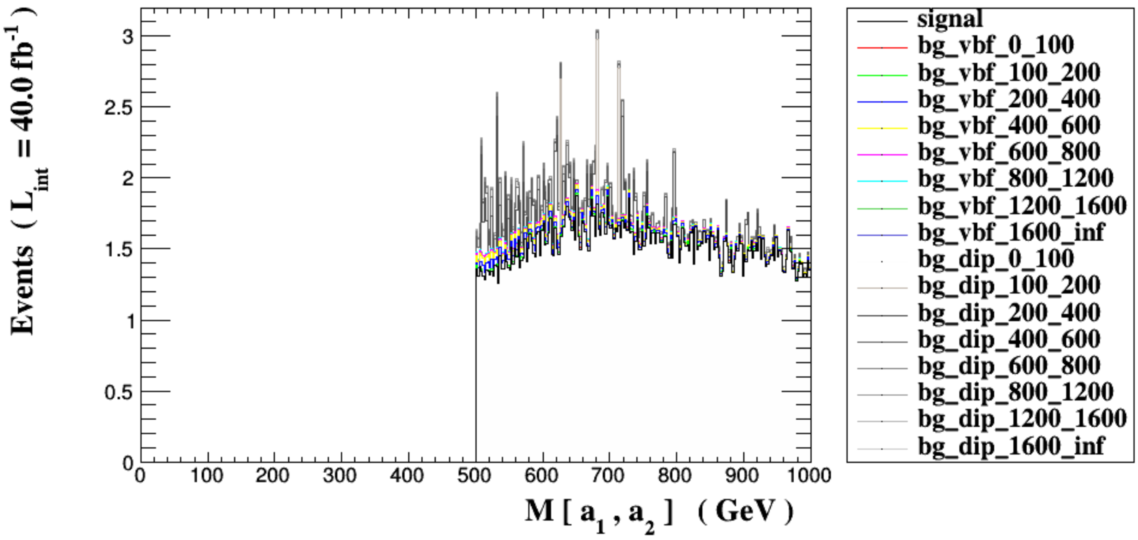

Figure 10.

3.15 Histogram 11

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	766	1.0	718.918	350.1	0.0	17.58
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	6.04	1.0	391.46	92.25	0.0	0.182
bg_vbf_400_60	4.44	1.0	436.107	113.9	0.0	0.3112
bg_vbf_600_80	1.64	1.0	516.8	150.3	0.0	0.5535
bg_vbf_800_12	0.623	1.0	657.311	223.5	0.0	7.762
bg_vbf_1200_1	0.0549	1.0	890.939	358.6	0.0	43.46
bg_vbf_1600_i	0.00581	1.0	1323.7	534.5	0.0	72.17
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	19.1	1.0	393.477	77.89	0.0	0.0
bg_dip_400_60	12.3	1.0	475.422	123.4	0.0	0.2257
bg_dip_600_80	3.6	1.0	603.382	164.2	0.0	0.5606
bg_dip_800_12	1.47	1.0	778.016	241.8	0.0	17.11
bg_dip_1200_1	0.105	1.0	1095.08	412.4	0.0	65.16
bg_dip_1600_i	0.00975	1.0	1602.75	495.3	0.0	87.04

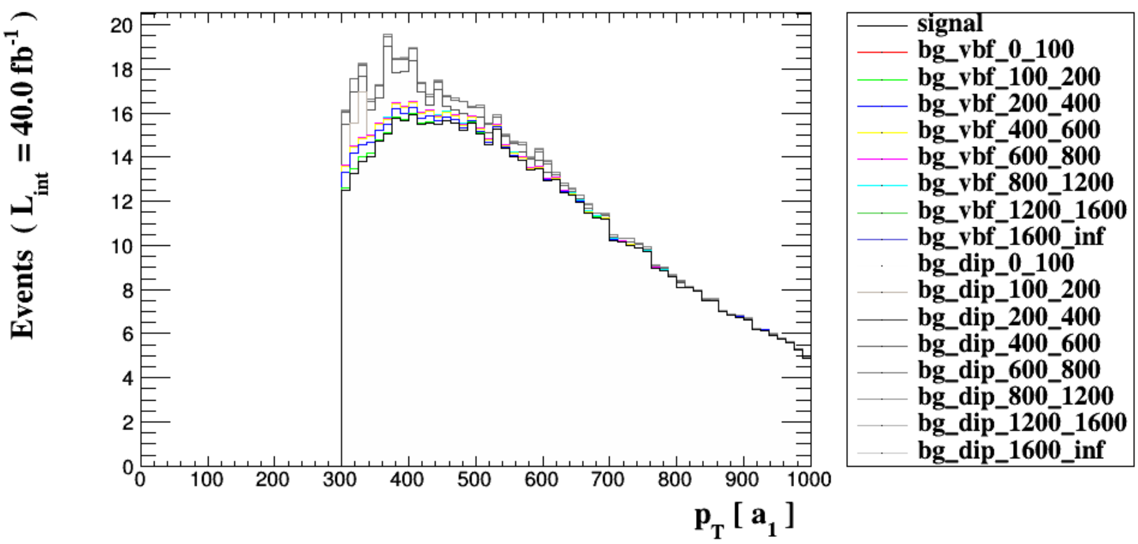

Figure 11.

3.16 Histogram 12

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	766	1.0	486.902	328.9	0.0	0.3176
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	6.04	1.0	209.251	118.9	0.0	0.0
bg_vbf_400_60	4.44	1.0	159.332	118.8	0.0	0.0
bg_vbf_600_80	1.64	1.0	157.378	113.0	0.0	0.0
bg_vbf_800_12	0.623	1.0	159.508	121.4	0.0	0.0
bg_vbf_1200_1	0.0549	1.0	167.561	142.6	0.0	0.0
bg_vbf_1600_i	0.00581	1.0	183.782	190.2	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	253.391	44.39	0.0	0.0
bg_dip_200_40	19.1	1.0	186.1	97.8	0.0	0.0
bg_dip_400_60	12.3	1.0	144.408	100.8	0.0	0.0
bg_dip_600_80	3.6	1.0	140.303	115.8	0.0	0.0
bg_dip_800_12	1.47	1.0	130.659	108.9	0.0	0.0
bg_dip_1200_1	0.105	1.0	151.48	146.8	0.0	0.0
bg_dip_1600_i	0.00975	1.0	125.146	119.5	0.0	0.0

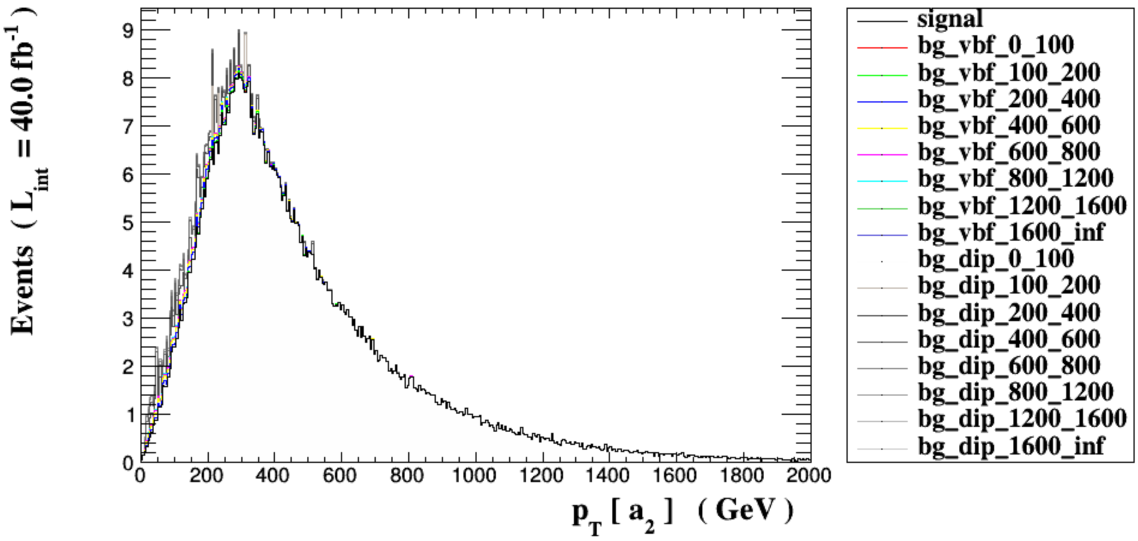

Figure 12.

3.17 Histogram 13

*** Plot: THT**

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	766	1.0	473.074	297.8	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	6.04	1.0	305.428	55.11	0.0	0.0
bg_vbf_400_60	4.44	1.0	485.133	55.92	0.0	0.0
bg_vbf_600_80	1.64	1.0	680.936	55.85	0.0	0.0
bg_vbf_800_12	0.623	1.0	929.067	102.2	0.0	0.0
bg_vbf_1200_1	0.0549	1.0	1324.24	99.5	0.0	0.0
bg_vbf_1600_i	0.00581	1.0	1789.2	191.2	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	19.1	1.0	312.487	53.59	0.0	0.0
bg_dip_400_60	12.3	1.0	483.667	56.67	0.0	0.0
bg_dip_600_80	3.6	1.0	677.891	53.6	0.0	0.0
bg_dip_800_12	1.47	1.0	924.952	102.7	0.0	0.0
bg_dip_1200_1	0.105	1.0	1350.6	122.7	0.0	0.0
bg_dip_1600_i	0.00975	1.0	1813.83	223.3	0.0	0.0

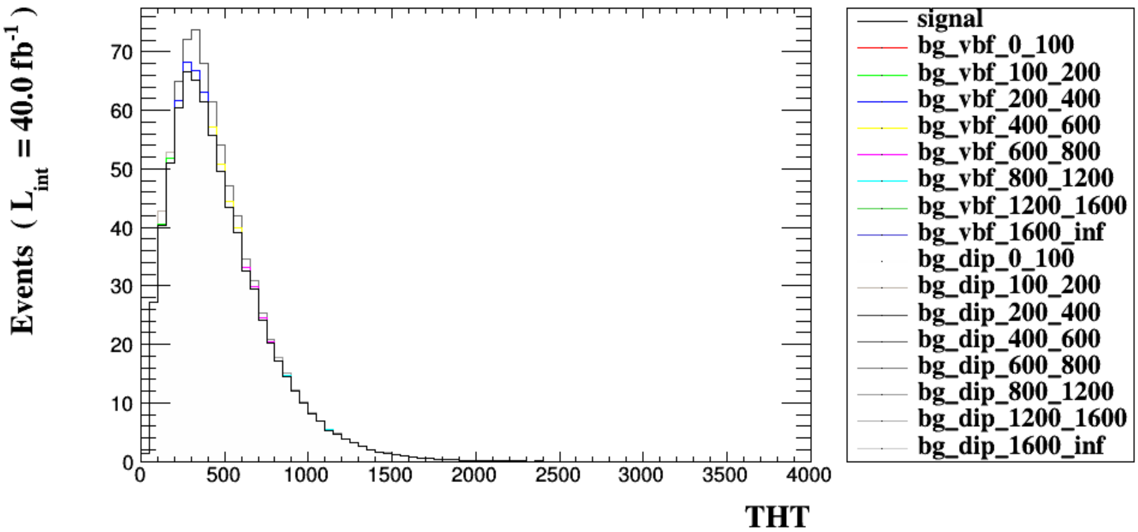

Figure 13.

3.18 Histogram 14

*** Plot: MET**

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	766	1.0	9.23621e-09	1.193e-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	6.04	1.0	5.28184e-09	3.059e-09	0.0	0.0
bg_vbf_400_60	4.44	1.0	5.56314e-09	3.759e-09	0.0	0.0
bg_vbf_600_80	1.64	1.0	5.7028e-09	3.425e-09	0.0	0.0
bg_vbf_800_12	0.623	1.0	6.73764e-09	5.92e-09	0.0	0.0
bg_vbf_1200_1	0.0549	1.0	1.72505e-08	1.831e-08	0.0	0.0
bg_vbf_1600_i	0.00581	1.0	3.09154e-08	2.364e-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	19.1	1.0	5.15652e-09	2.886e-09	0.0	0.0
bg_dip_400_60	12.3	1.0	5.26293e-09	2.848e-09	0.0	0.0
bg_dip_600_80	3.6	1.0	5.42862e-09	2.905e-09	0.0	0.0
bg_dip_800_12	1.47	1.0	7.13192e-09	8.331e-09	0.0	0.0
bg_dip_1200_1	0.105	1.0	2.55869e-08	2.401e-08	0.0	0.0
bg_dip_1600_i	0.00975	1.0	3.47198e-08	2.306e-08	0.0	0.0

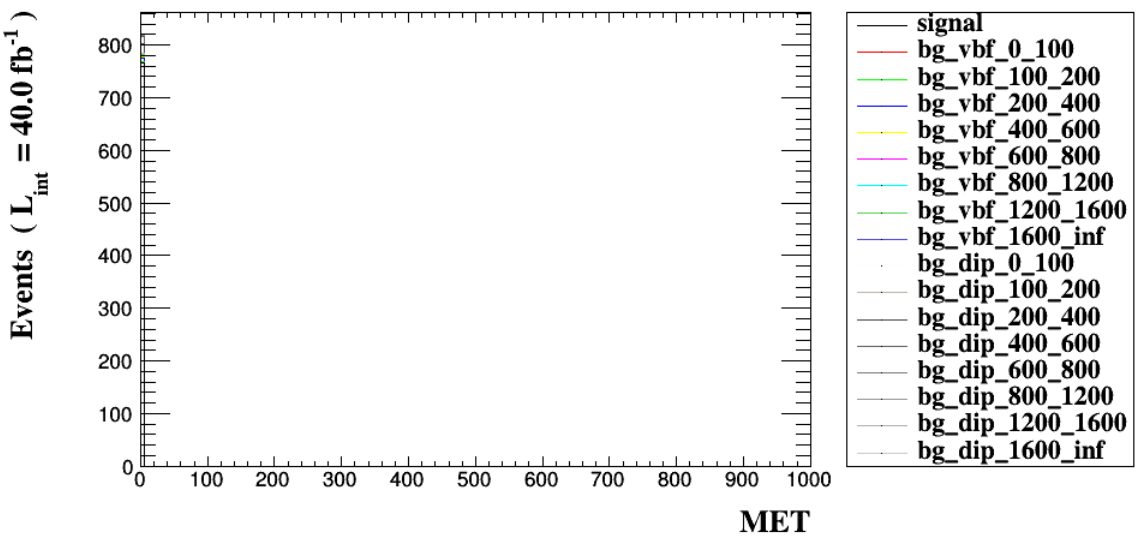

Figure 14.

3.19 Histogram 15

*** Plot: TET**

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	766	1.0	1678.89	734.6	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	6.04	1.0	906.139	195.9	0.0	0.0
bg_vbf_400_60	4.44	1.0	1080.57	211.3	0.0	0.0
bg_vbf_600_80	1.64	1.0	1355.11	216.7	0.0	0.0
bg_vbf_800_12	0.623	1.0	1745.89	291.5	0.0	0.0
bg_vbf_1200_1	0.0549	1.0	2382.74	401.9	0.0	0.0
bg_vbf_1600_i	0.00581	1.0	3296.68	649.6	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	728.733	80.65	0.0	0.0
bg_dip_200_40	19.1	1.0	892.065	159.2	0.0	0.0
bg_dip_400_60	12.3	1.0	1103.5	208.7	0.0	0.0
bg_dip_600_80	3.6	1.0	1421.58	241.6	0.0	0.0
bg_dip_800_12	1.47	1.0	1833.63	311.4	0.0	0.0
bg_dip_1200_1	0.105	1.0	2597.16	496.1	0.0	0.0
bg_dip_1600_i	0.00975	1.0	3541.73	662.3	0.0	0.0

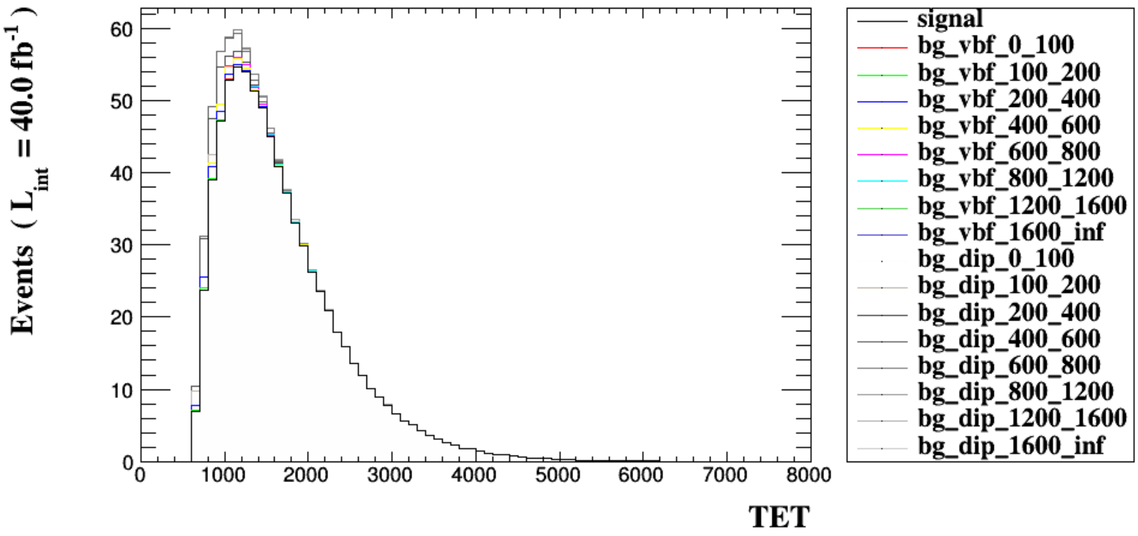

Figure 15.

3.20 Histogram 16

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	766	1.0	2.94599	0.5977	0.0	0.01708
bg_vbf_0_100	0.0486	1.0	3.37874	0.2507	0.0	0.0
bg_vbf_100_20	1.16	1.0	3.31191	0.3704	0.0	0.0
bg_vbf_200_40	6.04	1.0	3.31275	0.5726	0.0	0.0
bg_vbf_400_60	4.44	1.0	3.19307	0.6709	0.0	0.0
bg_vbf_600_80	1.64	1.0	2.98826	0.6955	0.0	0.0
bg_vbf_800_12	0.623	1.0	2.80957	0.7215	0.0	0.0
bg_vbf_1200_1	0.0549	1.0	2.63129	0.7516	0.0	0.0
bg_vbf_1600_i	0.00581	1.0	2.4724	0.6814	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	3.21229	0.191	0.0	0.0
bg_dip_200_40	19.1	1.0	3.36774	0.7038	0.0	0.0
bg_dip_400_60	12.3	1.0	3.29268	0.7919	0.0	0.0
bg_dip_600_80	3.6	1.0	3.12605	0.8764	0.0	0.0
bg_dip_800_12	1.47	1.0	2.99442	0.8567	0.0	0.0
bg_dip_1200_1	0.105	1.0	2.85727	0.8239	0.0	0.0
bg_dip_1600_i	0.00975	1.0	2.60421	0.657	0.0	0.0

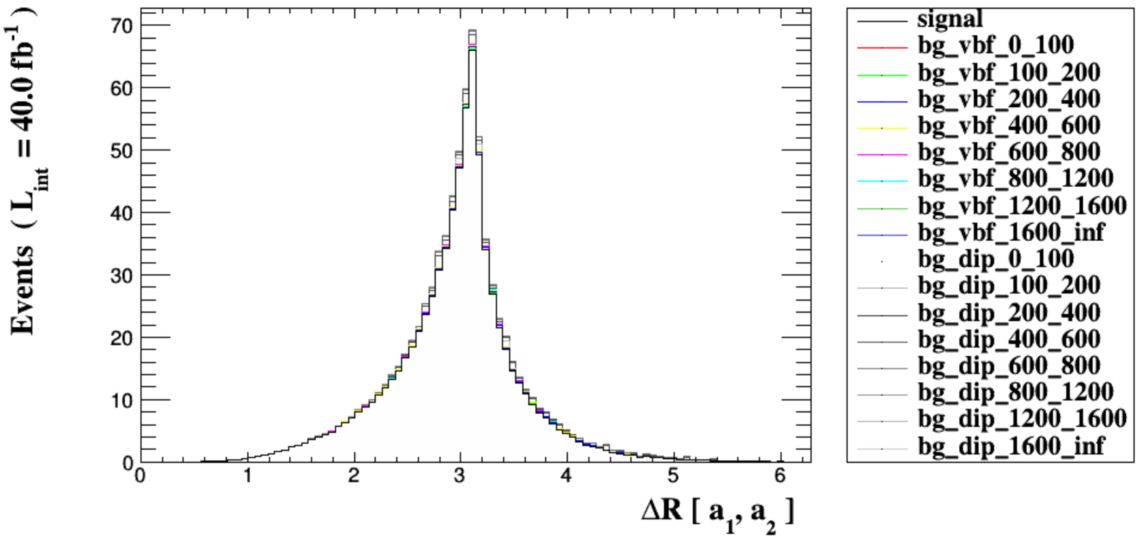

Figure 16.

3.21 Histogram 17

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	766	1.0	0.00338677	1.456	0.0005338	0.0005338
bg_vbf_0_100	0.0486	1.0	-0.407498	1.471	0.0	0.0
bg_vbf_100_20	1.16	1.0	-0.201543	1.52	0.0	0.0
bg_vbf_200_40	6.04	1.0	-0.0121975	2.014	0.0	0.0
bg_vbf_400_60	4.44	1.0	0.00671925	2.304	0.0	0.0
bg_vbf_600_80	1.64	1.0	-0.0144826	2.227	0.0	0.0
bg_vbf_800_12	0.623	1.0	0.0268473	2.074	0.0	0.0
bg_vbf_1200_1	0.0549	1.0	0.00305105	1.89	0.0	0.0
bg_vbf_1600_i	0.00581	1.0	-0.0378065	1.642	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	0.537315	1.068	0.0	0.0
bg_dip_200_40	19.1	1.0	-0.0986204	2.077	0.0	0.0
bg_dip_400_60	12.3	1.0	0.0922186	2.373	0.0	0.0
bg_dip_600_80	3.6	1.0	0.190539	2.36	0.0	0.0
bg_dip_800_12	1.47	1.0	-0.00670366	2.163	0.0	0.0
bg_dip_1200_1	0.105	1.0	0.0071442	2.124	0.0	0.0
bg_dip_1600_i	0.00975	1.0	-0.26003	1.746	0.0	0.0

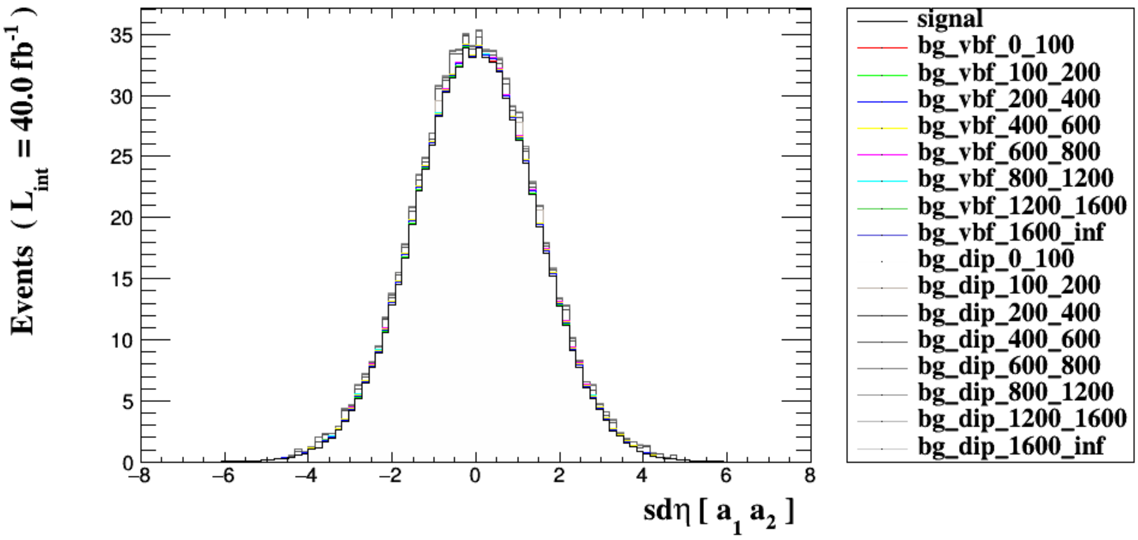

Figure 17.

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)	4094.08 +/- 1.13	4113516 +/- 4877	2.01760 +/- 0.00132
SEL: M (a[1] a[2]) > 500.0	2827.3 +/- 29.6	3483.6 +/- 58.9	35.590 +/- 0.333
SEL: PT (a[1]) > 300.0	2603.7 +/- 30.8	1182.5 +/- 34.3	42.31 +/- 0.38
SEL: M (jets[1] jets[2]) > 750.0	2140.3 +/- 32.0	160.9 +/- 12.6	44.617 +/- 0.377
SEL: sdETA (jets[1] jets[2]) > 3.6 or sdETA (je	767.0 +/- 25.0	53.75 +/- 7.33	26.772 +/- 0.479