The LaTeX report

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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 = 0.0
ma5>
# import samples -> change the path to the LHE file
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_signal/Events/1MeV_gurrola_cuts_cross_sec/-
unweighted_events.lhe.gz as signal1TeV
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_signal/Events/mass1MeV_Lambda4TeV/-
unweighted_events.lhe.gz as signal4TeV
ma5>
# define bg and signal samples
ma5>set signal1TeV.type = signal
ma5>set signal4TeV.type = signal
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>
# 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[1].xmin = 0
ma5>set selection[1].xmax = 2000
ma5>set selection[1].nbins = 200
ma5>set selection[1].rank = PTordering
ma5>set selection[1].titleX = "p_{T}[j_{1}] (GeV)"
ma5>set selection[2].xmin = -8
ma5>set selection[2].xmax = 8
ma5>set selection[2].nbins = 160
```

```
ma5>set selection[2].rank = PTordering
ma5>set selection[2].titleX = "#eta[j_{1}]"
ma5>set selection[3].xmin = -3.2
ma5>set selection[3].xmax = 3.2
ma5>set selection[3].nbins = 64
ma5>set selection[3].rank = PTordering
ma5>set selection[3].titleX = "#phi[j_{1}]"
ma5>set selection[4].xmin = 0
ma5>set selection[4].xmax = 1000
ma5>set selection[4].nbins = 100
ma5>set selection[4].rank = PTordering
ma5>set selection[4].titleX = "p_{T}[j_{2}] (GeV)"
ma5>set selection[5].xmin = -8
ma5>set selection[5].xmax = 8
ma5>set selection[5].nbins = 160
ma5>set selection[5].rank = PTordering
ma5>set selection[5].titleX = "#eta[j_{2}]"
ma5>set selection[6].xmin = -3.2
ma5>set selection[6].xmax = 3.2
ma5>set selection[6].nbins = 64
ma5>set selection[6].rank = PTordering
ma5>set selection[6].titleX = "#phi[j_{2}]"
ma5>set selection[7].xmin = 0
ma5>set selection[7].xmax = 15
ma5>set selection[7].nbins = 75
ma5>set selection[7].rank = PTordering
ma5>set selection[7].titleX = "#DeltaR[j_{1},j_{2}]"
ma5>set selection[8].xmin = 0
ma5>set selection[8].xmax = 3000
ma5>set selection[8].nbins = 160
ma5>set selection[8].rank = PTordering
ma5>set selection[8].titleX = "M[j_{1},j_{2}] (GeV)"
ma5>set selection[9].xmin = -15
ma5>set selection[9].xmax = 15
ma5>set selection[9].titleX = "#Delta#eta(j_{1},j_{2})"
ma5>set selection[10].xmin = 0
ma5>set selection[10].xmax = 4000
ma5>set selection[10].nbins = 400
ma5>set selection[10].rank = PTordering
ma5>set selection[10].titleX = "M[a_{1},a_{2}] (GeV)"
ma5>set selection[11].xmin = 0
ma5>set selection[11].xmax = 2000
ma5>set selection[11].nbins = 80
ma5>set selection[11].rank = PTordering
ma5>set selection[11].titleX = "p_{T}[a_{1}]"
ma5>set selection[12].xmin = 0
ma5>set selection[12].xmax = 2000
ma5>set selection[12].nbins = 400
ma5>set selection[12].rank = PTordering
```

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

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 signal1tev

- 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: 1000 events.
- Normalization to the luminosity: 406568+/- 2950 events.
- Ratio (event weight): 406 - 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_signal/Events/-1MeV_gurrola_cuts_cross_sec/-unweighted_events.lhe.gz	1000	10.2 @ 0.73%	0.0

2.2 signal4tev

- 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: 72 events.
- Normalization to the luminosity: 10221+/- 27 events.
- Ratio (event weight): 141 - 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_signal/Events/-mass1MeV_Lambda4TeV/-unweighted_events.lhe.gz	72	0.256 @ 0.26%	0.0

3 Histos and cuts

3.1 Histogram 1

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1tev	406162	1.0	258.263	210.2	0.0	0.0
signal4tev	10079	1.0	185.224	205.9	0.0	0.0

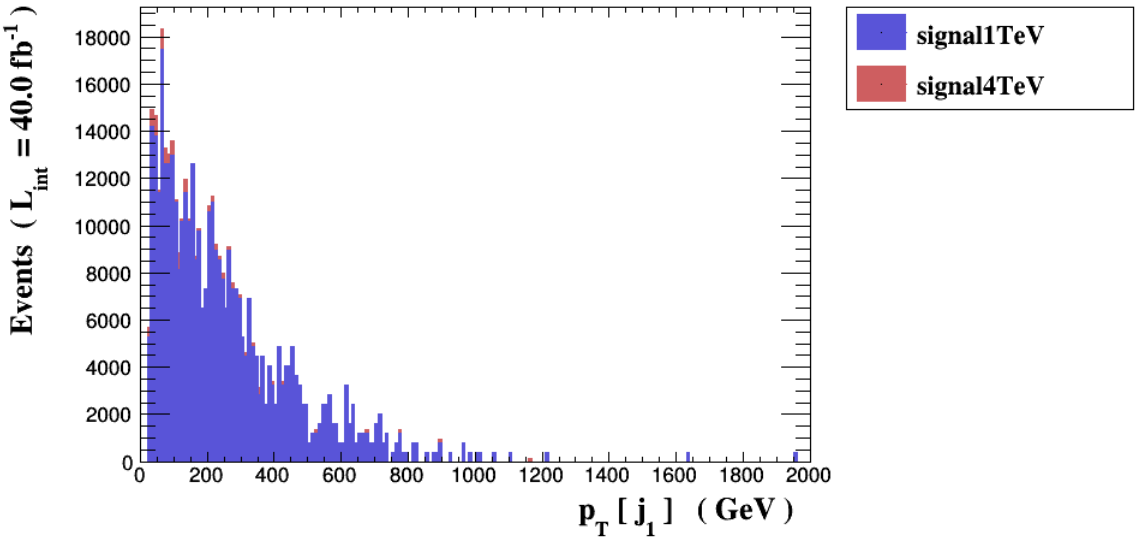

Figure 1.

3.2 Histogram 2

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1tev	406162	1.0	0.069541	1.839	0.0	0.0
signal4tev	10079	1.0	-0.0196854	2.175	0.0	0.0

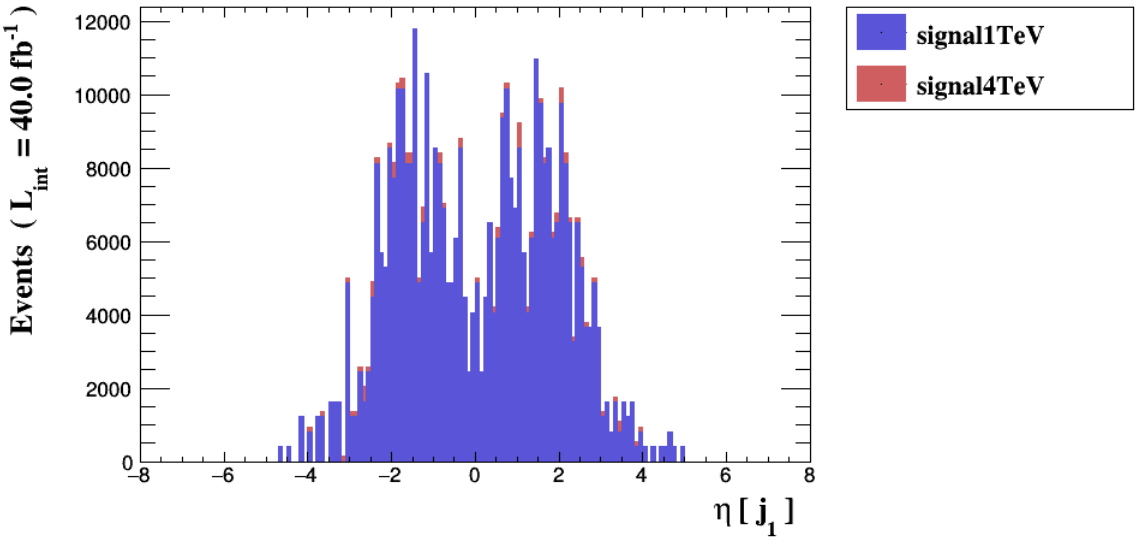

Figure 2.

3.3 Histogram 3

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1tev	406162	1.0	0.130532	1.82	0.0	0.0
signal4tev	10079	1.0	-0.130676	1.948	0.0	0.0

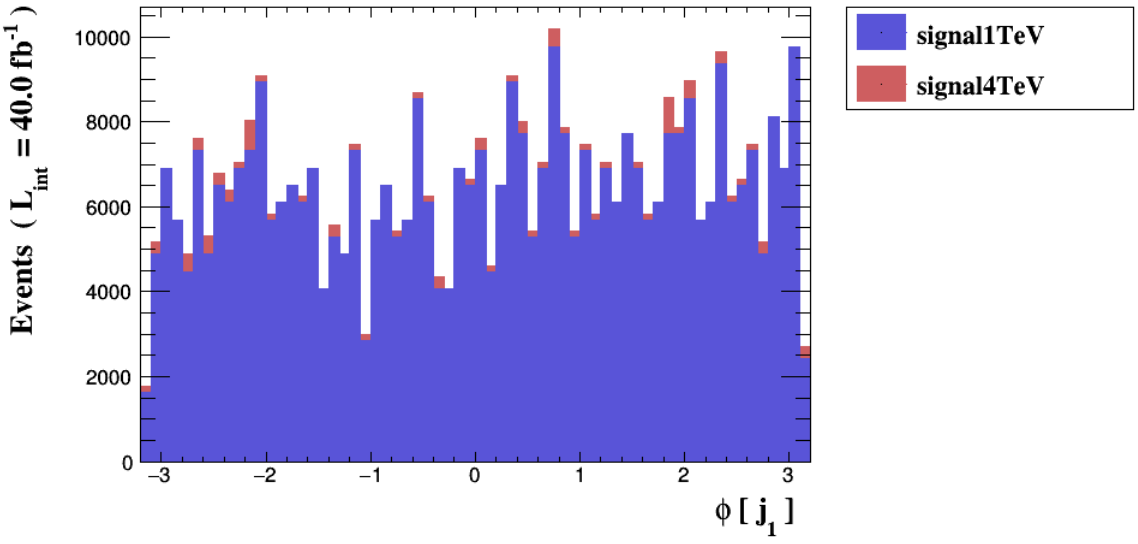

Figure 3.

3.4 Histogram 4

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1tev	406162	1.0	121.574	112.1	0.0	0.0
signal4tev	10079	1.0	69.2869	68.75	0.0	0.0

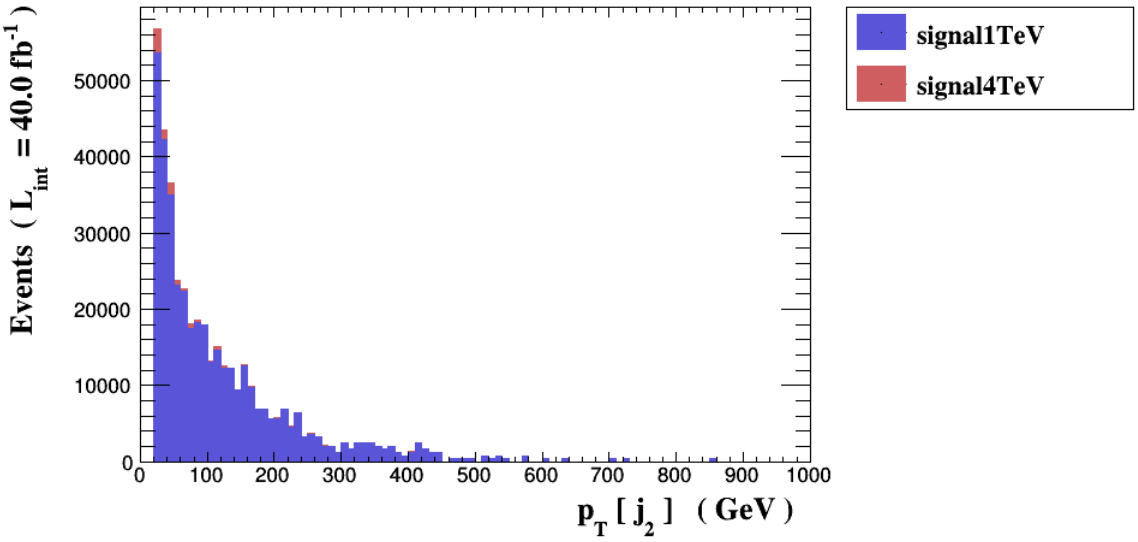

Figure 4.

3.5 Histogram 5

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1tev	406162	1.0	-0.0527262	2.281	0.0	0.0
signal4tev	10079	1.0	-0.0322806	2.777	0.0	0.0

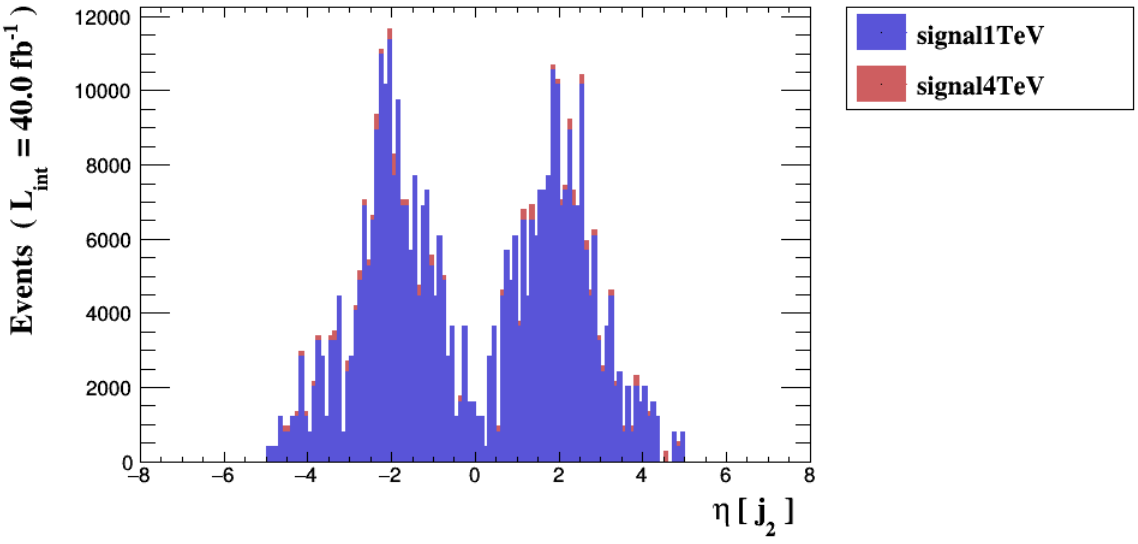

Figure 5.

3.6 Histogram 6

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1tev	406162	1.0	0.0258354	1.803	0.0	0.0
signal4tev	10079	1.0	-0.211309	1.836	0.0	0.0

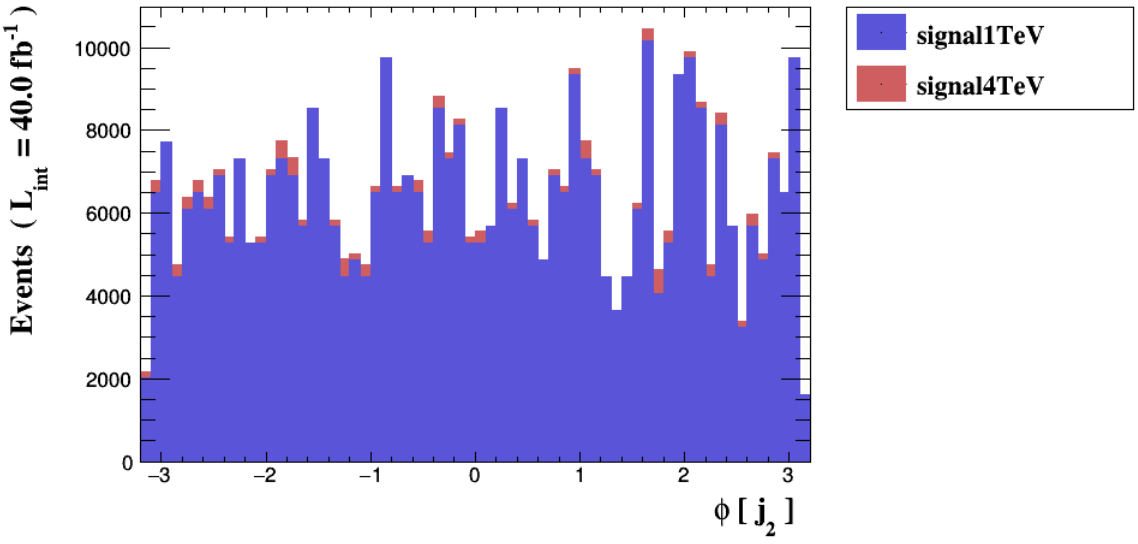

Figure 6.

3.7 Histogram 7

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1tev	406162	1.0	4.21235	1.039	0.0	0.0
signal4tev	10079	1.0	4.87408	1.167	0.0	0.0

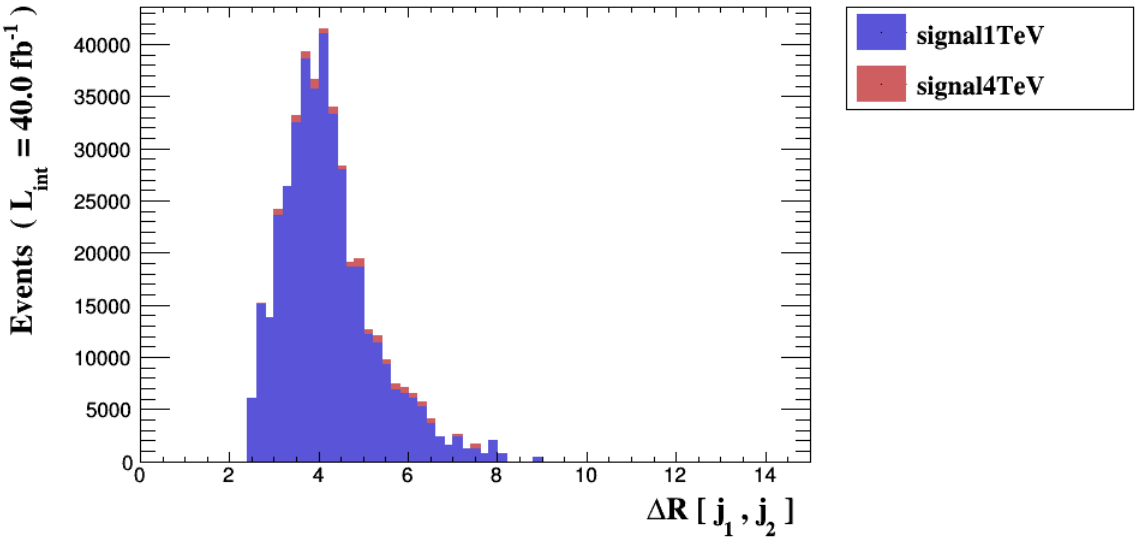

Figure 7.

3.8 Histogram 8

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1tev	406162	1.0	985.186	666.7	0.0	1.602
signal4tev	10079	1.0	1037.27	960.1	0.0	4.225

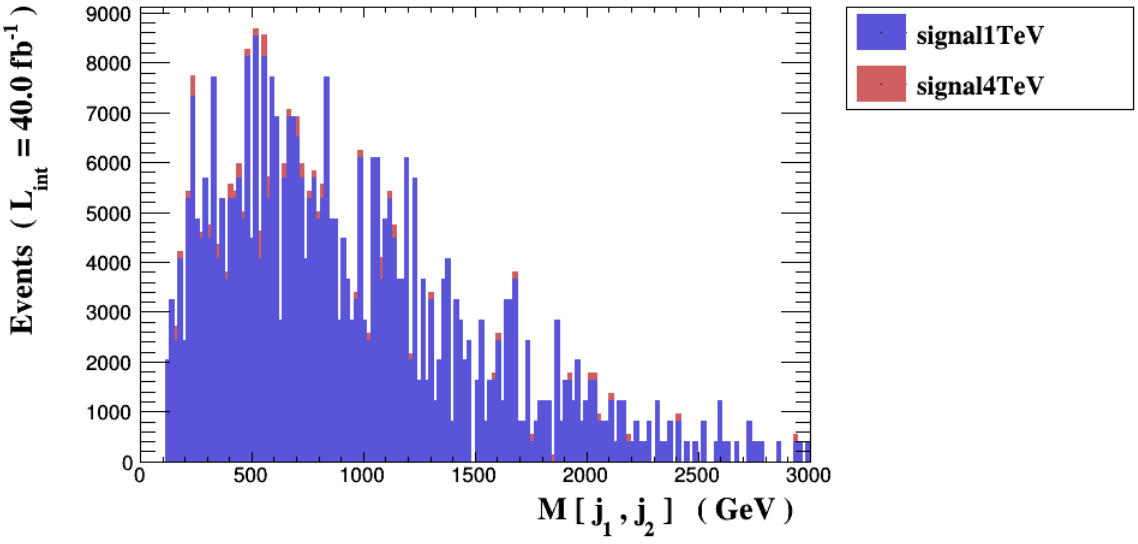

Figure 8.

3.9 Histogram 9

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1tev	406162	1.0	0.122267	3.815	0.0	0.0
signal4tev	10079	1.0	0.0125953	4.692	0.0	0.0

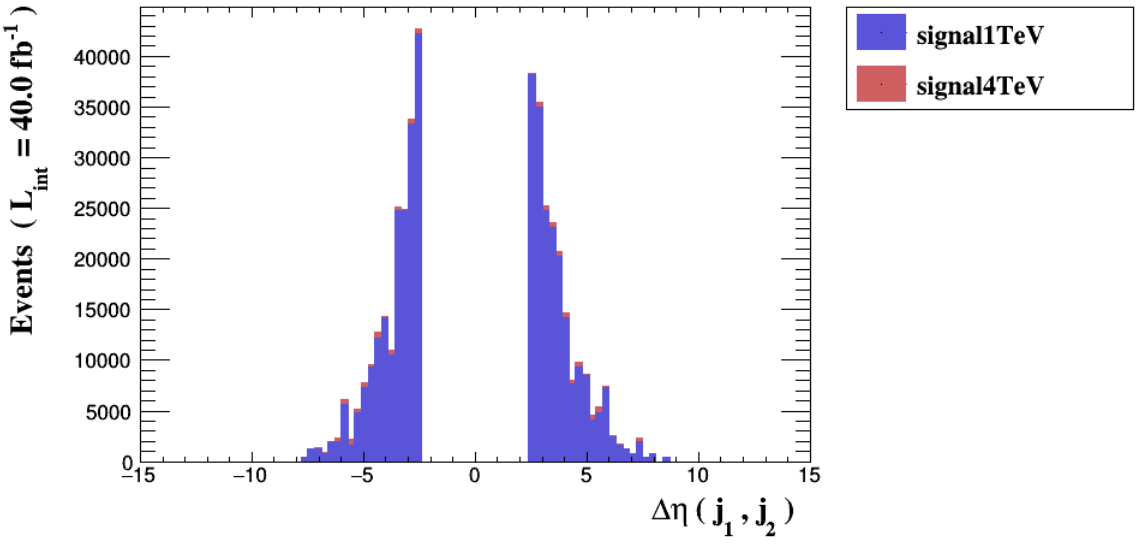

Figure 9.

3.10 Histogram 10

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1tev	0.0 +/- 0.0	0.	0.0	0.0	0.0	0.0
signal4tev	0.0 +/- 0.0	0.	0.0	0.0	0.0	0.0

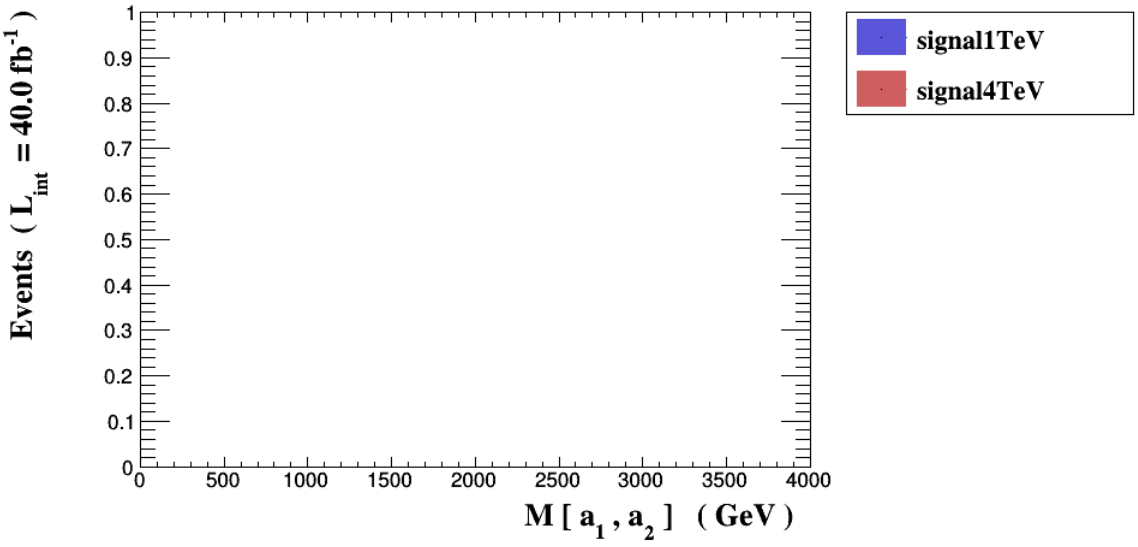

Figure 10.

3.11 Histogram 11

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1tev	0.0 +/- 0.0	0.	0.0	0.0	0.0	0.0
signal4tev	0.0 +/- 0.0	0.	0.0	0.0	0.0	0.0

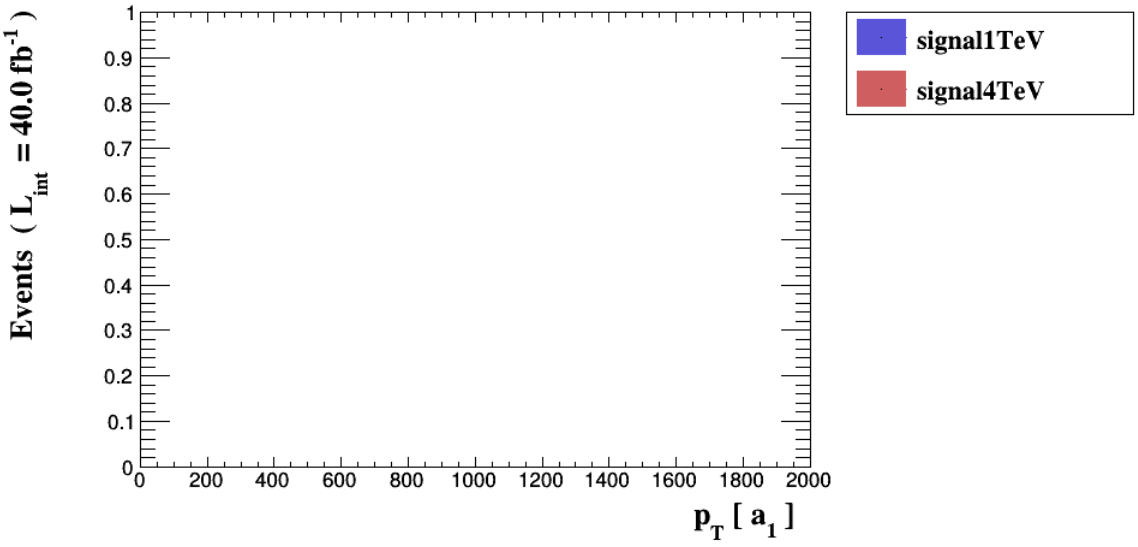

Figure 11.

3.12 Histogram 12

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1tev	0.0 +/- 0.0	0.	0.0	0.0	0.0	0.0
signal4tev	0.0 +/- 0.0	0.	0.0	0.0	0.0	0.0

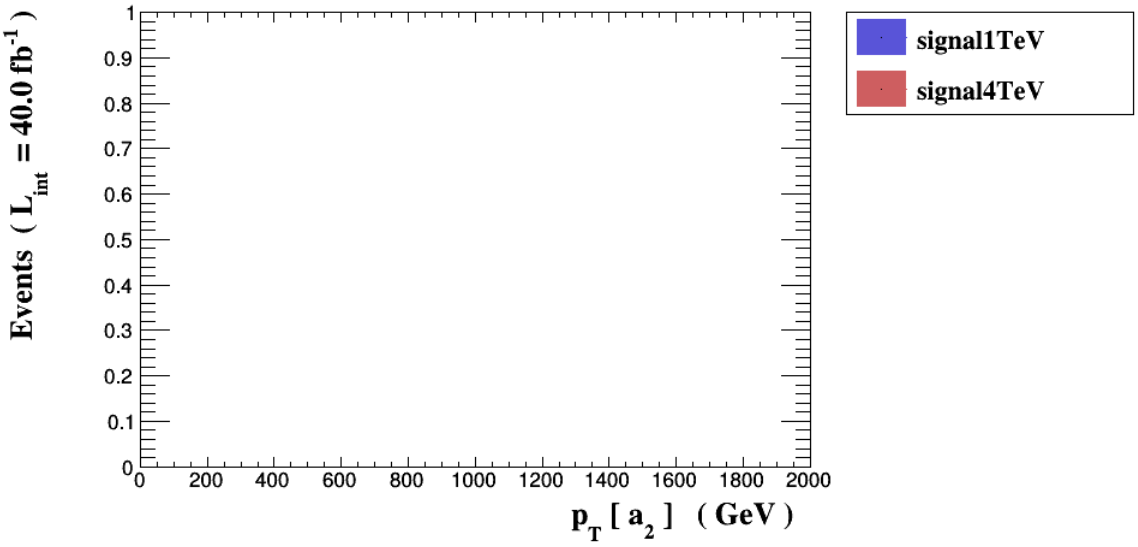

Figure 12.

3.13 Histogram 13

*** Plot: THT**

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1tev	406568	1.0	379.799	289.9	0.0	0.0
signal4tev	10221	1.0	241.215	257.3	0.0	0.0

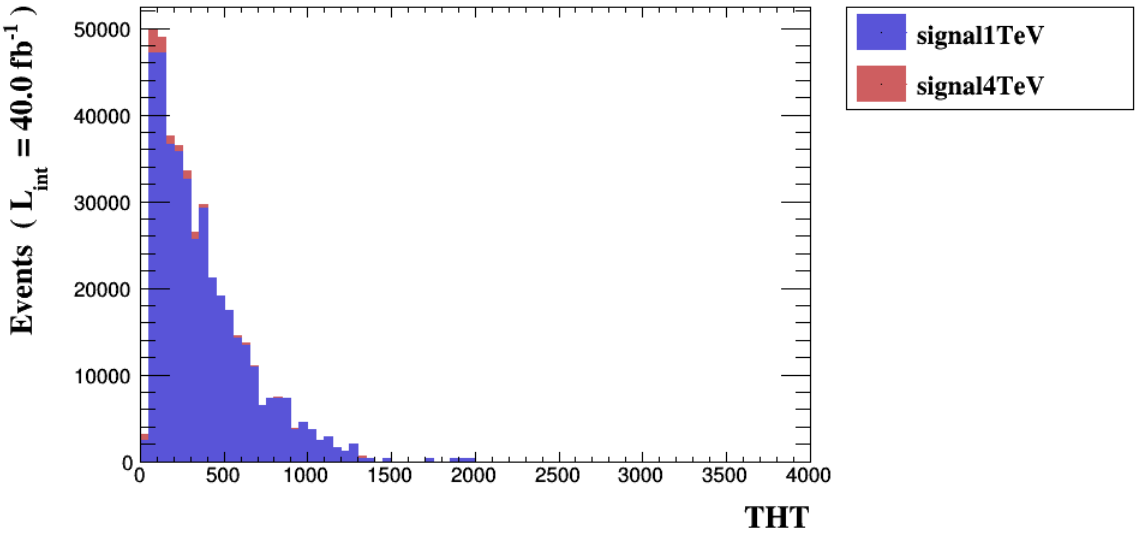

Figure 13.

3.14 Histogram 14

*** Plot: MET**

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1tev	406568	1.0	3.56703e-09	4.096e-09	0.0	0.0
signal4tev	10221	1.0	2.82887e-09	2.967e-09	0.0	0.0

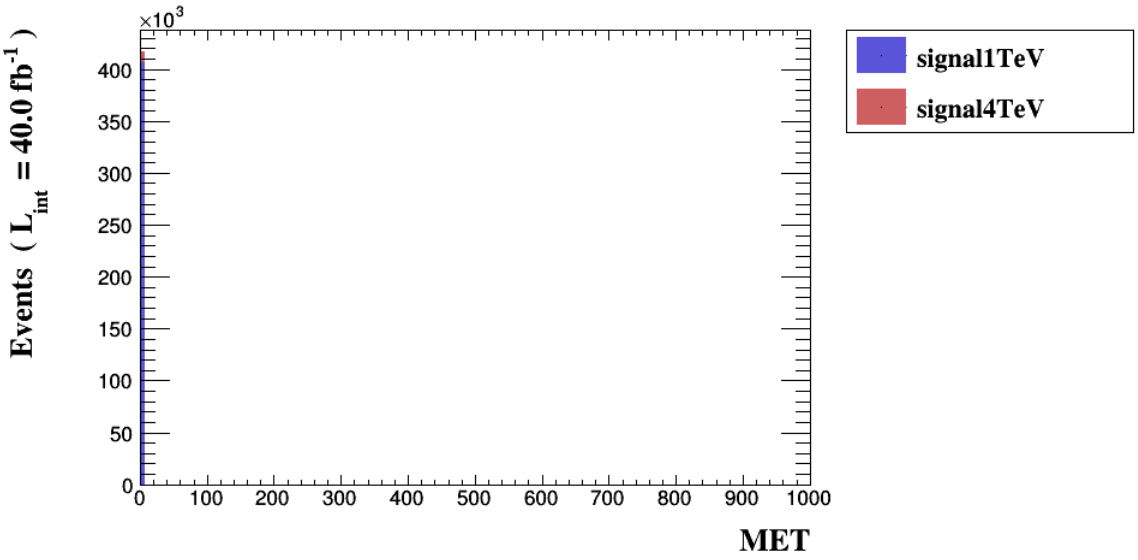

Figure 14.

3.15 Histogram 15

*** Plot: TET**

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1tev	406568	1.0	616.896	471.7	0.0	0.0
signal4tev	10221	1.0	427.901	479.4	0.0	0.0

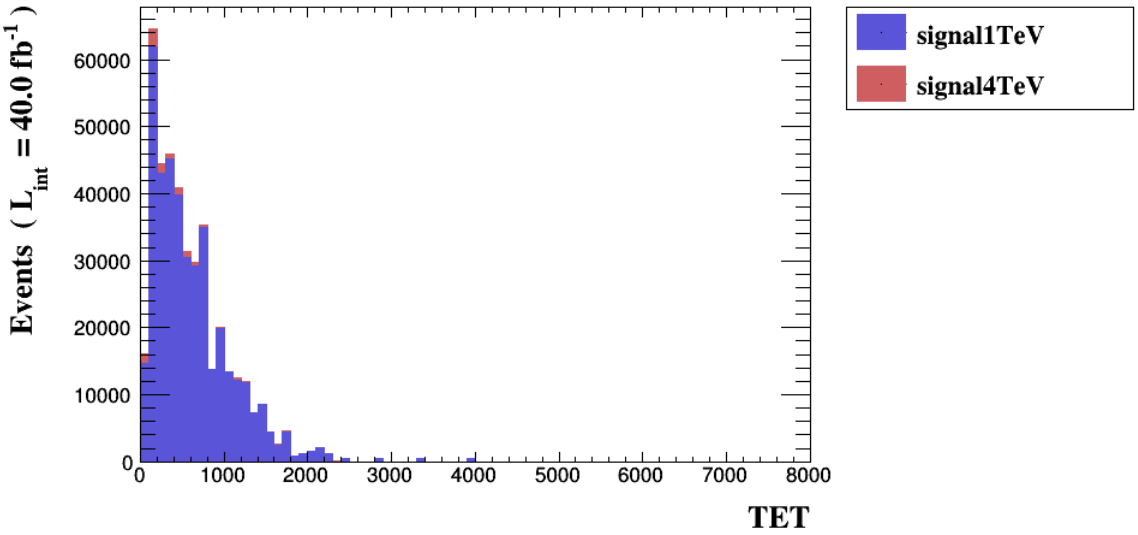

Figure 15.