

The LaTeX report

Generated by elijahsheridan on 19 June 2020, 17:44:25

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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].

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1 Setup

1.1 Command history

```
ma5># set directory where running "./bin/ma5"; set lumi; define the signal significance
ma5>set main.currentdir = /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/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 signal1MeV
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_signal/Events/100GeV_gurrola_cuts_cross_sec/-
unweighted_events.lhe.gz as signal100GeV1TeV
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_signal/Events/mass100GeV_Lambda1p5TeV/-
unweighted_events.lhe.gz as signal100GeV1p5TeV
ma5>import /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_signal/Events/mass100GeV_Lambda4TeV/-
unweighted_events.lhe.gz as signal100GeV4TeV
ma5># define bg and signal samples
ma5>set signal1MeV = signal
ma5>set signal100GeV1TeV = signal
ma5>set signal100GeV1p5TeV = signal
ma5>set signal100GeV4TeV = 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 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 = 80
ma5>set selection[10].rank = PTordering
ma5>set selection[10].titleX = "THT"
ma5>set selection[11].xmin = 0
ma5>set selection[11].xmax = 1000
ma5>set selection[11].nbins = 200
ma5>set selection[11].rank = PTordering
ma5>set selection[11].titleX = "MET"
ma5>set selection[12].xmin = 0

```

```
ma5>set selection[12].xmax = 8000
ma5>set selection[12].nbins = 80
ma5>set selection[12].rank = PTordering
ma5>set selection[12].titleX = "TET"
ma5>submit axion_masses_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 signal1mev

- 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 (%)
axion_signal/Events/- 1MeV_gurrola_cuts_cross_sec/- unweighted_events.lhe.gz	1000	10.2 @ 0.73%	0.0

2.2 signal100gev1tev

- Sample consisting of: [signal](#) events.
- Generated events: [1000](#) events.
- Normalization to the luminosity: [340913+/- 3026](#) events.
- **Ratio (event weight): 340 - warning: please generate more events (weight larger than 1)!**

Path to the event file	Nr. of events	Cross section (pb)	Negative wgts (%)
axion_signal/Events/- 100GeV_gurrola_cuts_cross_sec/- unweighted_events.lhe.gz	1000	8.52 @ 0.89%	0.0

2.3 signal100gev1p5tev

- Sample consisting of: [signal](#) events.
- Generated events: [10000](#) events.
- Normalization to the luminosity: [71082+/- 222](#) events.
- **Ratio (event weight): 7.1 - warning: please generate more events (weight larger than 1)!**

Path to the event file	Nr. of events	Cross section (pb)	Negative wgts (%)
axion_signal/Events/- mass100GeV_Lambda1p5TeV/- unweighted_events.lhe.gz	10000	1.78 @ 0.31%	0.0

2.4 signal100gev4tev

- Sample consisting of: [signal](#) events.
- Generated events: [10000](#) events.
- Normalization to the luminosity: [7153](#)+/- [20](#) events.
- Ratio (event weight): [0.72](#) .

Path to the event file	Nr. of events	Cross section (pb)	Negative wgts (%)
axion_signal/Events/- mass100GeV_Lambda4TeV/- unweighted_events.lhe.gz	10000	0.179 @ 0.28%	0.0

3 Histos and cuts

3.1 Histogram 1

* Plot: p_T (jets[1])

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1mev	406162	1.0	258.263	210.2	0.0	0.0
signal100gev1tev	340572	1.0	314.347	245.4	0.0	0.0
signal100gev1p5t	71075	1.0	241.573	216.5	0.0	0.03
signal100gev4tev	7152	1.0	191.202	171.1	0.0	0.0

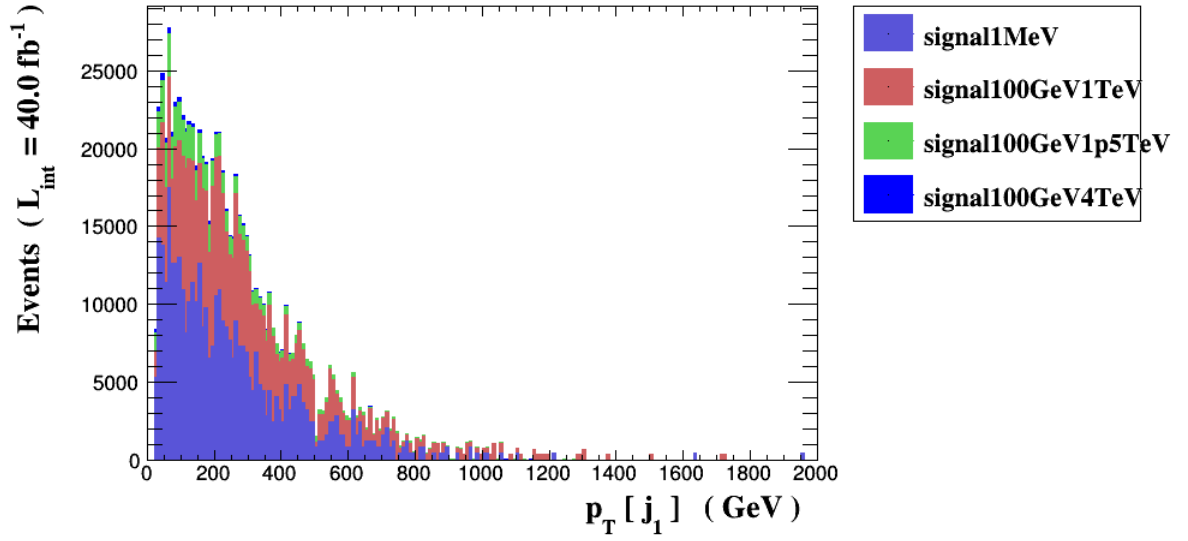


Figure 1.

3.2 Histogram 2

* Plot: $\text{ETA} (\text{jets}[1])$

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1mev	406162	1.0	0.069541	1.839	0.0	0.0
signal100gev1tev	340572	1.0	0.0506079	1.695	0.0	0.0
signal100gev1p5	71075	1.0	-0.0266127	2.051	0.0	0.0
signal100gev4tev	7152	1.0	-0.0218629	2.227	0.0	0.0

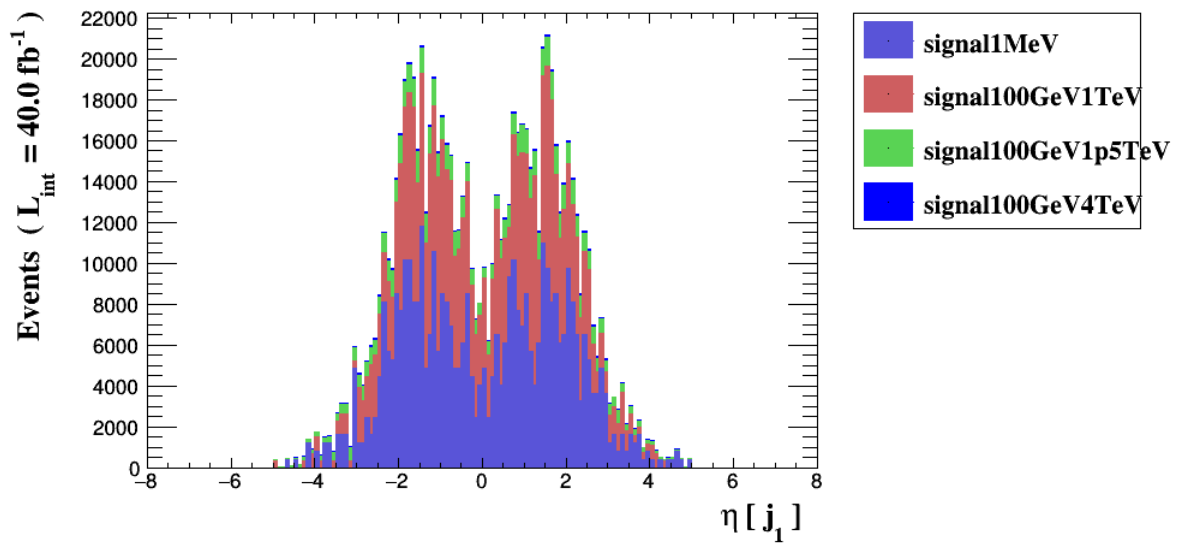


Figure 2.

3.3 Histogram 3

* Plot: PHI (jets[1])

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1mev	406162	1.0	0.130532	1.82	0.0	0.0
signal100gev1tev	340572	1.0	0.0367644	1.84	0.0	0.0
signal100gev1p5	71075	1.0	-0.0191116	1.806	0.0	0.0
signal100gev4tev	7152	1.0	0.0265117	1.818	0.0	0.0

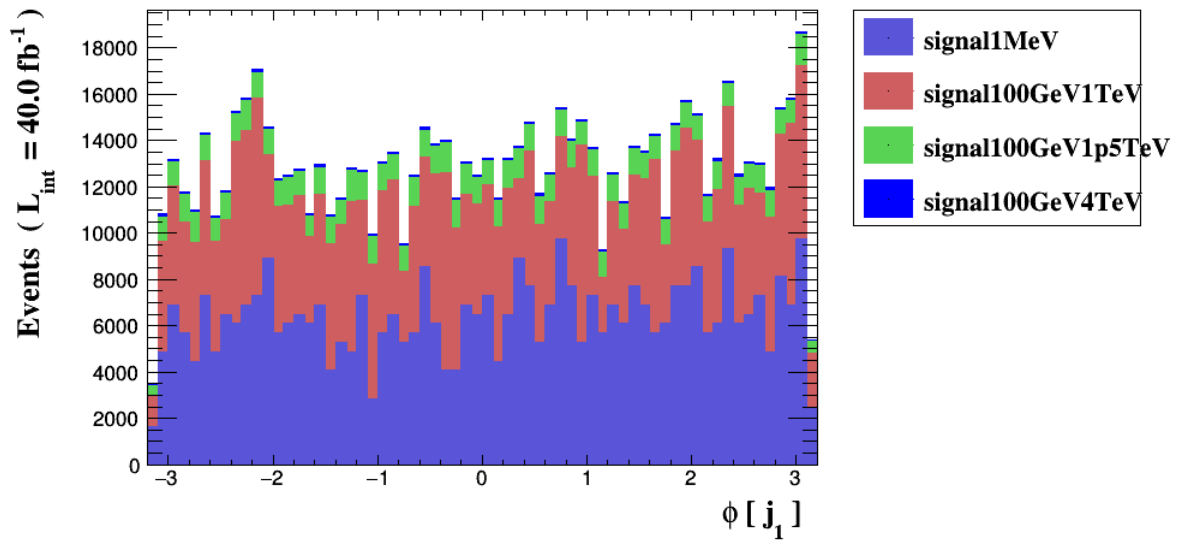


Figure 3.

3.4 Histogram 4

* Plot: p_T (jets[2])

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1mev	406162	1.0	121.574	112.1	0.0	0.0
signal100gev1tev	340572	1.0	136.673	117.6	0.0	0.0
signal100gev1p5t	71075	1.0	102.544	100.5	0.0	0.04
signal100gev4tev	7152	1.0	78.381	70.87	0.0	0.01

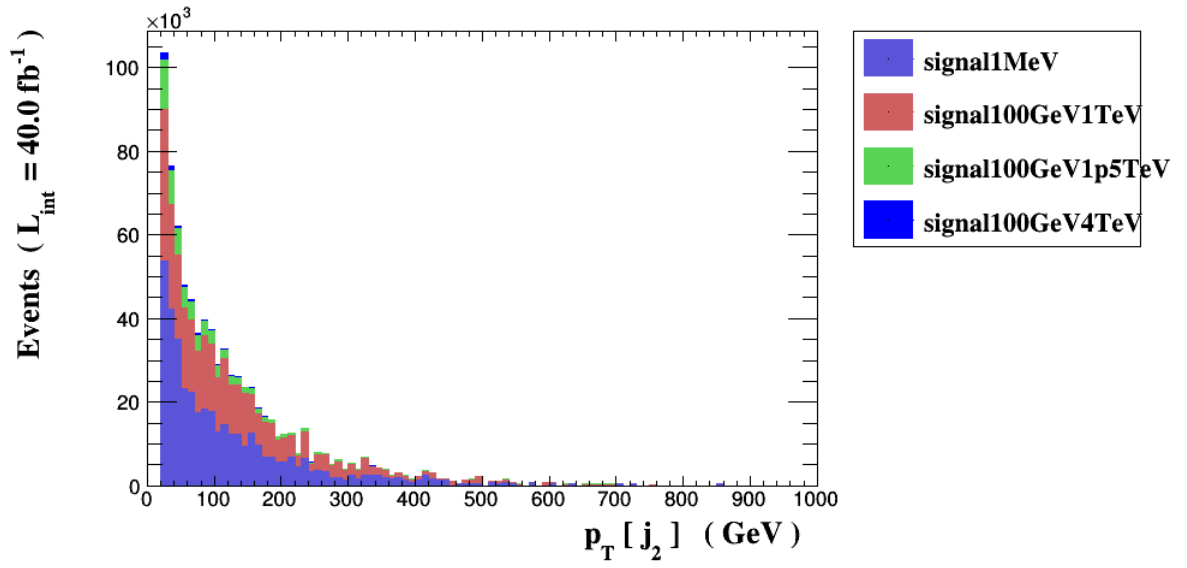


Figure 4.

3.5 Histogram 5

* Plot: $\text{ETA} (\text{jets}[2])$

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1mev	406162	1.0	-0.0527262	2.281	0.0	0.0
signal100gev1tev	340572	1.0	-0.00108636	2.3	0.0	0.0
signal100gev1p5	71075	1.0	0.0588376	2.589	0.0	0.0
signal100gev4tev	7152	1.0	0.00814923	2.789	0.0	0.0

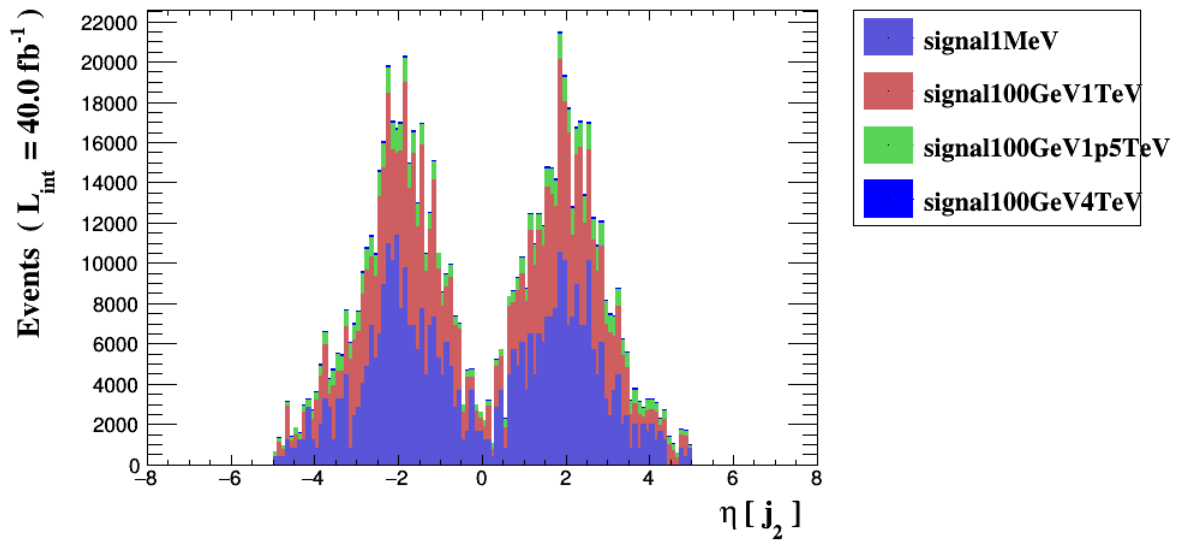


Figure 5.

3.6 Histogram 6

* Plot: PHI (jets[2])

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1mev	406162	1.0	0.0258354	1.803	0.0	0.0
signal100gev1tev	340572	1.0	0.0083797	1.807	0.0	0.0
signal100gev1p5	71075	1.0	-0.0105592	1.815	0.0	0.0
signal100gev4tev	7152	1.0	-0.000478749	1.832	0.0	0.0

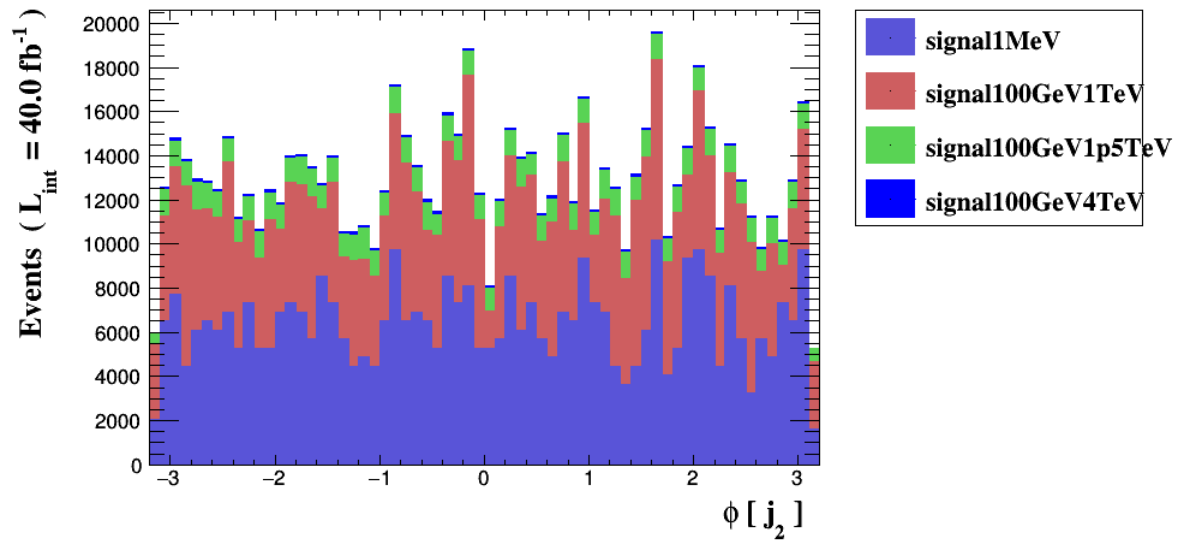


Figure 6.

3.7 Histogram 7

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1mev	406162	1.0	4.21235	1.039	0.0	0.0
signal100gev1tev	340572	1.0	4.08377	1.031	0.0	0.0
signal100gev1p5t	71075	1.0	4.55035	1.26	0.0	0.0
signal100gev4tev	7152	1.0	4.85618	1.299	0.0	0.0

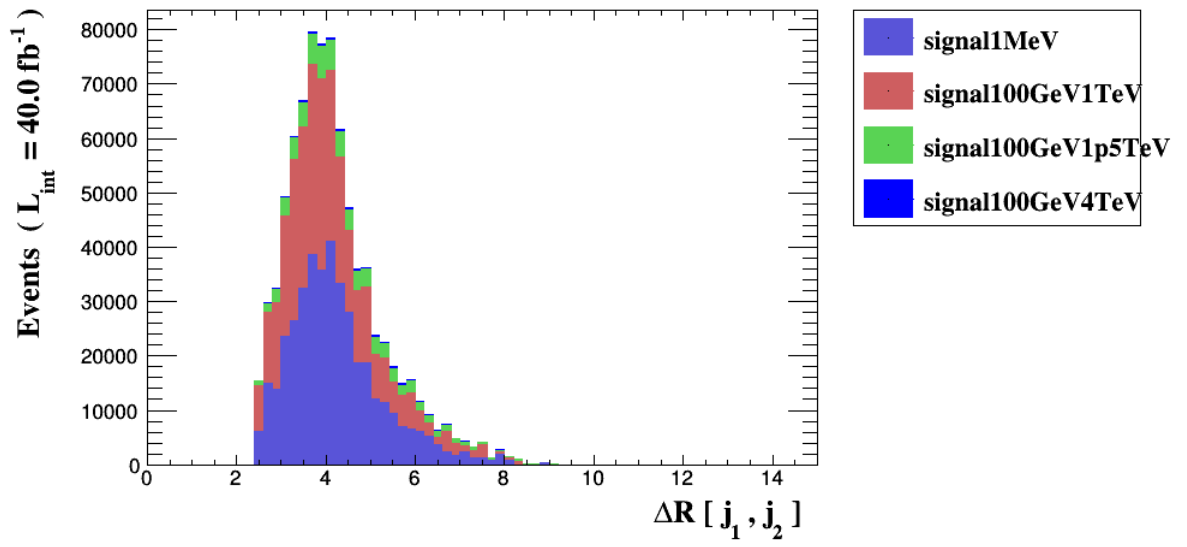


Figure 7.

3.8 Histogram 8

* Plot: $M(j_1, j_2)$

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1mev	406162	1.0	985.186	666.7	0.0	1.602
signal100gev1tev	340572	1.0	1094.3	687.1	0.0	2.202
signal100gev1p5	71075	1.0	1110.02	786.2	0.0	3.11
signal100gev4tev	7152	1.0	1096.34	808.0	0.0	3.8

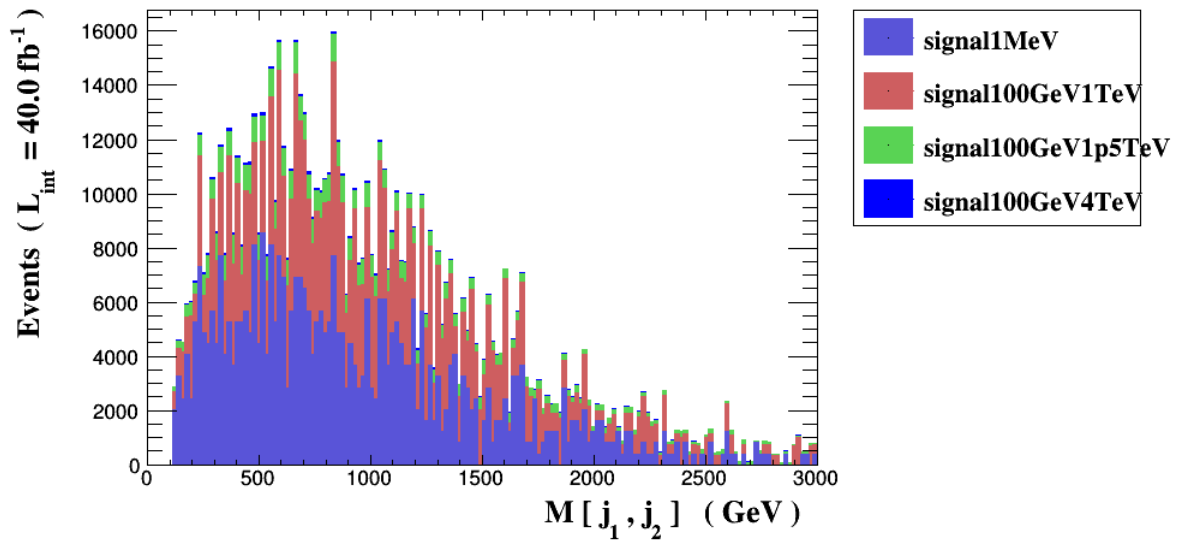


Figure 8.

3.9 Histogram 9

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1mev	406162	1.0	0.122267	3.815	0.0	0.0
signal100gev1tev	340572	1.0	0.0516943	3.713	0.0	0.0
signal100gev1p5	71075	1.0	-0.0854503	4.338	0.0	0.0
signal100gev4tev	7152	1.0	-0.0300121	4.701	0.0	0.0

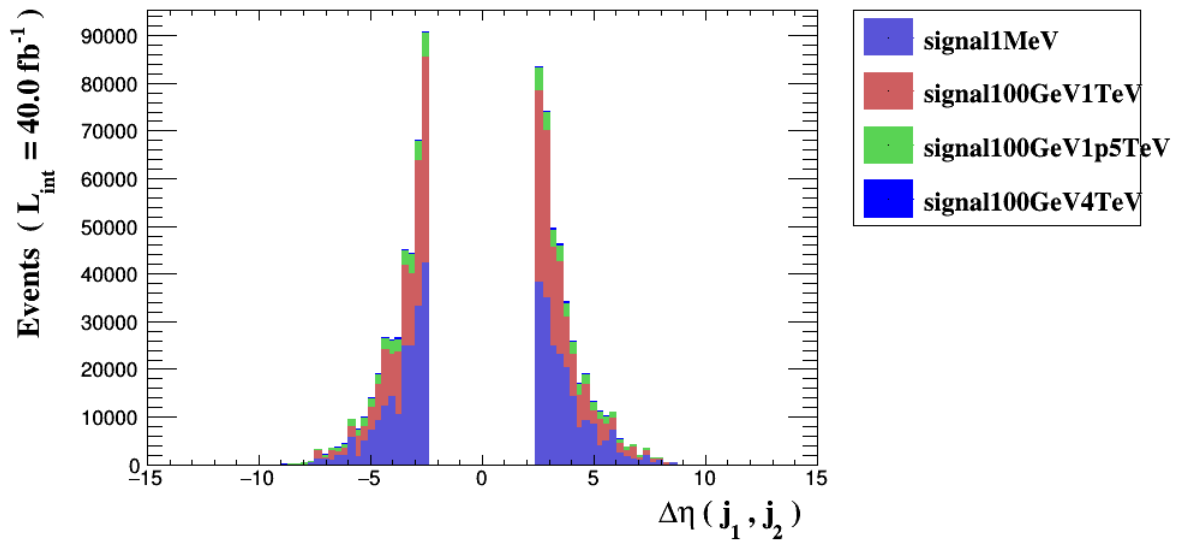


Figure 9.

3.10 Histogram 10

* Plot: THT

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1mev	406568	1.0	379.799	289.9	0.0	0.0
signal100gev1tev	340913	1.0	450.967	323.8	0.0	0.0
signal100gev1p5t	71082	1.0	344.097	286.7	0.0	0.0
signal100gev4tev	7153	1.0	269.432	217.8	0.0	0.0

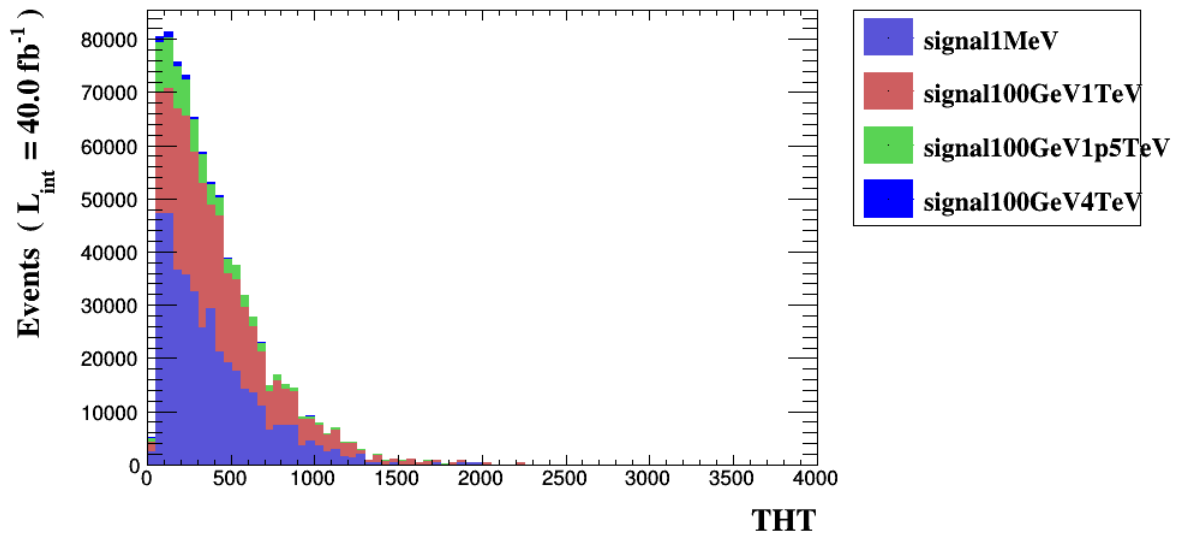


Figure 10.

3.11 Histogram 11

* Plot: MET

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1mev	406568	1.0	3.56703e-09	4.096e-09	0.0	0.0
signal100gev1tev	340913	1.0	4.36606e-09	5.231e-09	0.0	0.0
signal100gev1p5	71082	1.0	3.51729e-09	4.485e-09	0.0	0.0
signal100gev4tev	7153	1.0	3.04943e-09	3.811e-09	0.0	0.0

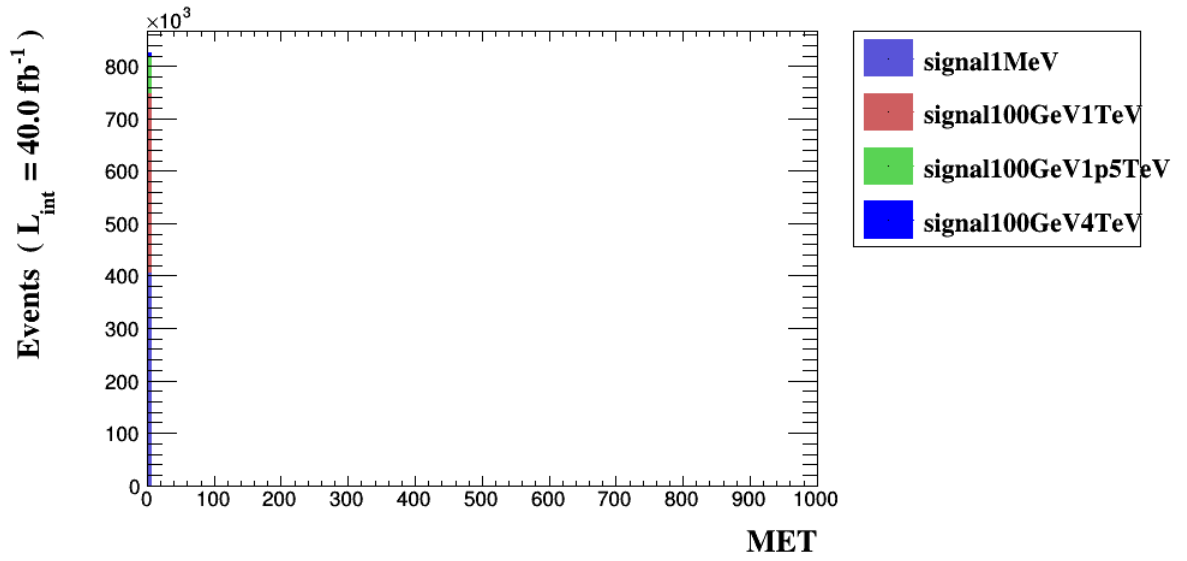


Figure 11.

3.12 Histogram 12

* Plot: TET

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal1mev	406568	1.0	616.896	471.7	0.0	0.0
signal100gev1tev	340913	1.0	745.517	543.9	0.0	0.0
signal100gev1p5t	71082	1.0	580.998	479.7	0.0	0.0
signal100gev4tev	7153	1.0	468.042	387.8	0.0	0.0

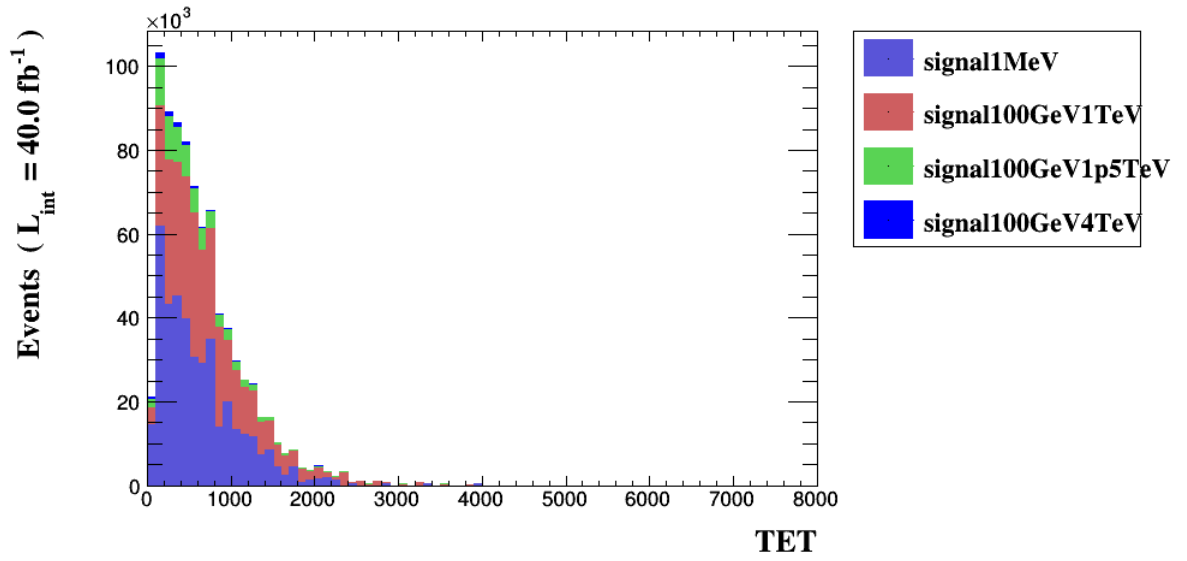


Figure 12.