



# The LaTeX report

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# 1 Setup

## 1.1 Command history

```
ma5># set directory where running "./bin/ma5"; set lumi; define the signal significance
ma5>set main.currentdir = /Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/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_sdeta_2.5_1MeV.lhe.gz as signal
ma5># define bg and signal samples
ma5>set signal.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 sdeta_2.5_cut

```

## 1.2 Configuration

- MadAnalysis version 1.6.33 (2017/11/20).
- Histograms given for an integrated luminosity of  $40.0\text{fb}^{-1}$ .

## 2 Datasets

### 2.1 signal

- Samples stored in the directory: `/Users/elijahsheridan/MG5_aMC_v2_6_5/axion_pheno/-optimization/ma_scripts` .
- Sample consisting of: `signal` events.
- Generated events: `10000` events.
- Normalization to the luminosity: `3716+/- 8` events.
- Ratio (event weight): `0.37` .

Path to the event file	Nr. of events	Cross section (pb)	Negative wgts (%)
<code>/Users/elijahsheridan/-MG5_aMC_v2_6_5/-axion_pheno/-madgraph_data/axion_signal/-axion_signal_sdeta_2.5_1MeV.lhe.g</code>	10000	0.0929 @ 0.21%	0.0

### 3 Histos and cuts

#### 3.1 Histogram 1

\* Plot: PT ( jets[1] )

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	3716	1.0	433.203	313.4	0.0	0.16

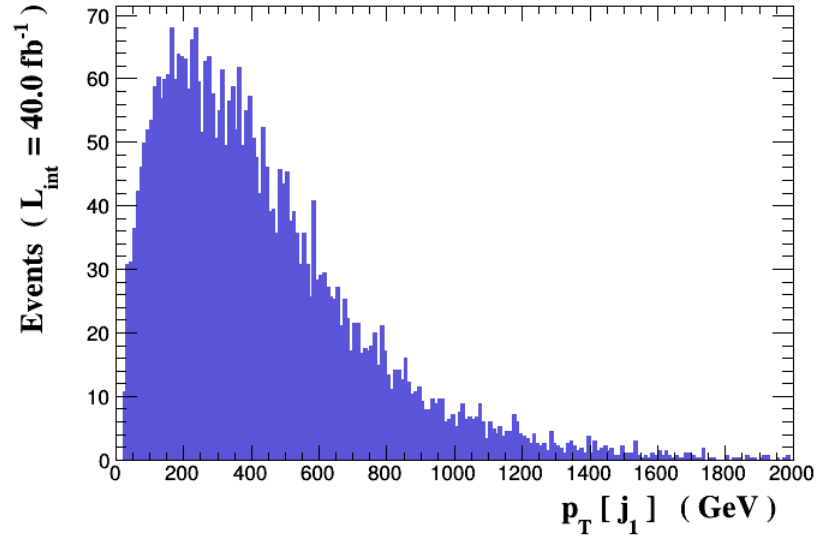


Figure 1.

### 3.2 Histogram 2

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	3716	1.0	-0.00375675	1.662	0.0	0.0

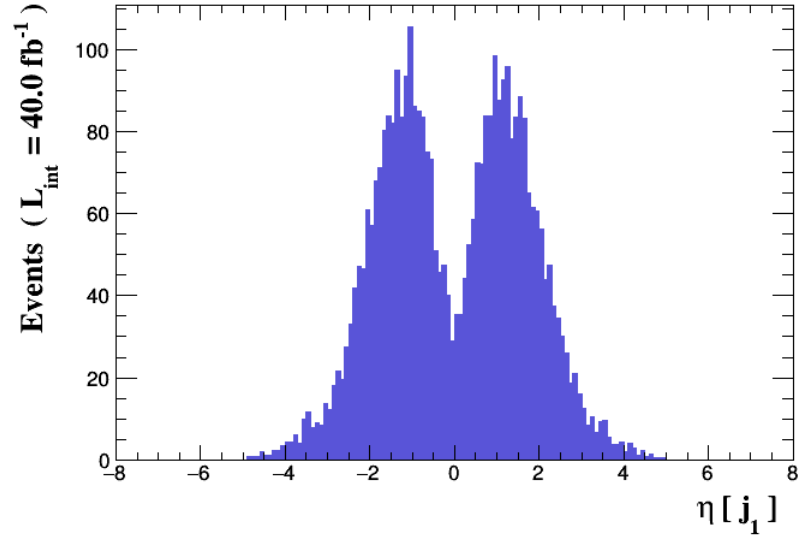


Figure 2.



### 3.3 Histogram 3

\* Plot: PHI ( jets[1] )

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	3716	1.0	-0.0144018	1.818	0.0	0.0

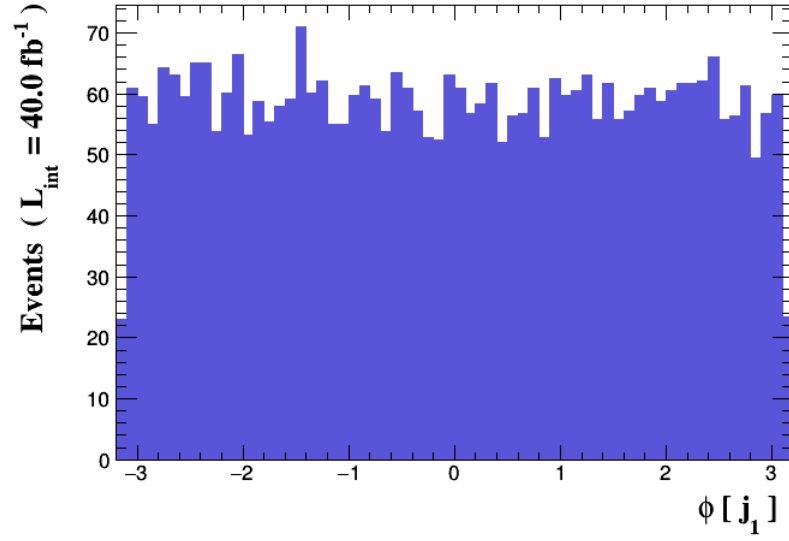


Figure 3.

### 3.4 Histogram 4

\* Plot: PT ( jets[2] )

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	3716	1.0	155.904	131.3	0.0	0.04

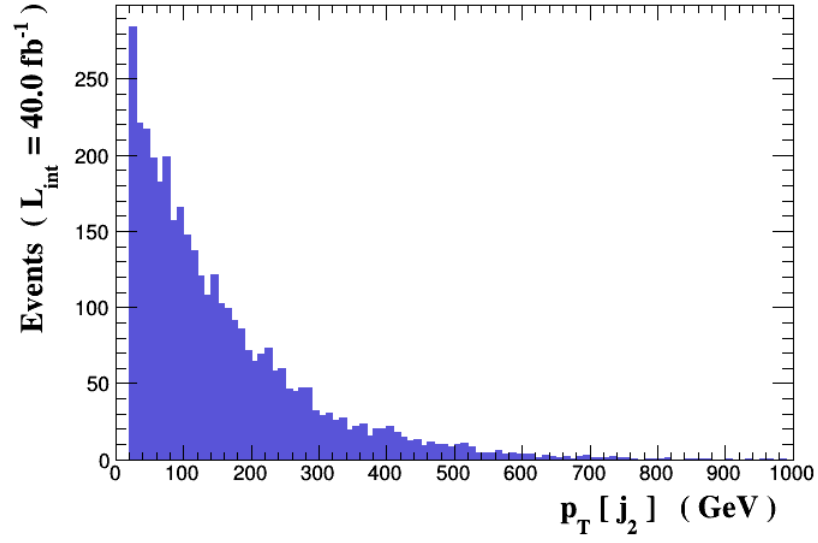


Figure 4.

### 3.5 Histogram 5

\* Plot: ETA ( jets[2] )

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	3716	1.0	-0.00265588	2.383	0.0	0.0

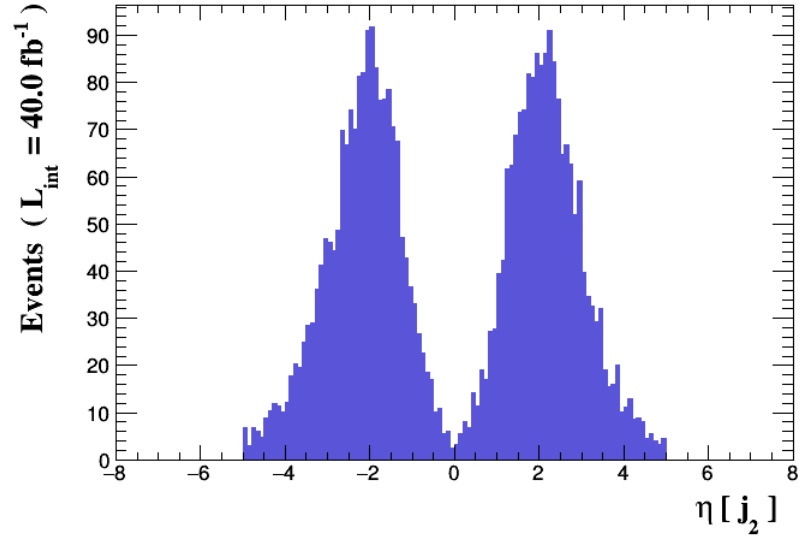


Figure 5.

### 3.6 Histogram 6

\* Plot: PHI ( jets[2] )

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	3716	1.0	0.0292571	1.821	0.0	0.0

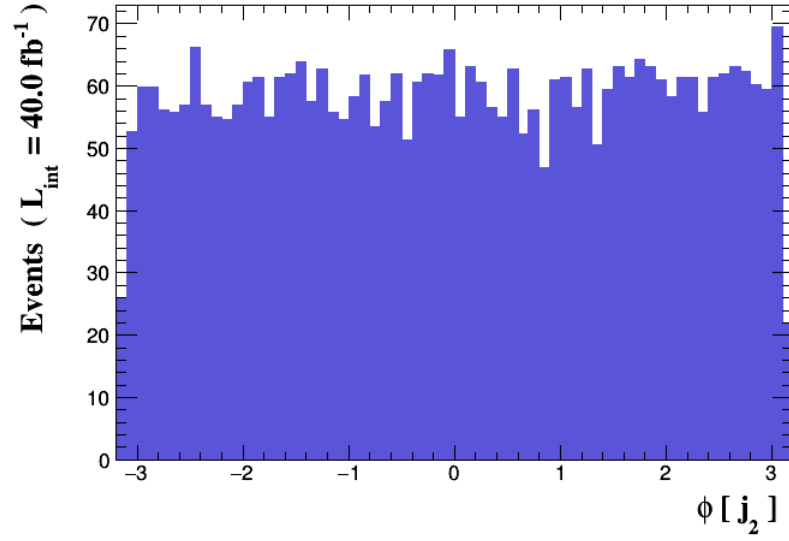


Figure 6.

### 3.7 Histogram 7

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	3716	1.0	4.1188	1.057	0.0	0.0

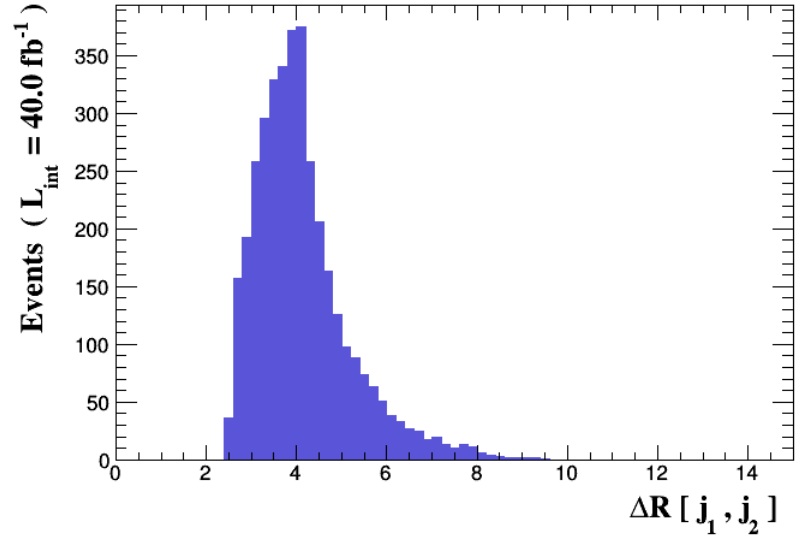


Figure 7.

### 3.8 Histogram 8

\* Plot:  $M(j_1, j_2)$

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	3716	1.0	1400.07	786.7	0.0	4.23

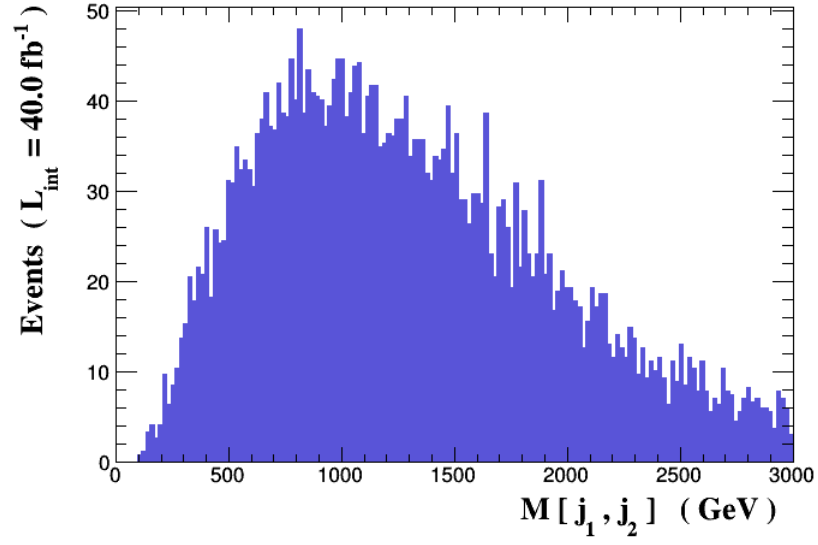


Figure 8.

### 3.9 Histogram 9

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

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	3716	1.0	-0.00110087	3.802	0.0	0.0

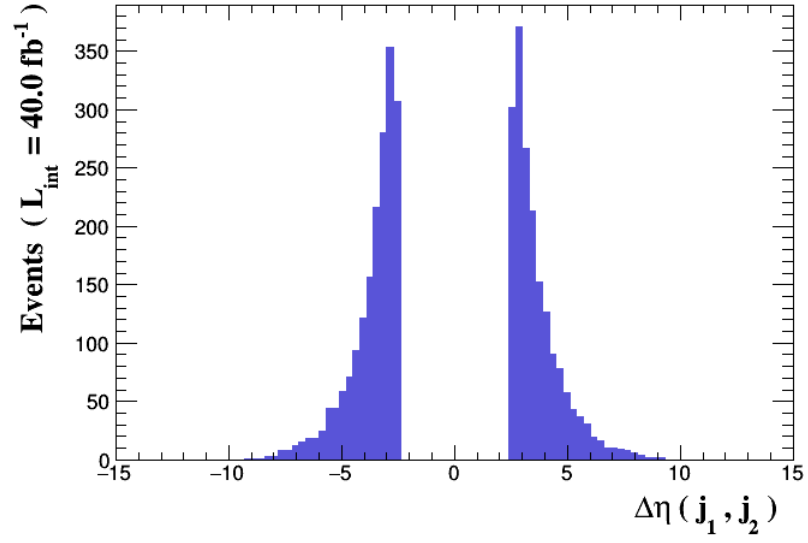


Figure 9.

### 3.10 Histogram 10

\* Plot:  $M(a_1, a_2)$

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	3716	1.0	938.368	726.3	0.0	0.38

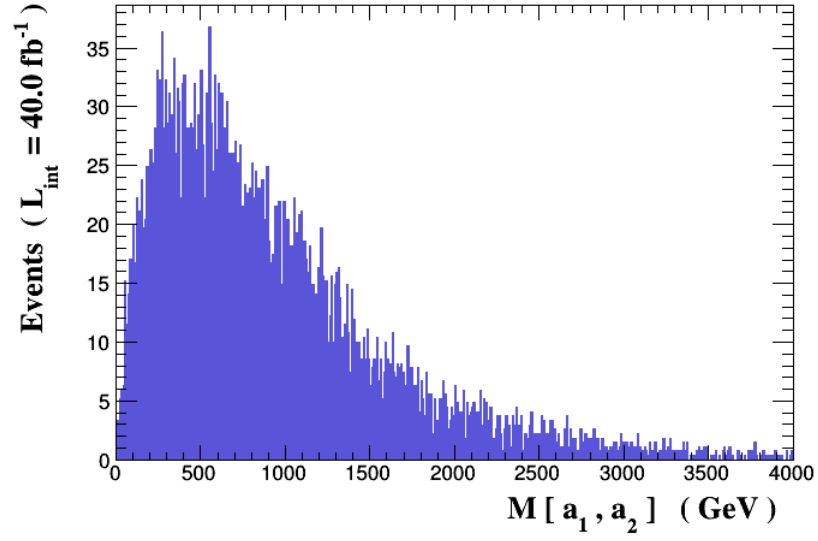


Figure 10.



### 3.11 Histogram 11

\* Plot: PT ( a[1] )

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	3716	1.0	577.445	368.0	0.0	0.49

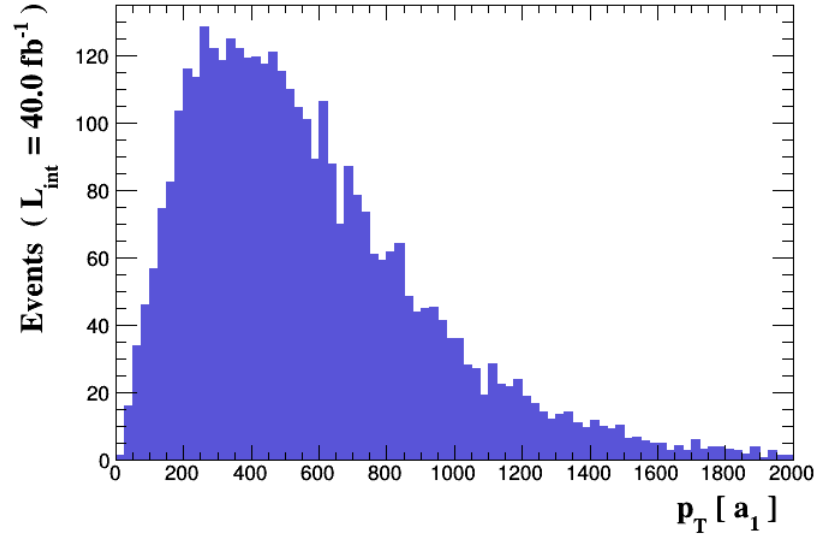


Figure 11.

### 3.12 Histogram 12

\* Plot: PT ( a[2] )

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	3716	1.0	329.642	294.4	0.0	0.16

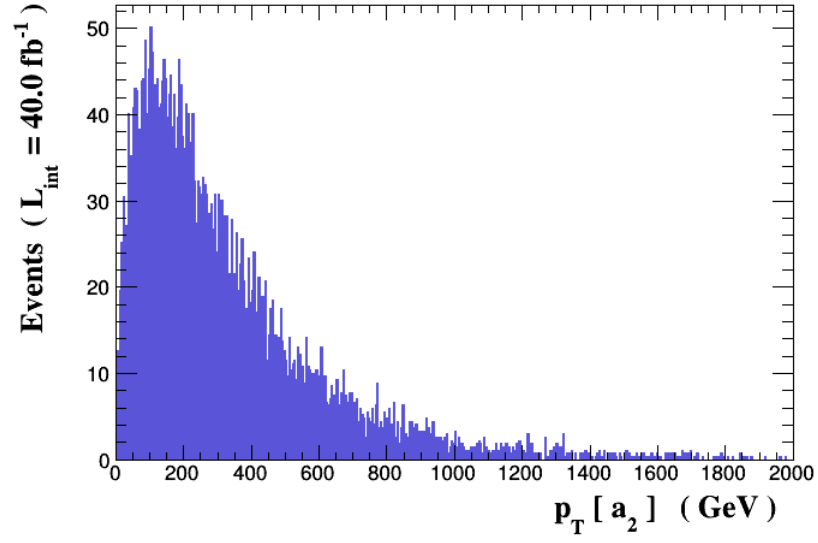


Figure 12.

### 3.13 Histogram 13

\* Plot: THT

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	3716	1.0	588.474	384.5	0.0	0.0

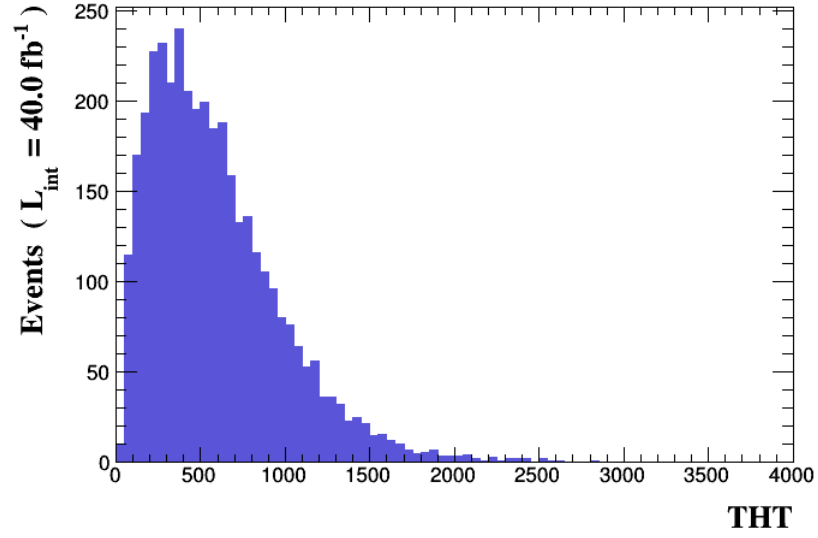


Figure 13.

### 3.14 Histogram 14

\* Plot: MET

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	3716	1.0	8.08588e-09	1.049e-08	0.0	0.0

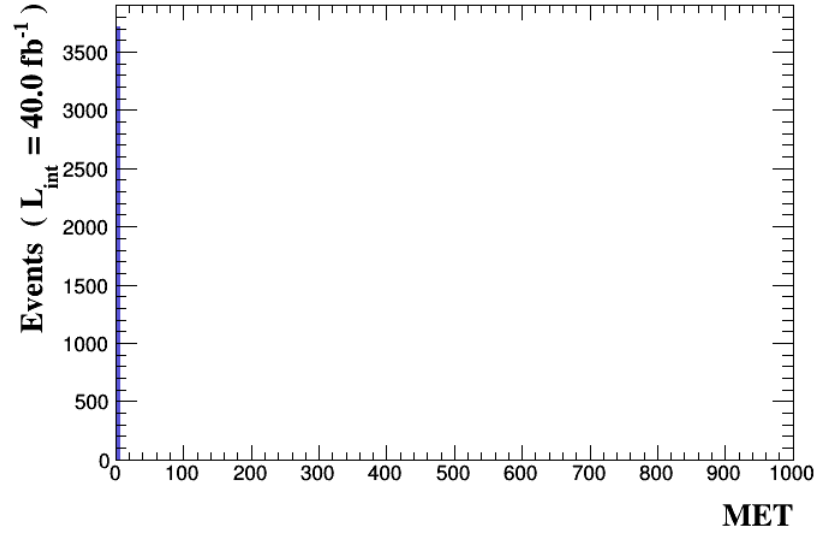


Figure 14.

### 3.15 Histogram 15

\* Plot: TET

Dataset	Integral	Entries per event	Mean	RMS	% underflow	% overflow
signal	3716	1.0	1494.59	819.8	0.0	0.0

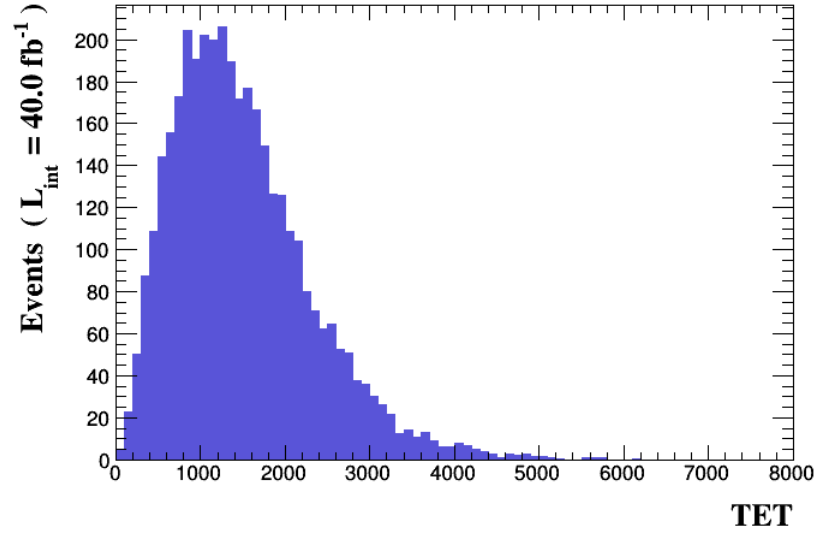


Figure 15.