

# EFT DM model kinematics and rates

Rebecca Pickles

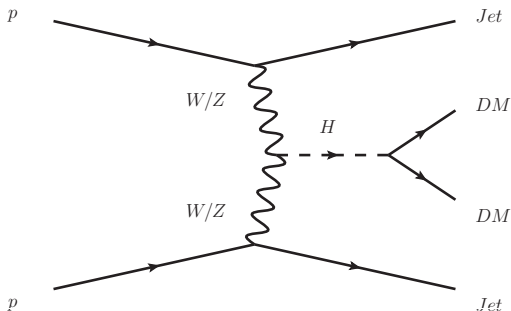
January 12, 2016



# What I've done:

- Overlaid distributions for various operators/masses.
- Automated run through and added in:
  - The Monojet HighPt and VBFDM OR Monojet HighPt phase spaces.
  - Mass 100GeV (Along with previous 10GeV and 1000GeV)
  - Dimension 5d (Along with previous 5a 5b 5c 6a 6b 7a 7b 7c 7d)
  - Higgs portal model with Higgs = 125GeV
- Ran through Rivet routine with background processes to compare to signal kinematics.  
 $\text{SM}( Z \rightarrow \nu \bar{\nu} ) + j j.$
- Overlaid these background distributions with the DM distributions.

# Higgs 'Dark Portal':



- Interactions are the same as the BSM EFT.
- Production of Higgs followed by a decay into dark matter.

# Phasespace Selection Cuts

**VBFZ Baseline:**  $\text{Jet1PT} > 55 \text{ GeV}$ ;  $\text{Jet2PT} > 45 \text{ GeV}$ ;  $\text{NumJets} \geq 2$ .

**VBFZ HighMass:**  $M_{jj} > 1000 \text{ GeV}$ ;  $\text{Jet1PT} > 55 \text{ GeV}$ ;  $\text{Jet2PT} > 45 \text{ GeV}$ ;  $\text{NumJets} \geq 2$ .

**VBFZ Search:**  $M_{jj} > 250 \text{ GeV}$ ;  $\text{Jet1PT} > 55 \text{ GeV}$ ;  $\text{Jet2PT} > 45 \text{ GeV}$ ;  $\text{NumJets} \geq 2$ .

**VBFDM:**  $M_{jj} > 250 \text{ GeV}$ ;  $\text{Jet1PT} > 55 \text{ GeV}$ ;  $\text{Jet2PT} > 45 \text{ GeV}$ ;  $\text{NumJets} \geq 2$ ;  $\eta < 4.4$ ;  $\text{MET} > 150 \text{ GeV}$ .

**Monojet:**  $\text{Jet1PT} > 100 \text{ GeV}$ ;  $\text{NumJets} \geq 1$ ;  $\eta < 4.4$ ;  $\text{MET} > 150 \text{ GeV}$ .

**Monojet HighPt:**  $\text{Jet1PT} > 250 \text{ GeV}$ ;  $\text{NumJets} \geq 1$ ;  $\eta < 4.4$ ;  $\text{MET} > 250 \text{ GeV}$ .

**VBFDM OR Monojet:** VBFDM; Monojet.

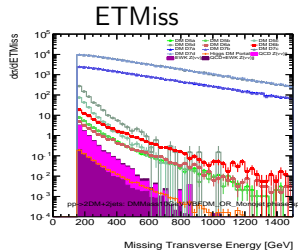
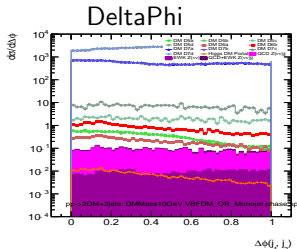
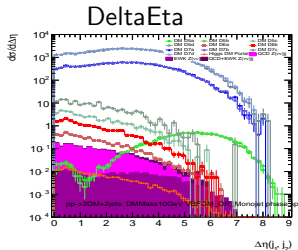
**VBFDM OR Monojet HighPt:** VBFDM; Monojet HighPt.

# Distributions of interest:

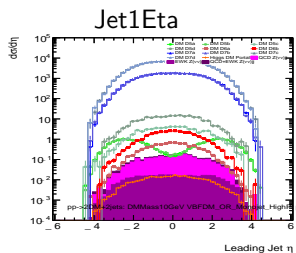
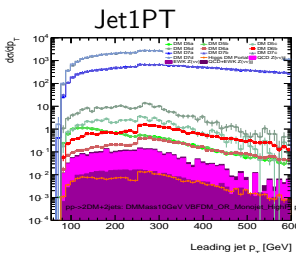
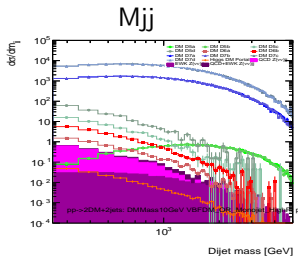
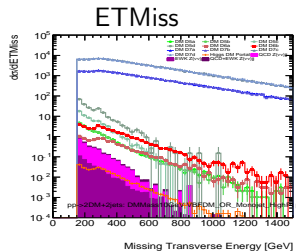
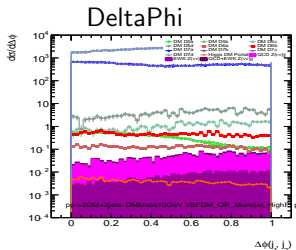
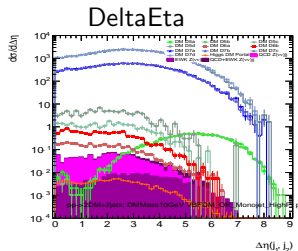
## Main distributions that have been produced:

- Transverse Momentum of Jets,  $P_T(j1)$  and  $P_T(j2)$ .
- Dijet Mass,  $M_{jj}$ .
- Missing Transverse Energy,  $\cancel{E}_T$ .
- Difference in Jet Angle  $\Delta\phi$ .
- Difference in Jet Pseudorapidity,  $\Delta\eta$ .

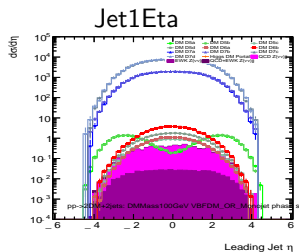
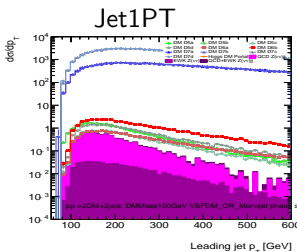
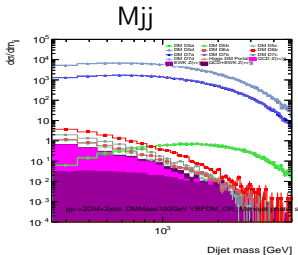
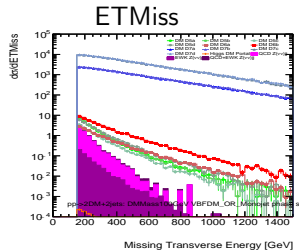
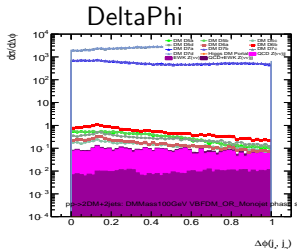
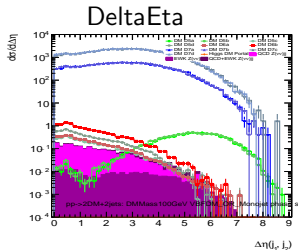
# Distributions for VBFDM OR Monojet Selection, 10 GeV



## Distributions for VBFDM OR Monojet HighPt Selection, 10 GeV

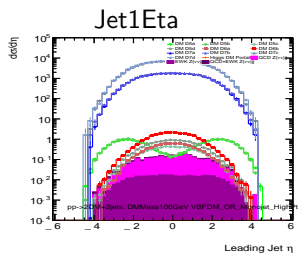
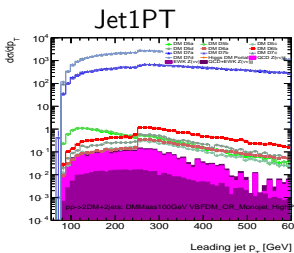
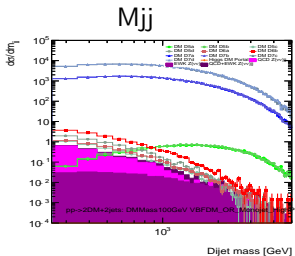
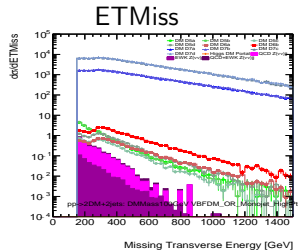
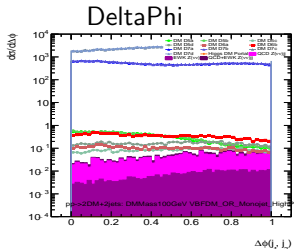
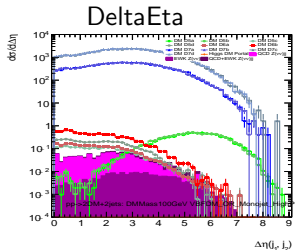


# Distributions for VBFDM OR Monojet Selection, 100 GeV

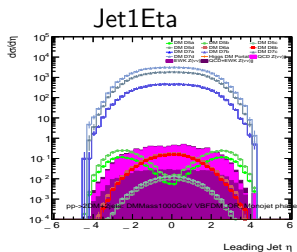
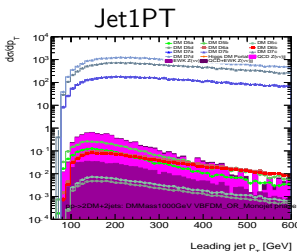
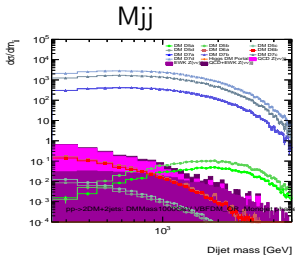
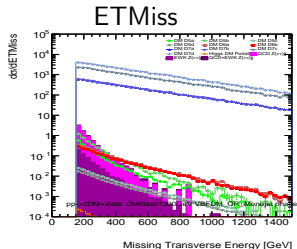
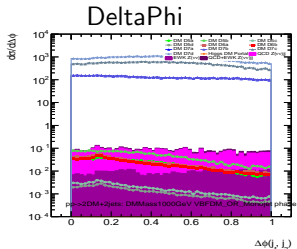
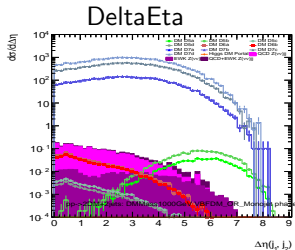




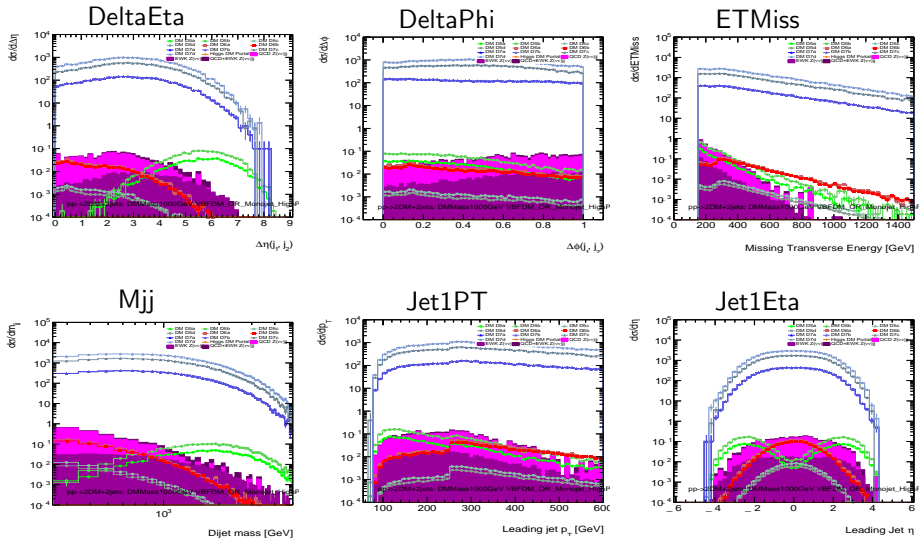
# Distributions for VBFDM OR Monojet HighPt Selection, 100 GeV



## Distributions for VBFDM OR Monojet Selection, 1000 GeV



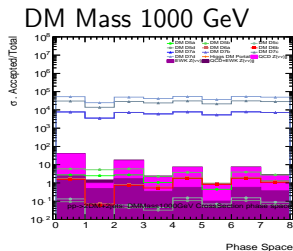
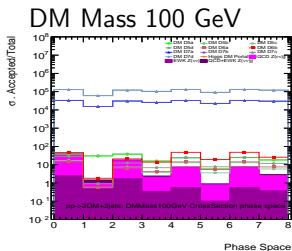
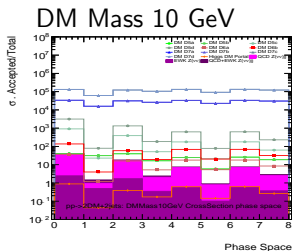
# Distributions for VBFDM OR Monojet HighPt Selection, 1000 GeV



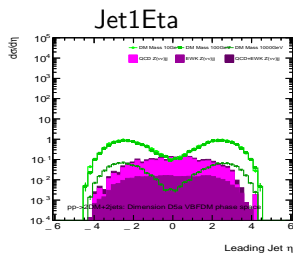
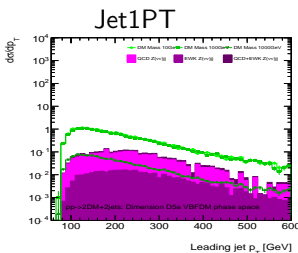
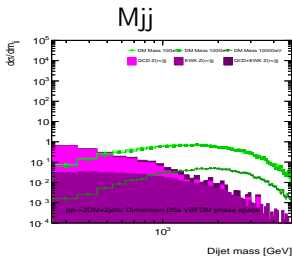
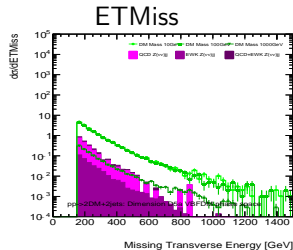
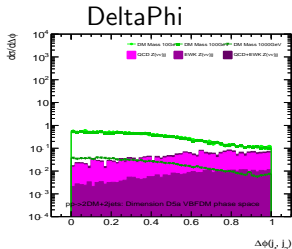
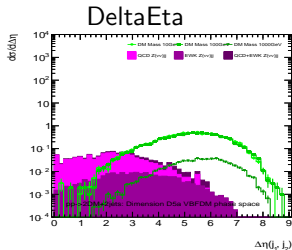
# Scaled Cross-section:

## Phase Space Key:

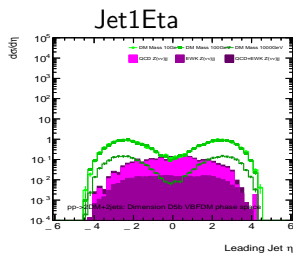
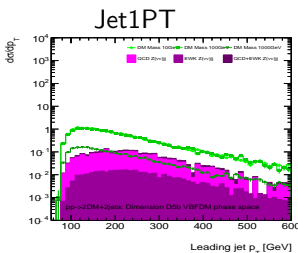
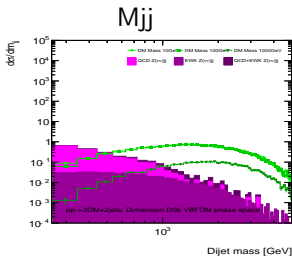
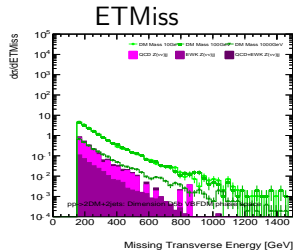
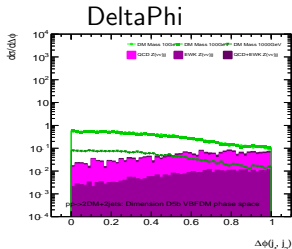
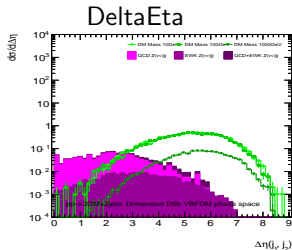
1 = VBFZ Baseline; 2 = VBFZ HighMass; 3 = VBFZ Baseline; 4 = VBFDM;  
5 = Monojet; 6 = Monojet HighPt; 7 = VBFDM OR Monojet;  
8 = VBFDM OR Monojet HighPt



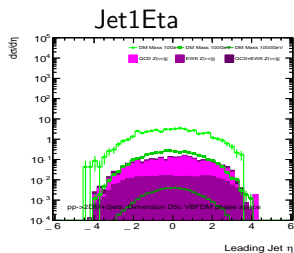
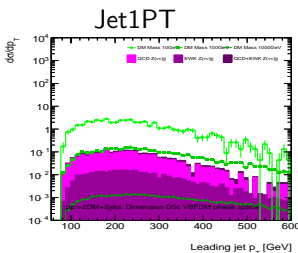
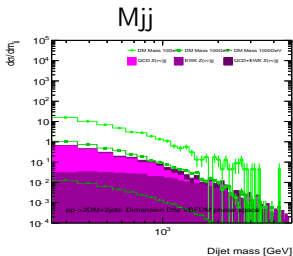
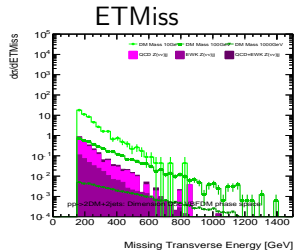
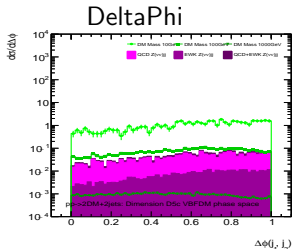
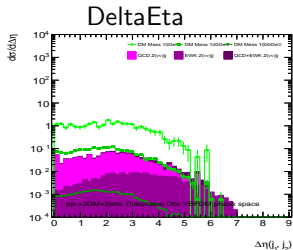
# Distributions for D5a, VBFDM Selection



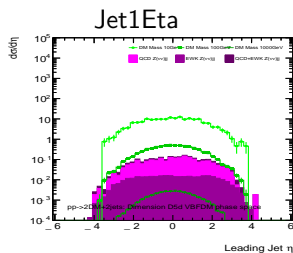
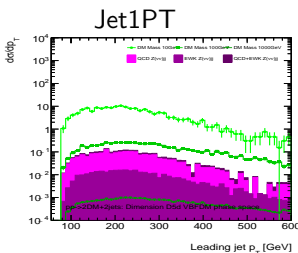
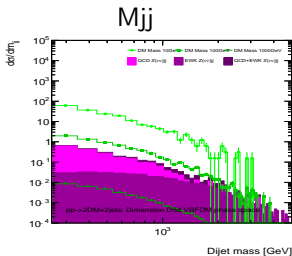
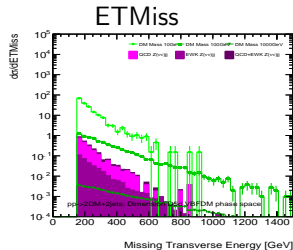
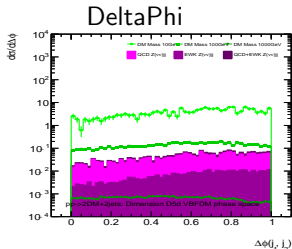
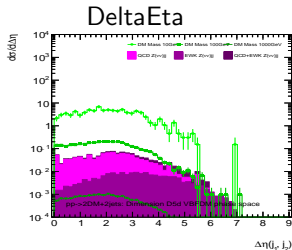
# Distributions for D5b, VBFDM Selection



# Distributions for D5c, VBFDM Selection

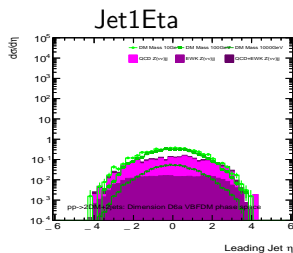
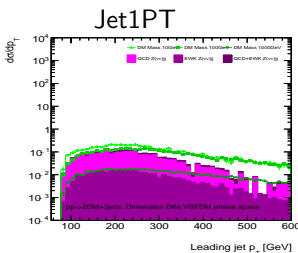
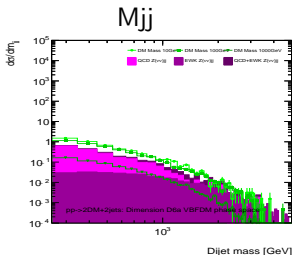
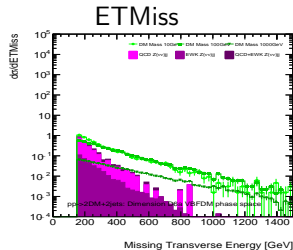
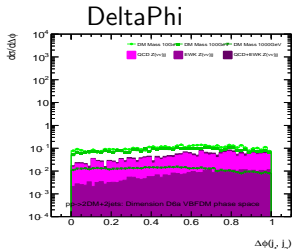
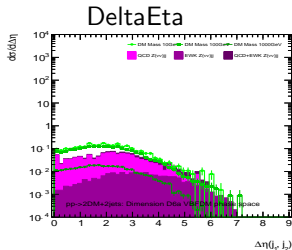


# Distributions for D5d, VBFDM Selection



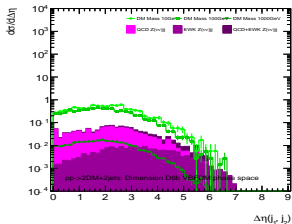


# Distributions for D6a, VBFDM Selection

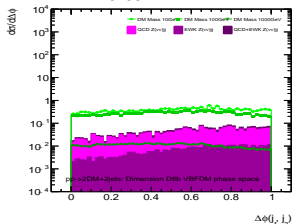


# Distributions for D6b, VBFDM Selection

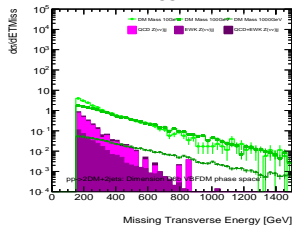
## DeltaEta



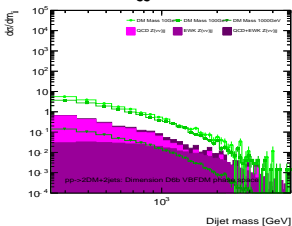
## DeltaPhi



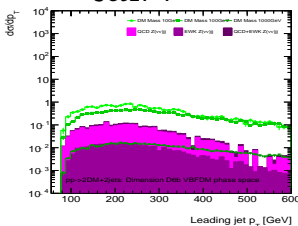
## ETMiss



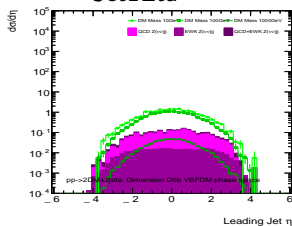
## Mjj



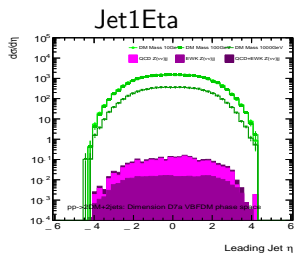
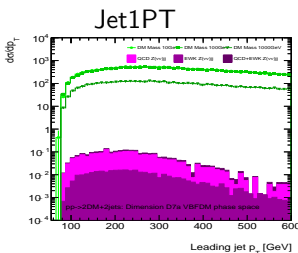
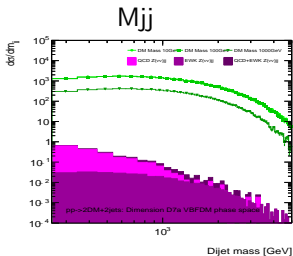
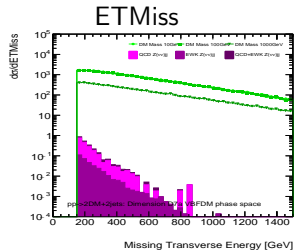
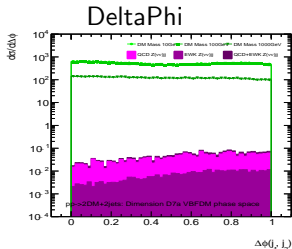
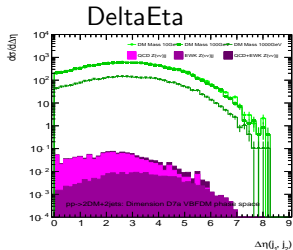
## Jet1PT



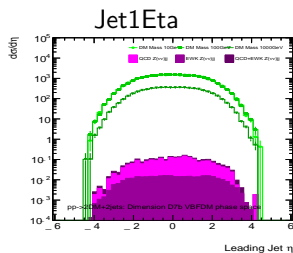
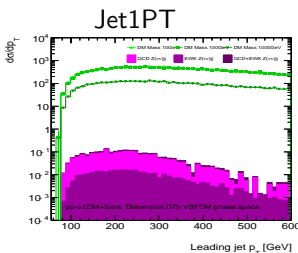
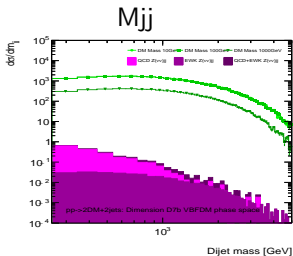
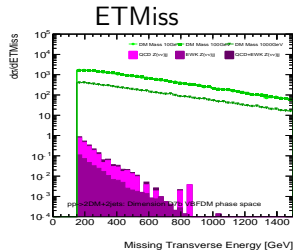
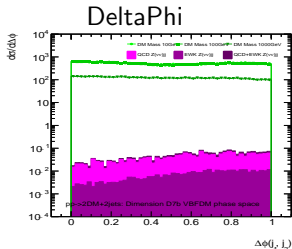
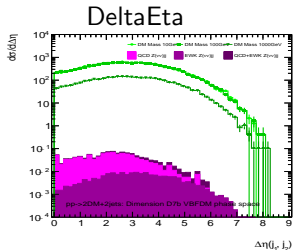
## Jet1Eta



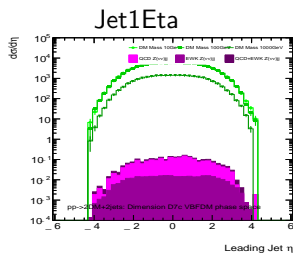
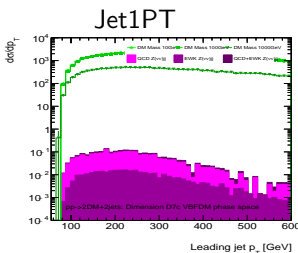
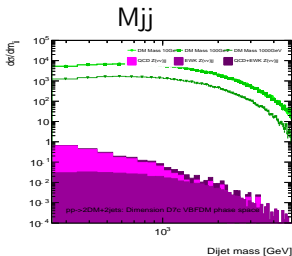
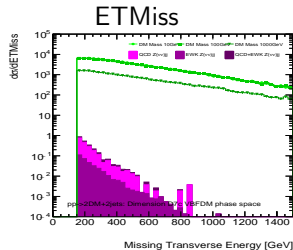
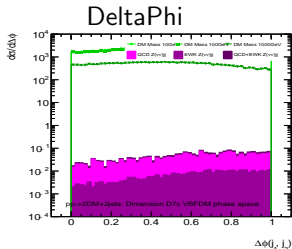
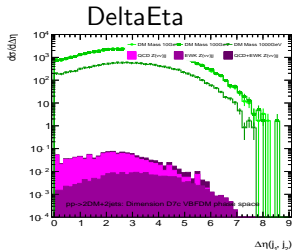
# Distributions for D7a, VBFDM Selection



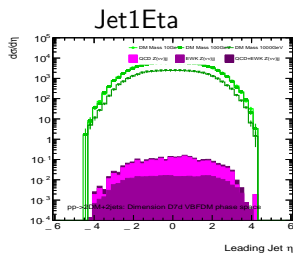
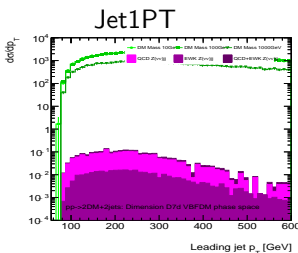
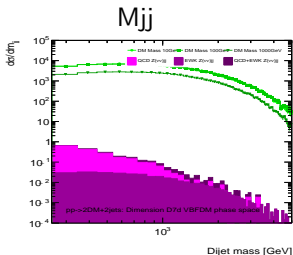
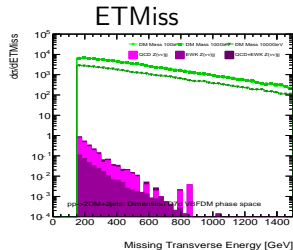
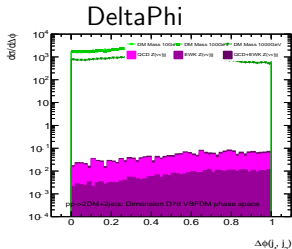
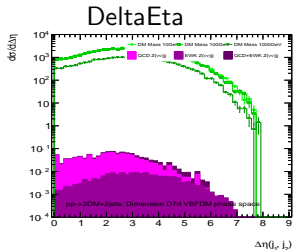
# Distributions for D7b, VBFDM Selection



# Distributions for D7c, VBFDM Selection



# Distributions for D7d, VBFDM Selection



# Next Steps:

- Make 2D plots from the distributions
- Look at invisible Higgs validation of Sherpa.
- Add three jet contributions.
- Make 2D plots of rates in mass and  $\Lambda$ .
- Any other thoughts?