

# **Analysis of $H \rightarrow b\bar{b}\mu\mu$ Based on Particle Flow Jet**

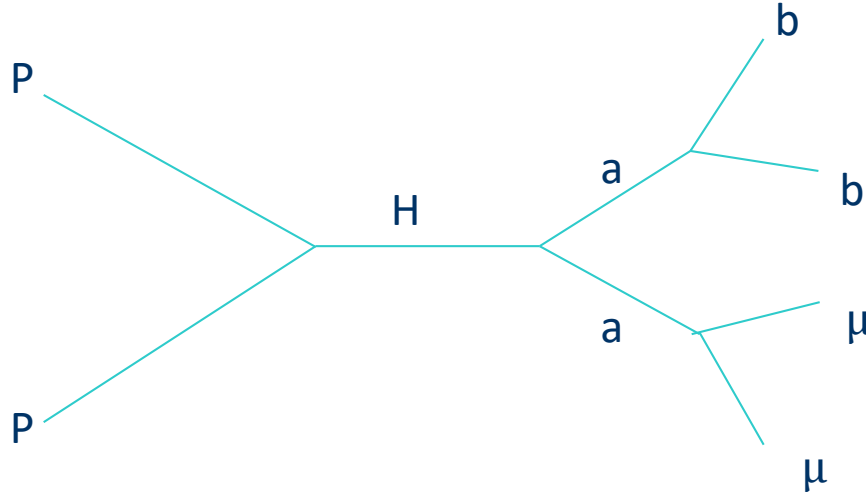
Yingyue Zhu

# Physics Background

Looking into an exotic decay mode of the 125 GeV Higgs where  
 $H \rightarrow aa \rightarrow bb\mu\mu$

$$m_{bb\mu\mu} \leq 125 \text{ GeV}$$

$$m_{bb} \leq 60 \text{ GeV}$$



# Physics Background

Major background noises come from

- $t\bar{t}$

- $Z + \text{jets}$

# Selection Code

## Structure

### Jet

Jet Calibration

pT Cut

eta Cut

JetVertexTagger Tool

Jet Cleaning Tool(Calo only)

Jet/Elec Overlap Removal

Jet/ Muon Overlap Removal(2)

### Muon

Muon calibration

Type selection

pT cut(7GeV)

Z0&d0 cut

Muon isolation

### Electron

ET cut(7GeV)

Likelihood Tool

Electron isolation

Z0&d0

Electron/muon overlap removal

final good jet  
final good muon

good muon

final good electron

signal

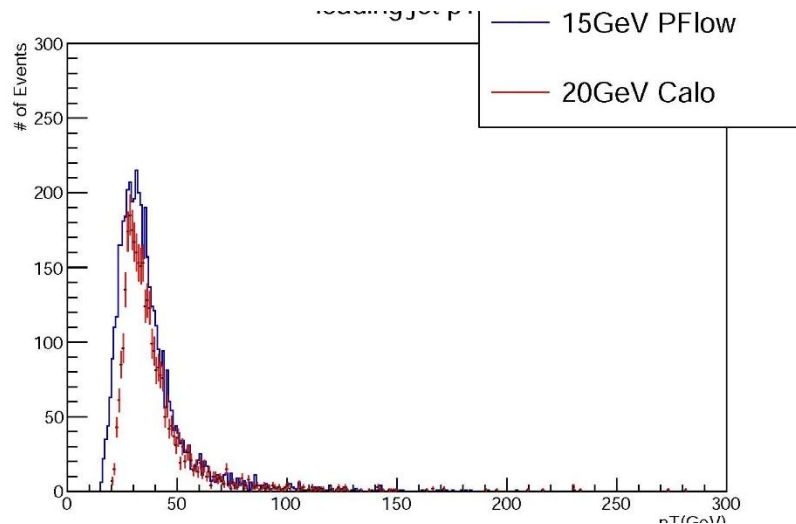
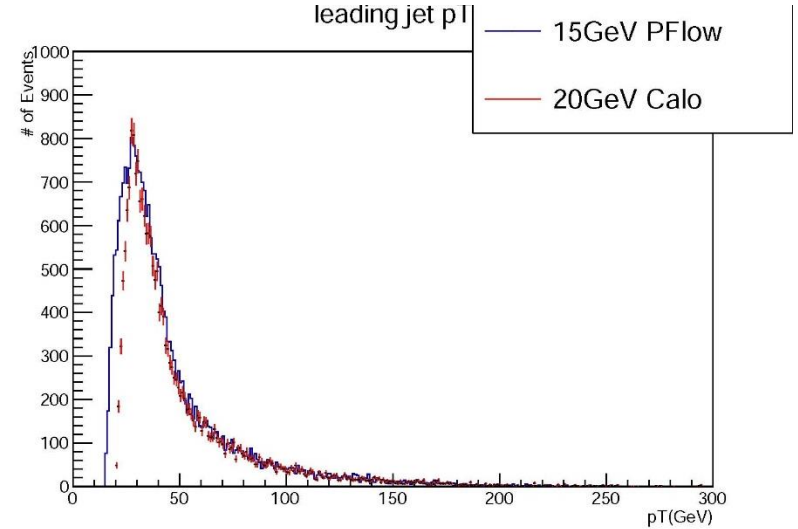
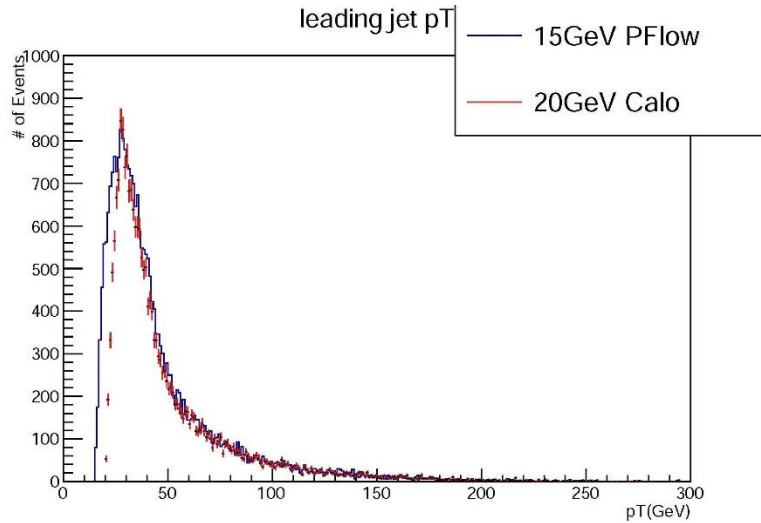
# leading jet pT (15GeV PFlow v. 20GeV Calo)

Cut applied:

Upper right: two muons

Upper left : two muon &  $\geq 2$  good jets

Bottom : 2 muon and 2 b jets



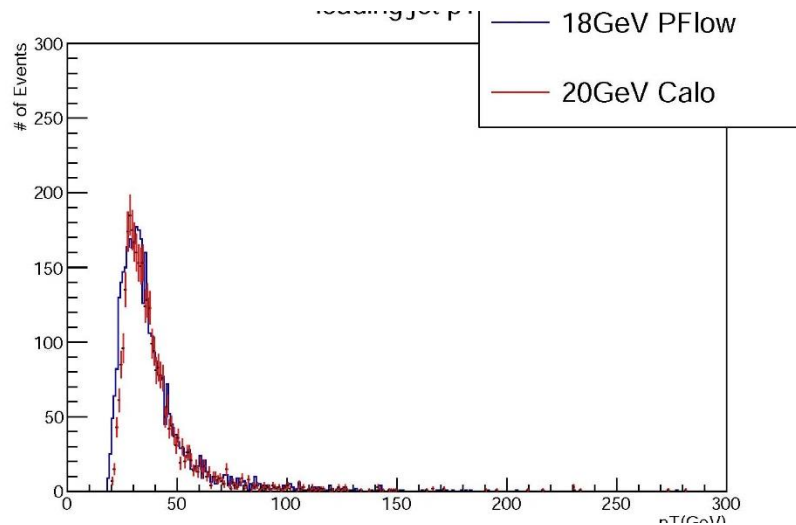
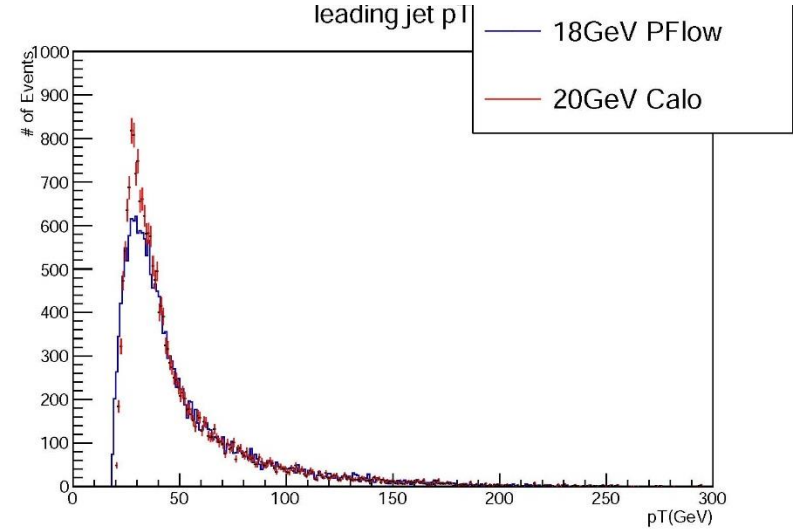
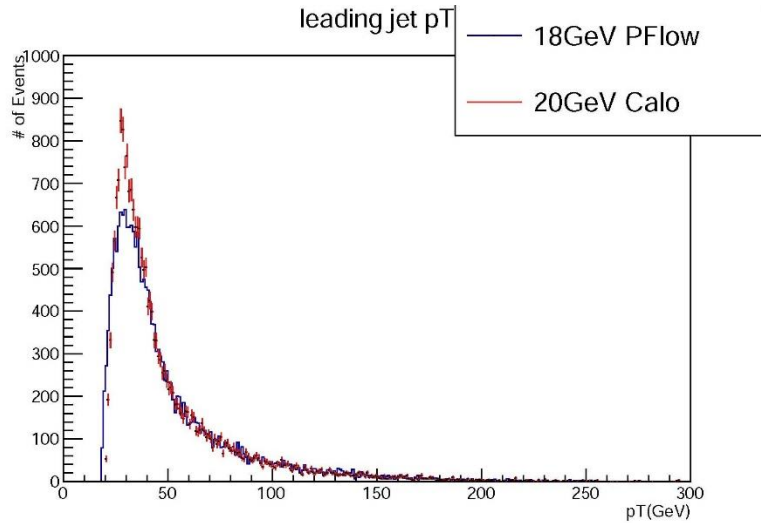
# leading jet pT (18GeV PFlow v. 20GeV Calo)

Cut applied:

Upper right: two muons

Upper left : two muon &  $\geq 2$  good jets

Bottom : 2 muon and 2 b jets



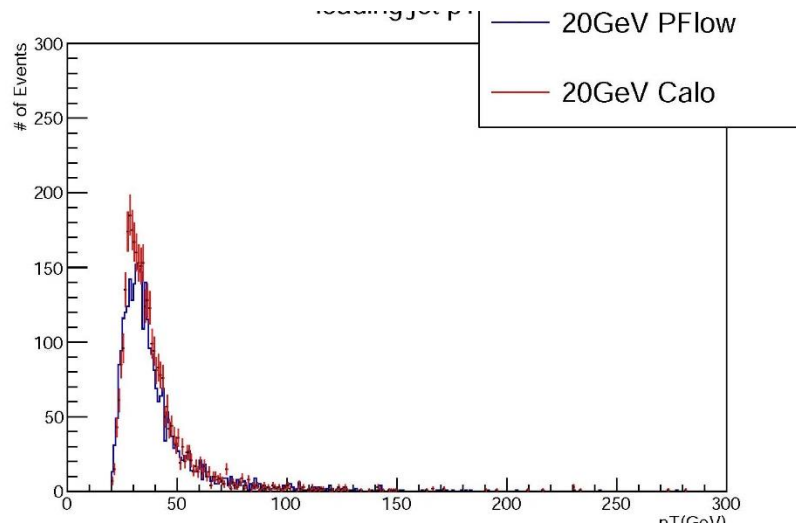
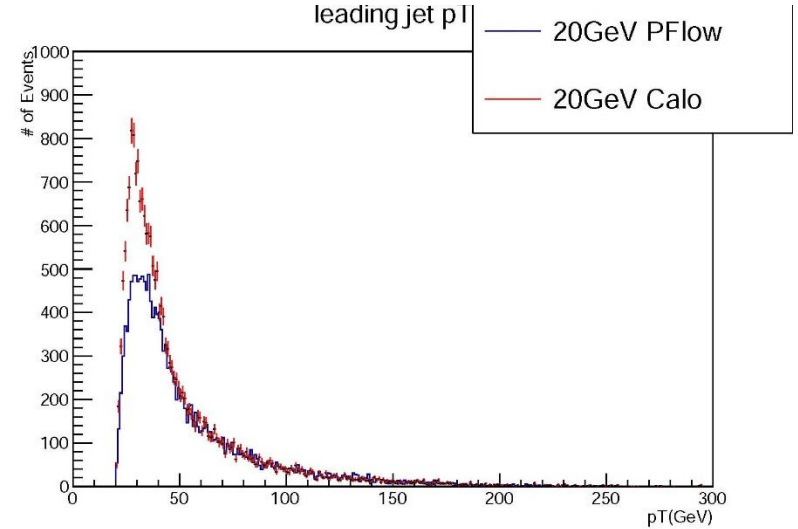
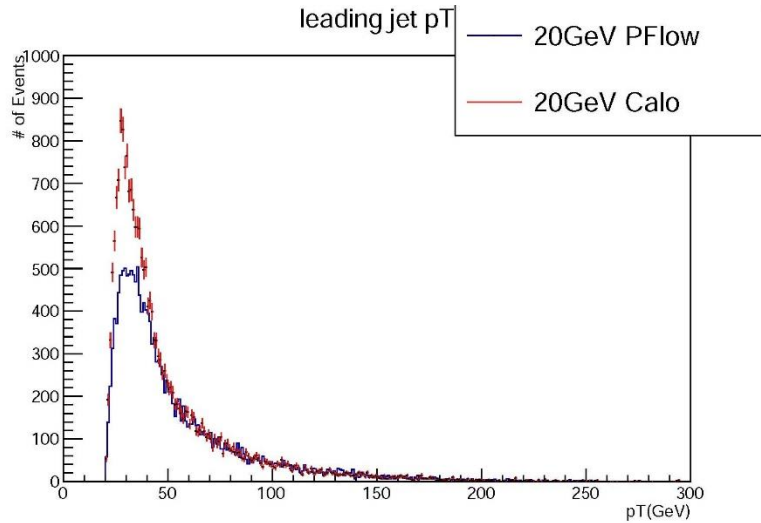
# leading jet pT (20GeV PFlow v. 20GeV Calo)

Cut applied:

Upper right: two muons

Upper left : two muon &  $\geq 2$  good jets

Bottom : 2 muon and 2 b jets





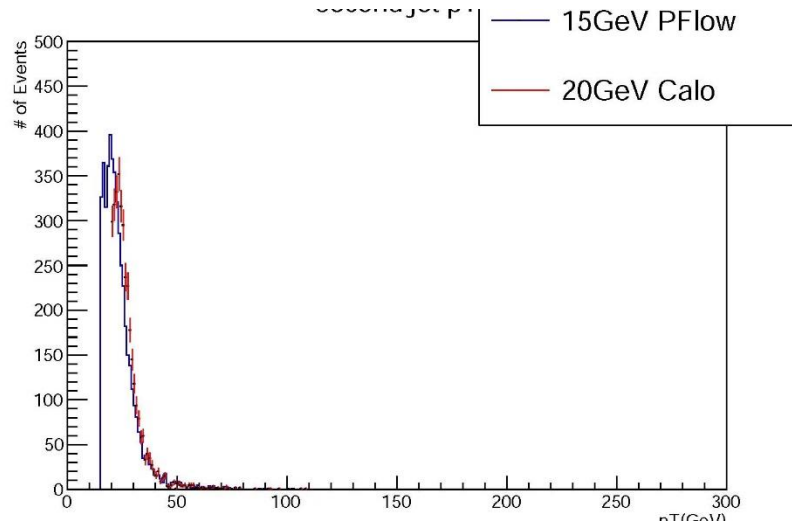
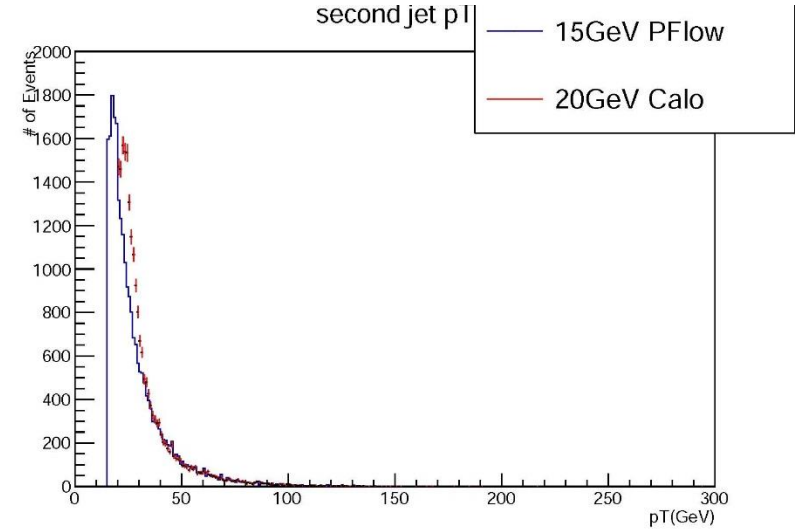
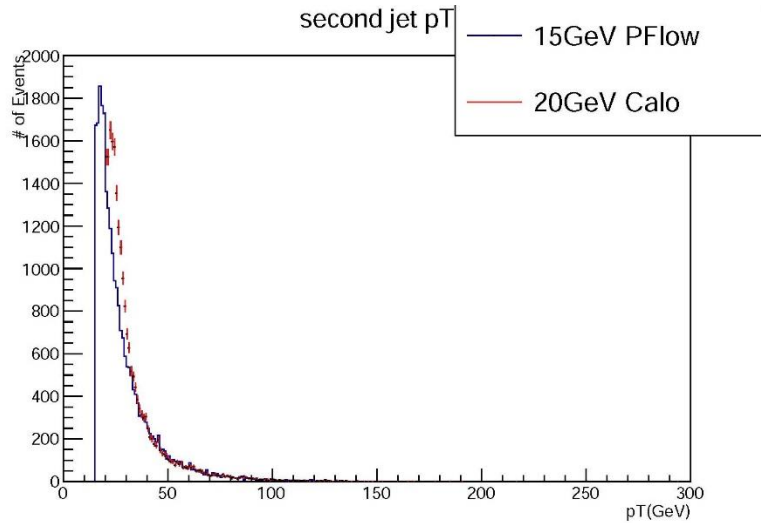
# Second jet pT (15GeV PFlow v. 20GeV Calo)

Cut applied:

Upper right: two muons

Upper left : two muon &  $\geq 2$  good jets

Bottom : 2 muon and 2 b jets



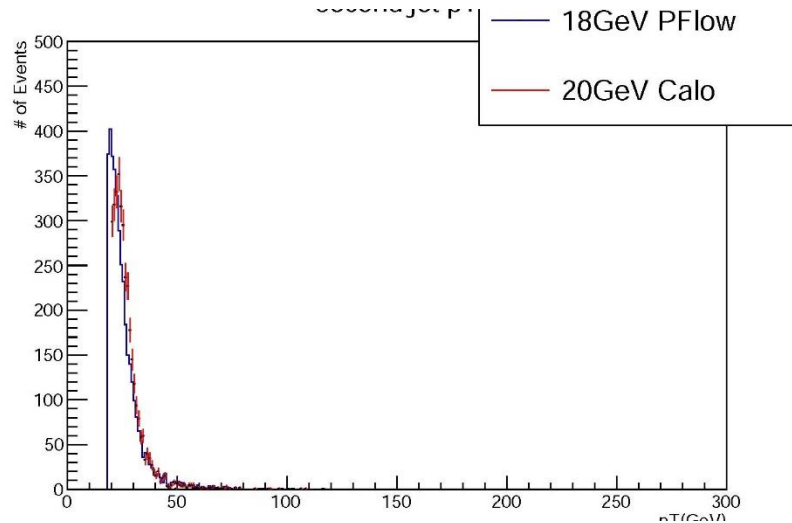
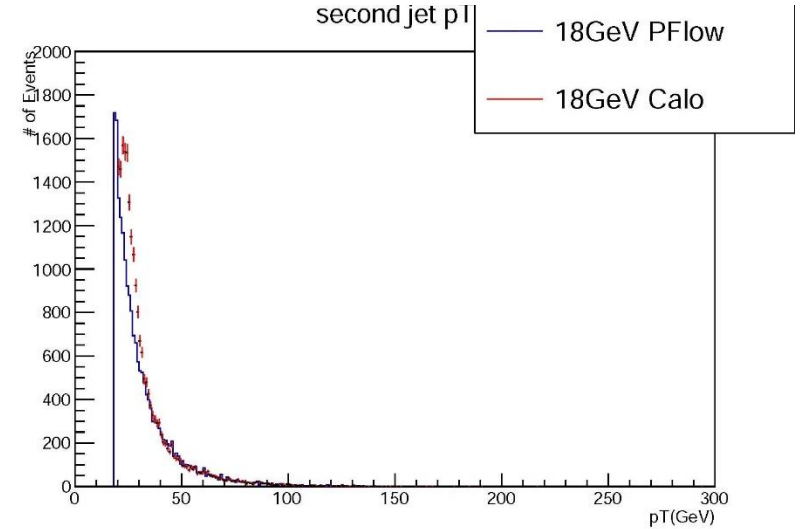
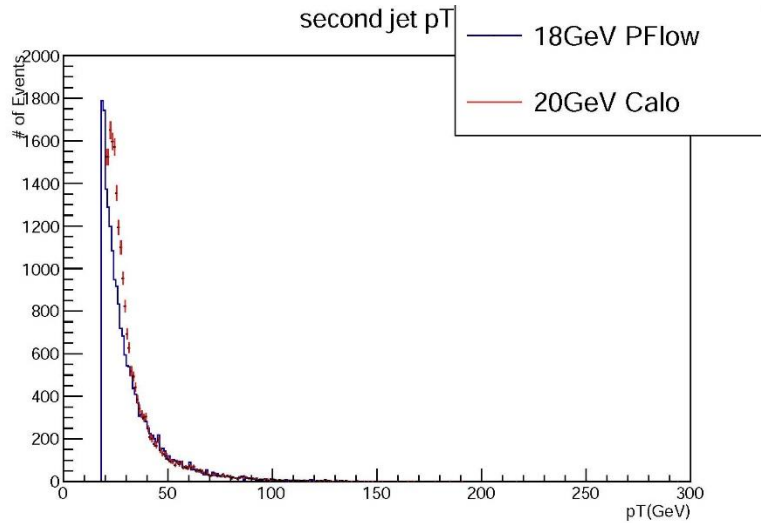
# Second jet pT (18GeV PFlow v. 20GeV Calo)

Cut applied:

Upper right: two muons

Upper left : two muon &  $\geq 2$  good jets

Bottom : 2 muon and 2 b jets



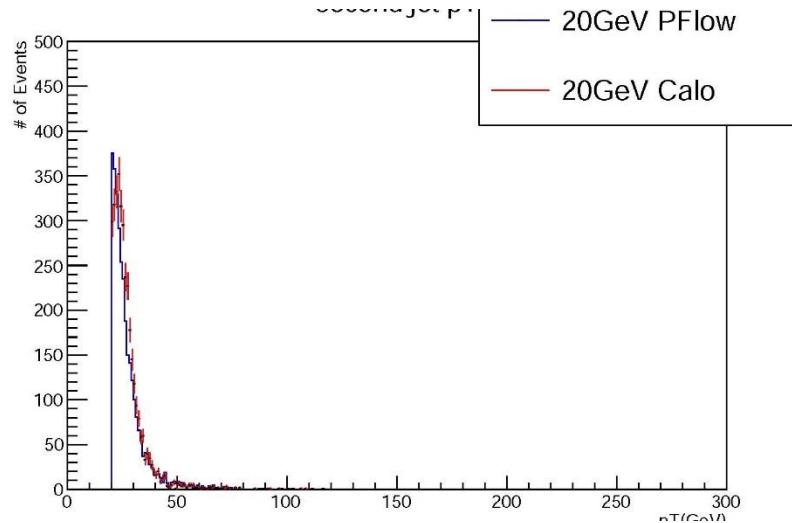
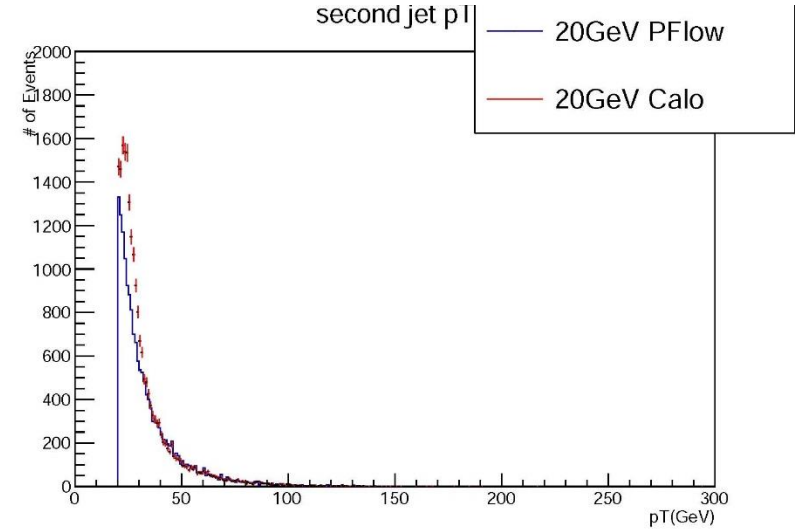
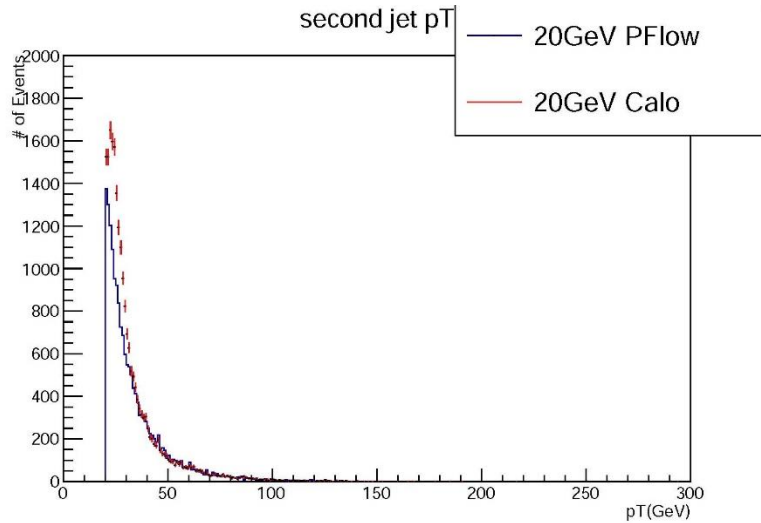
# Second jet pT (20GeV PFlow v. 20GeV Calo)

Cut applied:

Upper right: two muons

Upper left : two muon &  $\geq 2$  good jets

Bottom : 2 muon and 2 b jets



# Dijet Mass

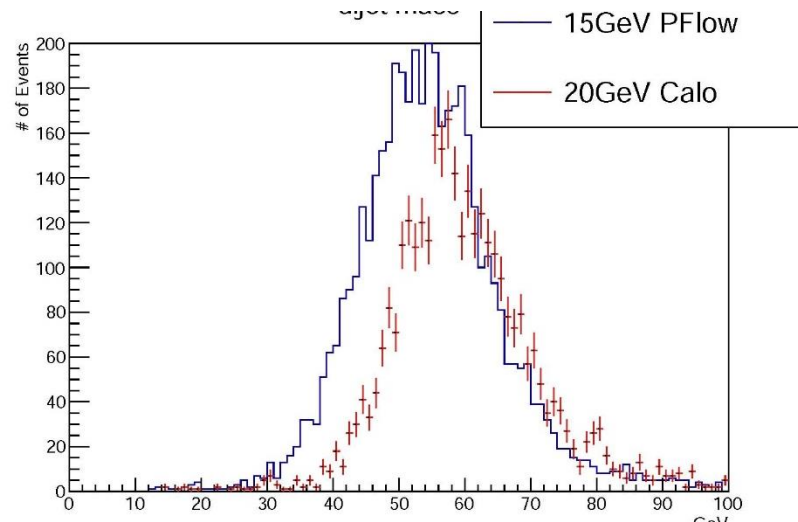
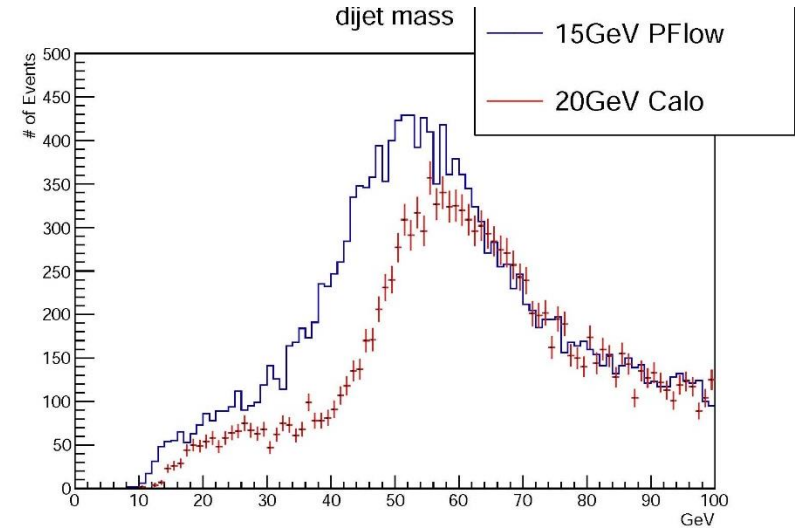
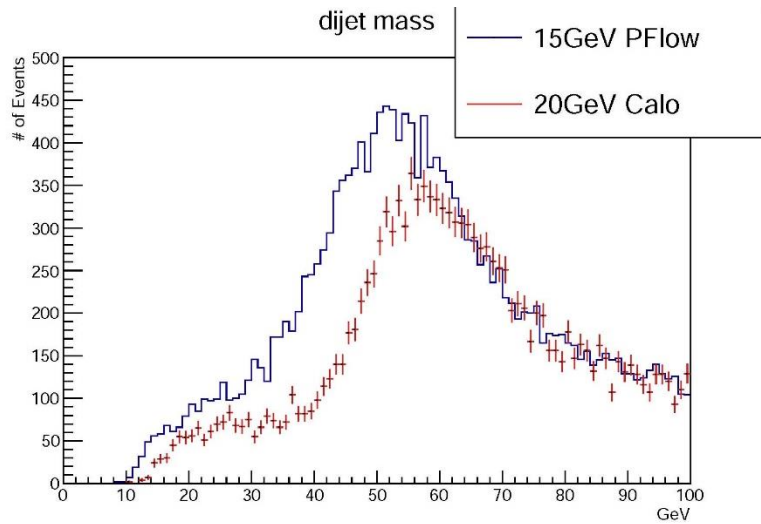
(15GeV PFlow v. 20GeV Calo)

Cut applied:

Upper right: two muons

Upper left : two muon &  $\geq 2$  good jets

Bottom : 2 muon and 2 b jets



# Dijet Mass

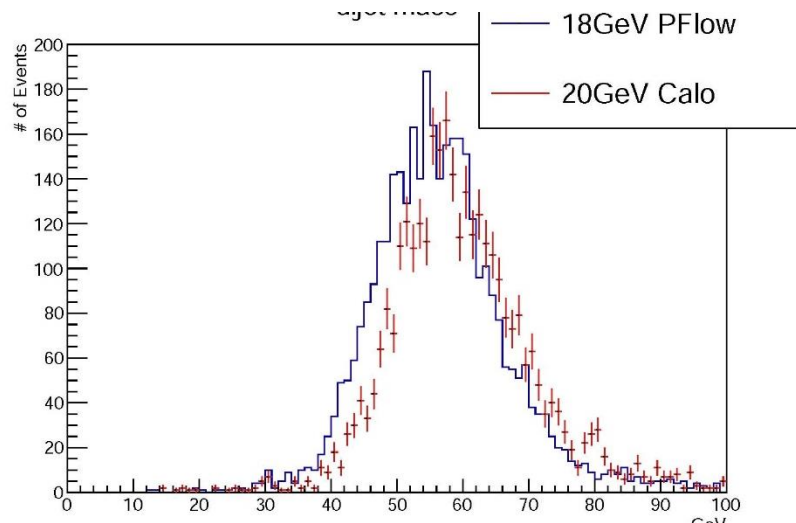
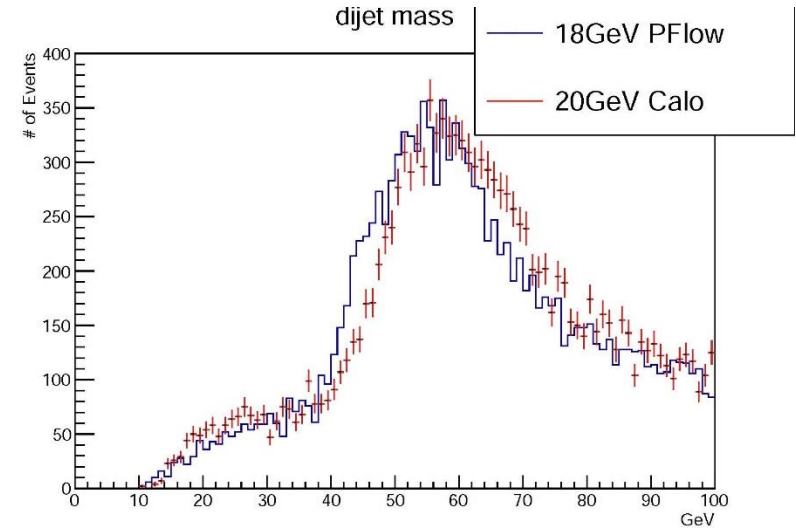
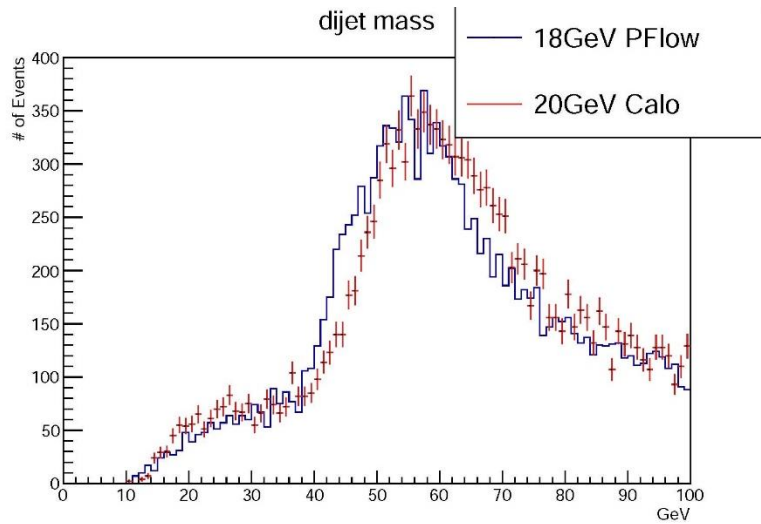
(18GeV PFlow v. 20GeV Calo)

Cut applied:

Upper right: two muons

Upper left : two muon &  $\geq 2$  good jets

Bottom : 2 muon and 2 b jets



# Dijet Mass

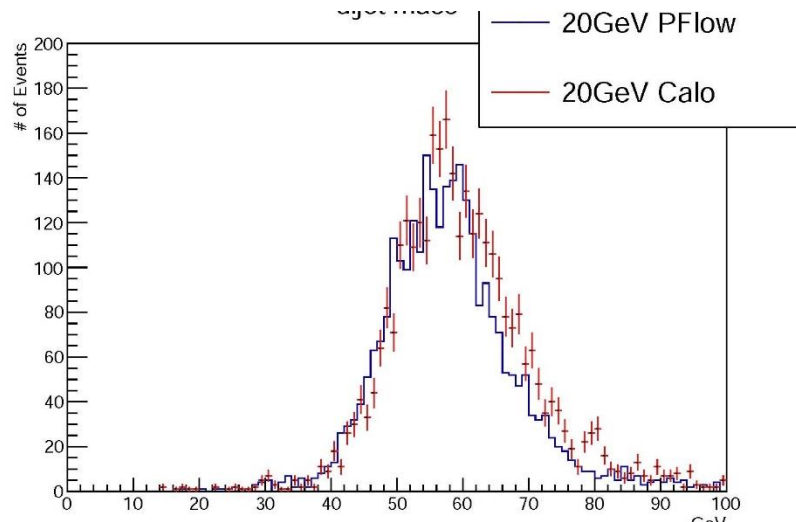
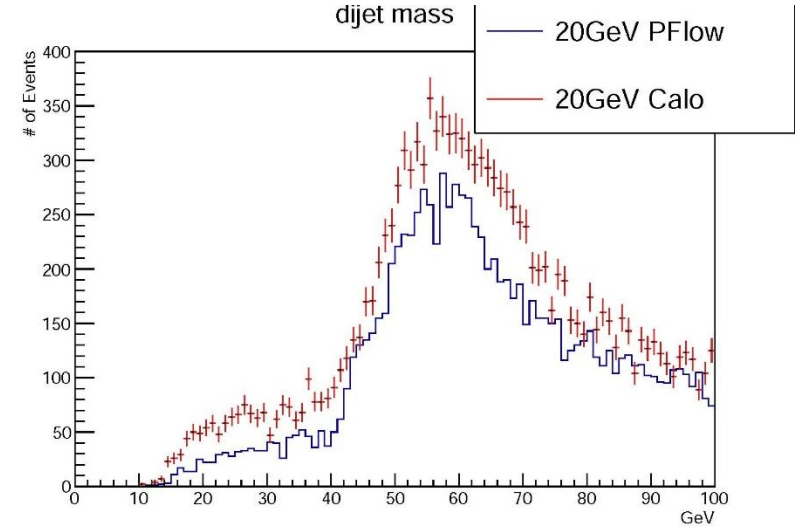
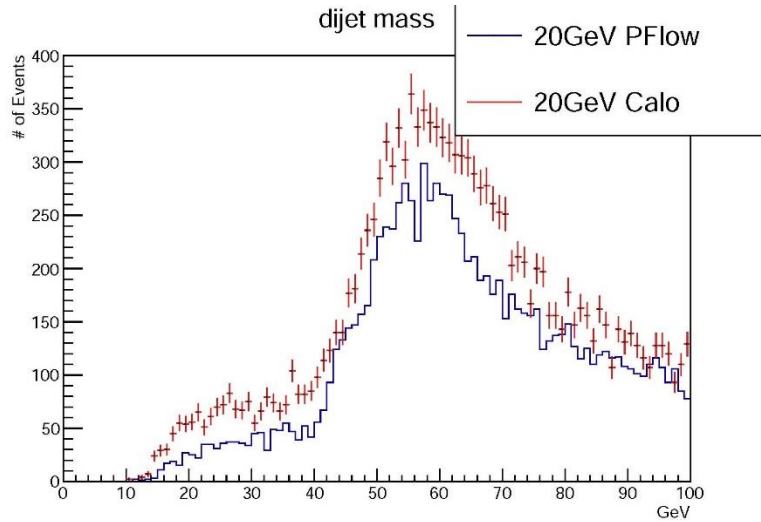
## (20GeV PFlow v. 20GeV Calo)

Cut applied:

Upper right: two muons

Upper left : two muon &  $\geq 2$  good jets

Bottom : 2 muon and 2 b jets



# Cut Flow Table

Cut	15GeV PFlow	18GeV PFlow	20GeV PFlow	15GeV Calo	18GeV Calo	20GeV Calo
Total	72114	72114	72114	72114	72114	72114
Pass LUP Trigger	48708	48708	48708		48708	48708
$N_\mu = 2$	32536	30654	28909		30539	29333
$pT^{\mu 1} > 27, pT^{\mu 2} > 7$	32536	30654	28909		30539	29333
$12 < M_{\mu\mu} < 80$	32484	30603	28859		30479	29333
OS	32273	30399	28661		30233	29047
2 b jets	4799	3867	3124		3854	3430
MET<60	3810	3010	2370		3055	2663
$ M_{bbuu} - M_H  < 15$	2823	2375	1919		2467	2186

# yield

	15Gev PFlow	18Gev PFlow	20Gev PFlow	15Gev Calo	18Gev Calo	20Gev Calo
yield	370.6	298.7	245.5	287.5	286.1	265.4

$$\gamma = \varepsilon \sigma L$$

$$\varepsilon = \frac{N_{bb\mu\mu}}{N_0}$$

$$\sigma = 0.08 \text{ Pb}$$

$$L = 100 \text{ fb}^{-1}$$

$$N_0 = 95433$$



background

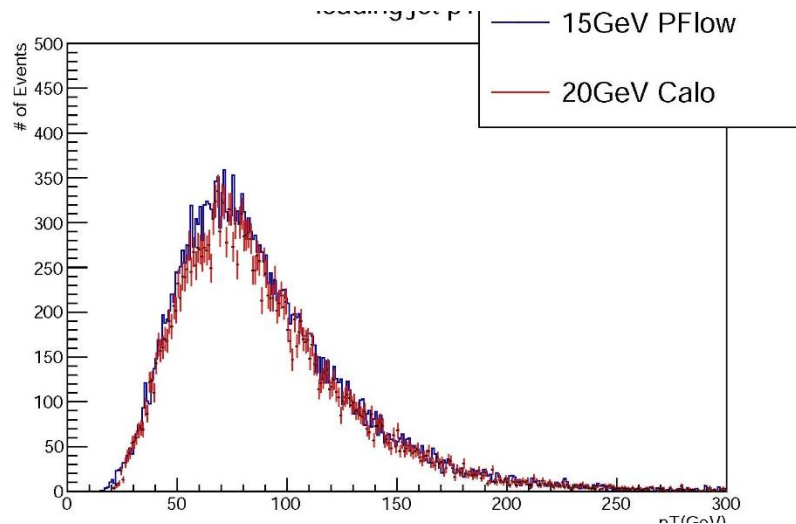
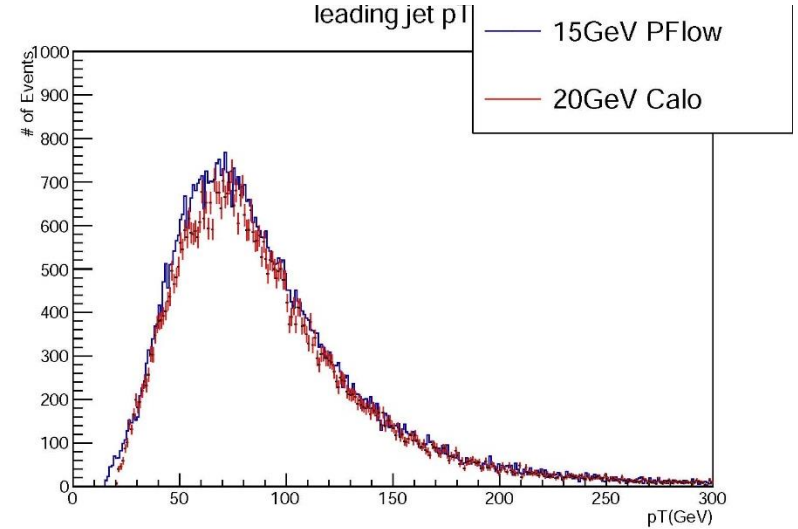
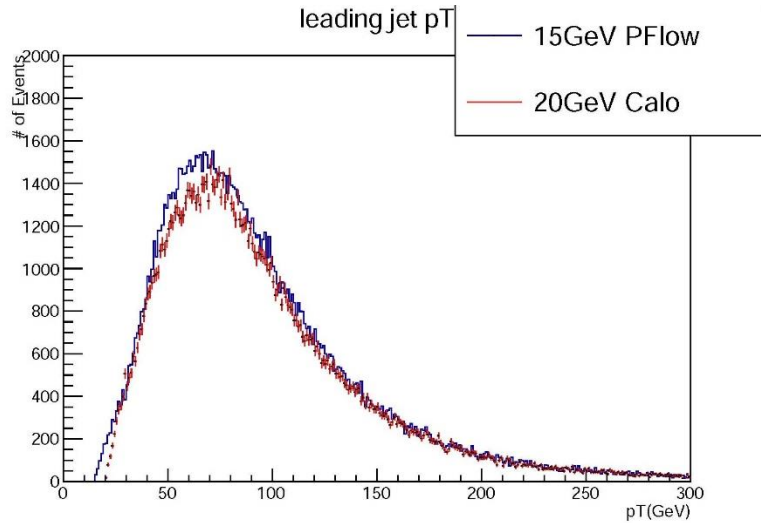
# Leading jet pT (15GeV PFlow v. 20GeV Calo)

Cut applied:

Upper right: two muons

Upper left : two muon &  $\geq 2$  good jets

Bottom : 2 muon and 2 b jets



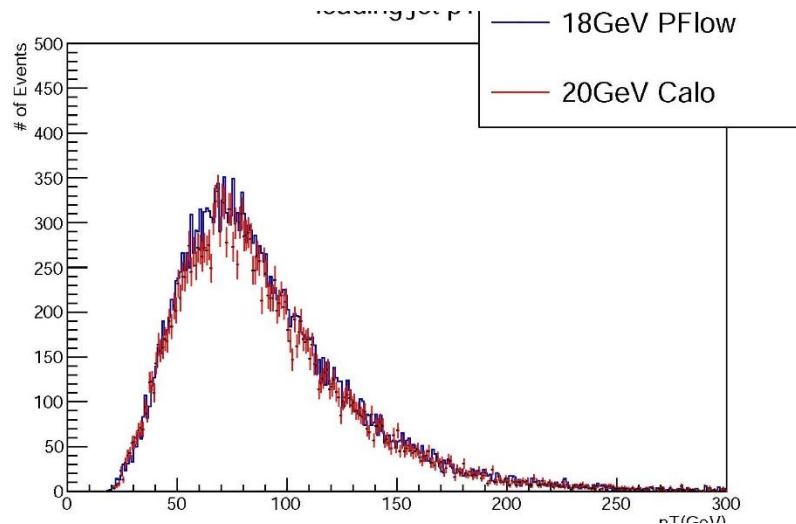
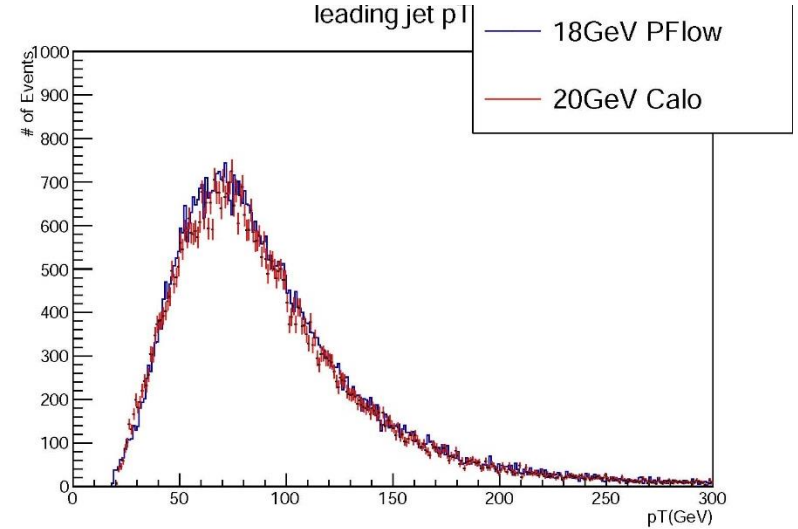
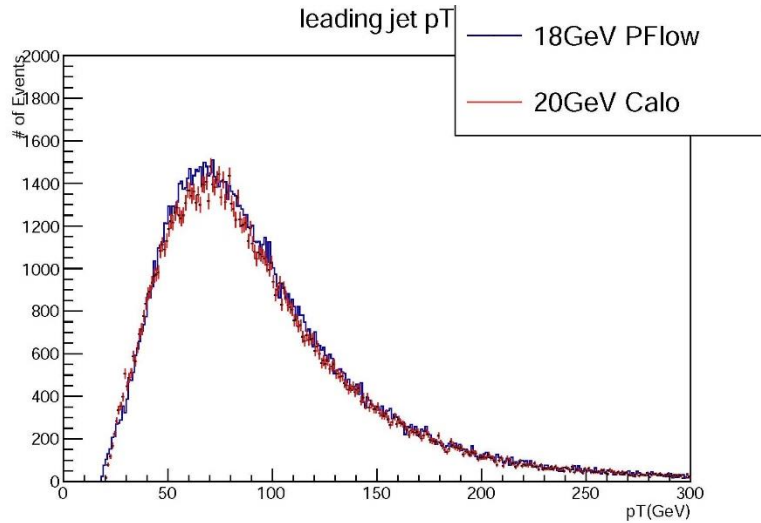
# Leading Jet pT (18GeV PFlow v. 20GeV Calo)

Cut applied:

Upper right: two muons

Upper left : two muon &  $\geq 2$  good jets

Bottom : 2 muon and 2 b jets



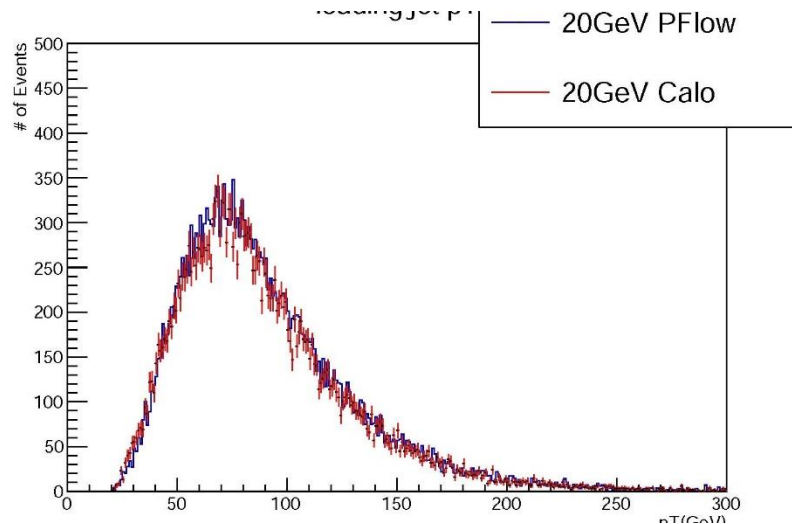
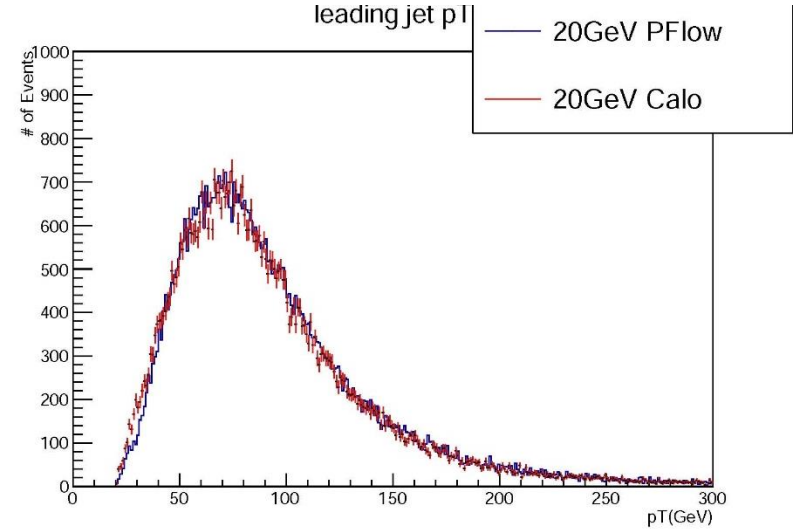
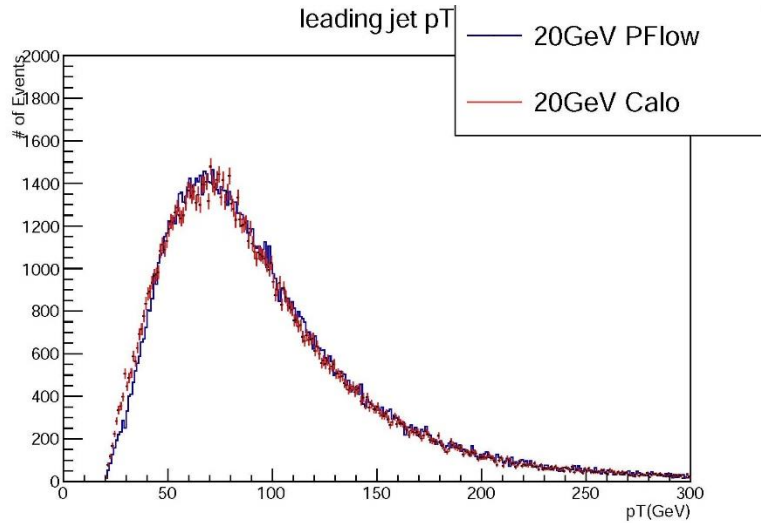
# Leading Jet pT (20GeV PFlow v. 20GeV Calo)

Cut applied:

Upper right: two muons

Upper left : two muon &  $\geq 2$  good jets

Bottom : 2 muon and 2 b jets



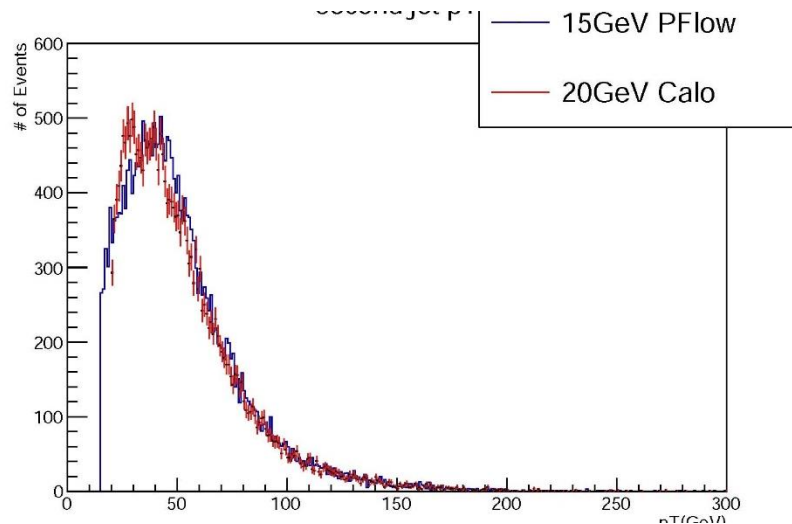
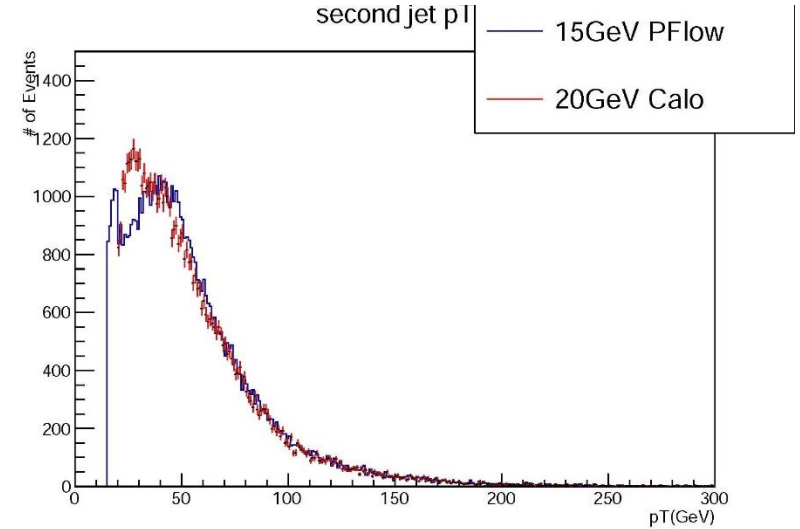
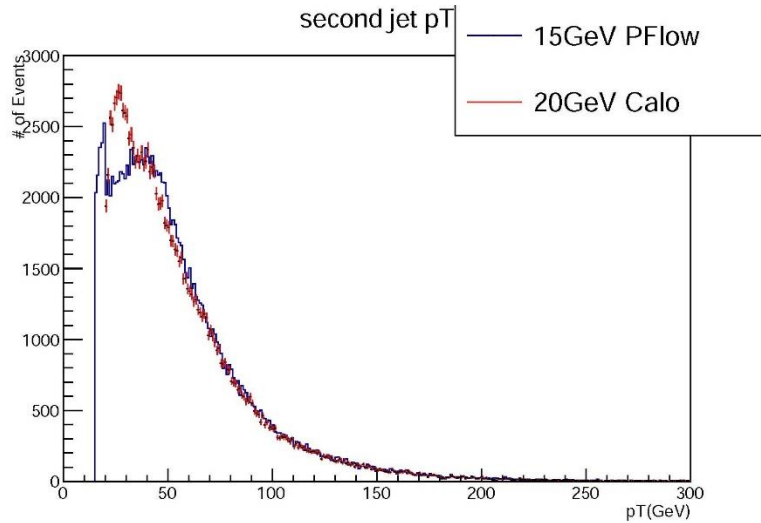
# Second Jet pT (15GeV PFlow v. 20GeV Calo)

Cut applied:

Upper right: two muons

Upper left : two muon &  $\geq 2$  good jets

Bottom : 2 muon and 2 b jets



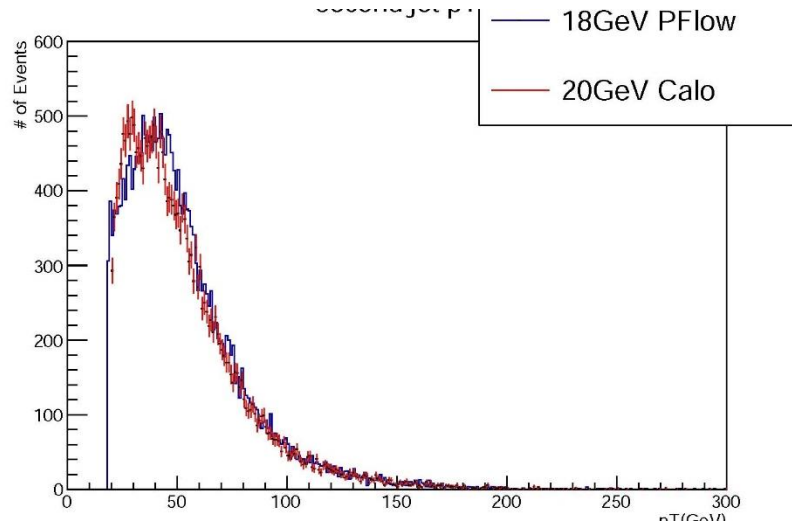
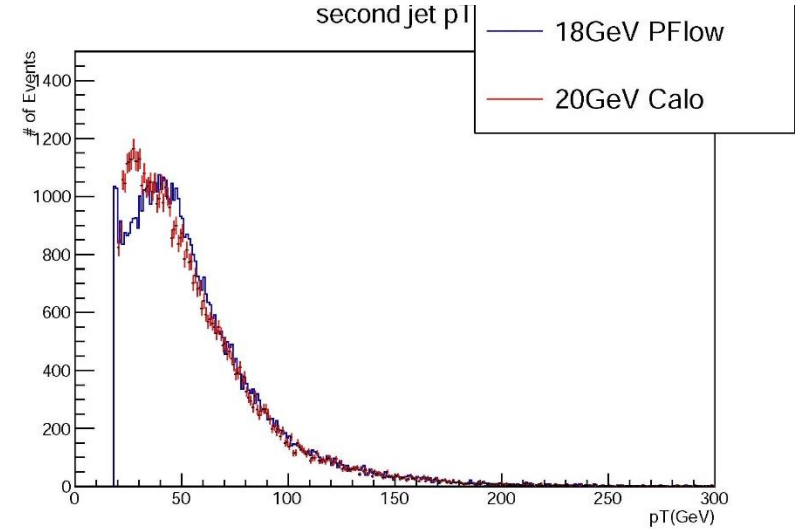
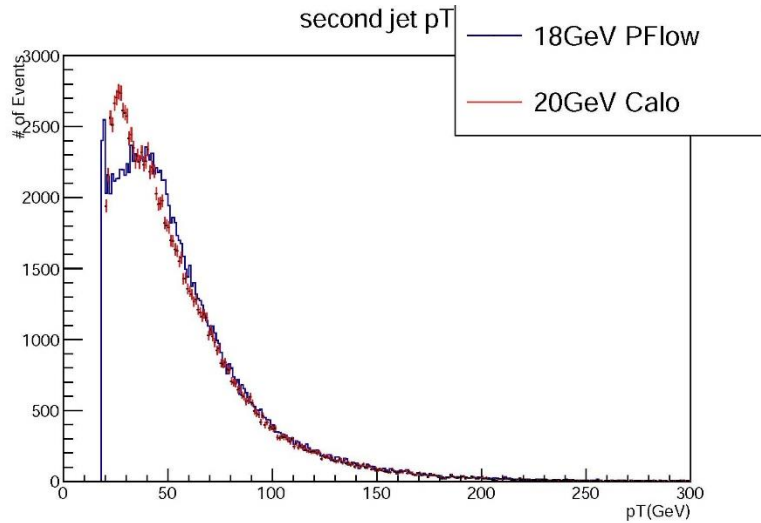
# Second Jet pT (18GeV PFlow v. 20GeV Calo)

Cut applied:

Upper right: two muons

Upper left : two muon &  $\geq 2$  good jets

Bottom : 2 muon and 2 b jets



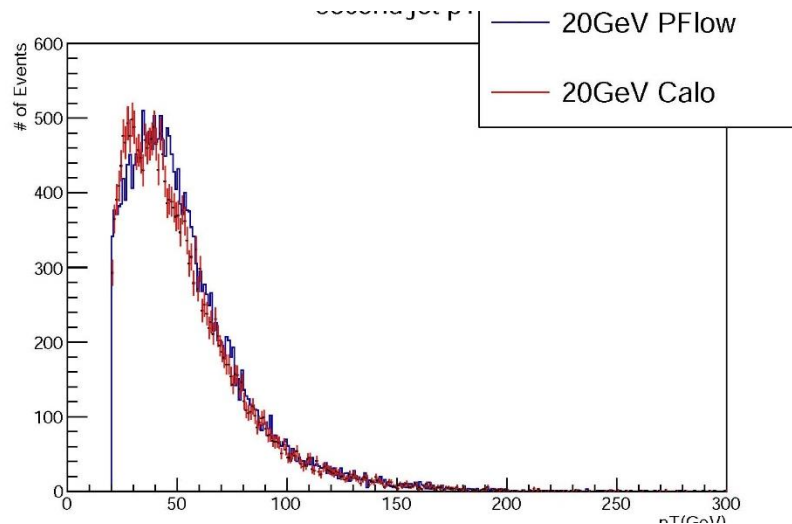
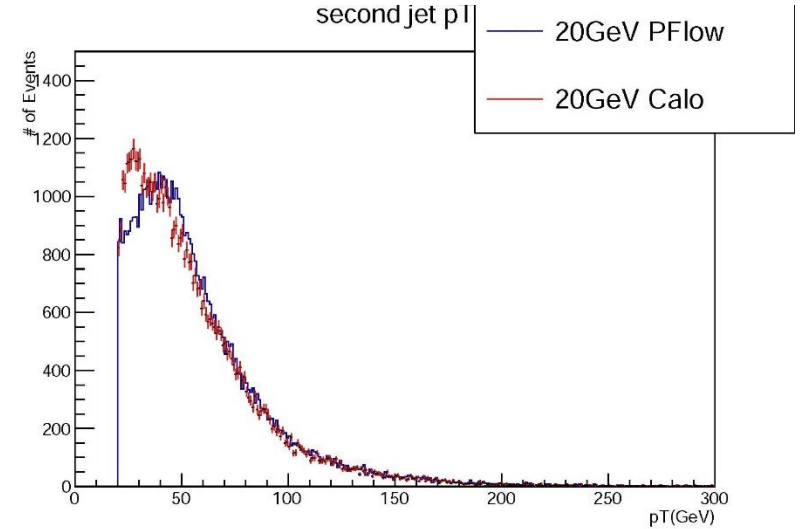
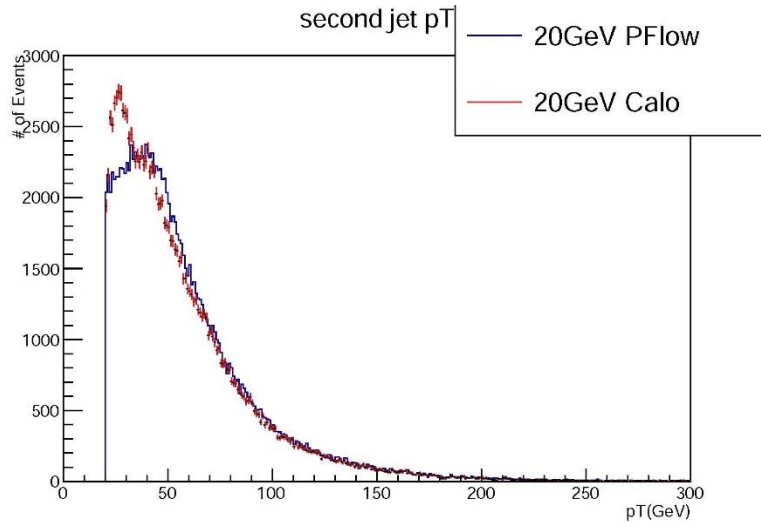
# Second Jet pT (20GeV PFlow v. 20GeV Calo)

Cut applied:

Upper right: two muons

Upper left : two muon &  $\geq 2$  good jets

Bottom : 2 muon and 2 b jets



# Dijet Mass

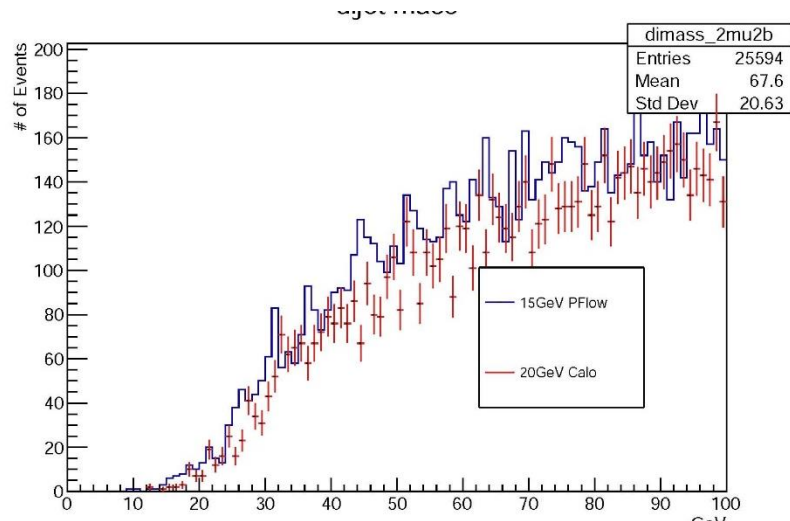
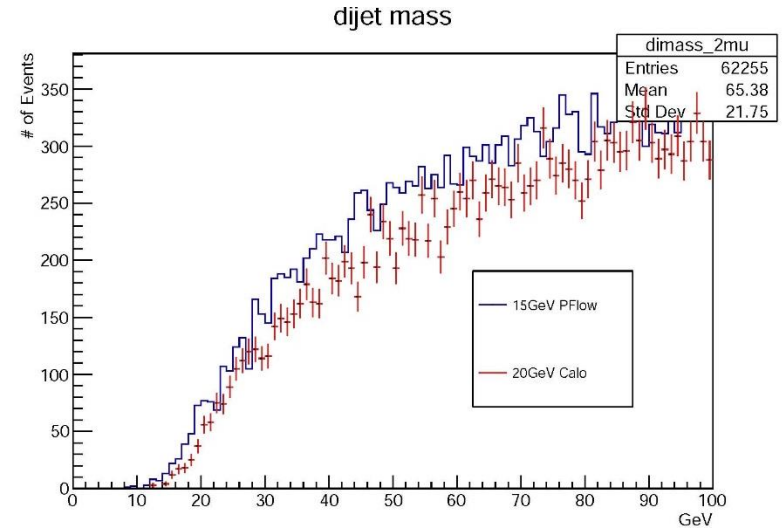
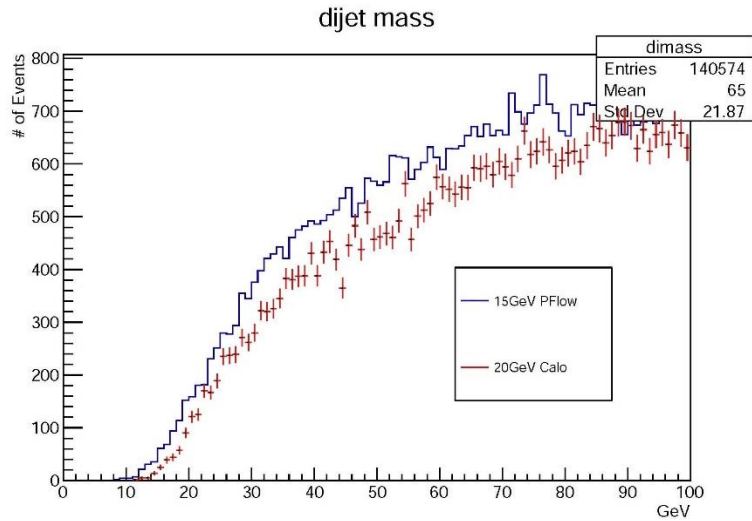
## (15GeV PFlow v. 20GeV Calo)

Cut applied:

Upper right: two muons

Upper left : two muon &  $\geq 2$  good jets

Bottom : 2 muon and 2 b jets





# Dijet Mass

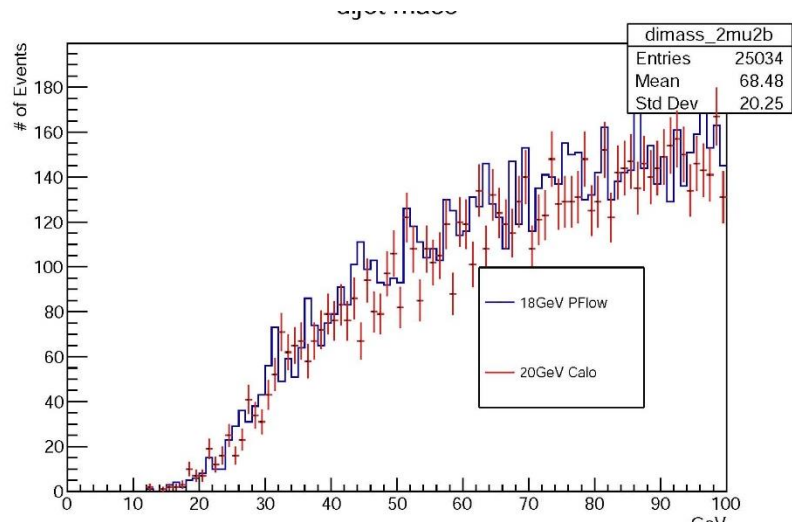
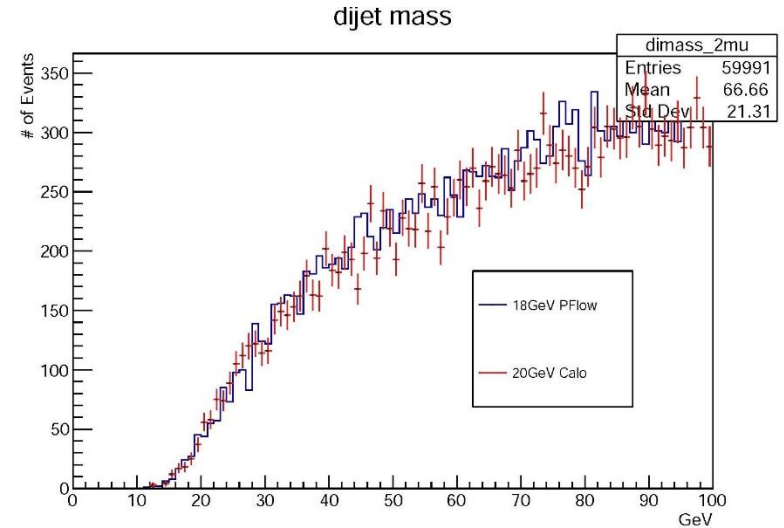
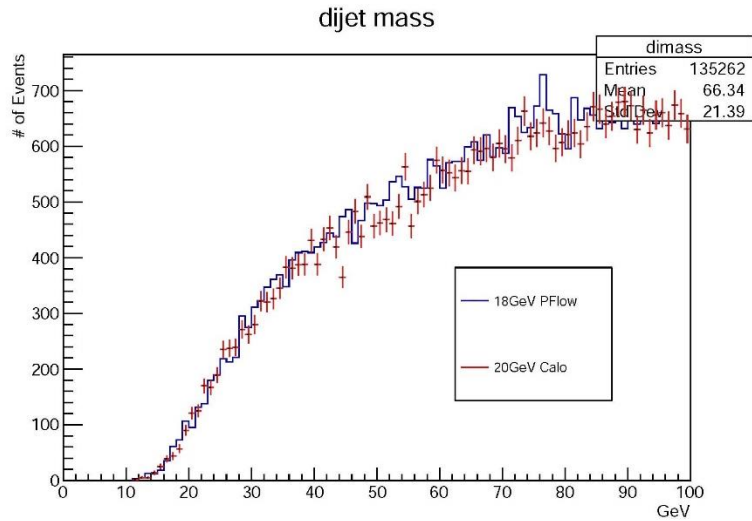
## (18GeV PFlow v. 20GeV Calo)

Cut applied:

Upper right: two muons

Upper left : two muon &  $\geq 2$  good jets

Bottom : 2 muon and 2 b jets



# Dijet Mass

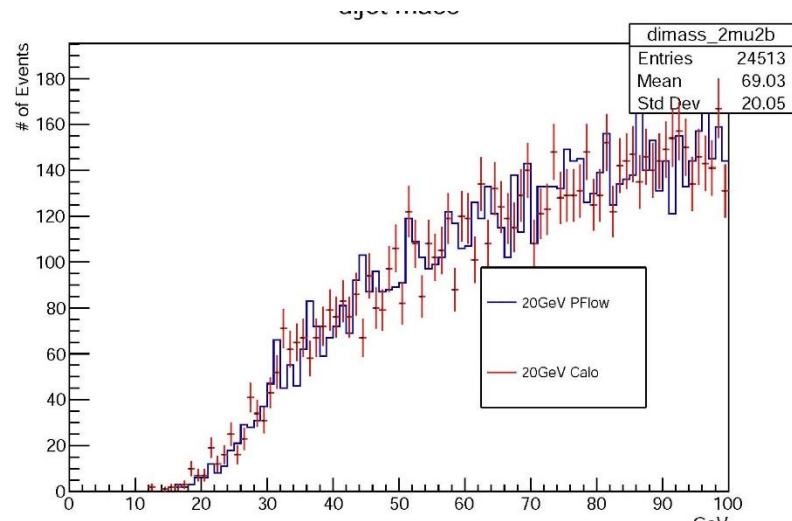
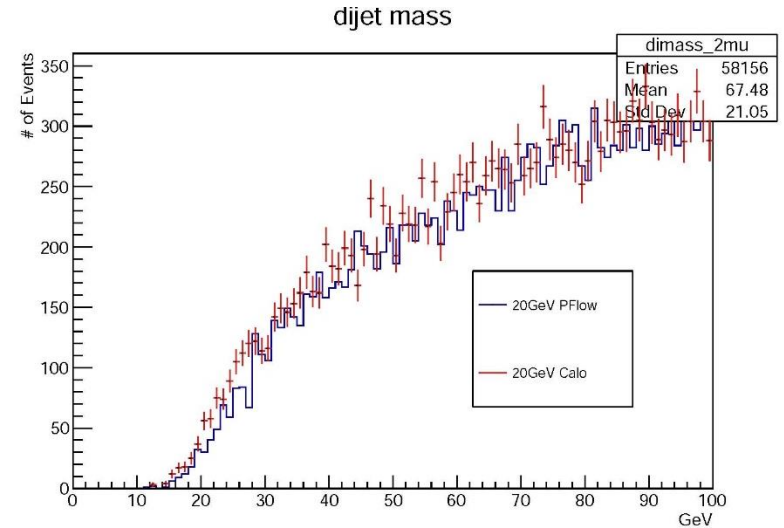
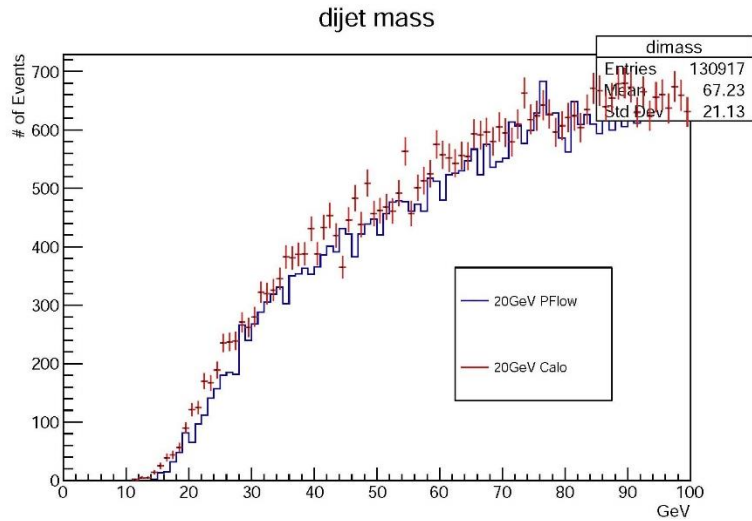
## (20GeV PFlow v. 20GeV Calo)

Cut applied:

Upper right: two muons

Upper left : two muon &  $\geq 2$  good jets

Bottom : 2 muon and 2 b jets



# Cut Flow Table

Cut	15GeV PFlow	18GeV PFlow	20GeV PFlow	15GeV Calo	18GeV Calo	20GeV Calo
<b>Total</b>	1199054	1199054	1199054	1199054	1199054	1199054
<b>Pass LUP Trigger</b>	524854	524854	524854	524854	524854	524854
<b>2 muon(&gt;=1 good jet)</b>						
<b>2 muon(&gt;=2 good jet)</b>						
$N_\mu = 2$	147999	148675	148786	137829	138959	140782
$pT^{\mu 1} > 27, pT^{\mu 2} > 7$	147999	148675	148786	137829	138959	140782
$12 < M_{\mu\mu} < 80$	70469	70707	70727	65223	65747	66657
<b>OS</b>	66677	66894	66915	61789	62300	63186
	25594	25034	24513	23303	23406	23491
<b>2 b jets</b>						
<b>MET&lt;60</b>	2268	2211	2158	2096	2093	2089
$ M_{bbuu} - M_H  < 15$	94	80	64	88	82	78

# Backup

Full Sample name of Sample used:

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/sbahead/atlas/dq2/mc15\_13TeV/DAOD\_HIGG3D1/mc15\_13TeV.364100.Sherpa\_221\_NNPD  
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2\_r7676\_p2812

/sbahead/atlas/dq2/mc15\_13TeV/DAOD\_HIGG3D1/mc15\_13TeV.364102.Sherpa\_221\_NNPD  
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812

# Backup

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