Analysis of H->bb$\mu\mu$ Based on Particle Flow Jet

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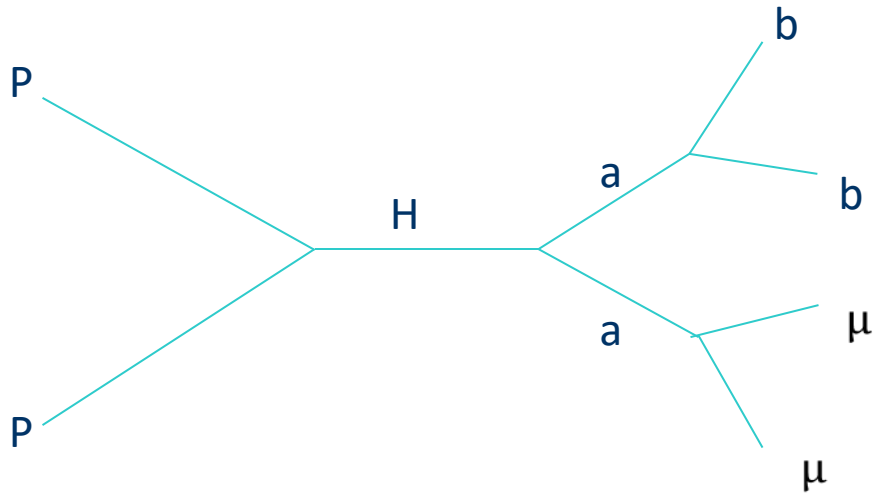
Physics Background

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

- $m_{bb\mu\mu} \leq 125$ GeV
- $m_{bb} \leq 60\ GeV$



Physics Background

Major background noises come from

- ttbar

- Z+ jets

Motivations

The calorimeter

Reconstruct the energy of both charged and neutral particles

Have higher resolution and outperform the inner traker at high energy regions

slow read-out speed –pileup energy from other bunch crossings

The inner tracker

can only reconstruct charged particles by momentum

outperforms the calorimeter in low energy area

Higher read-out speed

Motivations

Calorimeter jet is widely used in current analyses. It is reconstructed solely from the calorimeter energy deposits. Two problems arise from here.

jet pT threshold 20 GeV

Pile-up

PFlow jet is reconstructed from the combination of signals from the calorimeter and the inner tracker.

Motivations

Advantages of Particle Flow Jet over Calo Jet

Lower jet pT threshold 18GeV (15GeV), higher jet finding efficiency, and more signal events

less sensitive to pile-up: more accurate result

higher jet energy : combines the advantages of the calorimeter and the inner tracker together to include more energy fragments into the jet

Expectations

- Higher efficiency

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

- Larger yield

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

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)

final good jet
final good muon

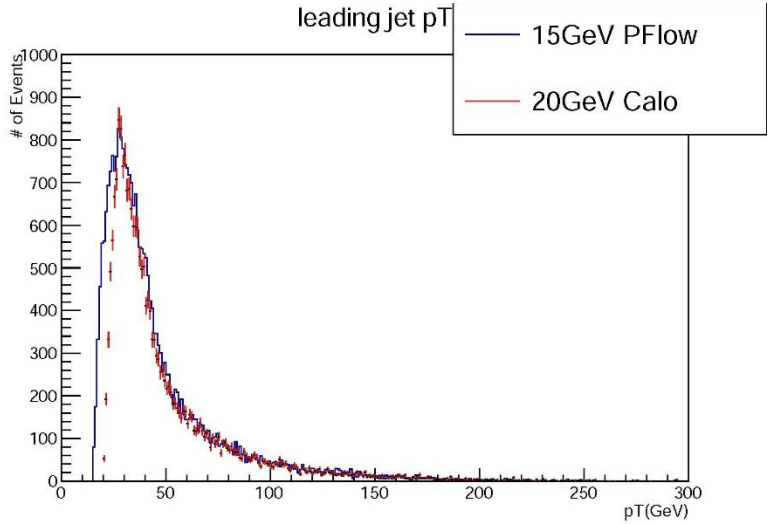
good muon

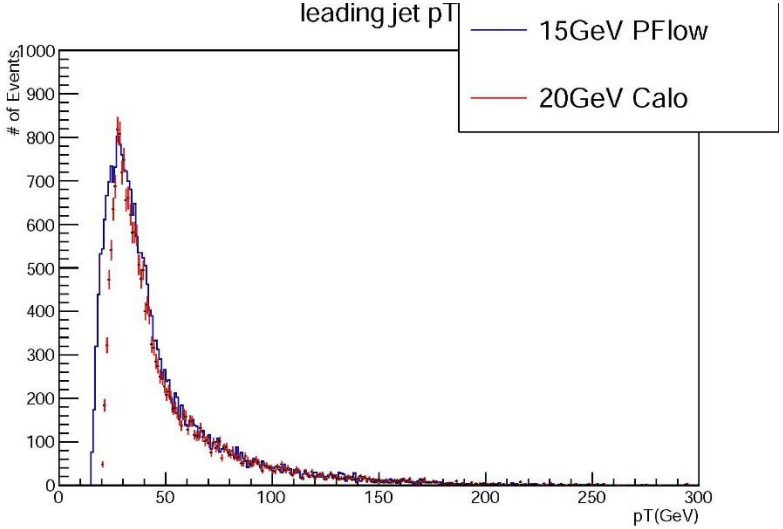
final good electron

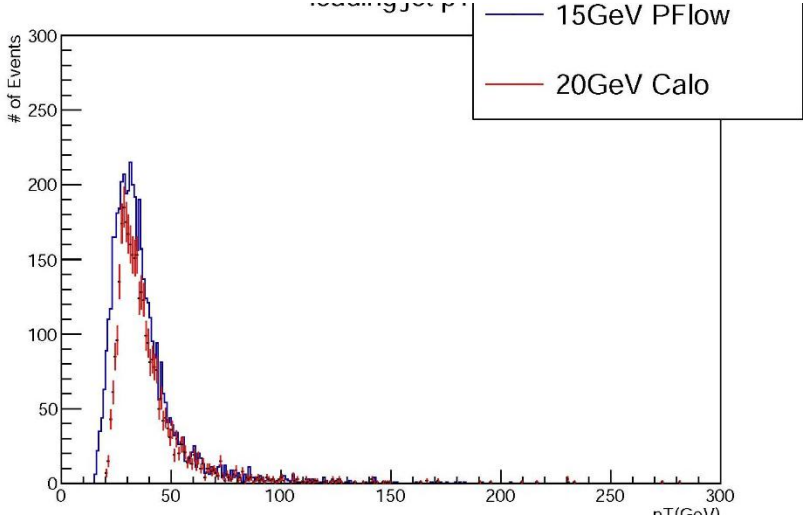
signal

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

Cut applied:
Upper right: two muons
Upper left : two muon & >= 2 good jets
Bottom : 2 muon and 2 b jets







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

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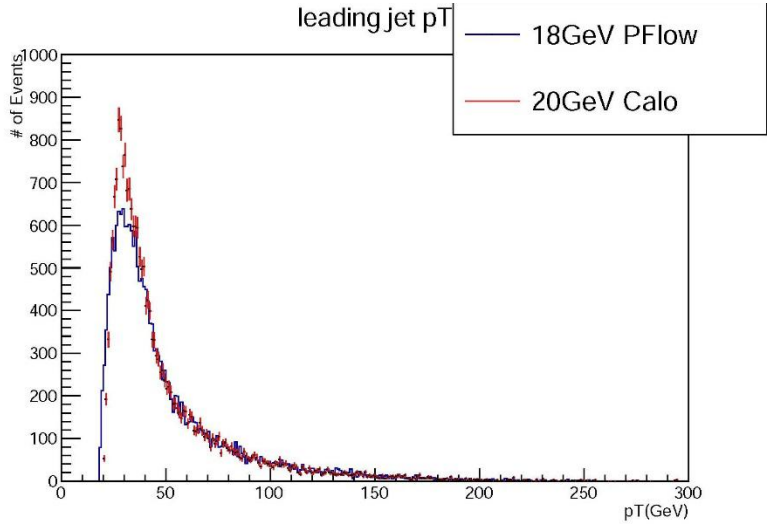

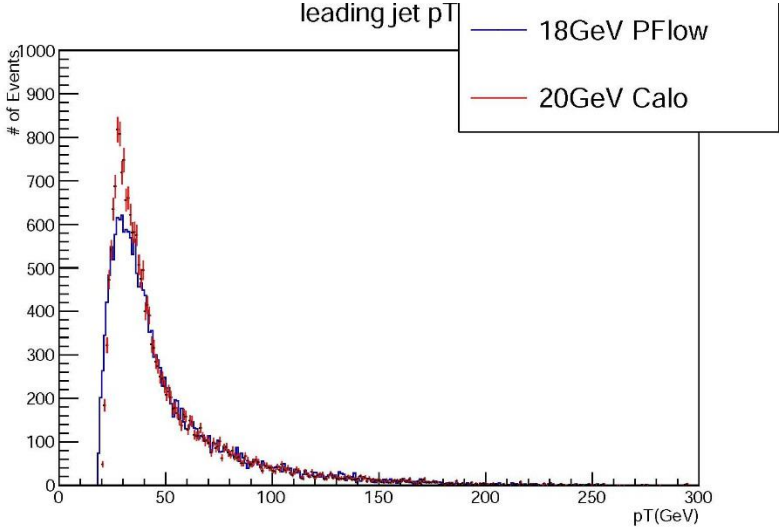

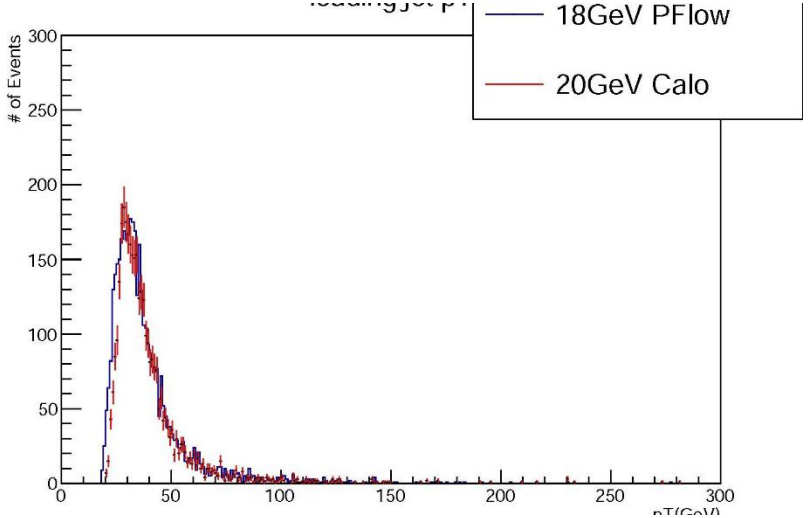

leading jet pT
(20GeV PFlow v. 20GeV Calo)

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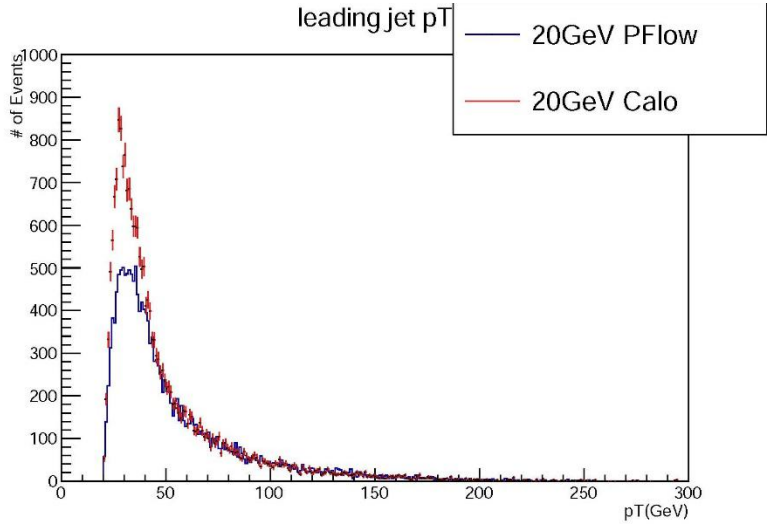
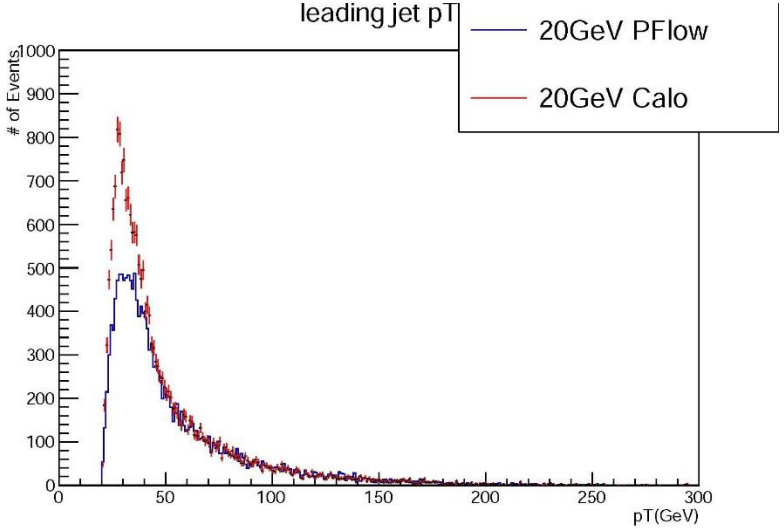
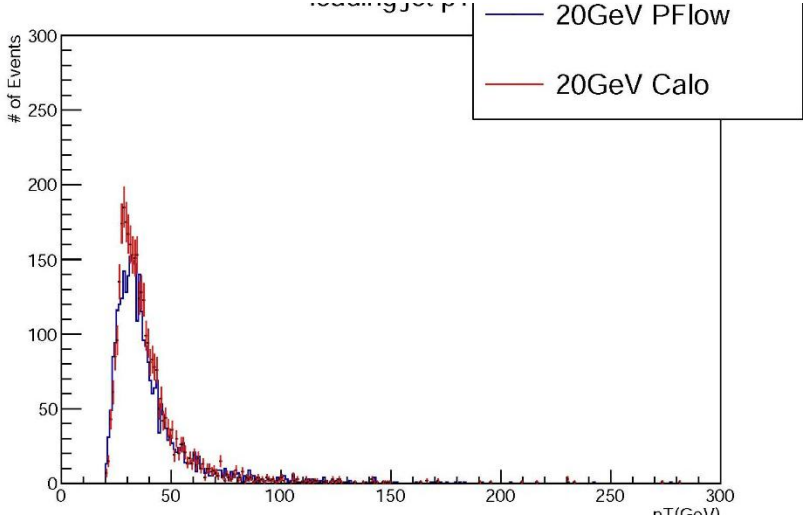
Bottom : 2 muon and 2 b jets







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

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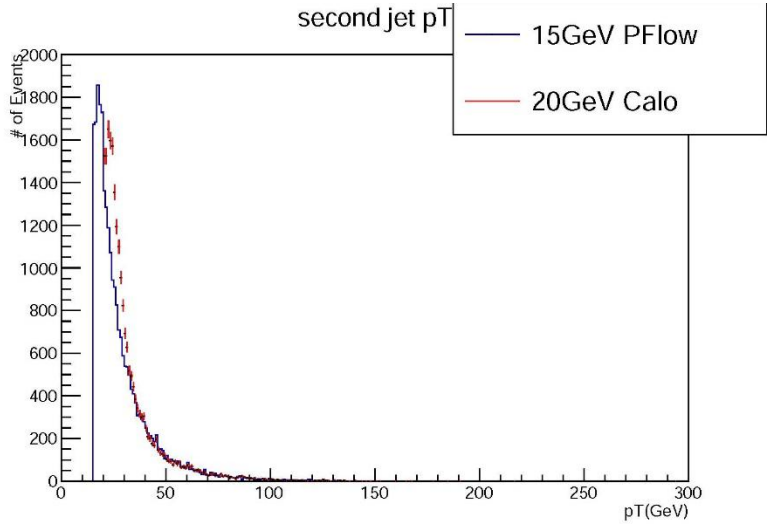

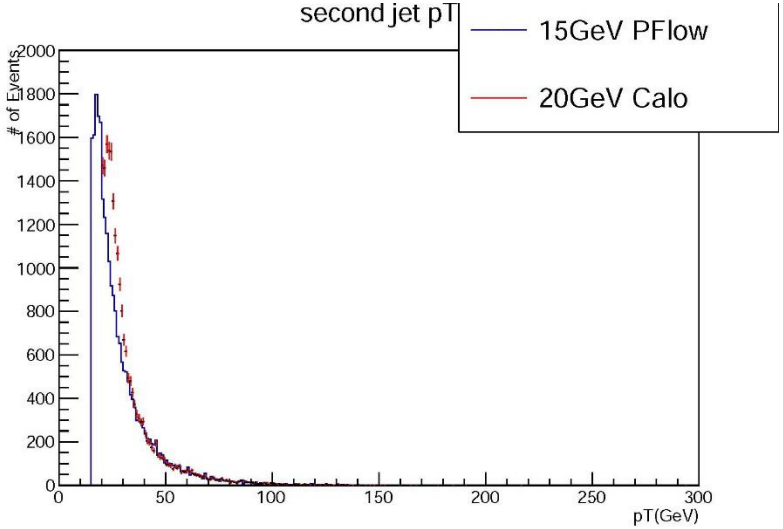

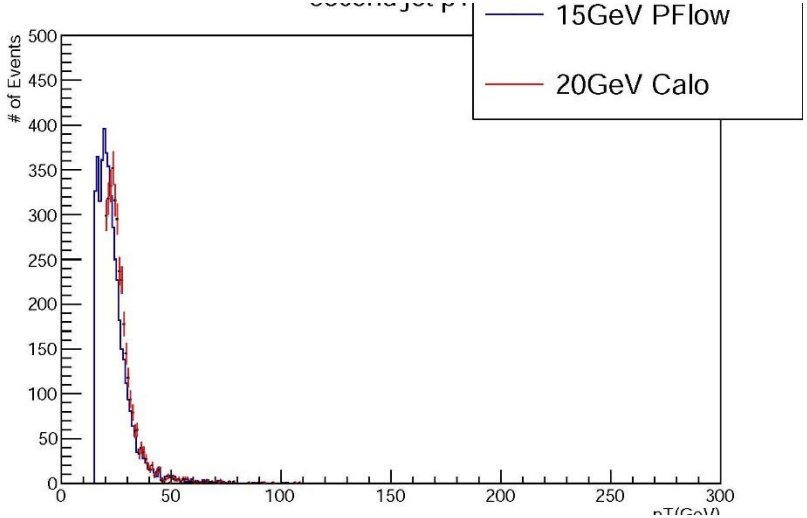

Second jet pT
(18GeV PFlow v. 20GeV Calo)

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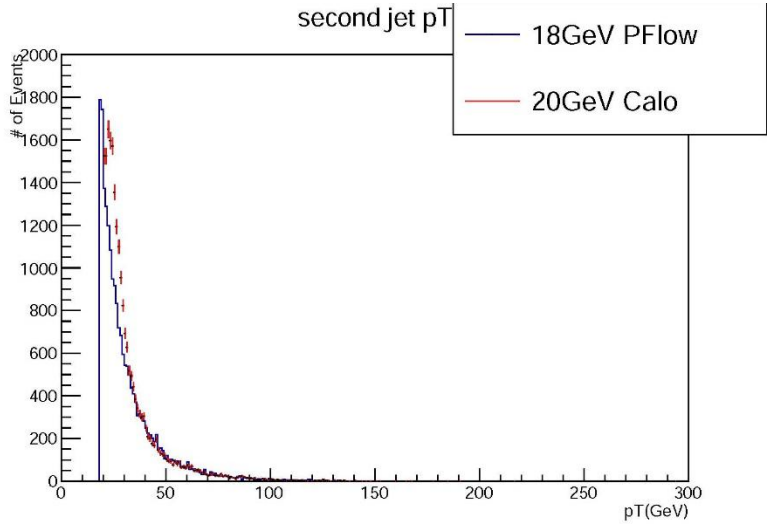

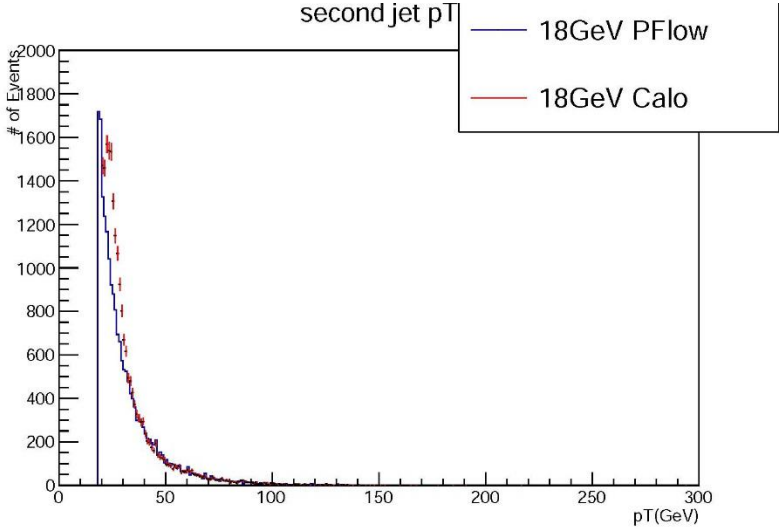

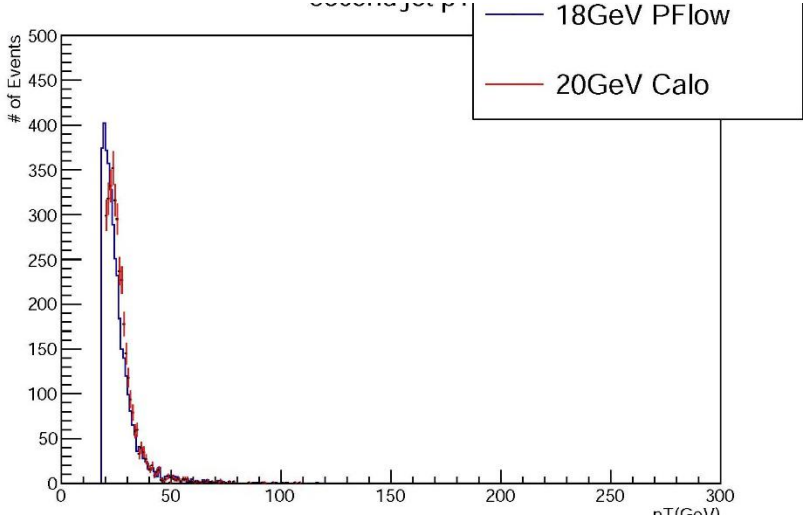

Second jet pT
(20GeV PFlow v. 20GeV Calo)

Cut applied:
Upper right: two muons
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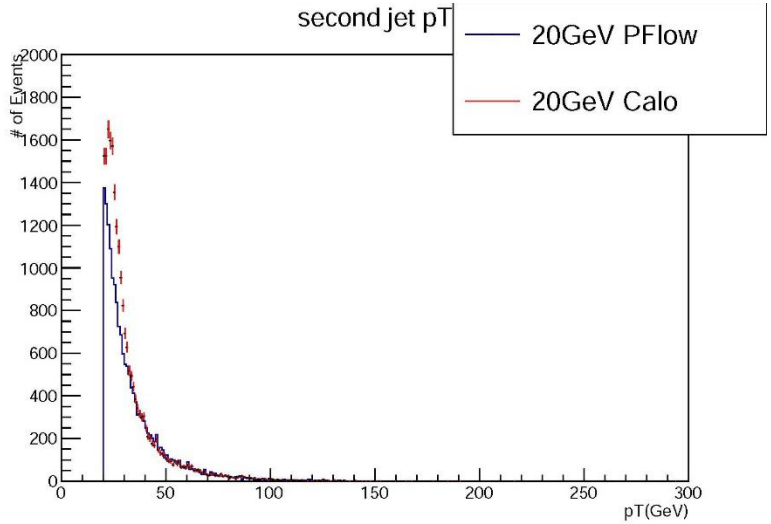
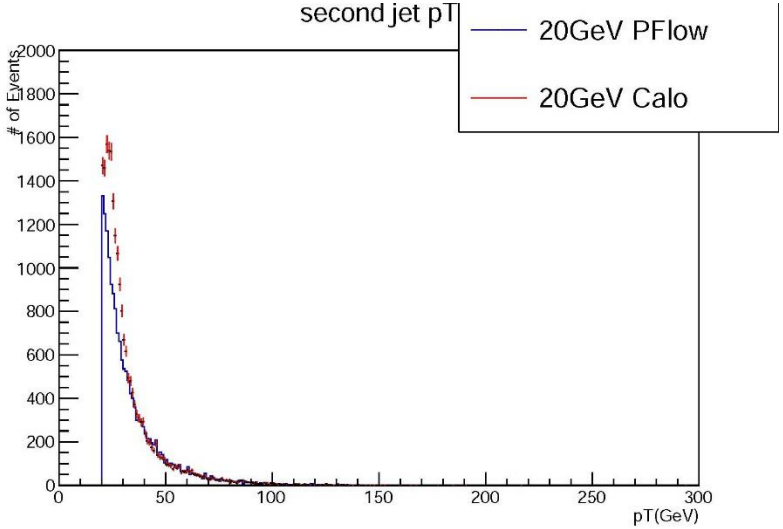
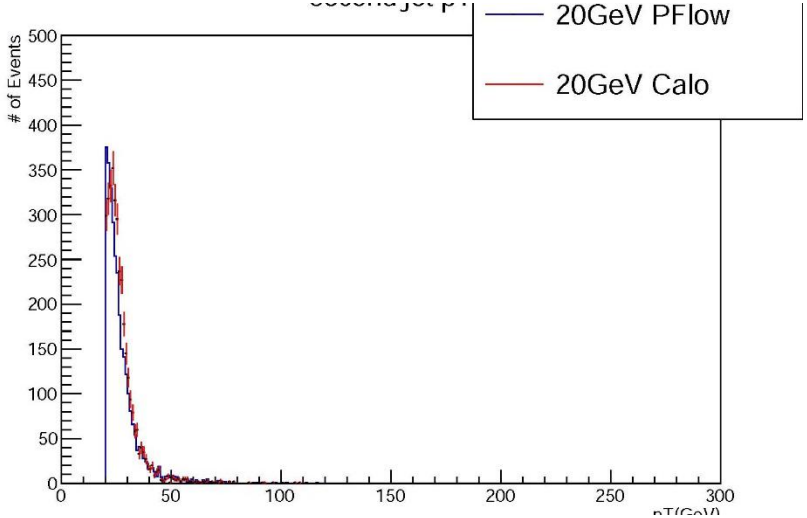
Bottom : 2 muon and 2 b jets







Dijet Mass

(15GeV PFlow v. 20GeV Calo)

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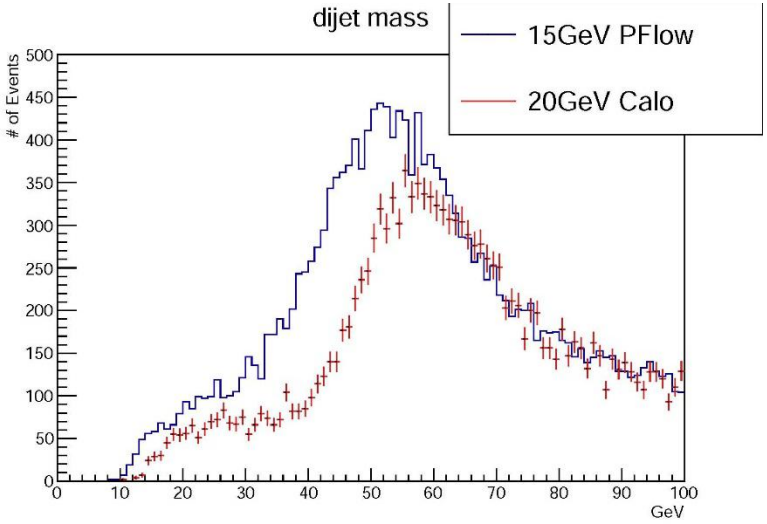

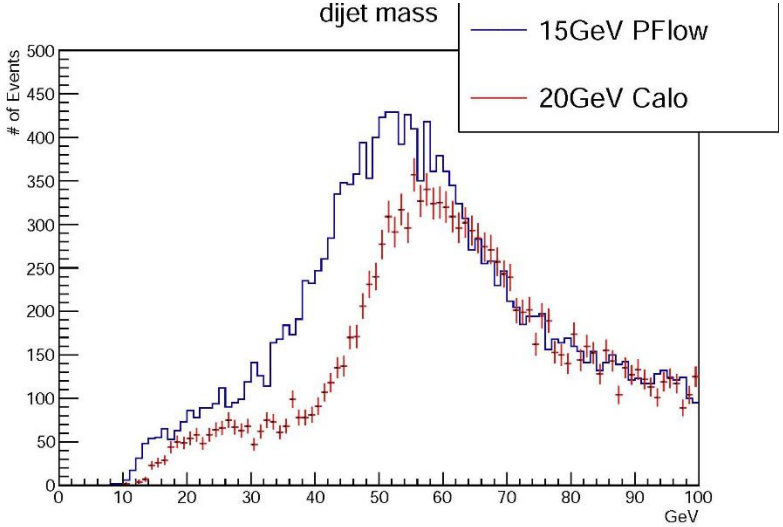

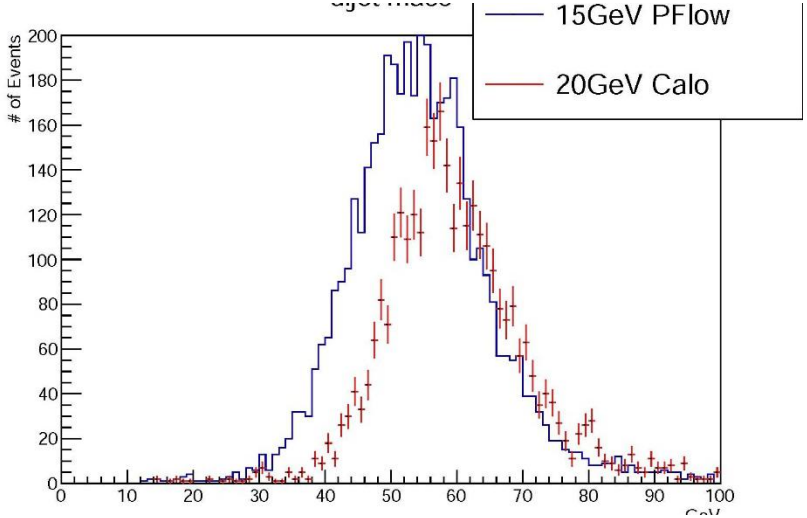

Dijet Mass

(18GeV PFlow v. 20GeV Calo)

Cut applied:
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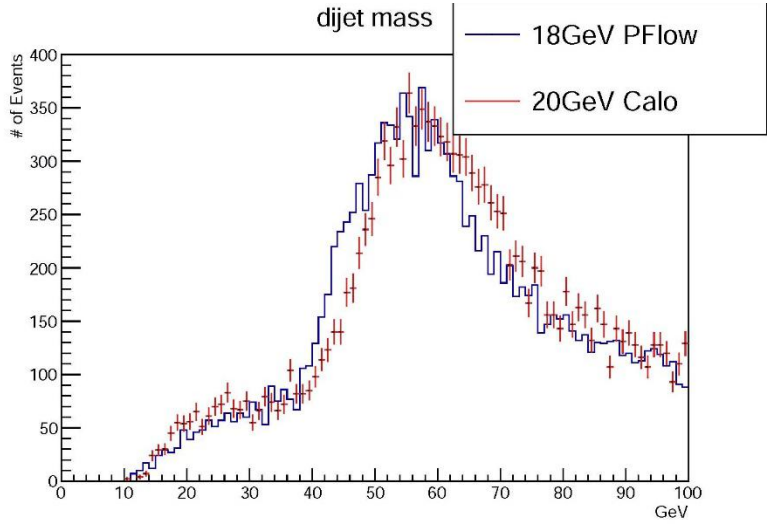
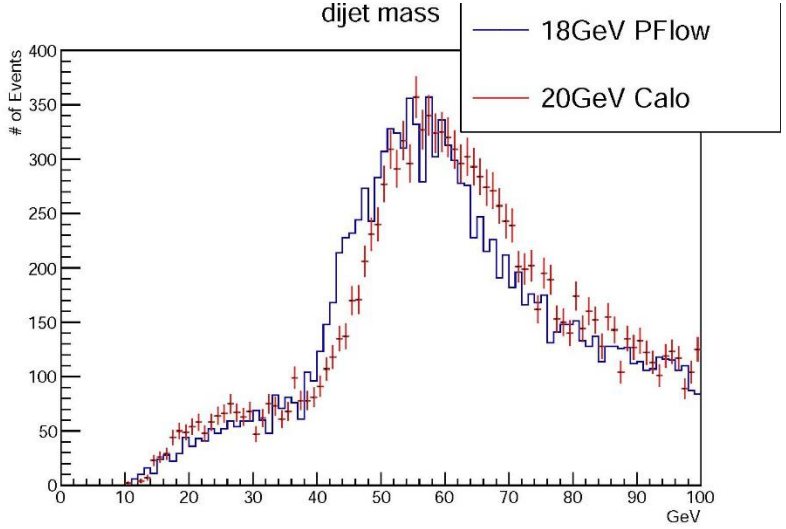
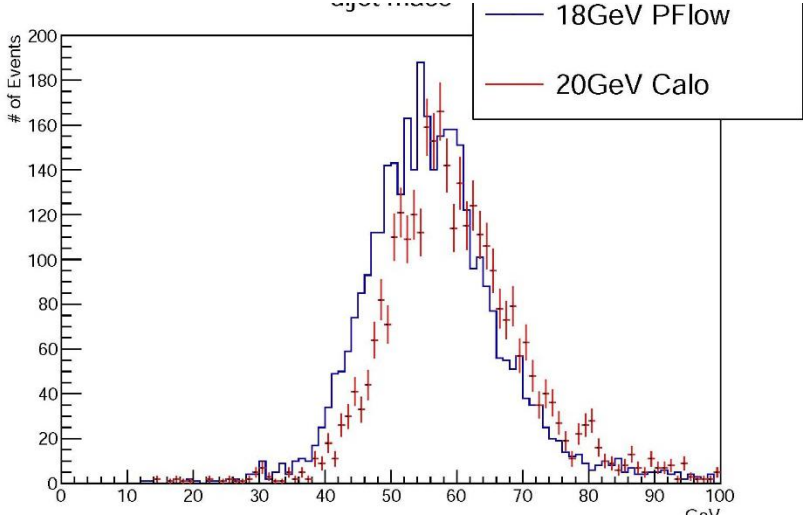
Upper left : two muon & >= 2 good jets
Bottom : 2 muon and 2 b jets







Dijet Mass
(20GeV PFlow v. 20GeV Calo)

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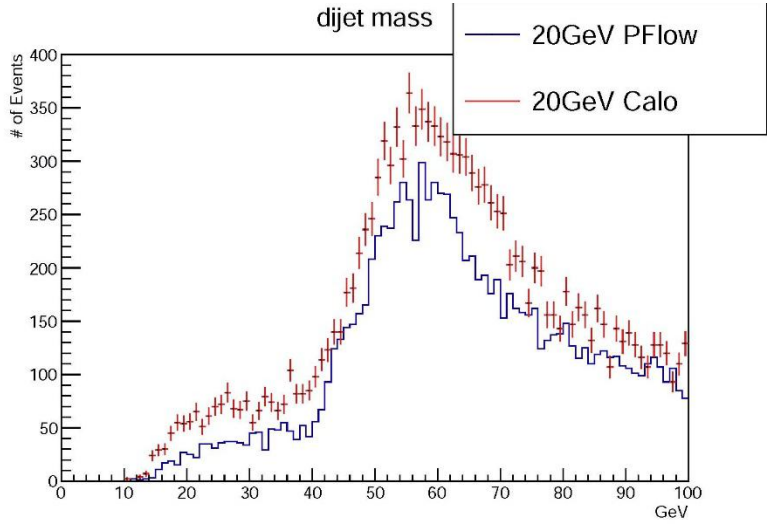

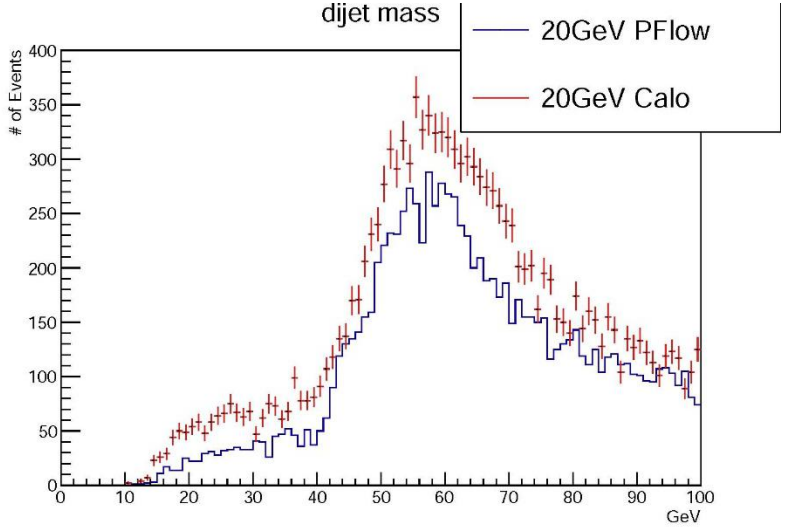

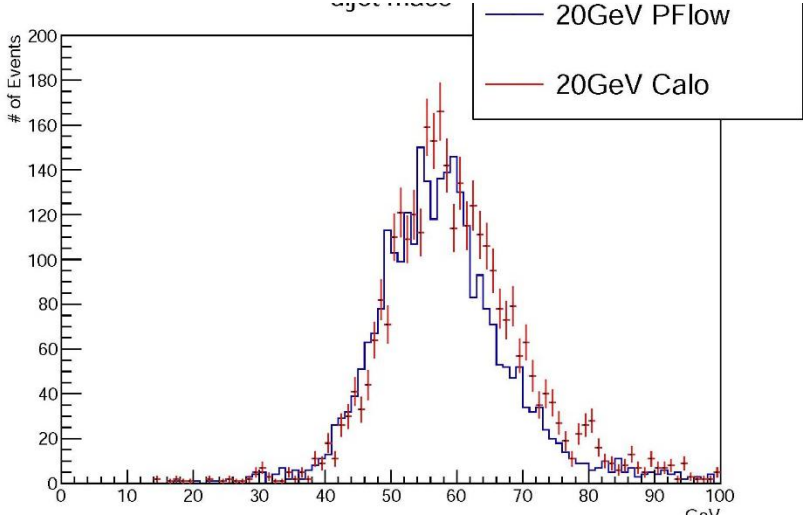

Cut Flow Table

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
$\lvert M_{bbuu} - M_H \rvert < 15$	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

$$\gamma = \varepsilon\sigma L$$
$$\varepsilon = \frac{N_{bb\mu\mu}}{N_0}$$
$$\sigma = 0.08\ Pb$$
$$L = 100\ fb^{-1}$$
$$N_0 = 95433$$

background

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

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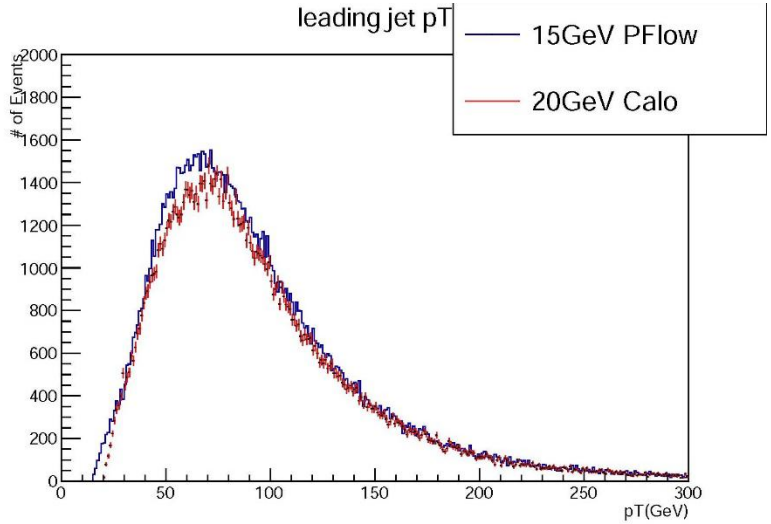

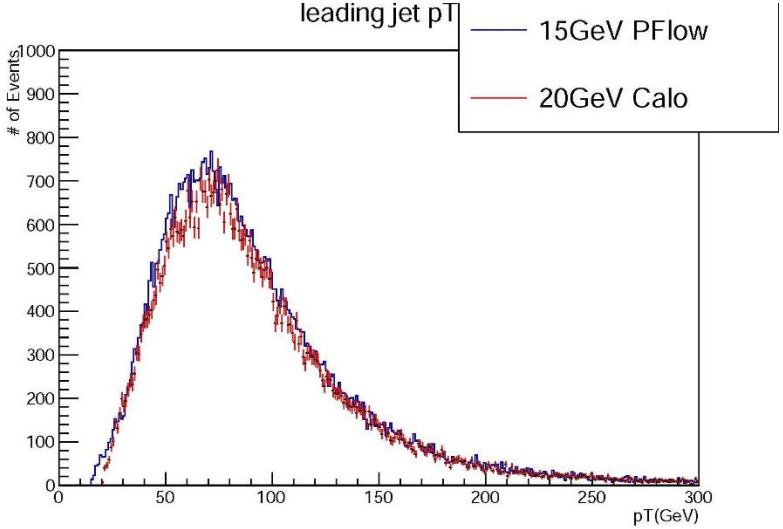

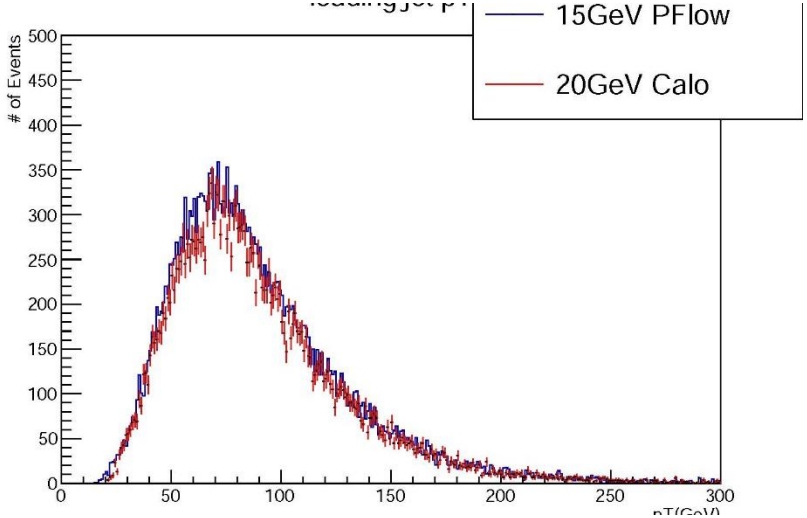

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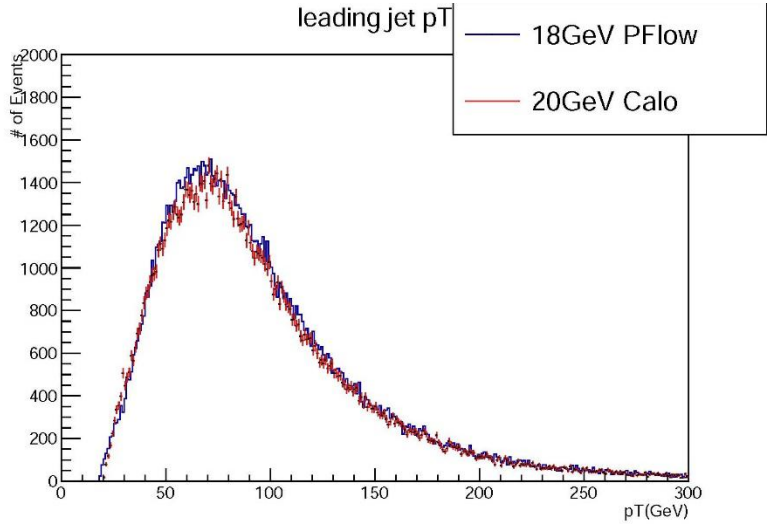

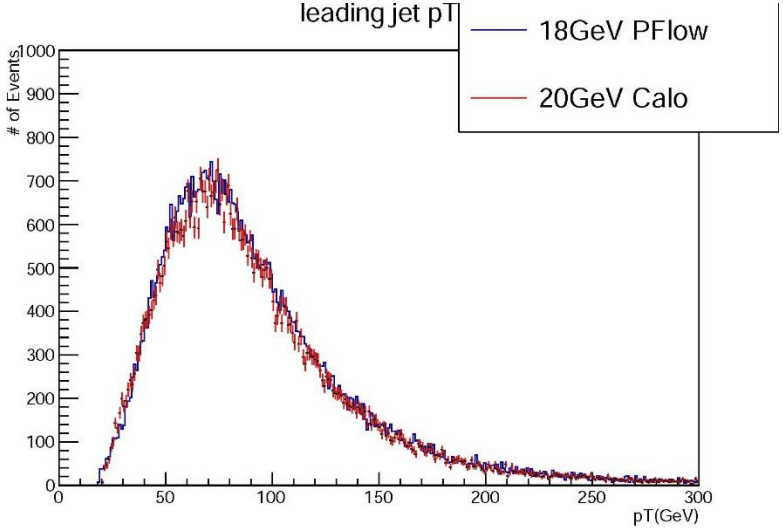

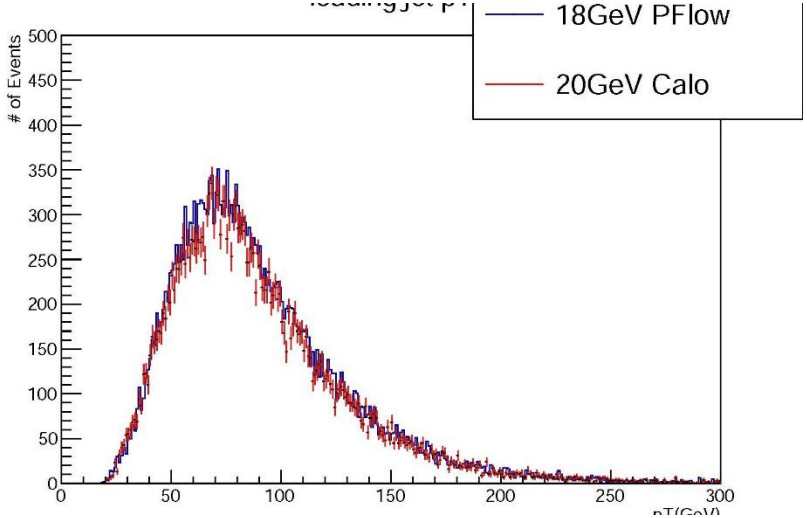

Leading Jet pT
(20GeV PFlow v. 20GeV Calo)

Cut applied:
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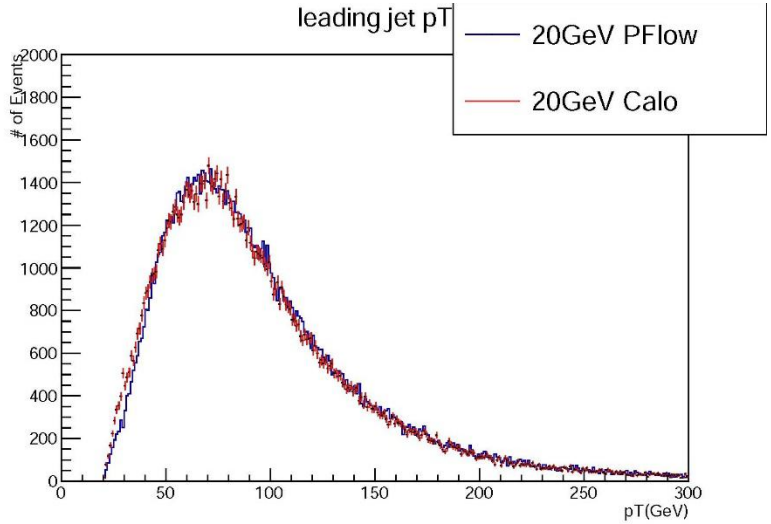

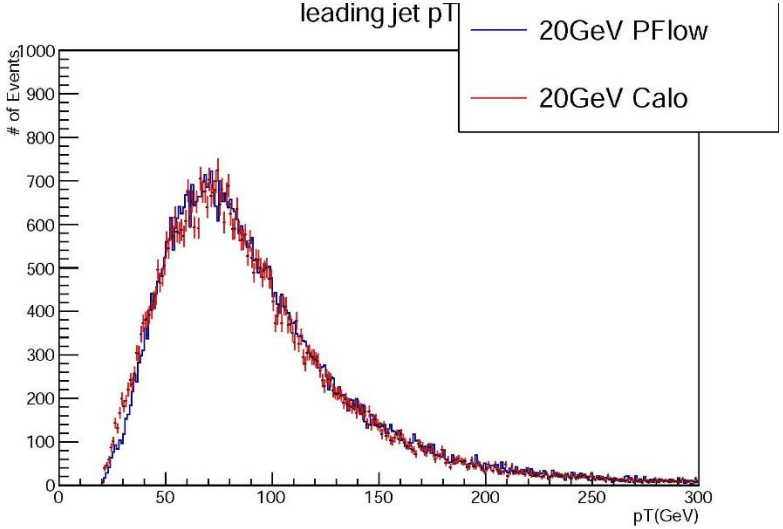

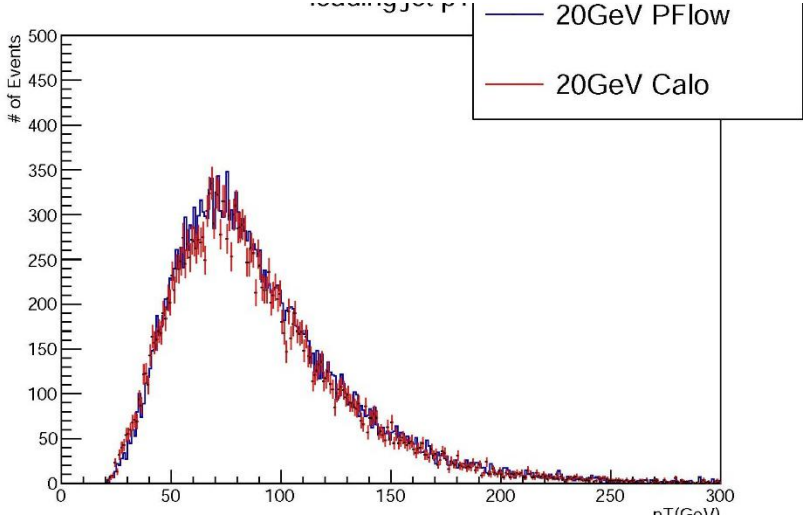

Second Jet pT
(15GeV PFlow v. 20GeV Calo)

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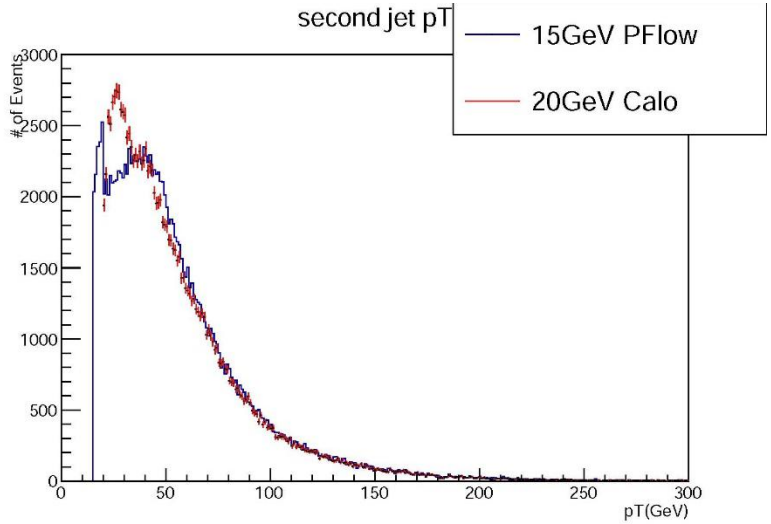

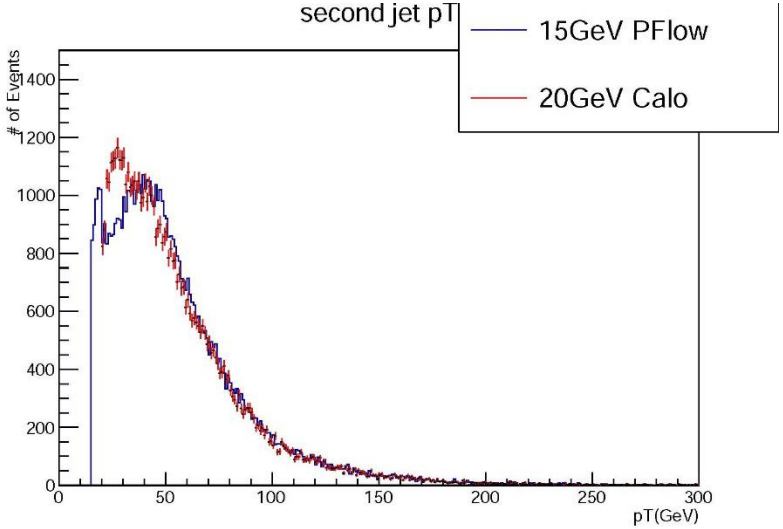

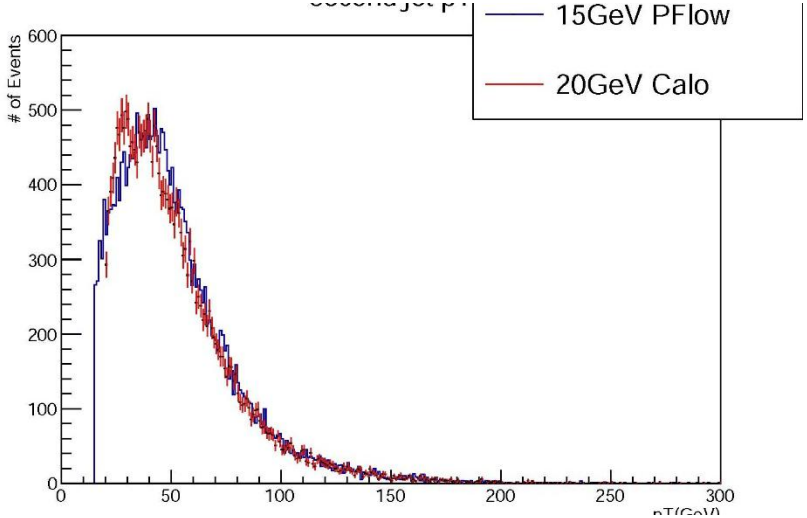

Second Jet pT
(18GeV PFlow v. 20GeV Calo)

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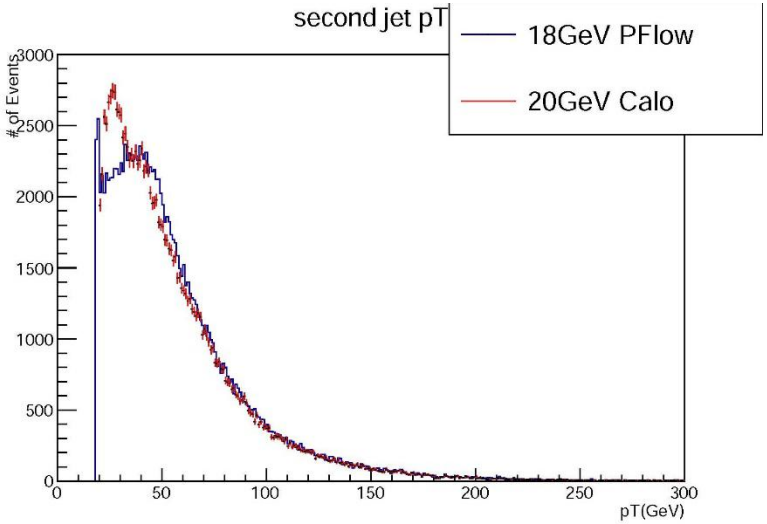

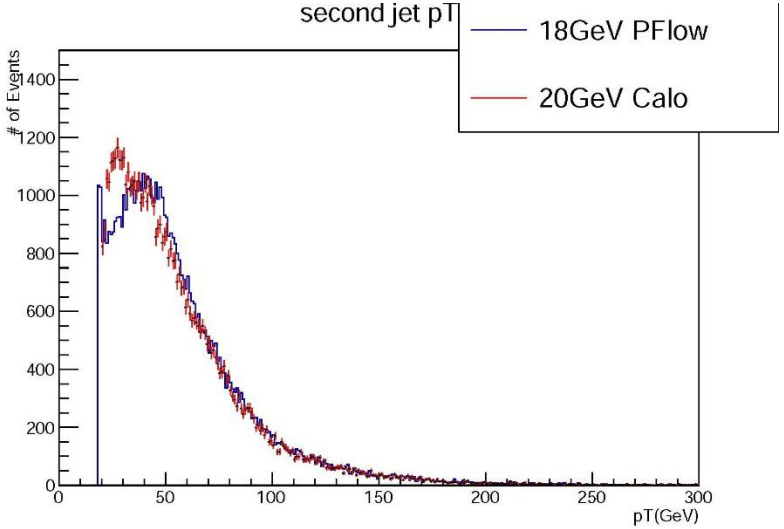

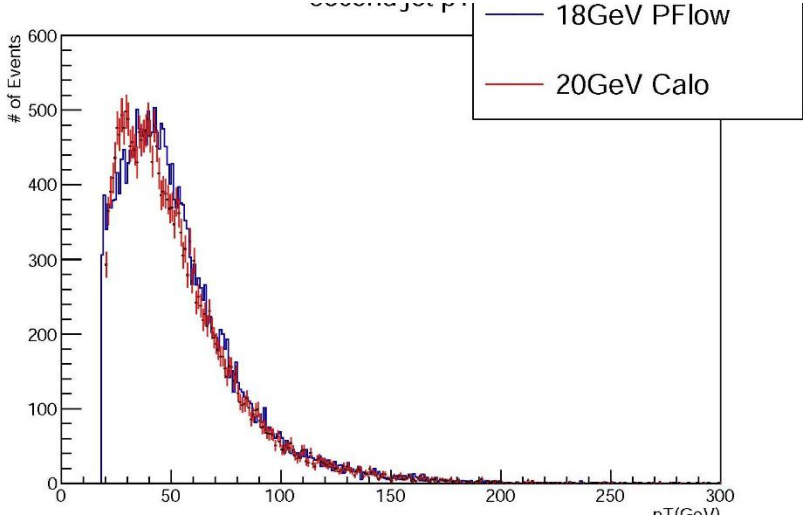

Second Jet pT
(20GeV PFlow v. 20GeV Calo)

Cut applied:
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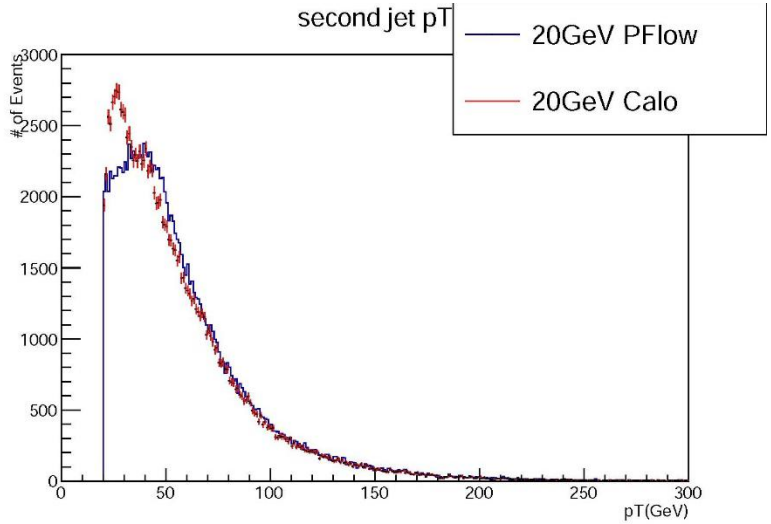
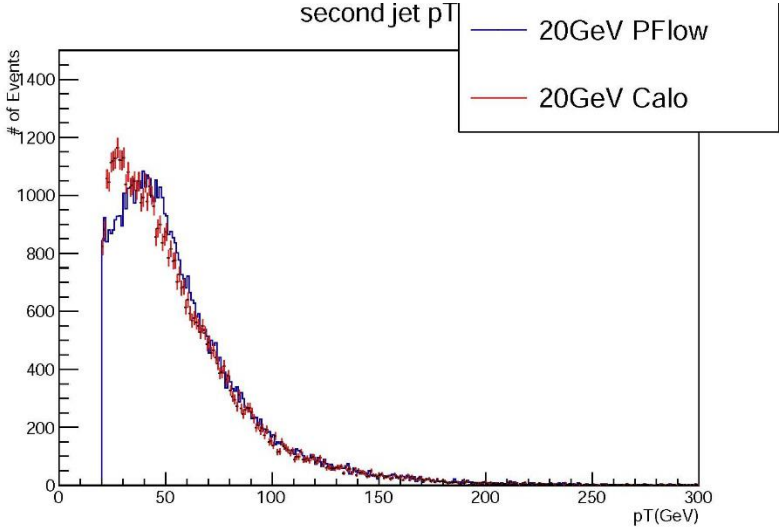
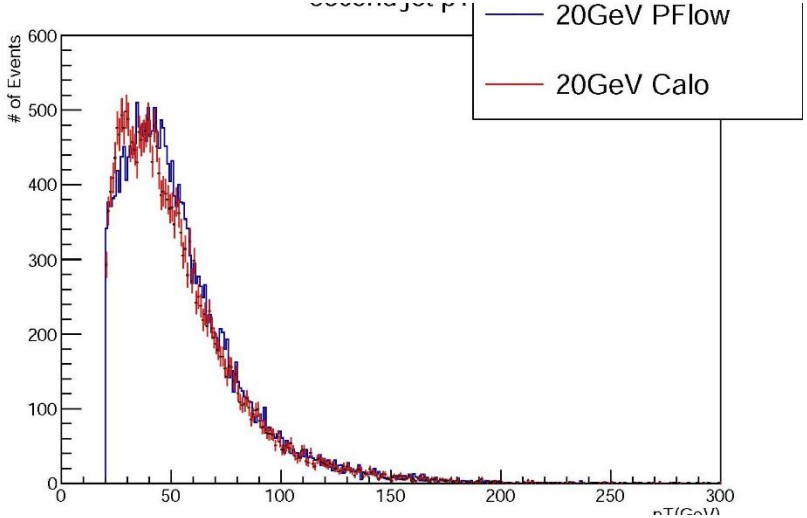
Upper left : two muon & >= 2 good jets
Bottom : 2 muon and 2 b jets







Dijet Mass
(15GeV PFlow v. 20GeV Calo)

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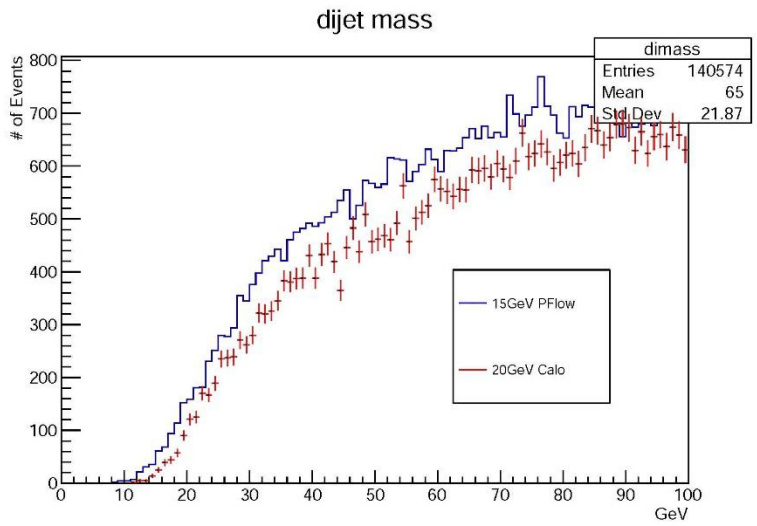
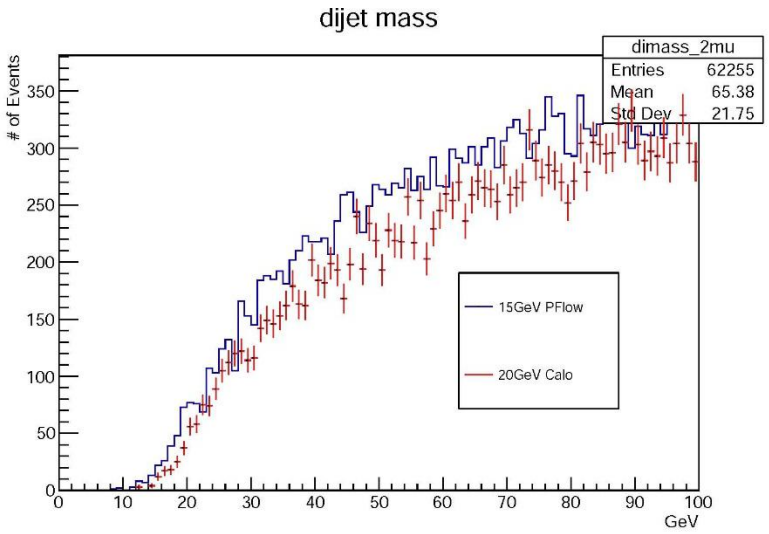
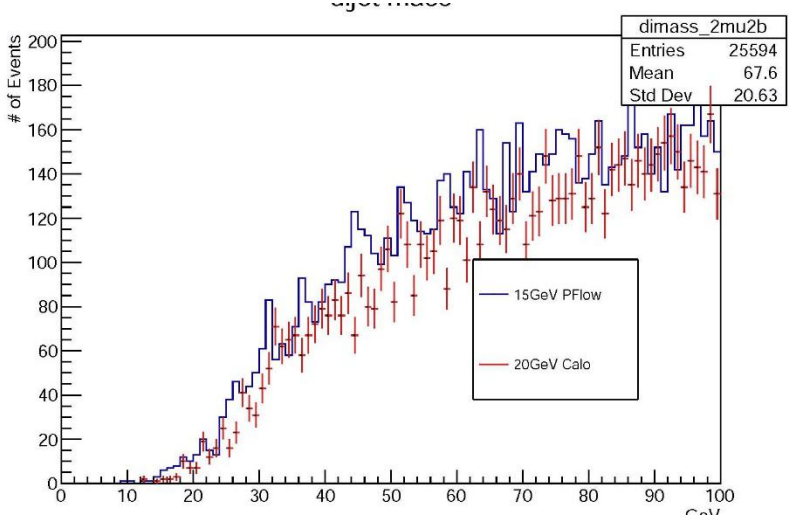
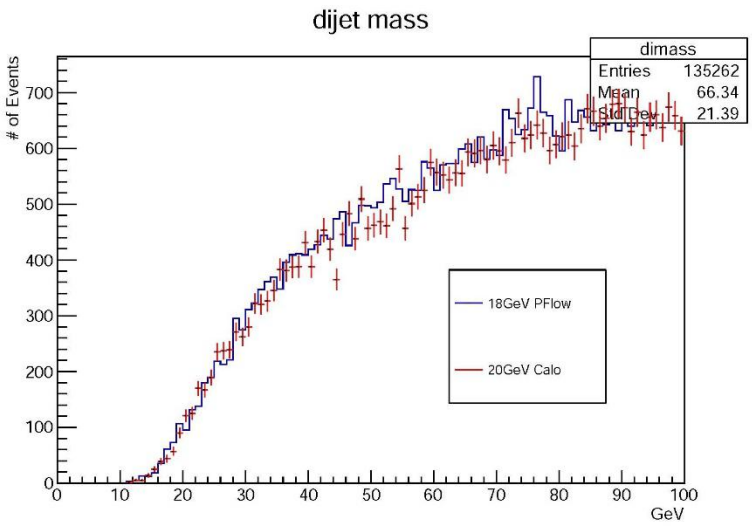


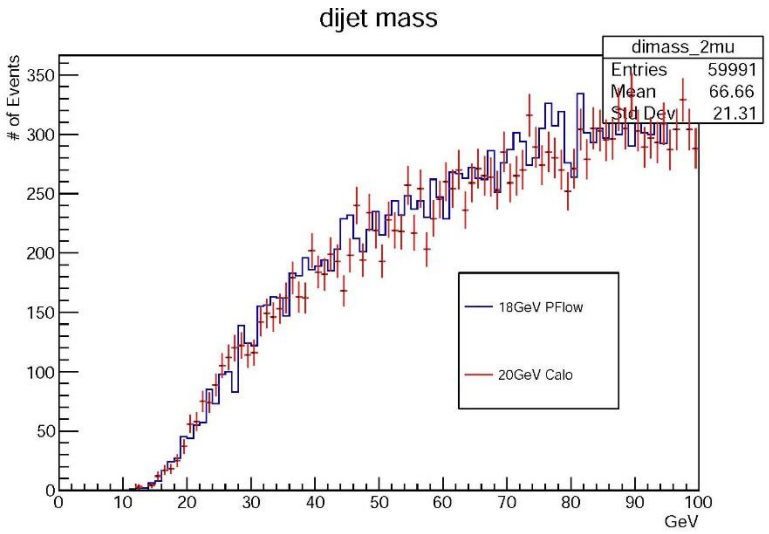


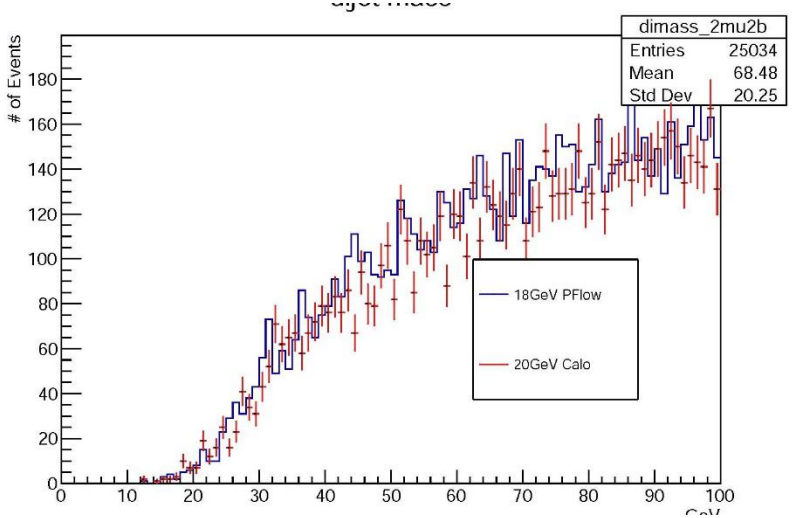


Dijet Mass
(18GeV PFlow v. 20GeV Calo)

Cut applied:
Upper right: two muons
Upper left : two muon & >= 2 good jets
Bottom : 2 muon and 2 b jets

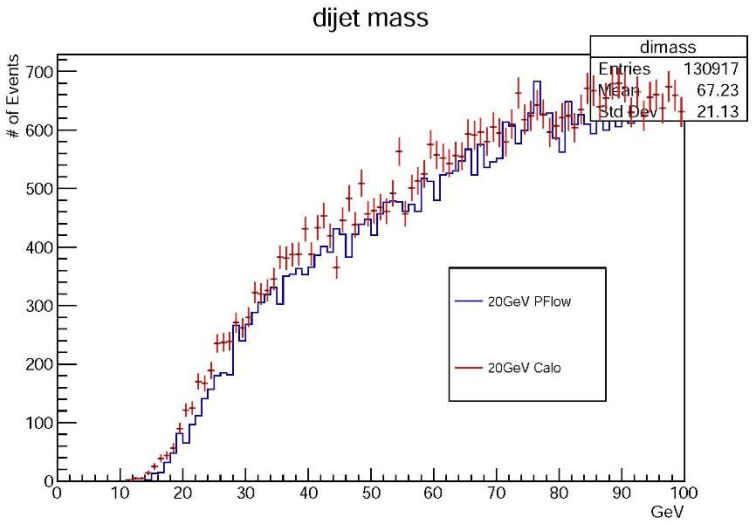


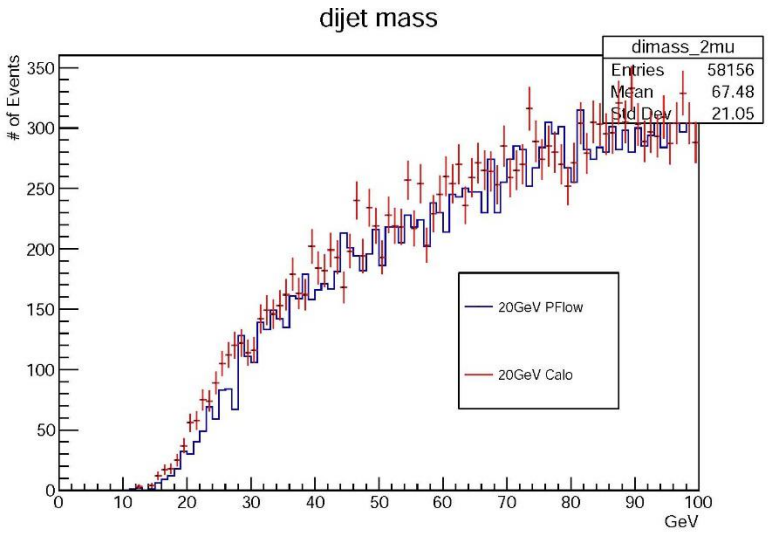


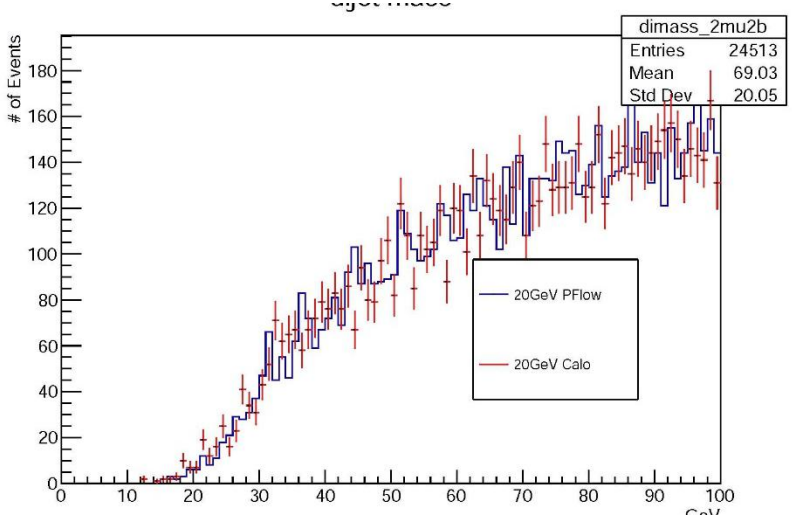


Dijet Mass
(20GeV PFlow v. 20GeV Calo)

Cut applied:
Upper right: two muons
Upper left : two muon & >= 2 good jets
Bottom : 2 muon and 2 b jets





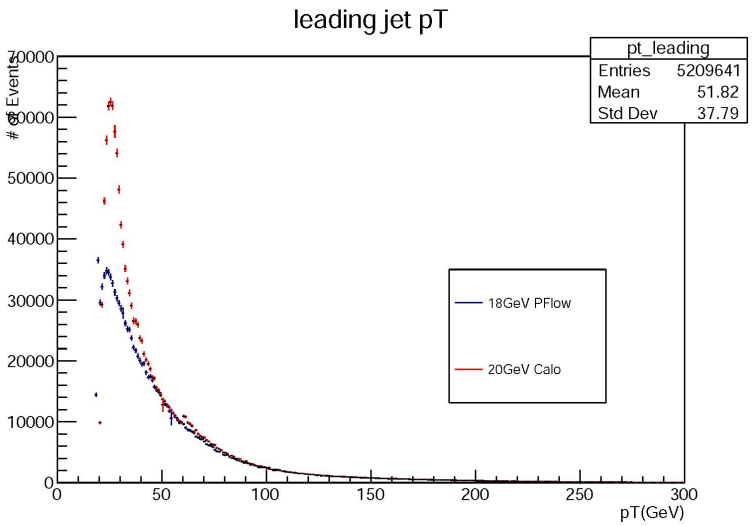


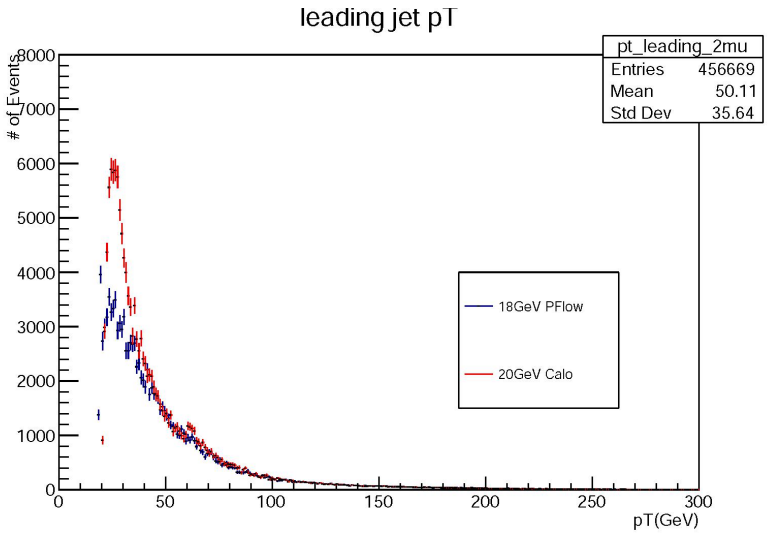
Cut Flow Table

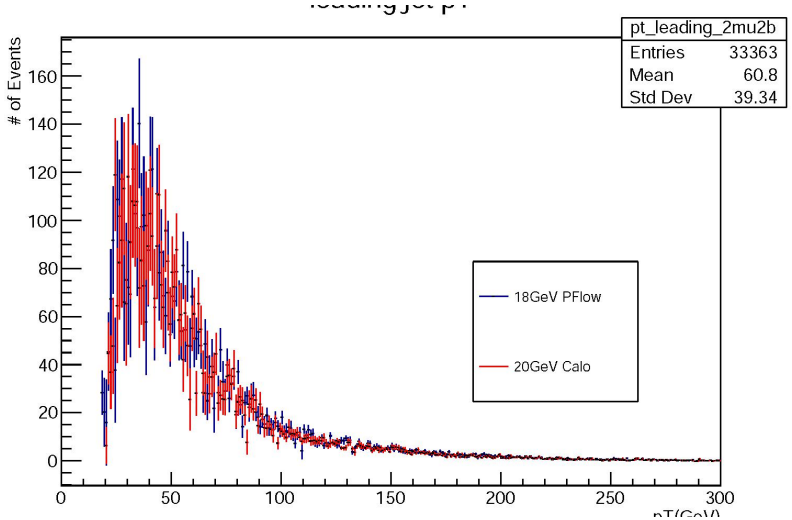
Cut	15GeV PFlow	18GeV PFlow	20GeV PFlow	15GeV Calo	18GeV Calo	20GeV Calo
Total	1199054	1199054	1199054	1199054	1199054	1199054
Pass LUP Trigger	524854	524854	524854	524854	524854	524854
2 muon(>=1 good jet)						
2 muon(>=2 good jet)						
$N_\mu = 2$	147999	148675	148786	137829	138959	140782
$pT^{\mu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

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

Cut applied:
Upper right: two muons
Upper left : two muon & >= 2 good jets
Bottom : 2 muon and 2 b jets



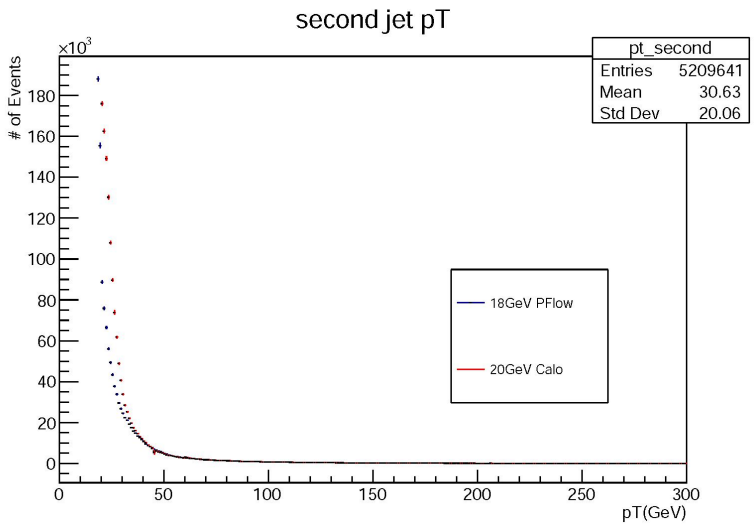


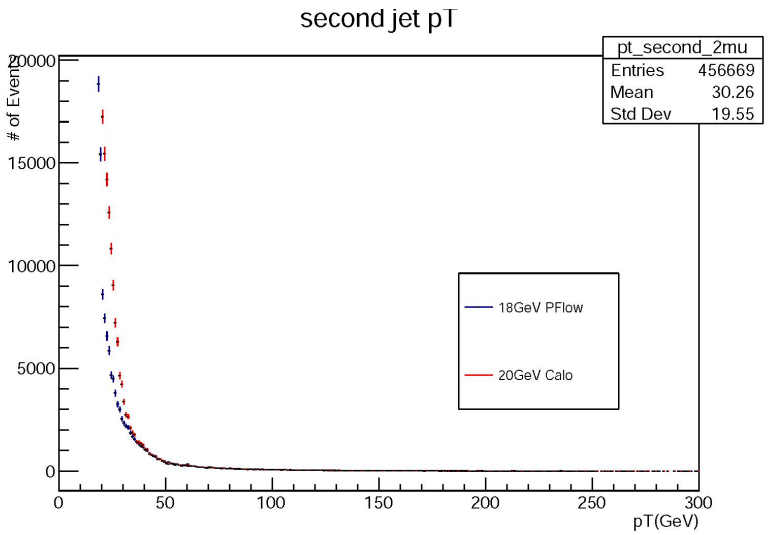


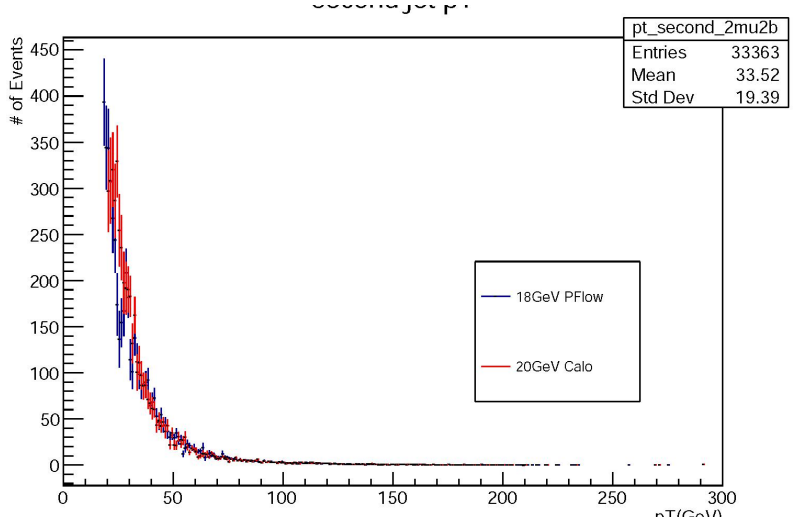
Second pT

(18GeV PFlow v. 20GeV Calo)

Cut applied:
Upper right: two muons
Upper left : two muon & >= 2 good jets
Bottom : 2 muon and 2 b jets



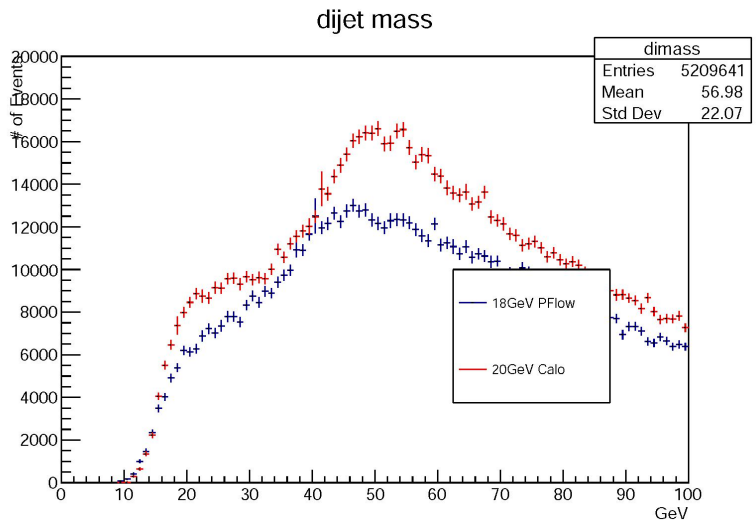


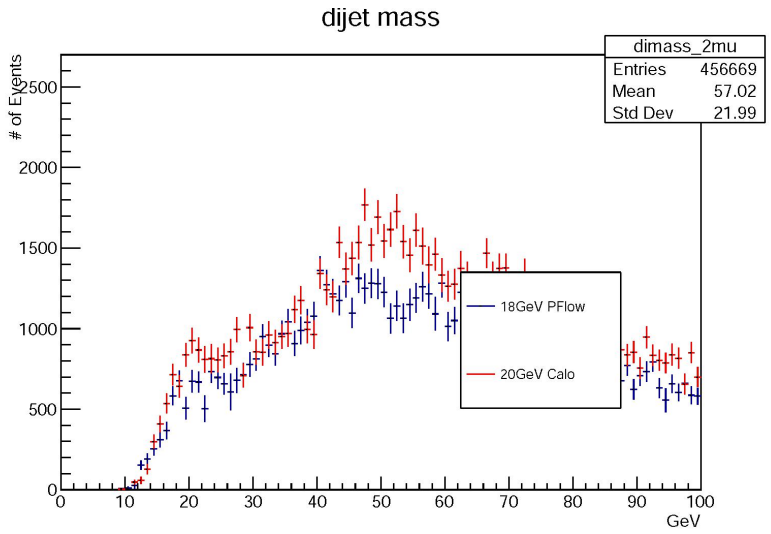


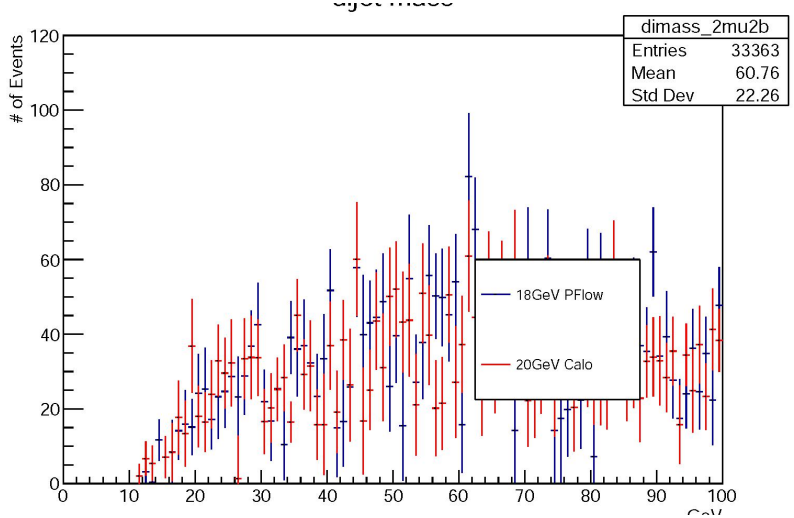
Dijet Mass

(18GeV PFlow v. 20GeV Calo)

Cut applied:
Upper right: two muons
Upper left : two muon & >= 2 good jets
Bottom : 2 muon and 2 b jets







Backup

Full Sample name of Sample used：

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Backup

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