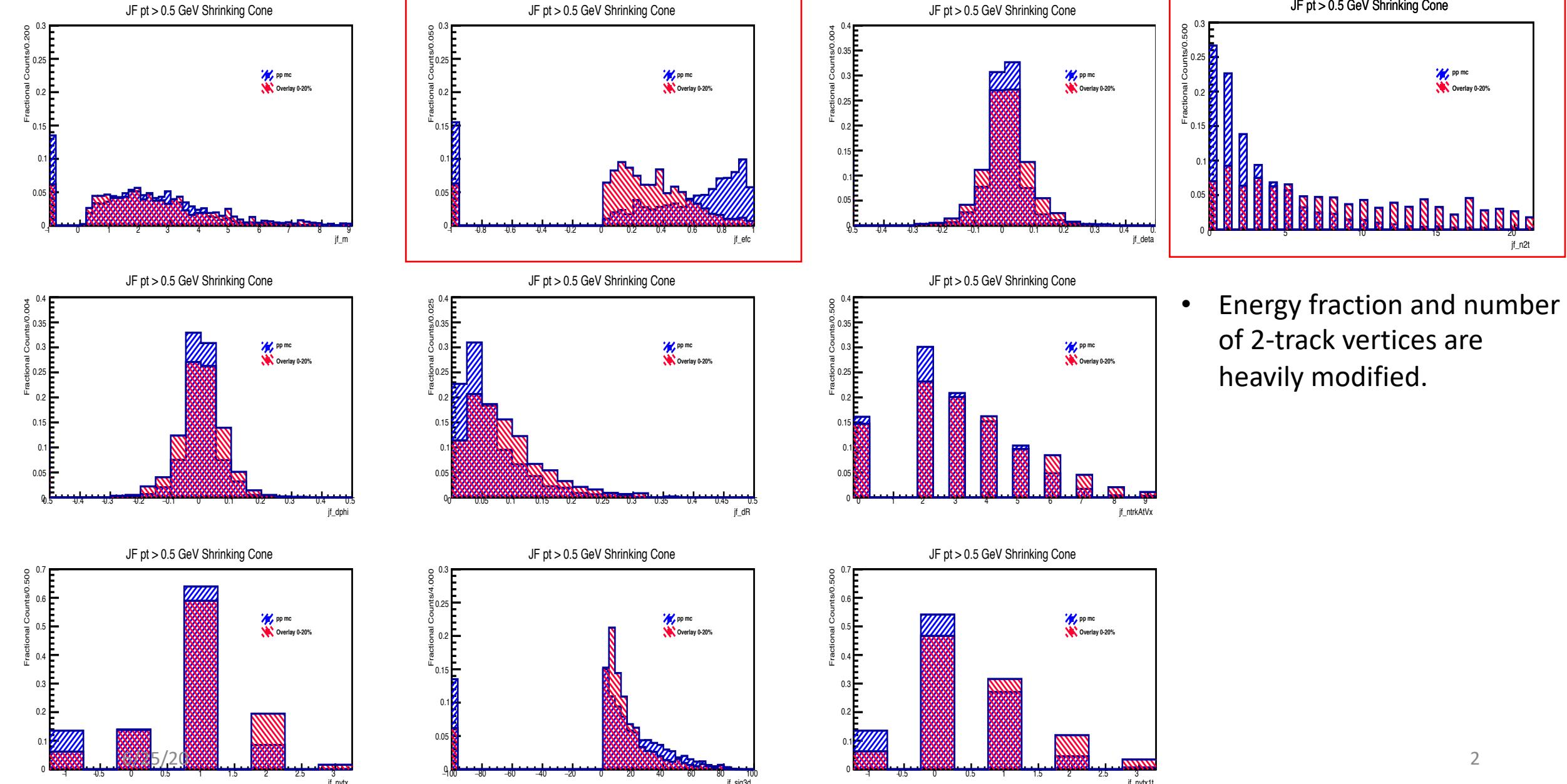


# Plans

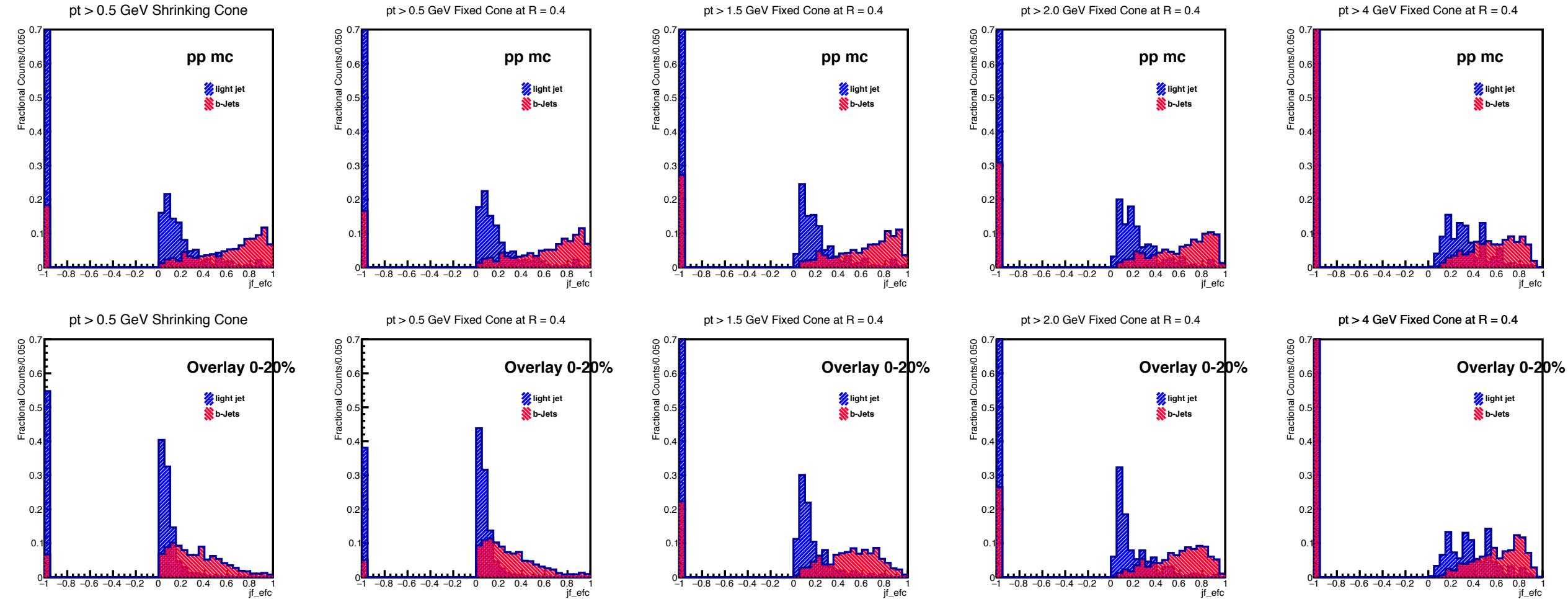
- Taggers: IPxD, SVF, JetFitter
  - IPxD: re-tune with inclusive dijet samples:
    - Weights added.
    - Centrality dependence added.
    - Setup LOCALGROUPDISK space for inclusive n-tuples.
    - templates and evaluation using Shrinking Cone No Cut and 1.5 GeV Cut, making ROC curves
      - On grid: Fixed cone with different pT cut.
  - SVF & JetFitter Performance: physics variables:
    - Added comparison with light jet
    - Simplified cuts being compared
    - In progress: ROC curve for vertexing efficiency of different tagger & centrality

# JF Variables at Default Setup



# JF Energy Fraction

↓ over cutting causes light jet to right-shift as well



Top Row: pp mc

Bottom Row: Overlay 0-20%

From left to right:

1. No pT Shrinking Cone
2. No pT Fixed Cone
3. Min pt = 1.5 GeV Fixed Cone

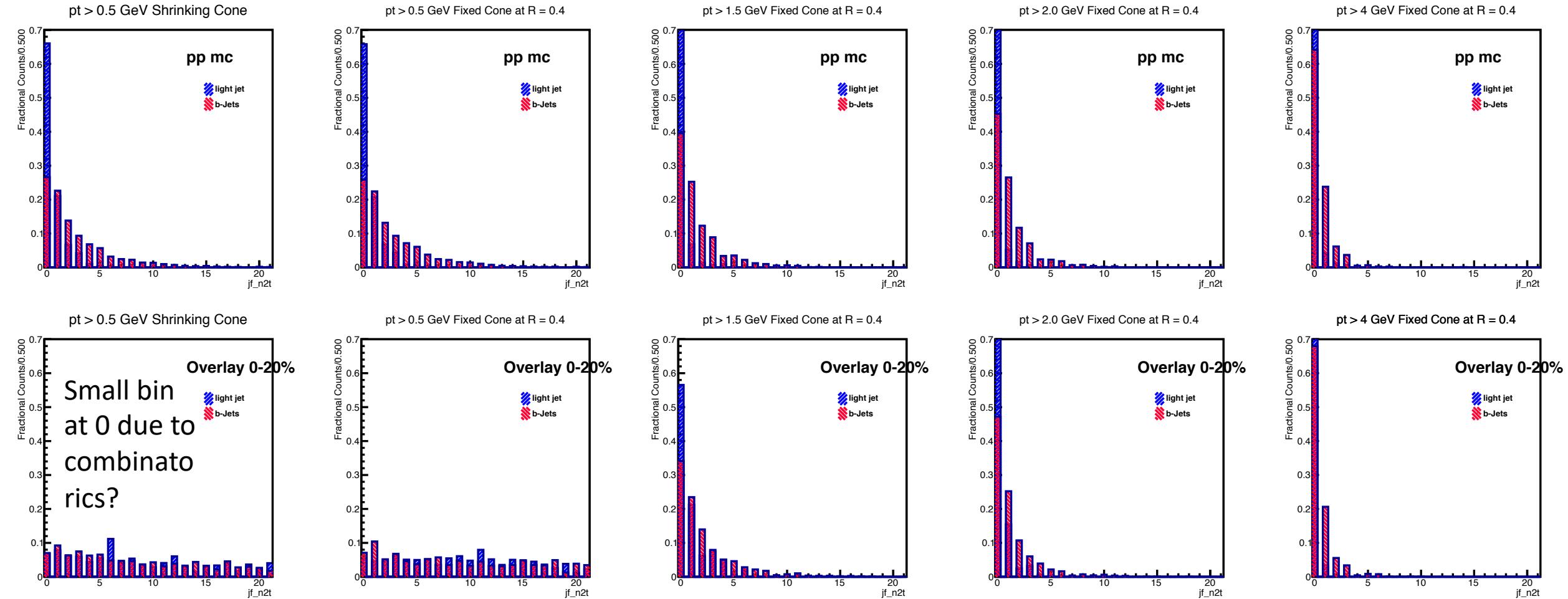
4. Min pt = 2.0 GeV Fixed Cone

5. Min pt = 4.0 GeV Fixed Cone

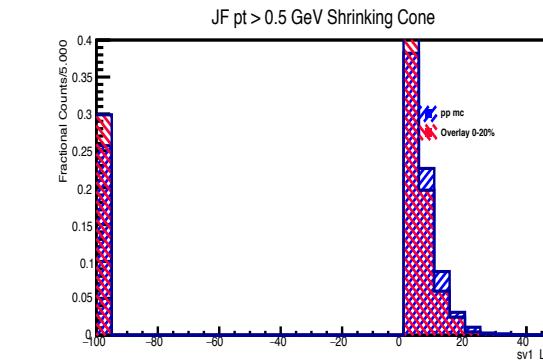
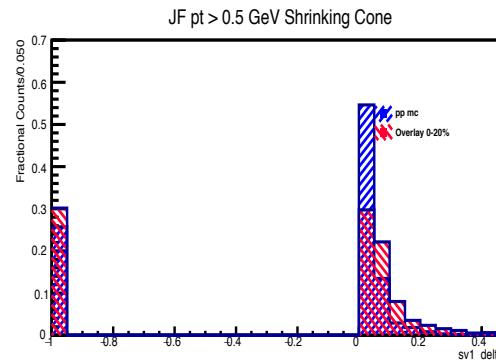
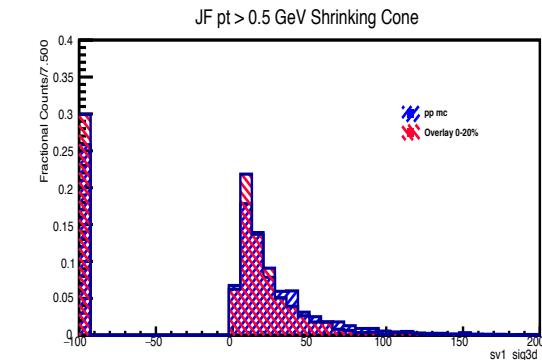
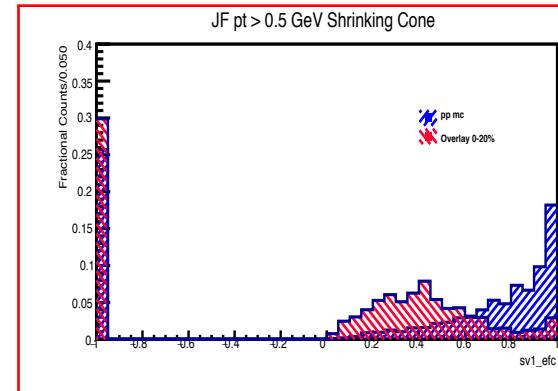
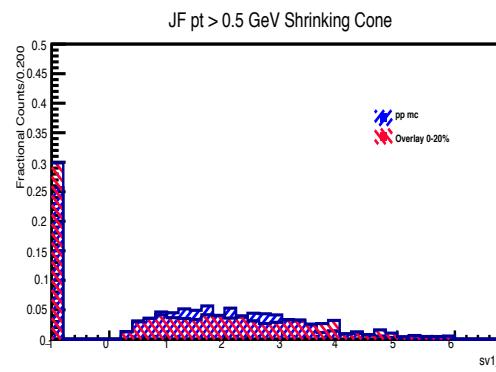
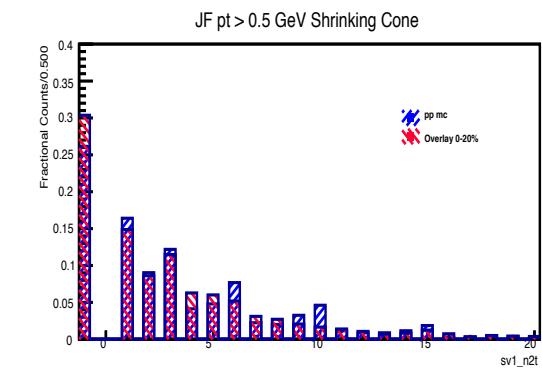
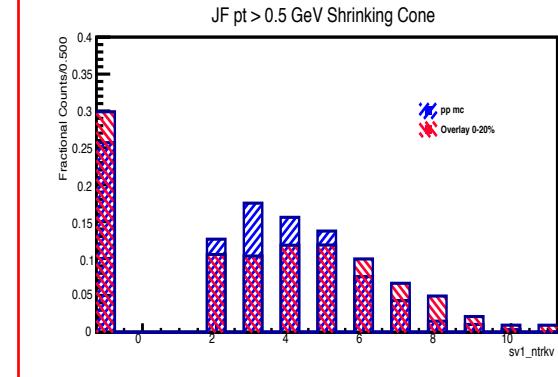
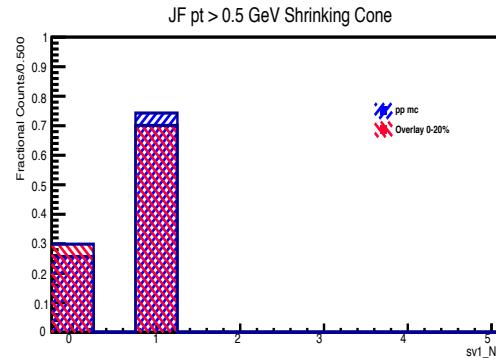
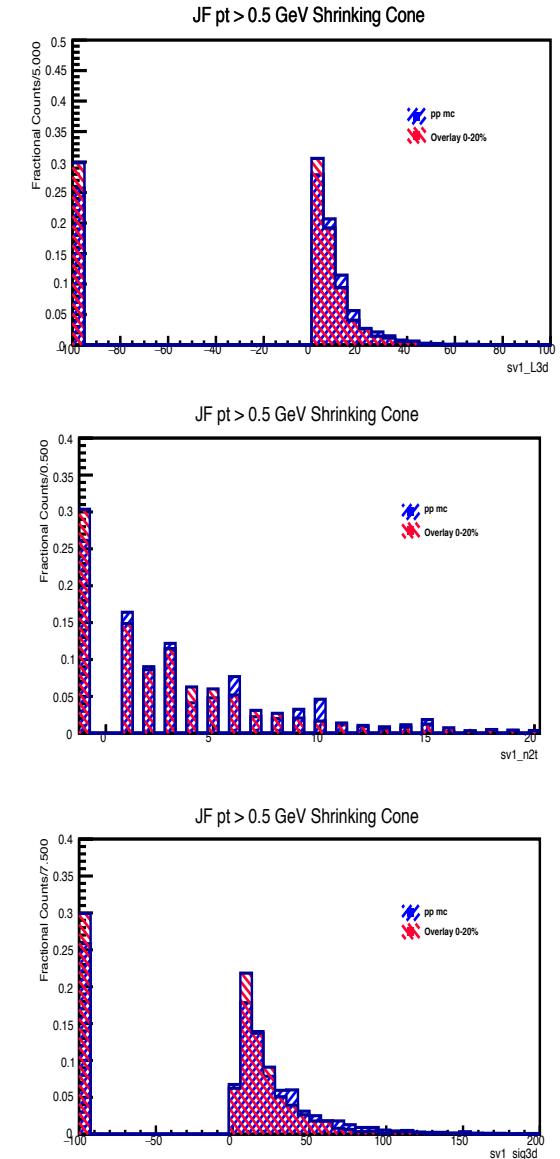
Red: b-jet

Blue: light jet

# JF n2t (2-trk vertices candidates)

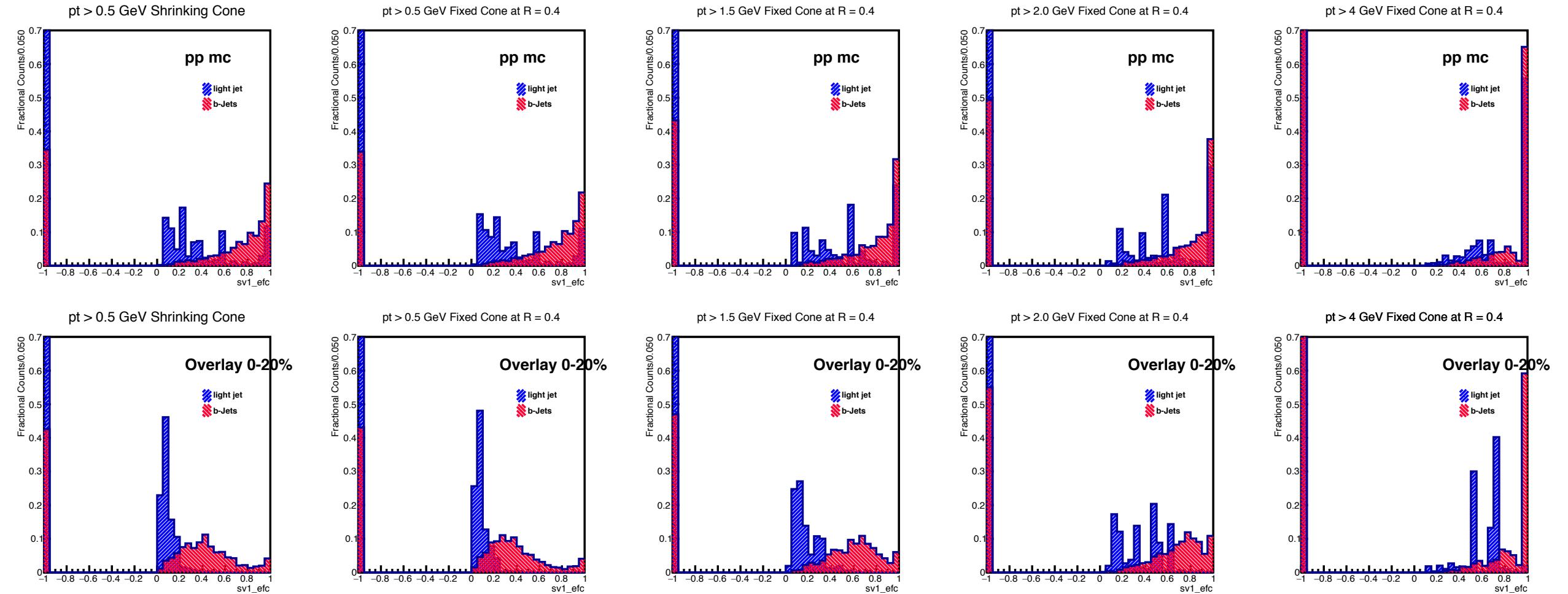


# SV Variables at Default Setup



- Energy fraction and number of 2-track vertices are heavily modified.
- Peak at 1 is due to missing tracks. See back up slide 18.

# SV Energy Fraction



Top Row: pp mc

Bottom Row: Overlay 0-20%

From left to right:

1. No pT Shrinking Cone
2. No pT Fixed Cone
3. Min pt = 1.5 GeV Fixed Cone

4. Min pt = 2.0 GeV Fixed Cone

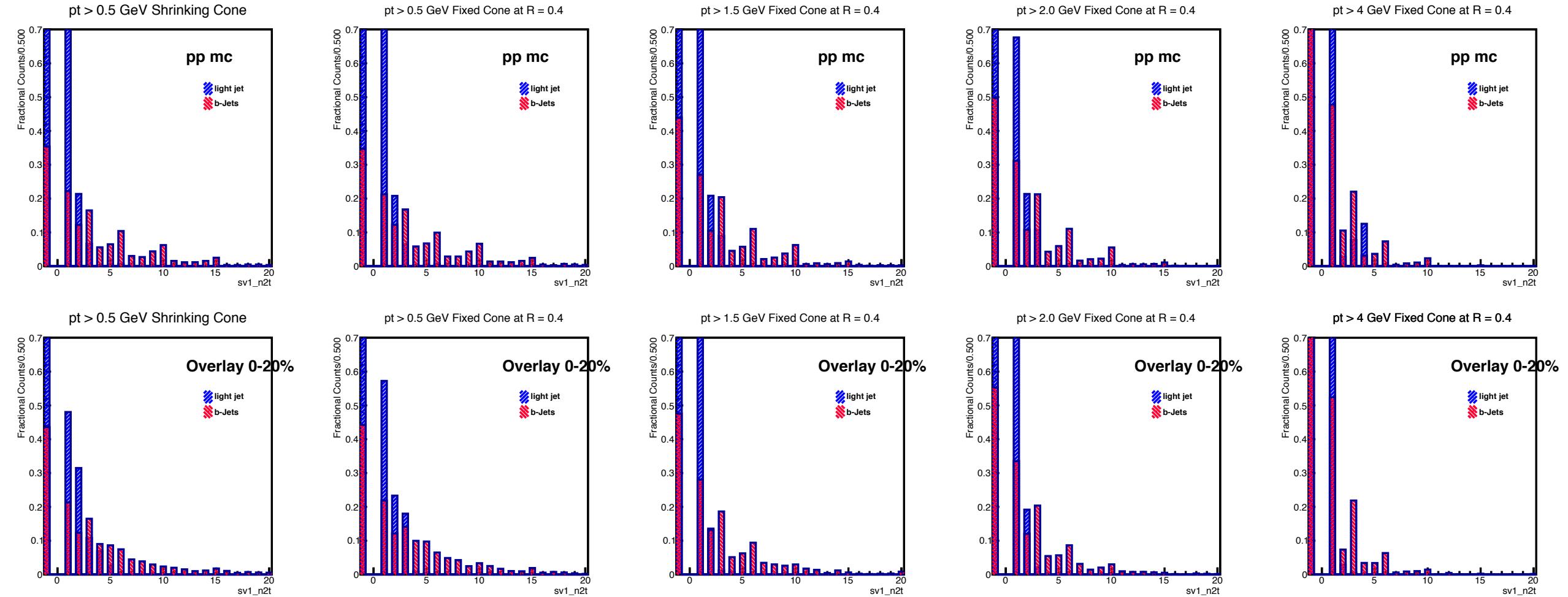
5. Min pt = 4.0 GeV Fixed Cone

Red: b-jet

Blue: light jet

# SV n2t (2-trk vertices candidates)

↓ overcutting left-shifted b-jet bins too much



Top Row: pp mc

Bottom Row: Overlay 0-20%

From left to right:

1. No pT Shrinking Cone
2. No pT Fixed Cone
3. Min pt = 1.5 GeV Fixed Cone

4. Min pt = 2.0 GeV Fixed Cone

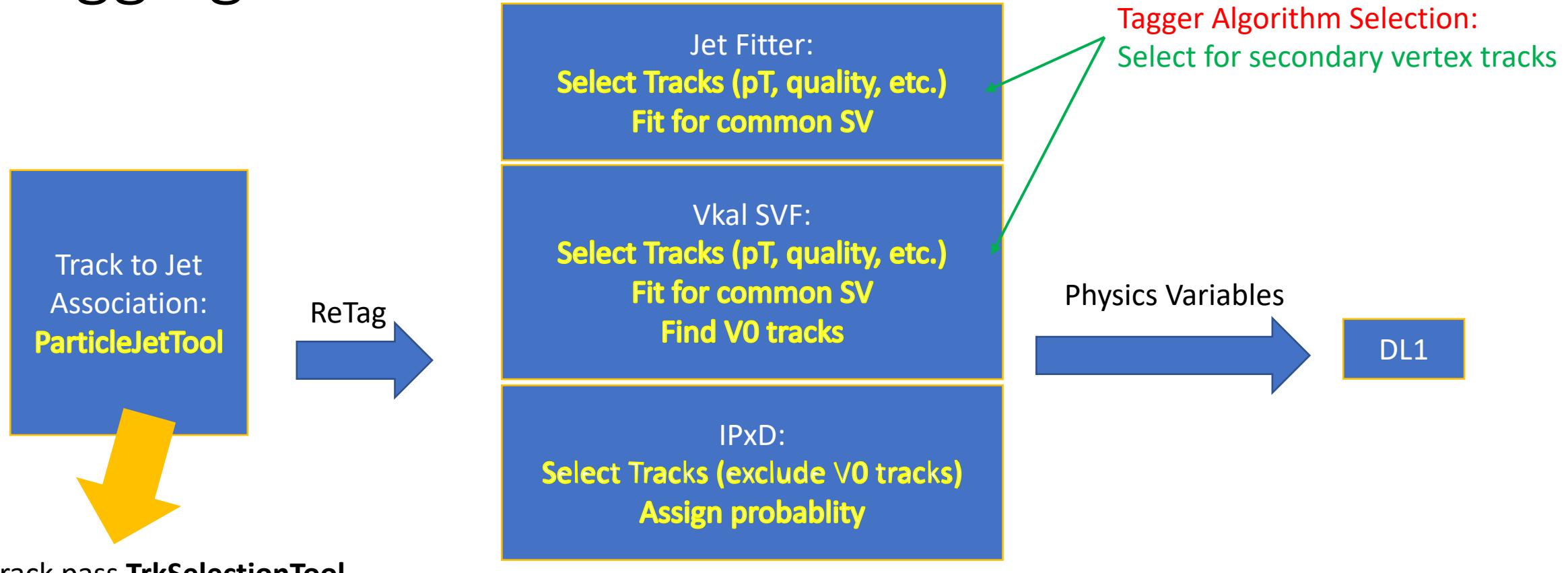
5. Min pt = 4.0 GeV Fixed Cone

Red: b-jet

Blue: light jet

# Back up

# B-Tagging Workflow



-track pass TrkSelectionTool

-associate each track to closest jet

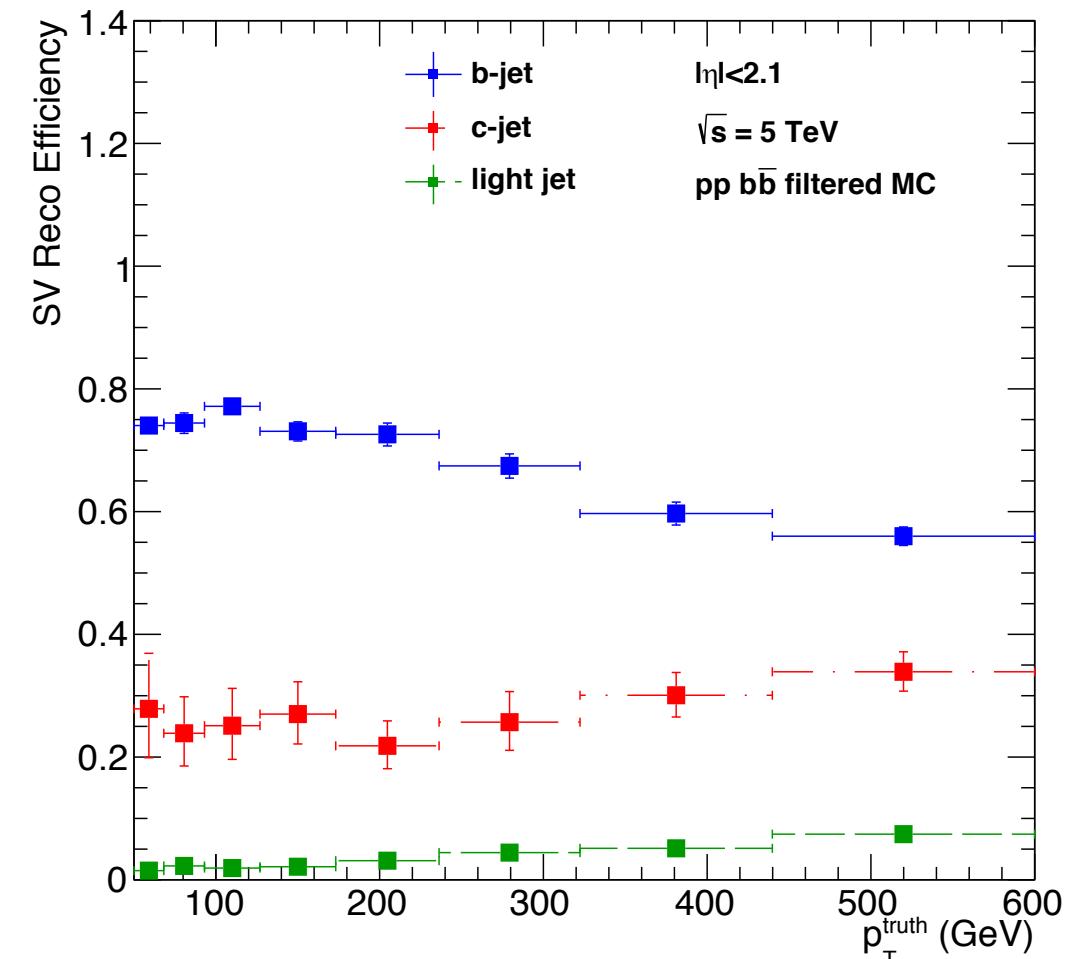
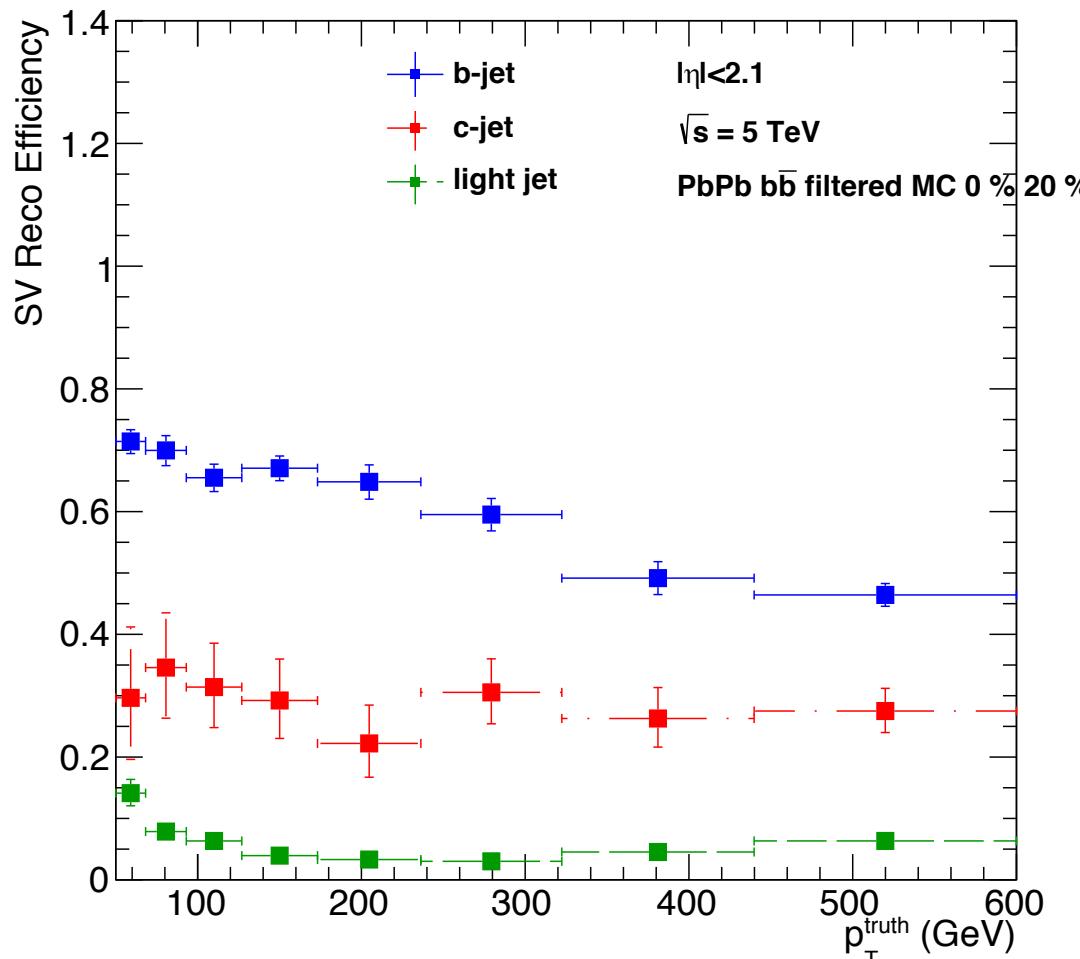
-if  $dR <$  threshold, track is associated

Shrinking Cone: higher jet pT, smaller the threshold  $dR$

Fixed Cone: threshold  $dR = 0.4$  for all jet pR

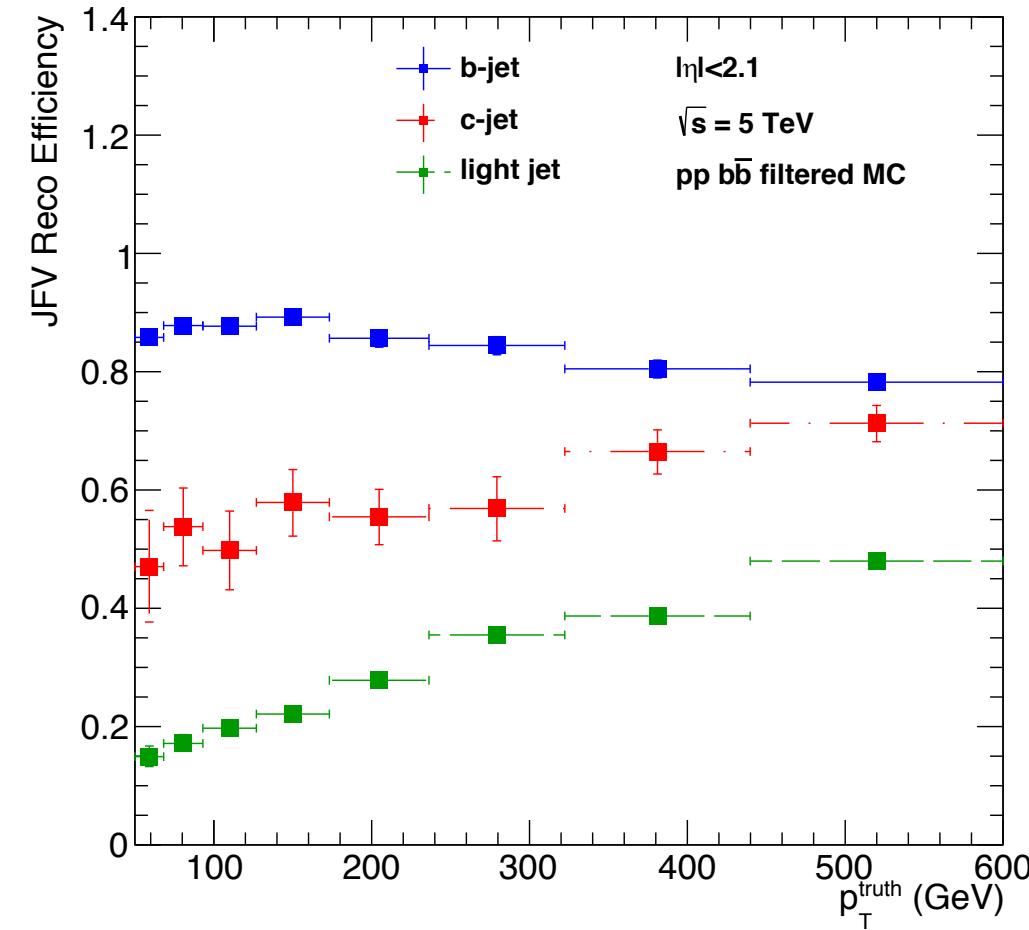
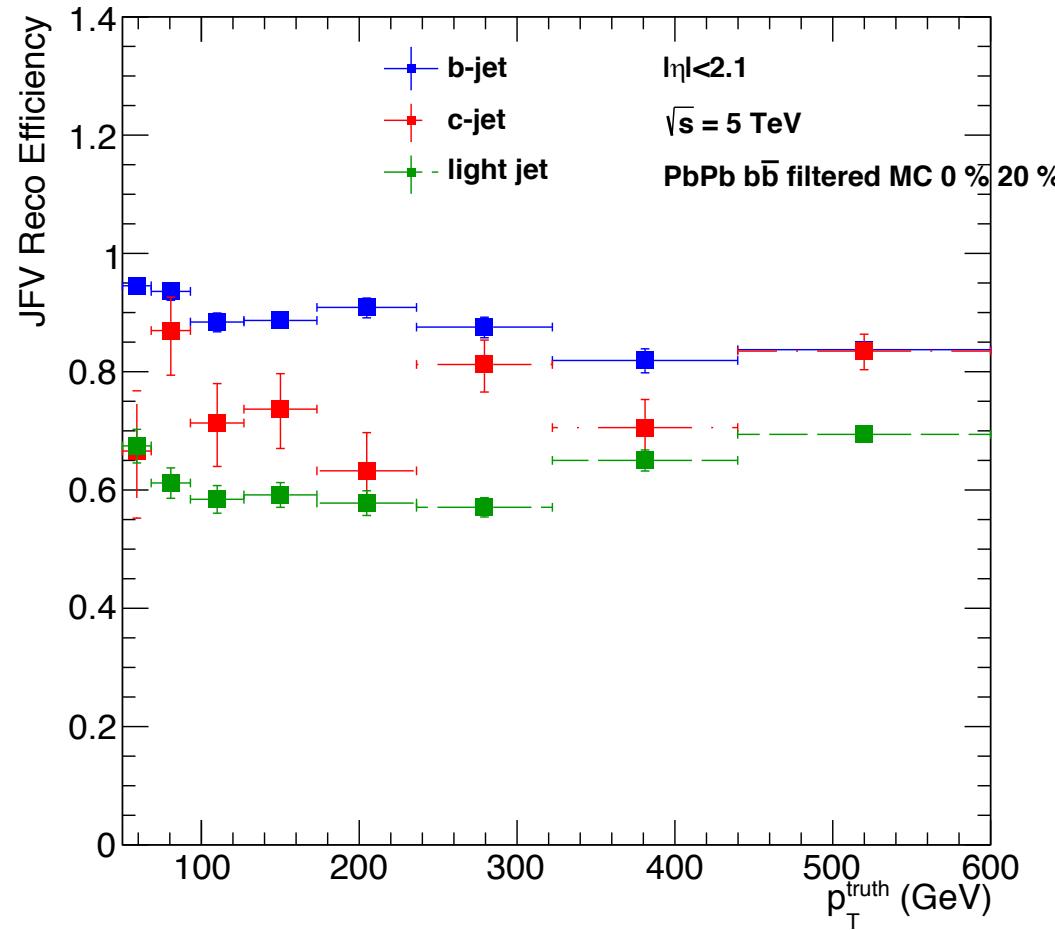
Pre-Tagging  
Selection

# Secondary Vertexing at Default Setup for SVF (VKal)



In comparison to pp, central PbPb MC has lower tagging efficiency, especially in high jet  $p_T$  region, the efficiency drops to below 50%.

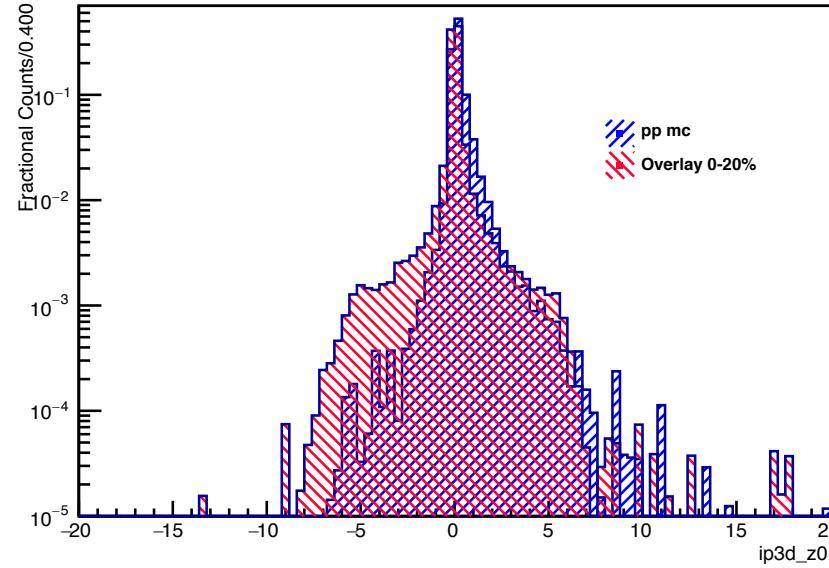
# Secondary Vertexing at Default Setup for JetFitter



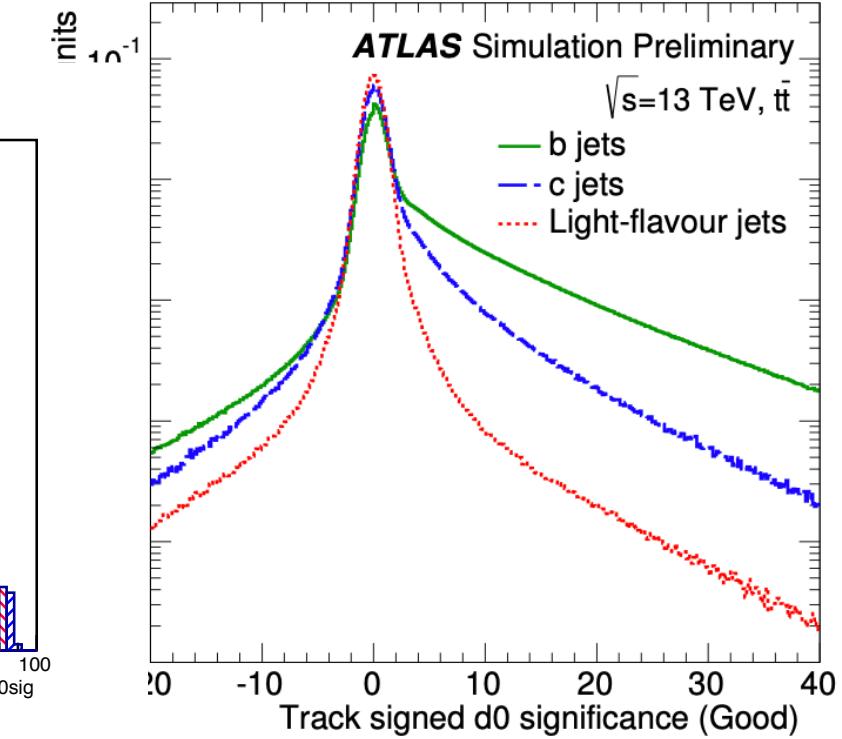
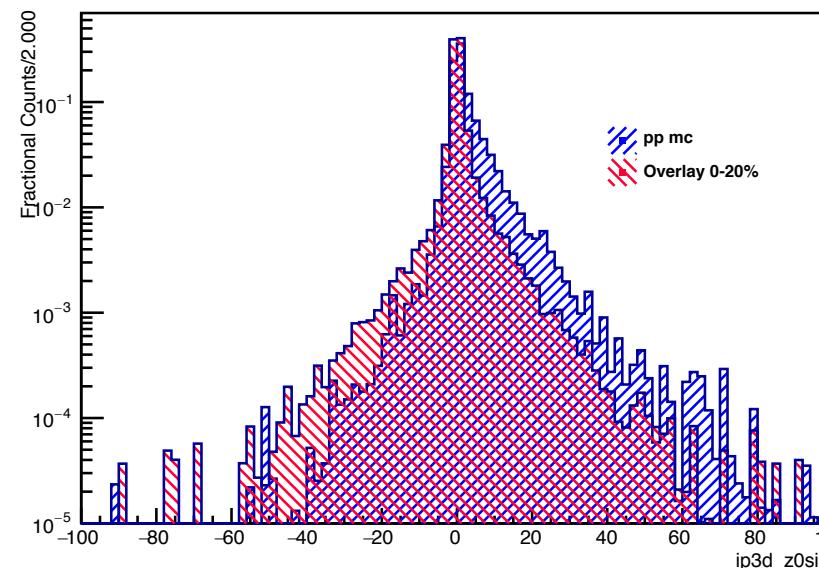
In comparing to pp, central PbPb MC has similar b-tagging efficiency but very high fake rate from both c-jet and light jet.

# IPxD Variables

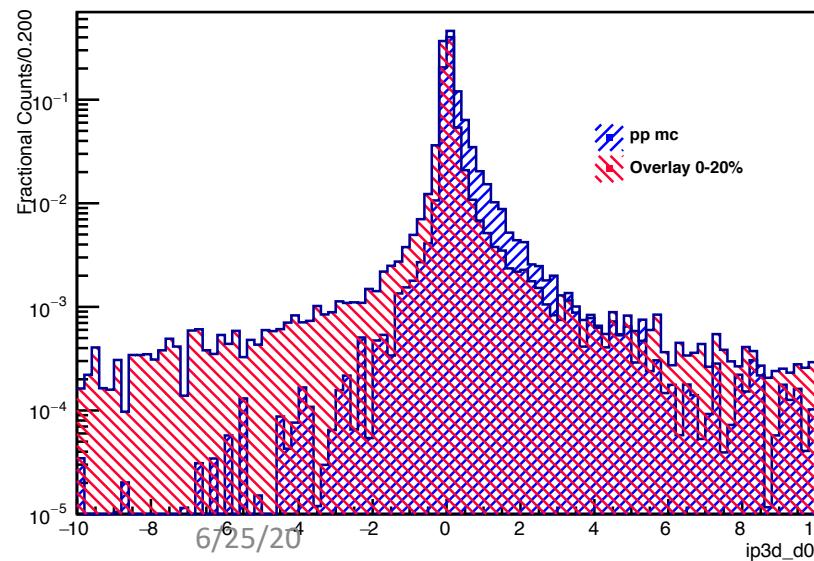
Default Cuts Shrinking Cone



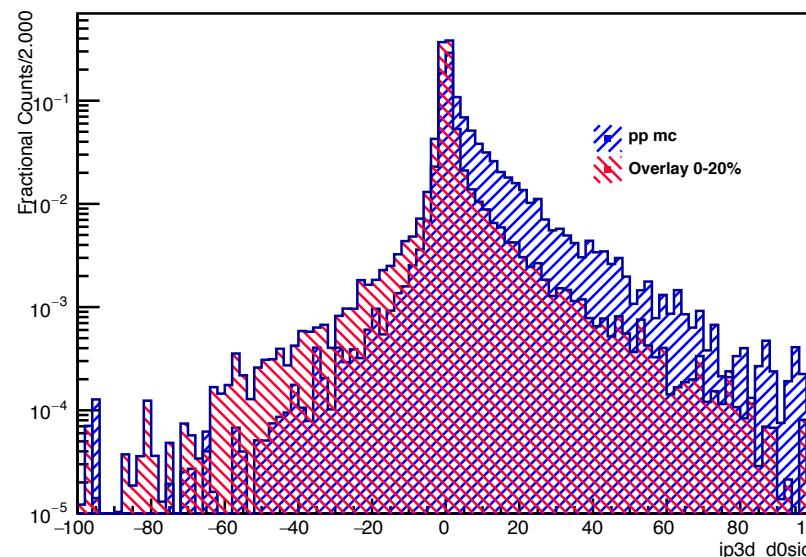
Default Cuts Shrinking Cone



Default Cuts Shrinking Cone



Default Cuts Shrinking Cone



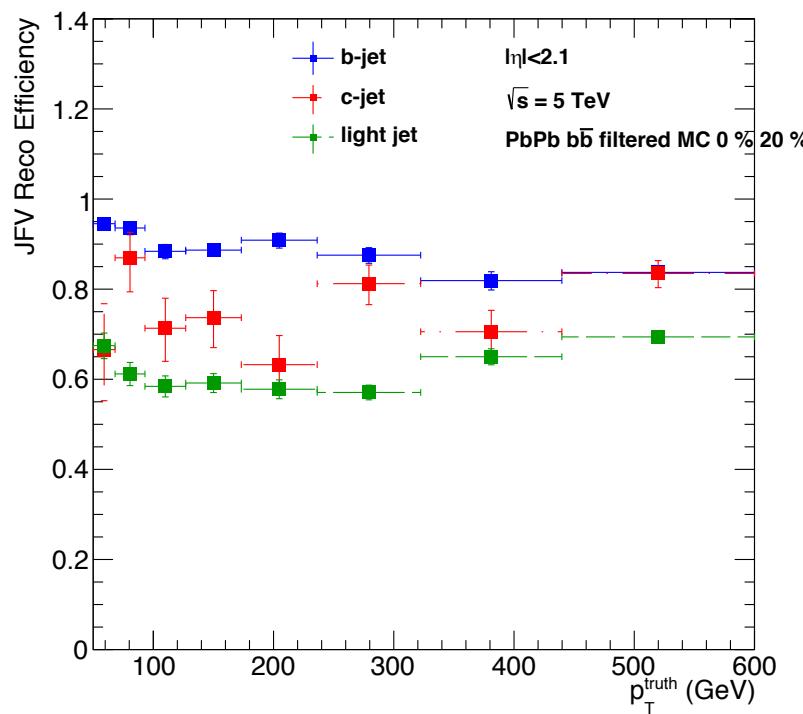
- Overlay samples have almost symmetric distribution of d0 and z0. (left two plots)
- IPxD uses IP significance (right two plots)

# Motivation for Cuts made

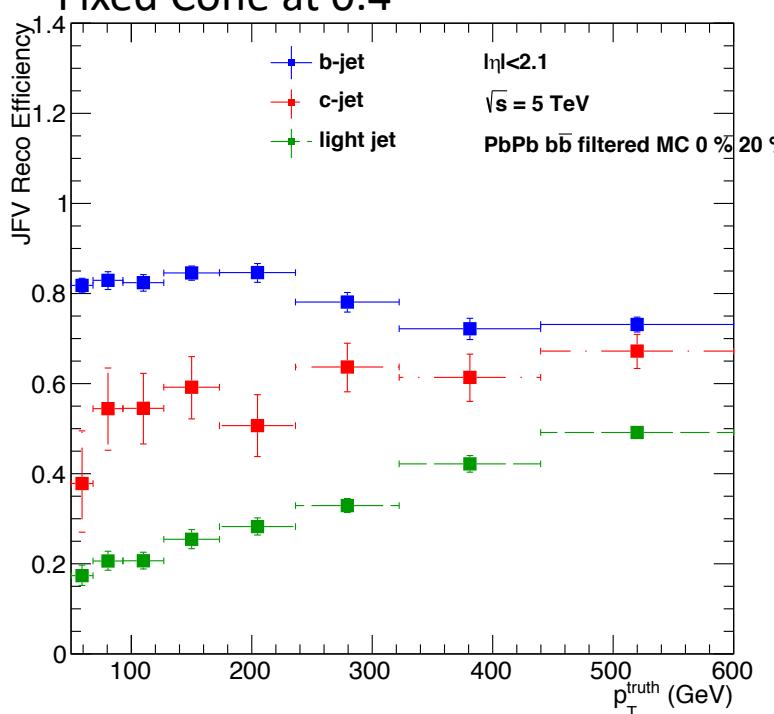
Item	Default	Change	Which Tool	Reason
Track Association	Shrinking Cone	Fixed R = 0.4	ParticleJetTools	Unknown PbPb track distribution vs jet pT SVF has efficiency drop in high pT due to track loss
Min pT Cut	0.5 GeV	1.5 GeV	JetFitter	Central Events have high fake rate possibly due to UE tracks contribution
Min pT Cut	0.7 GeV	1.5 GeV	VKal	Same as above
Min pT Cut	No Cut	1.5 GeV	ParticleJetTools	Physics variables like efc are still affected by UE tracks if only modifies in tagger algo
Anti Pile Up Tool	On	Off	Vkal + JetFitter	Irrelevant in single PV events

# Secondary Vertexing Efficiency with JetFitter

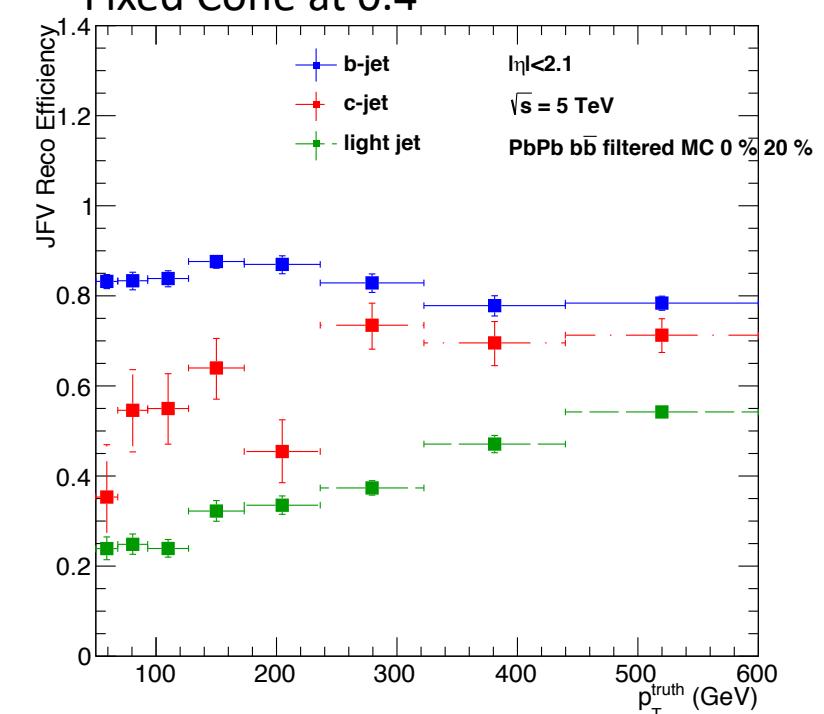
Default JF Setup  
No Selection on Input Tracks  
Shrinking Cone



Default JF Setup  
Selection on TrackAssociation:  
-- Min  $p_T = 1.5 \text{ GeV}$   
-- "HILoose" without IP cuts  
Fixed Cone at 0.4



Modified JF Setup:  
Requirement for SV candidate tracks:  
-- Min  $p_T = 1.0 \text{ GeV}$  for first fitting  
-- Min  $p_T = 1.75 \text{ GeV}$  for second fitting  
No Selection on Input Tracks  
Fixed Cone at 0.4

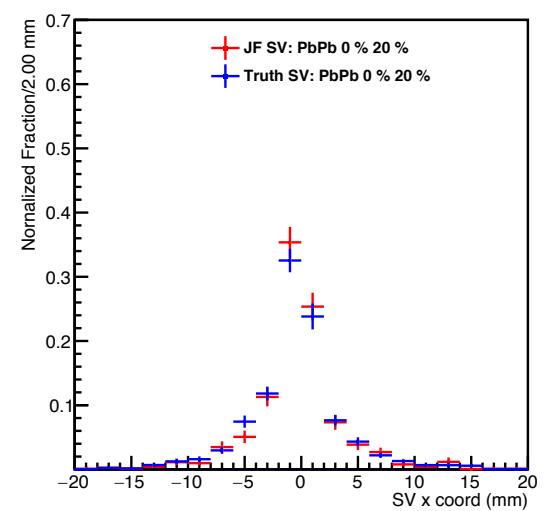


The vertexing efficiency for secondary vertex is similar when using the same value of minimum  $p_T$ , either by selecting tracks before vertexing or changing  $p_T$  selection in JF algorithm.

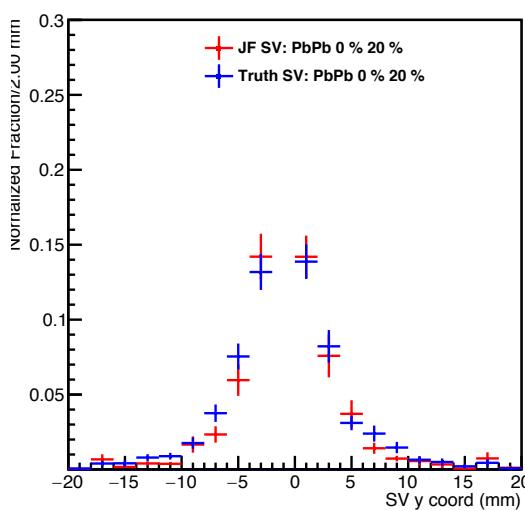
# Secondary Vertexing Resolution with JetFitter

Default JF Setup; No Selection on Input Tracks; Shrinking Cone

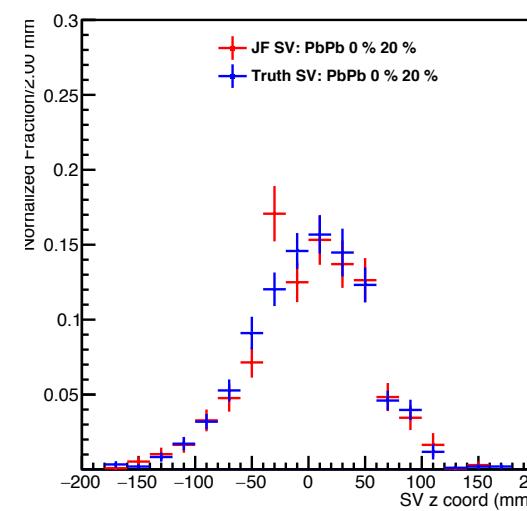
x Coordinate of JF Secondary Vertex



y Coordinate of JF Secondary Vertex



z Coordinate of JF Secondary Vertex

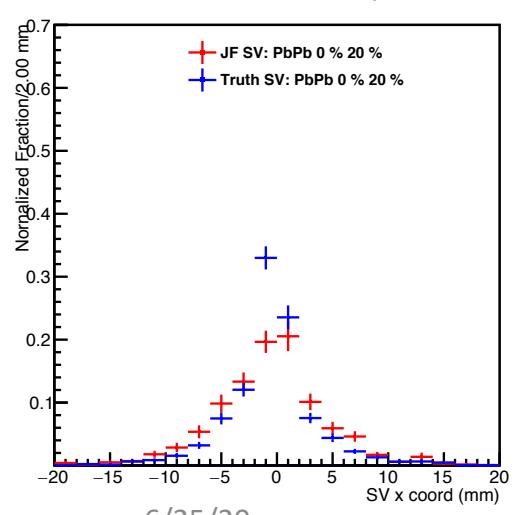


No big change in secondary vertex resolution, reconstructed SV coordinates have similar distribution with truth SV.

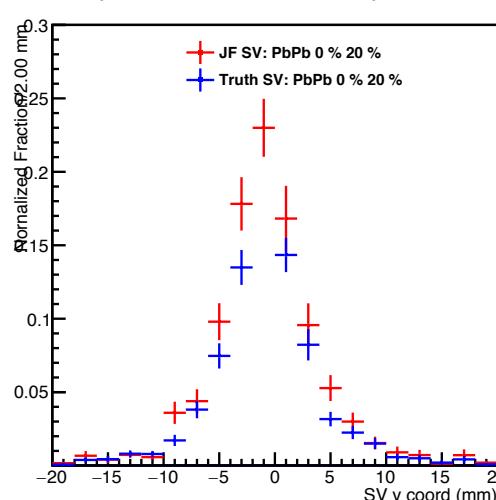
*Plan: plot coordinate difference and fit for quantitative comparison.*

Default JF Setup (anti PU off); Loose Selection on TrackAssociation; Min pT = 1.5 GeV; Fixed Cone at 0.4

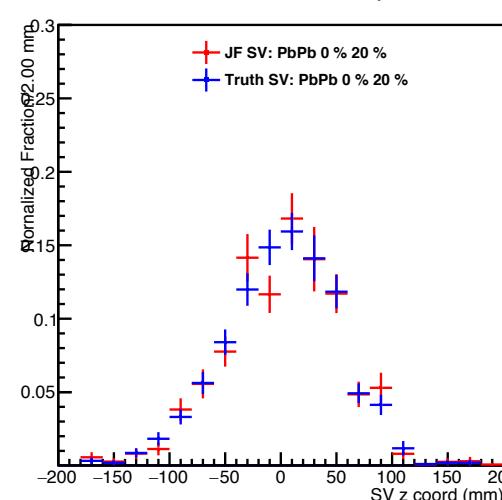
x Coordinate of JF Secondary Vertex



y Coordinate of JF Secondary Vertex



z Coordinate of JF Secondary Vertex

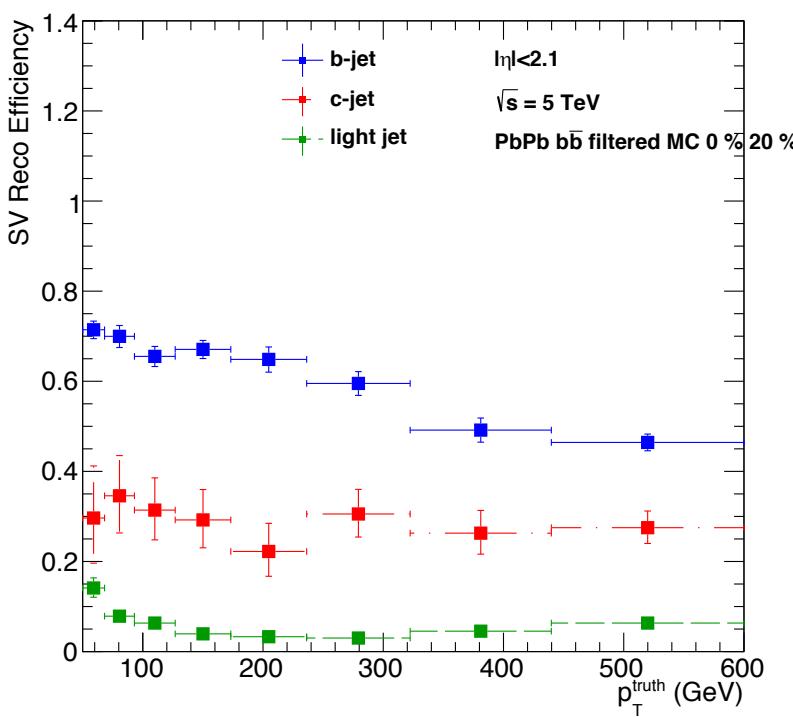


# Secondary Vertexing Efficiency with SV1

Default JF Setup

No Selection on Input Tracks

Shrinking Cone



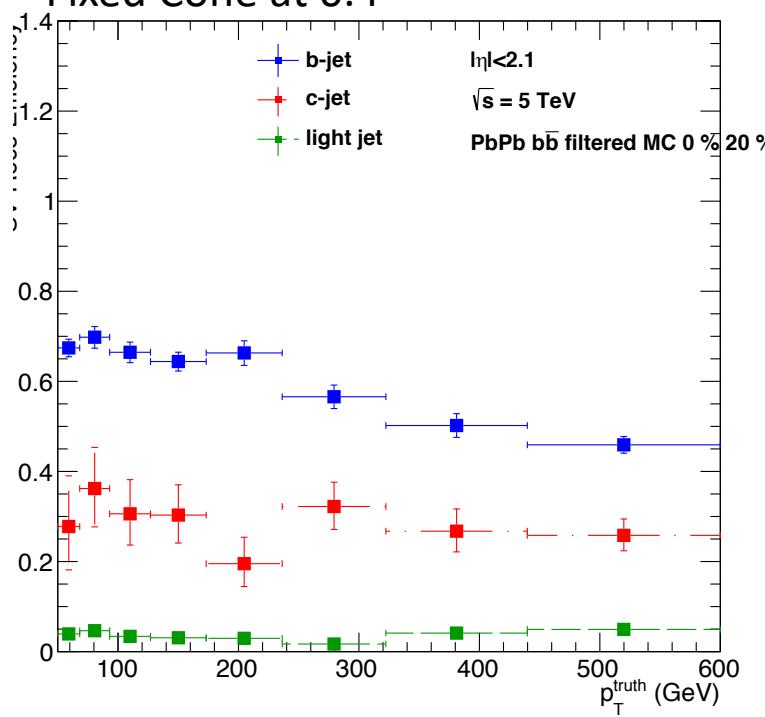
Default SVF Setup

Selection on TrackAssociation:

-- Min  $p_T = 1.5 \text{ GeV}$

-- "HILoose" without IP cuts

Fixed Cone at 0.4



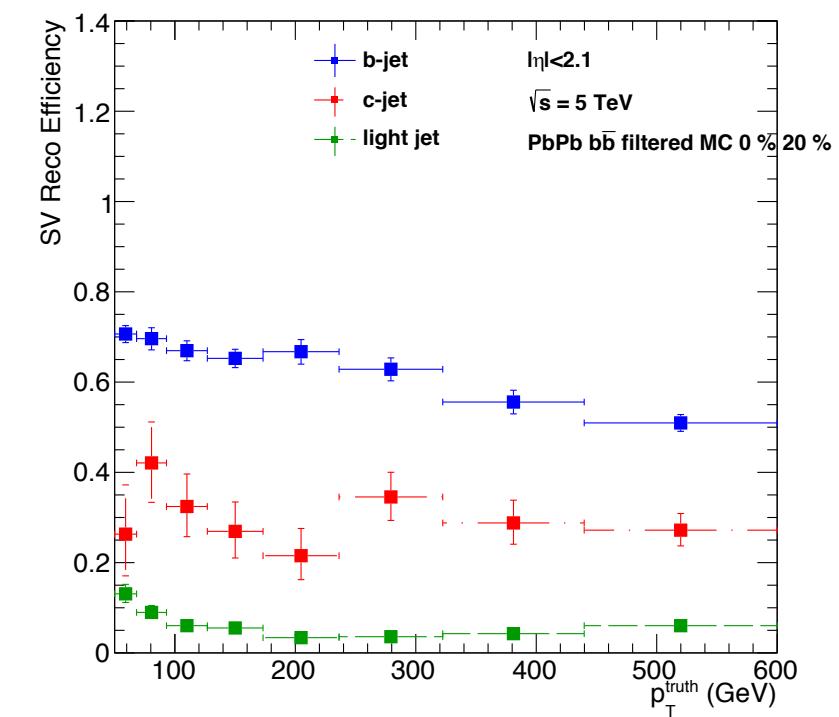
Modified SVF Setup:

SVF requirement for SV candidate tracks:

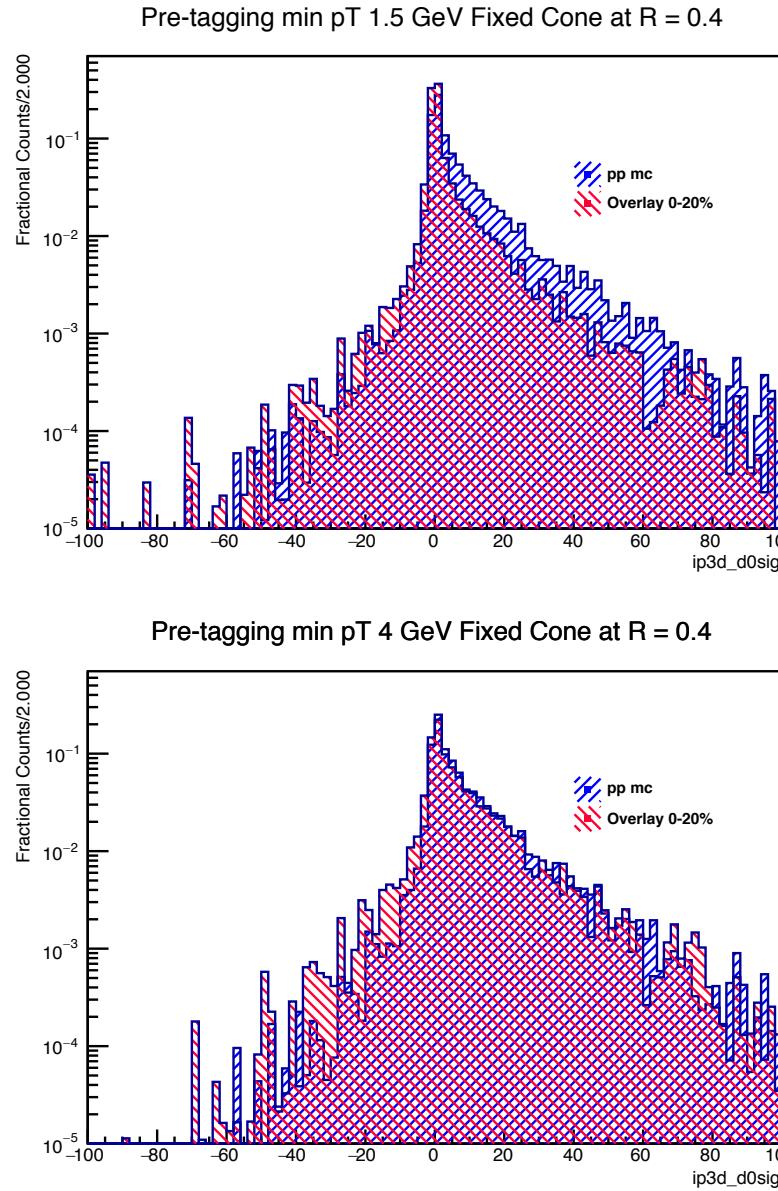
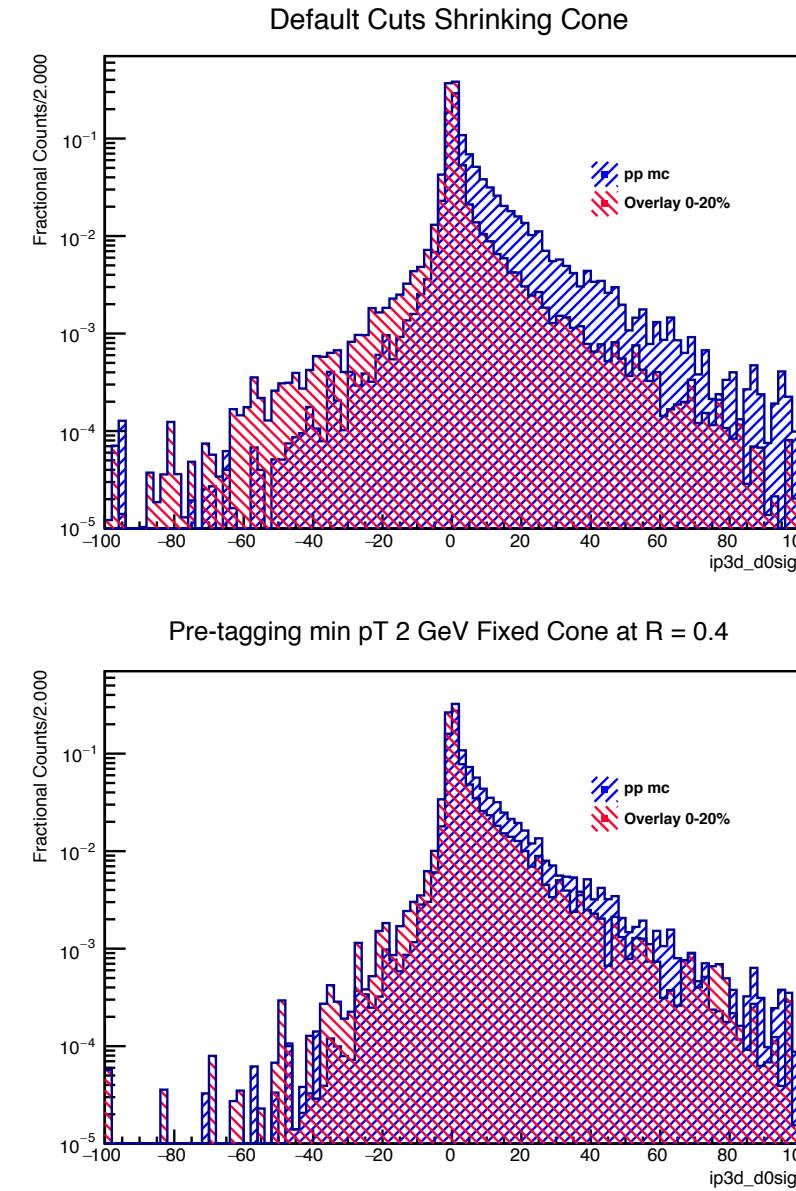
-- Min  $p_T = 1.0 \text{ GeV}$  (**will compare for 1.5 GeV**)

No Selection on Input Tracks

Fixed Cone at 0.4



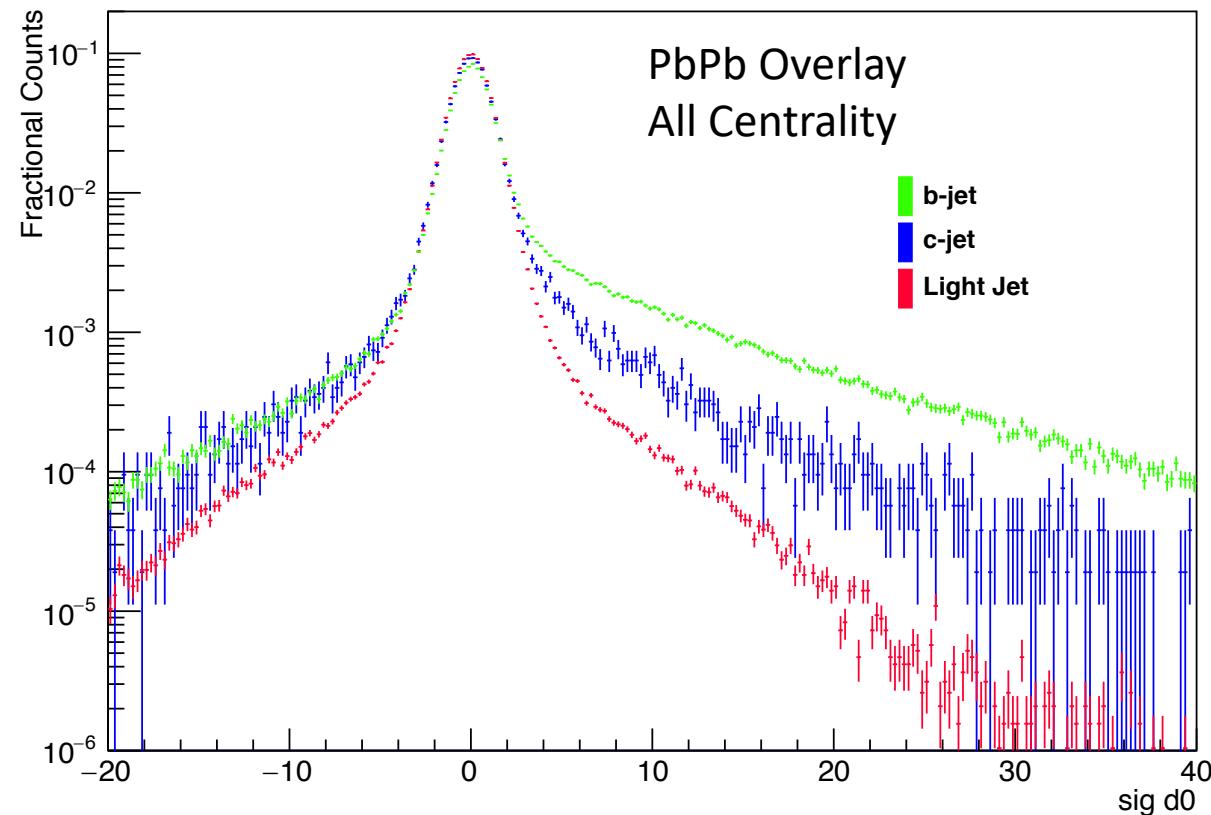
# IPxD Variables improvements over pT cuts



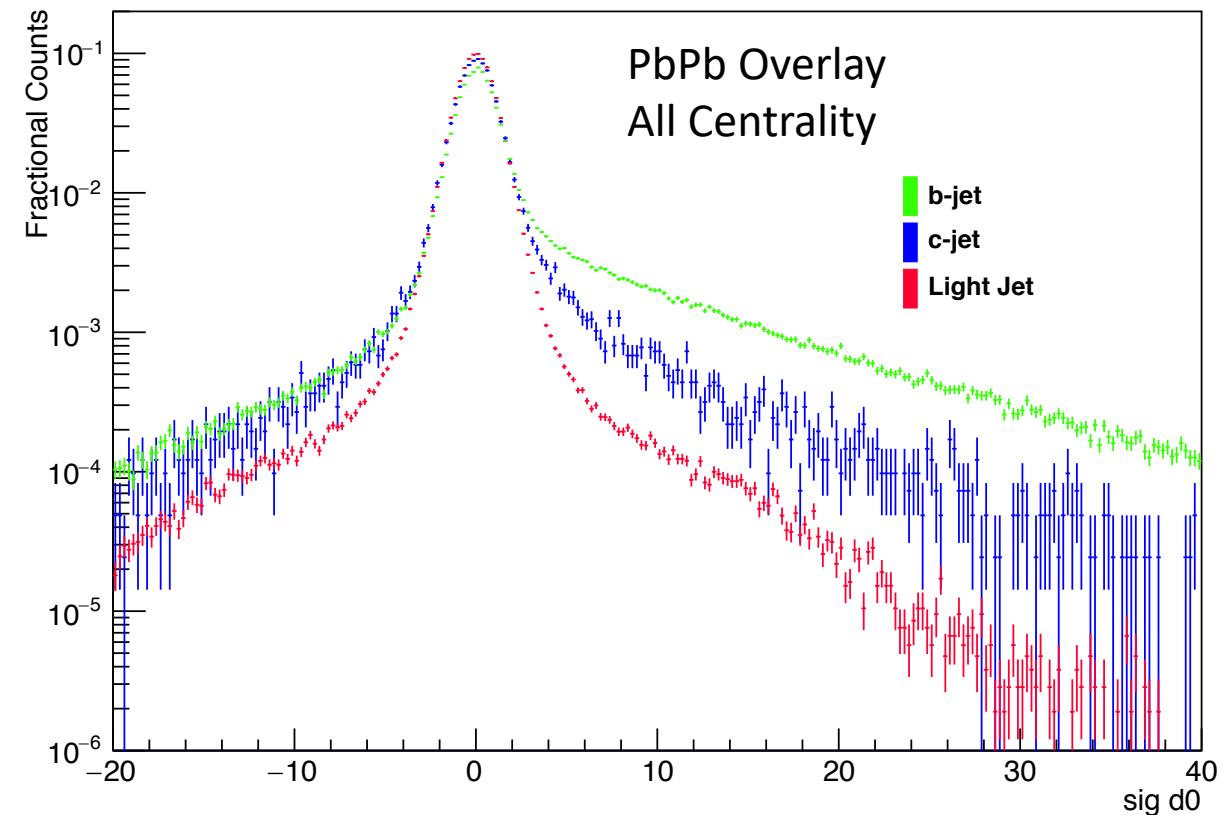
- d0 significance distributions assimilate at pT cut  $\approx 2$  GeV.
- Similarly for z0 and z0sig.

# Templates Making with Overlay Sample for Quality Good

Default Setup Shrinking Cone



Fixed Cone +  $pT \geq 1.5 \text{ GeV}$

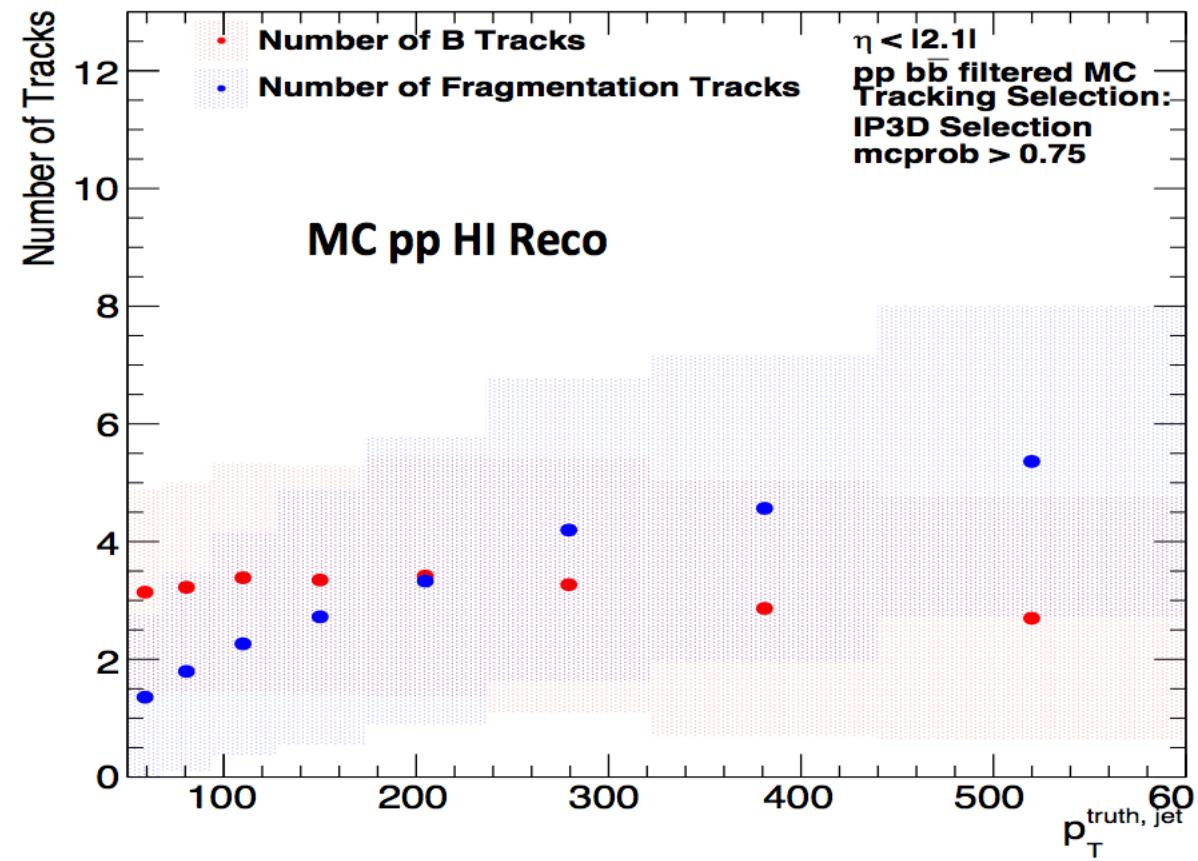


With  $pT$  cut combined with changing to fixed cone, the difference between jets are wider spreadout, which should help classification.

# Conclusion and next steps

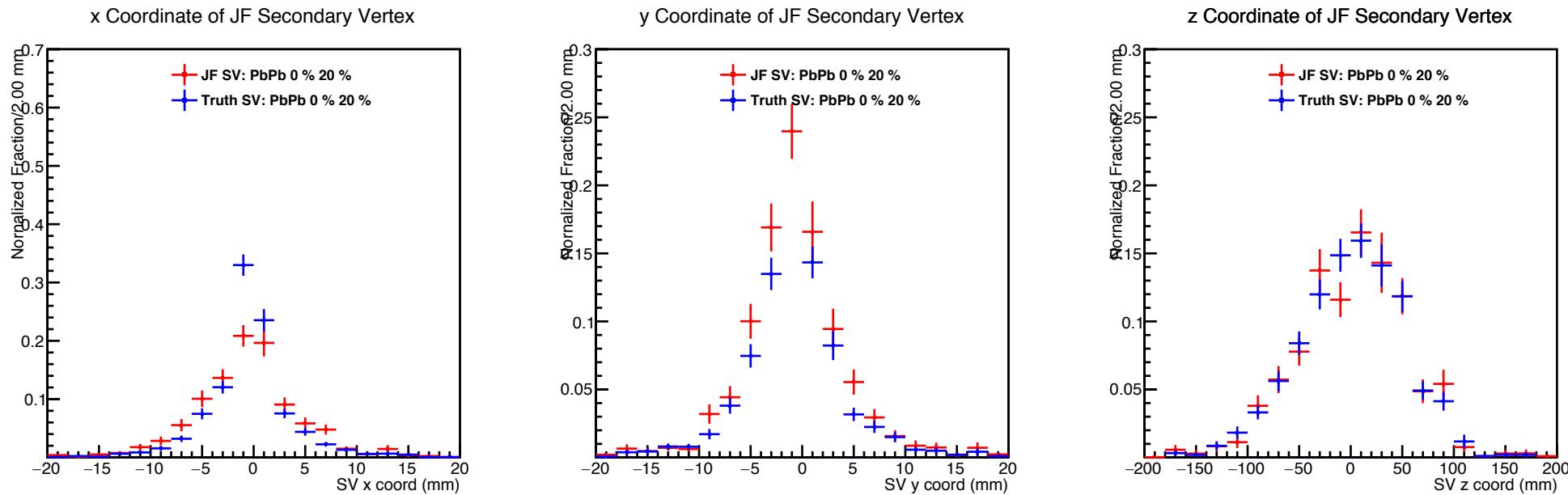
- Experimented cuts, especially with min pT requirement helps reduce fake and improve physics variables.
- Cuts applied at TrackAssociation stage to improve physics variables like energy fraction.
- Applying these cuts do not affect SV resolution qualitatively in JetFitter.
  - Plan: compare for VKal tool.
  - Plan: make fitting and quantitative comparison.
- In SVF tool, lower cuts (1 GeV instead of 1.5 GeV) are giving better SV efficiency.
  - Plan: modify tagger algo further to reproduce improvements by changing TrackAssociation s.t. cuts can be tagger specific.

# Back-up





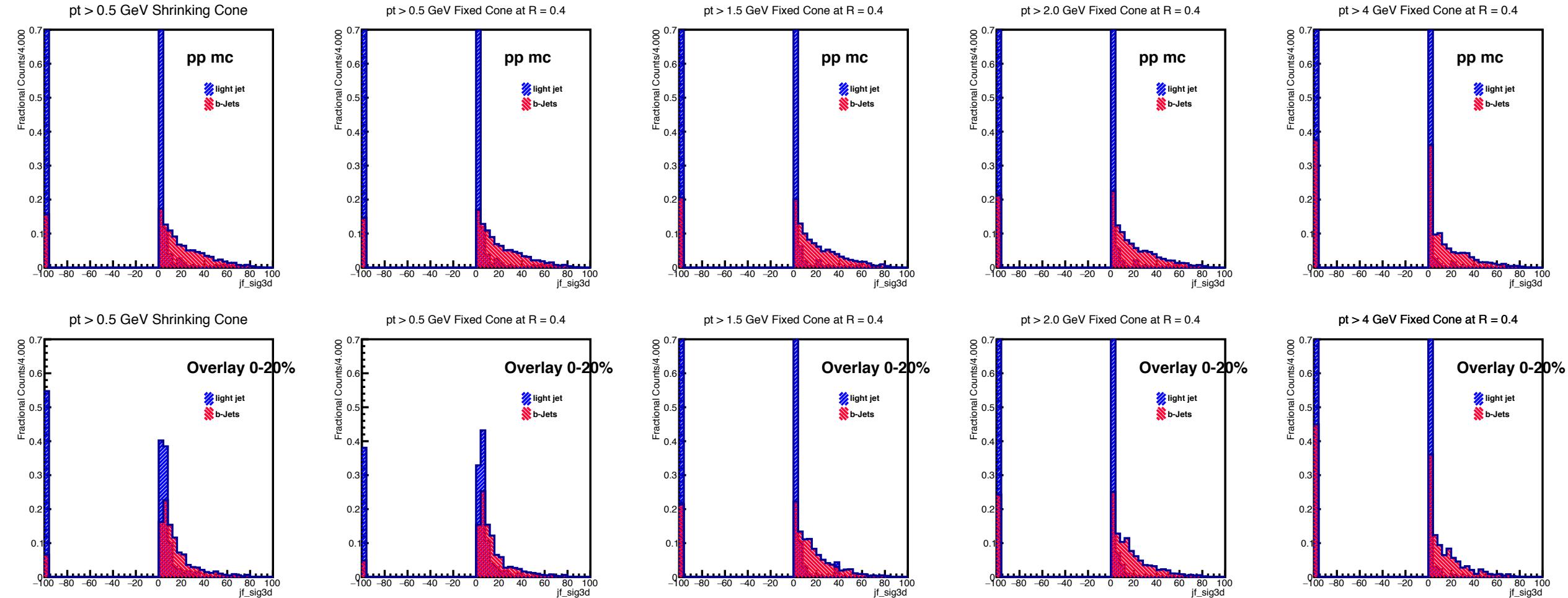
# JF pre-tagging selection, $pT \geq 1.5$ GeV



Modified JF Setup (anti PU off)  
First Fitting min Track  $pT$ : 1.5 GeV  
Second Fitting min Track  $pT$ : 1.75 GeV  
No Selection on Input Tracks  
Fixed Cone at 0.4

SV1

# JF sig3d (decay length significance)



Top Row: pp mc

Bottom Row: Overlay 0-20%

From left to right:

1. No pT Shrinking Cone
2. No pT Fixed Cone
3. Min pt = 1.5 GeV Fixed Cone

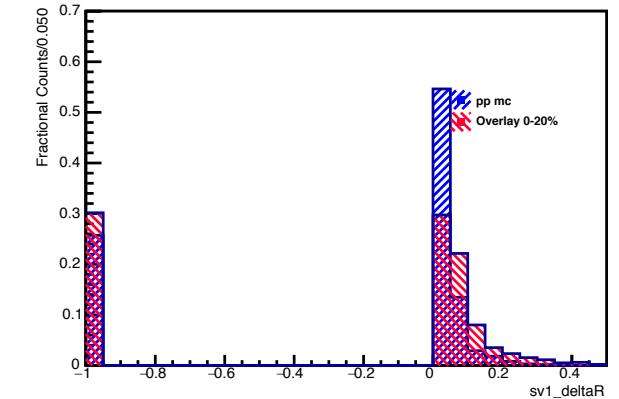
4. Min pt = 2.0 GeV Fixed Cone

5. Min pt = 4.0 GeV Fixed Cone

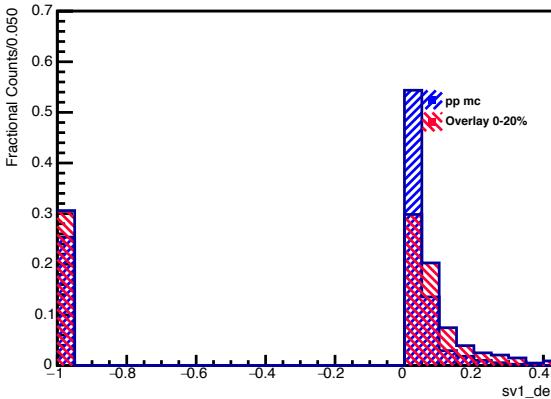
Red: b-jet

Blue: light jet

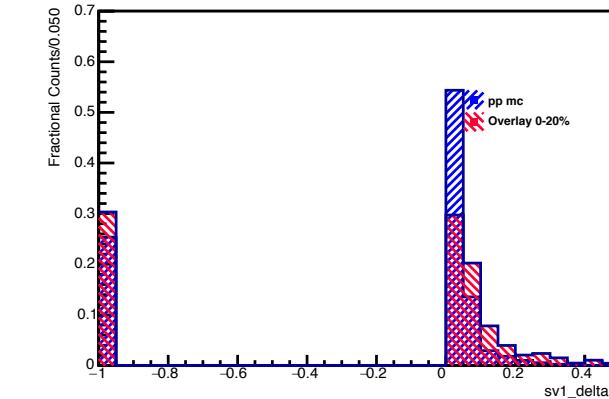
JF pt &gt; 0.5 GeV Shrinking Cone



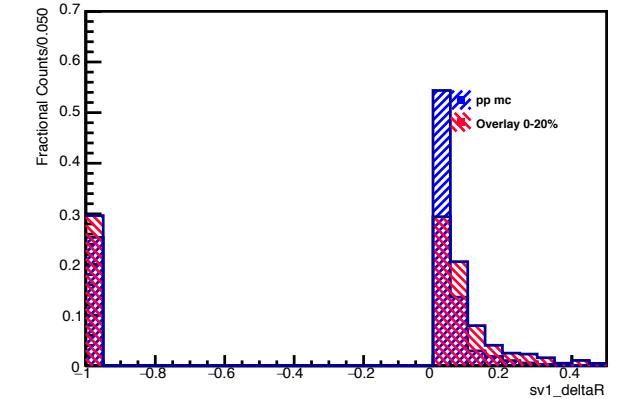
JF pt &gt; 0.5 GeV Fixed Cone at R = 0.4



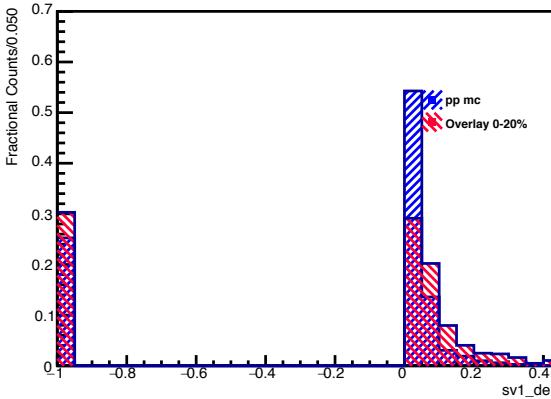
JF pt &gt; 1.0 GeV Fixed Cone at R = 0.4



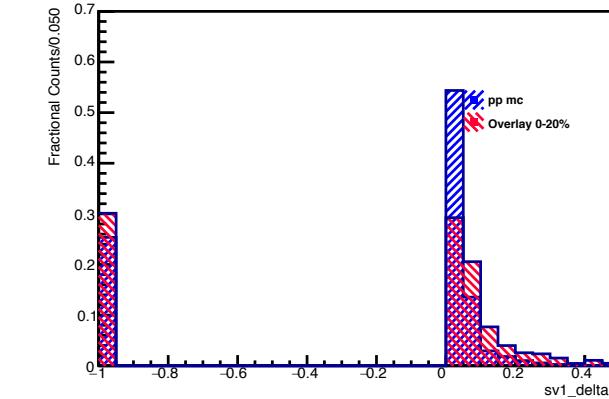
JF pt &gt; 1.5 GeV Fixed Cone at R = 0.4



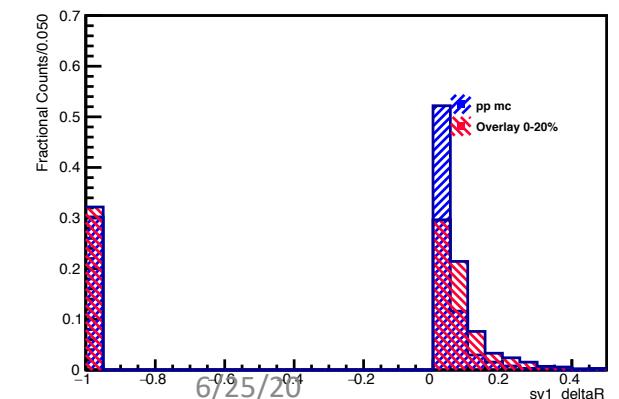
JF pt &gt; 2.0 GeV Fixed Cone at R = 0.4



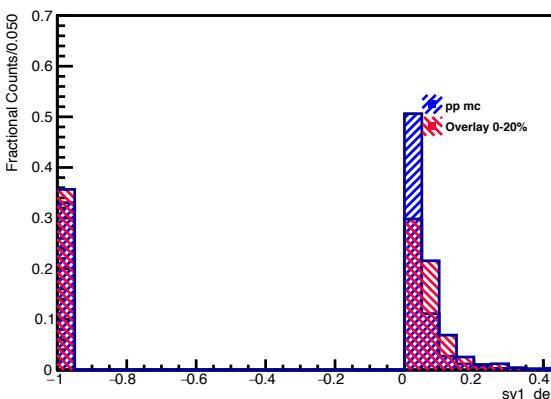
JF pt &gt; 4 GeV Fixed Cone at R = 0.4



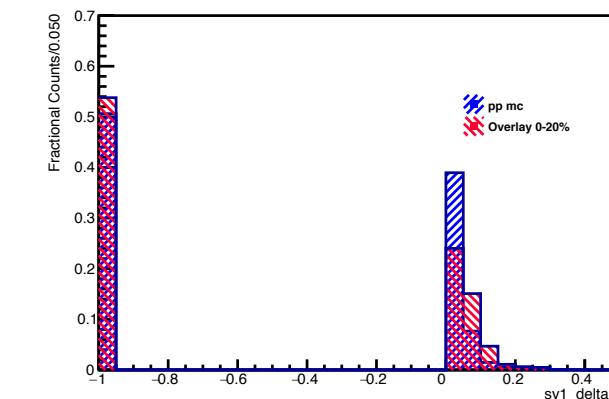
pre-tagging pt &gt; 1.5 GeV Fixed Cone at R = 0.4



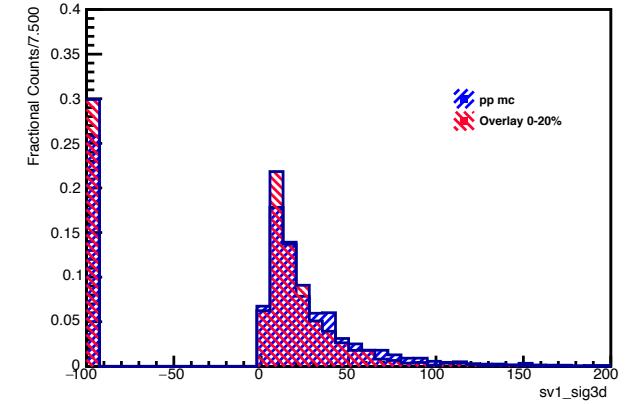
pre-tagging pt &gt; 2.0 GeV Fixed Cone at R = 0.4



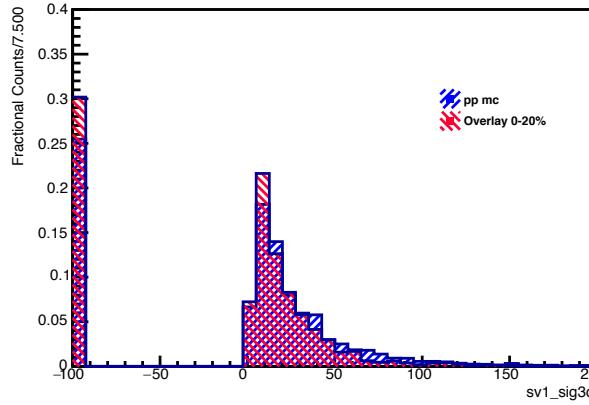
pre-tagging pt &gt; 4.0 GeV Fixed Cone at R = 0.4



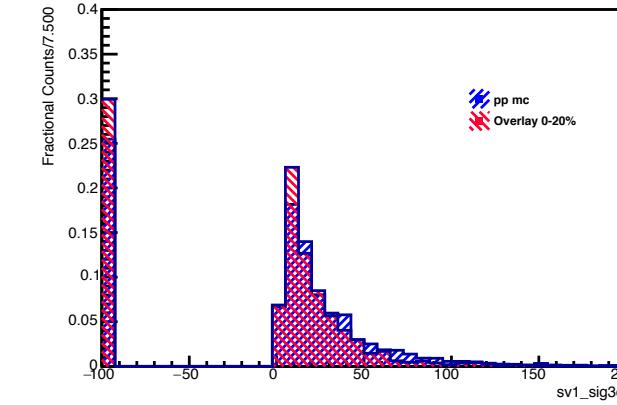
JF pt &gt; 0.5 GeV Shrinking Cone



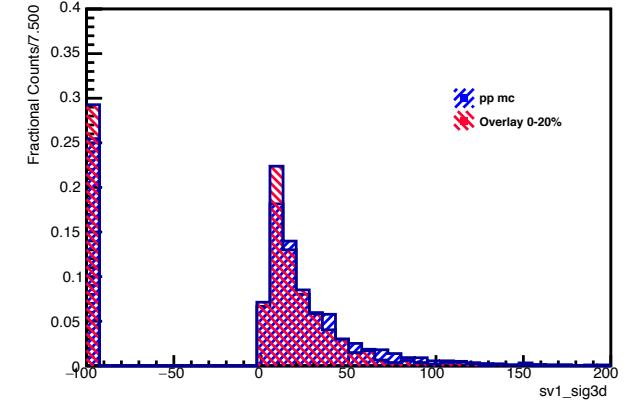
JF pt &gt; 0.5 GeV Fixed Cone at R = 0.4



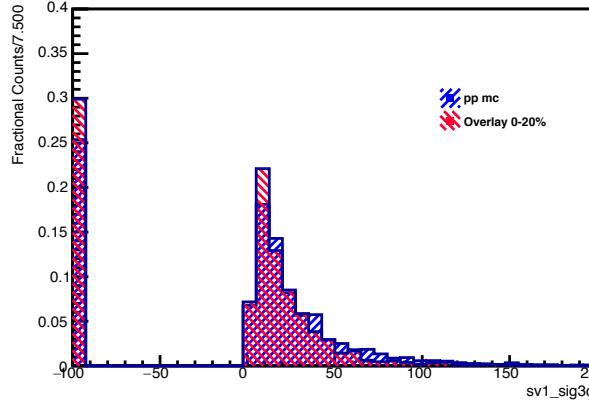
JF pt &gt; 1.0 GeV Fixed Cone at R = 0.4



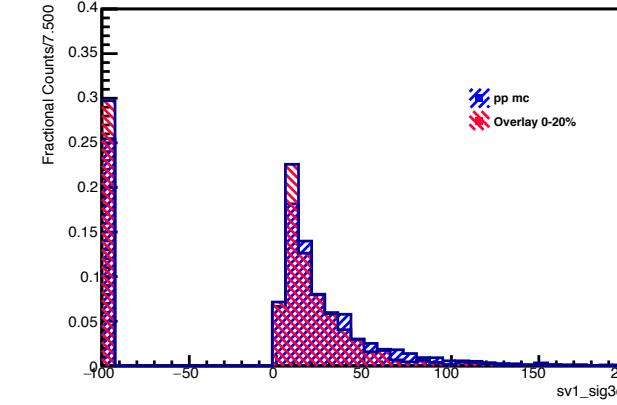
JF pt &gt; 1.5 GeV Fixed Cone at R = 0.4



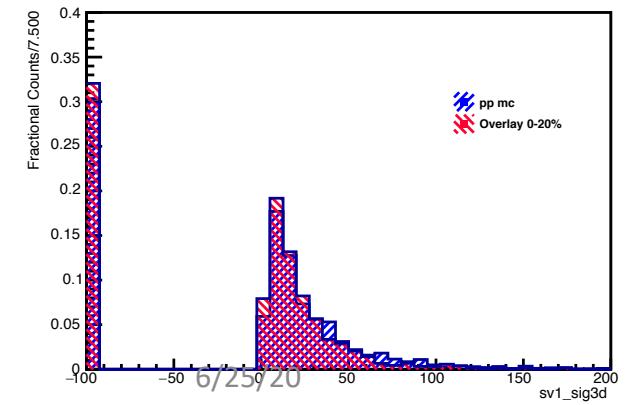
JF pt &gt; 2.0 GeV Fixed Cone at R = 0.4



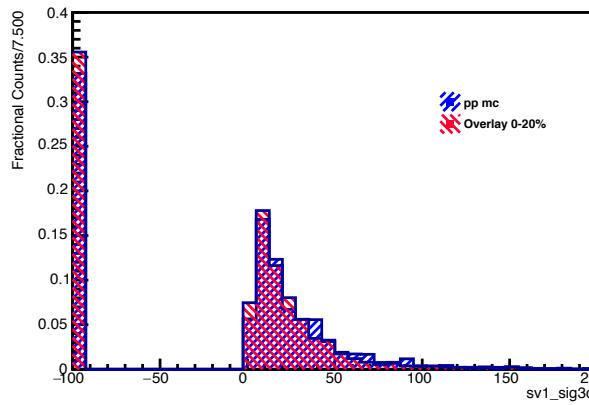
JF pt &gt; 4 GeV Fixed Cone at R = 0.4



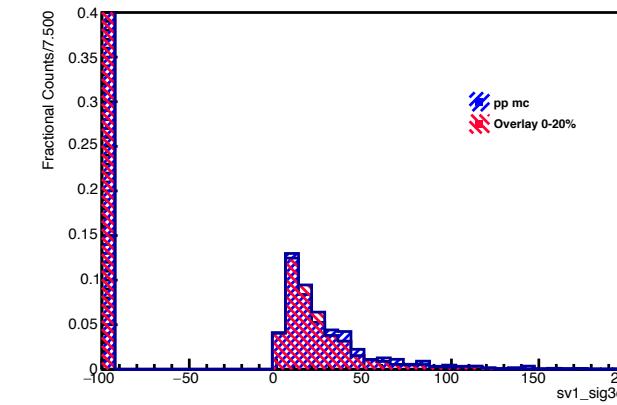
pre-tagging pt &gt; 1.5 GeV Fixed Cone at R = 0.4



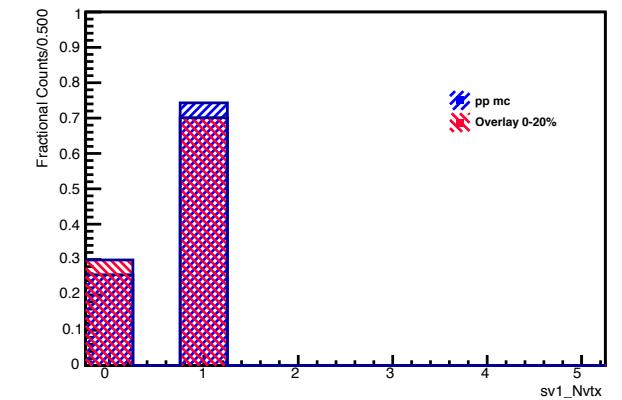
pre-tagging pt &gt; 2.0 GeV Fixed Cone at R = 0.4



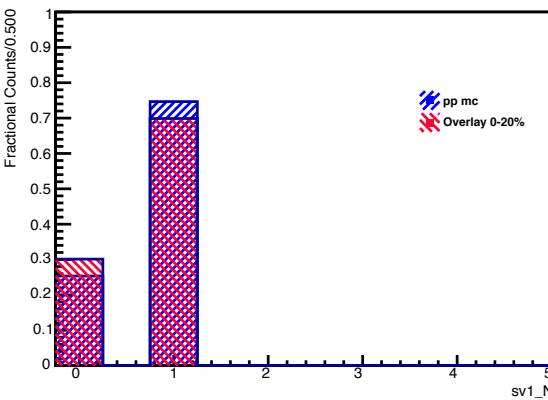
pre-tagging pt &gt; 4.0 GeV Fixed Cone at R = 0.4



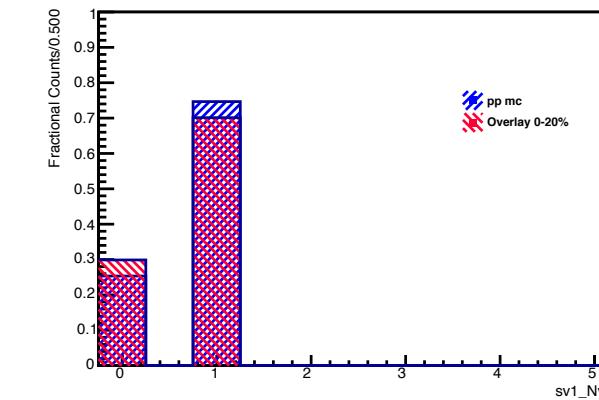
JF pt &gt; 0.5 GeV Shrinking Cone



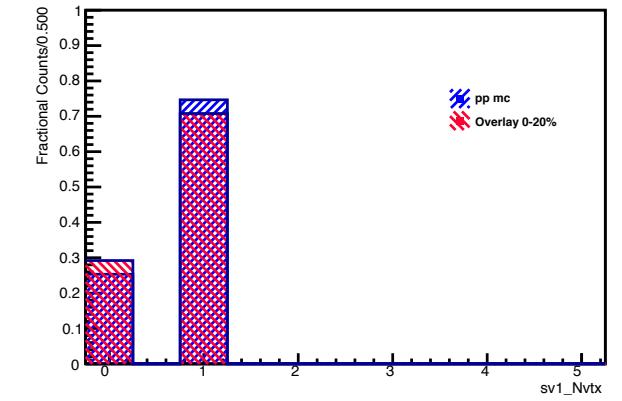
JF pt &gt; 0.5 GeV Fixed Cone at R = 0.4



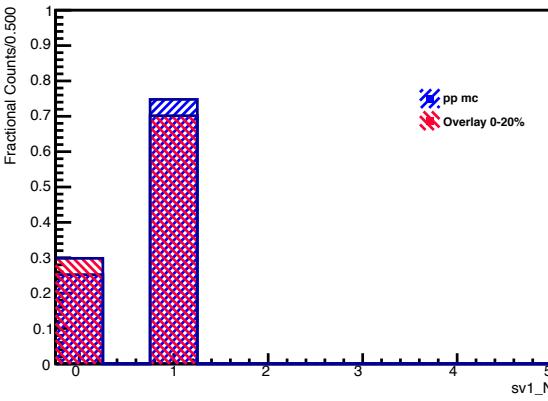
JF pt &gt; 1.0 GeV Fixed Cone at R = 0.4



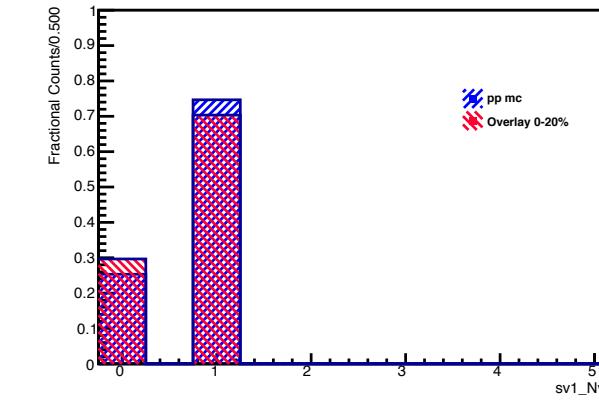
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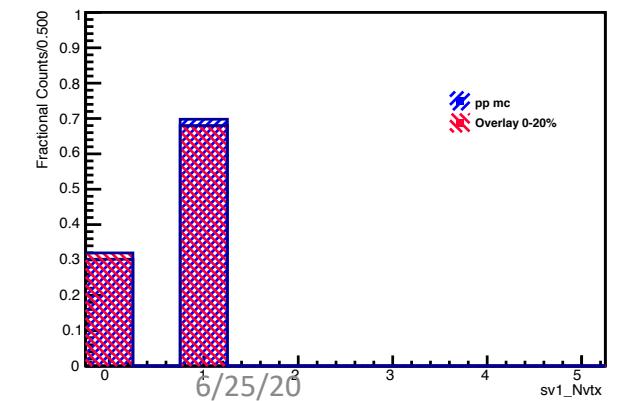
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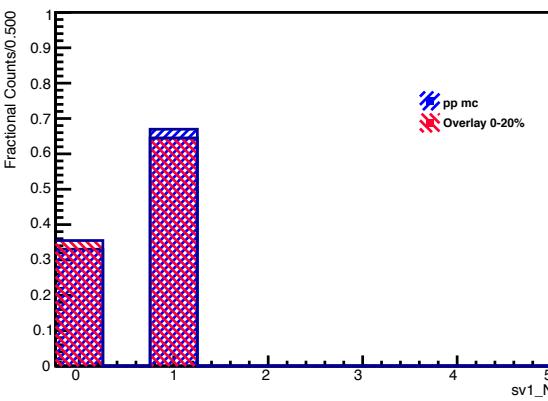
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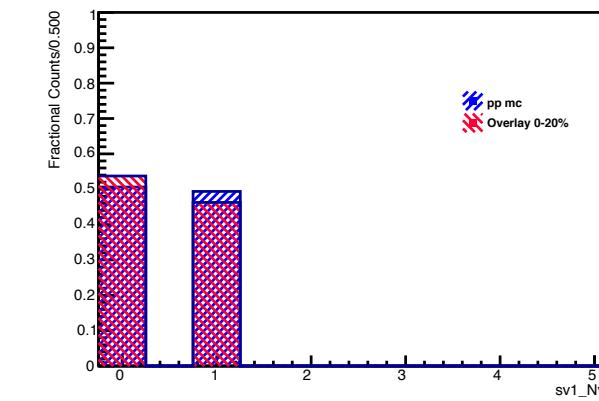
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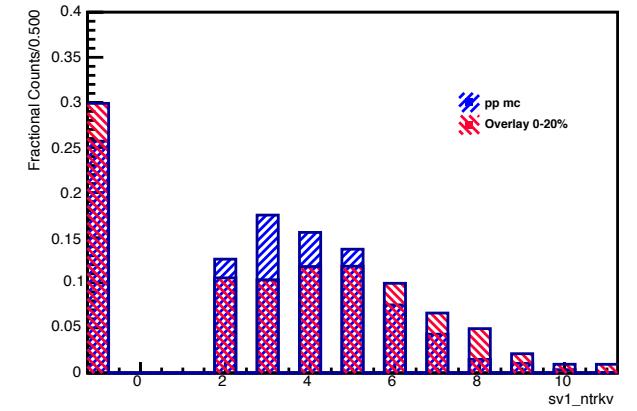
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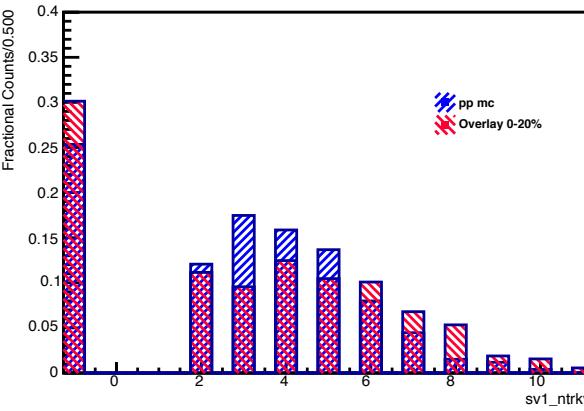
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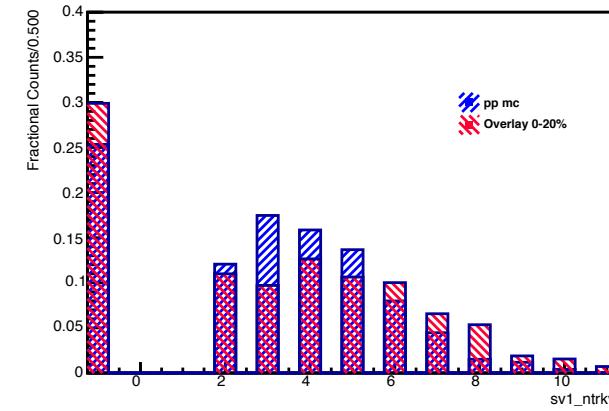
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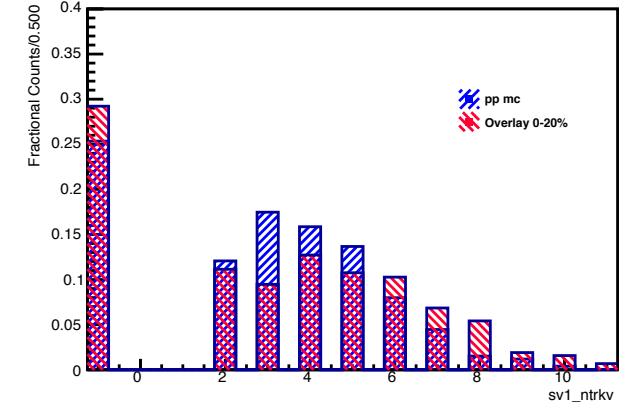
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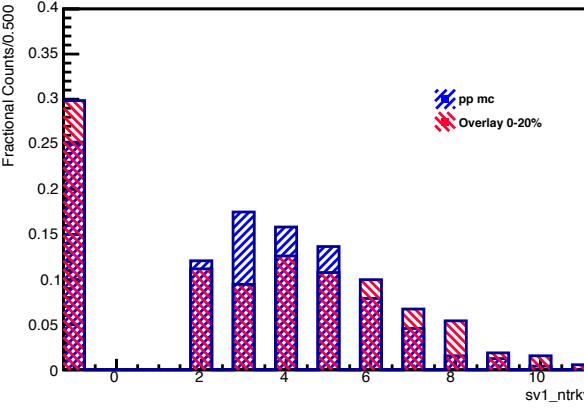
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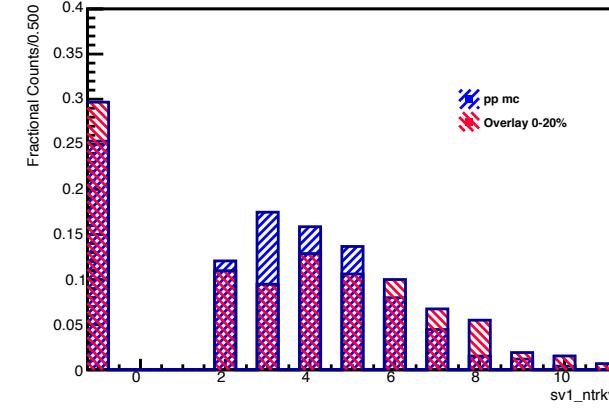
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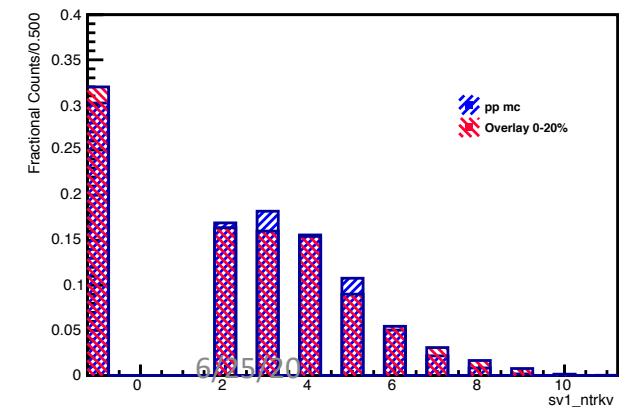
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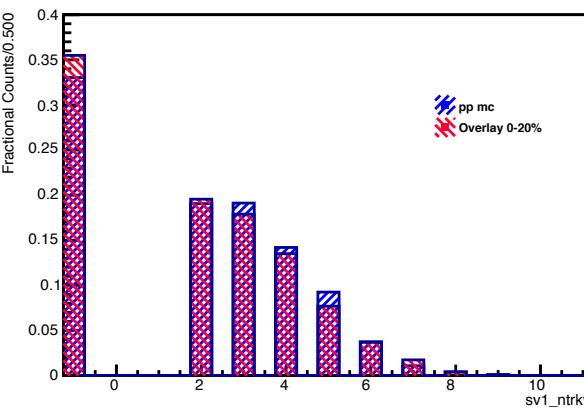
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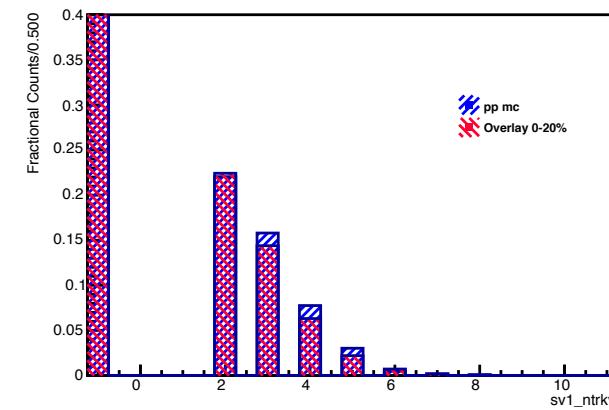
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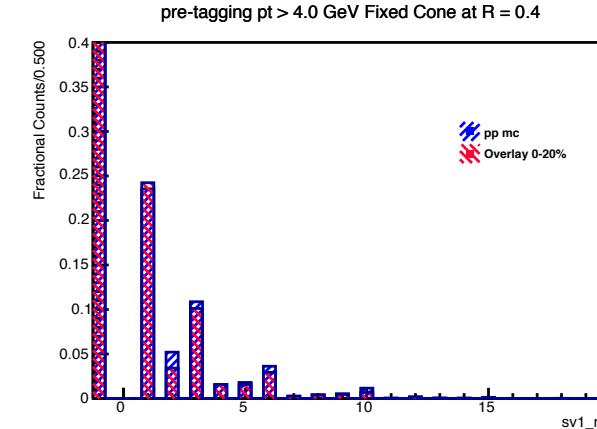
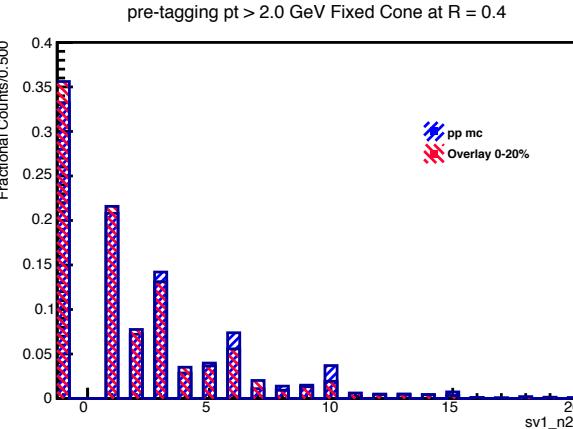
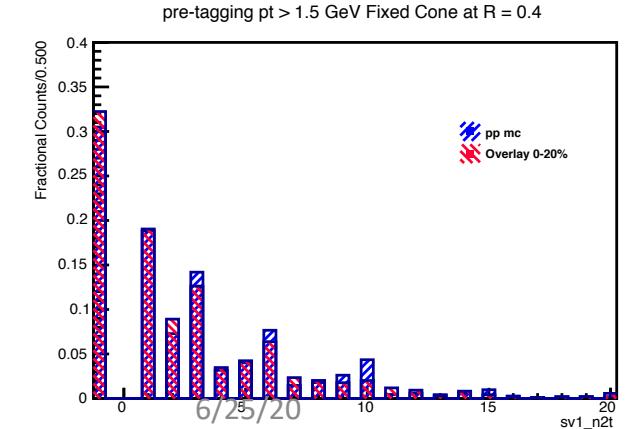
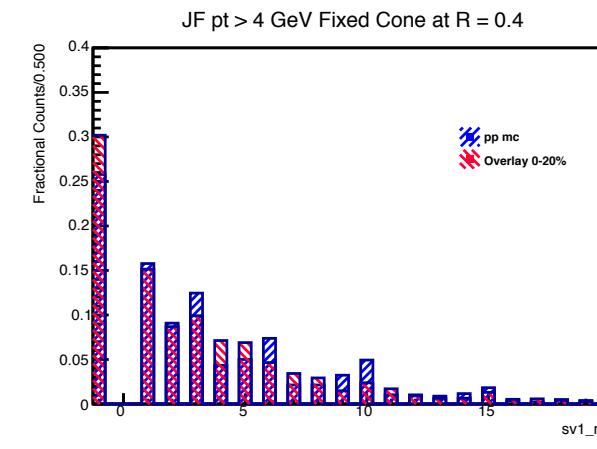
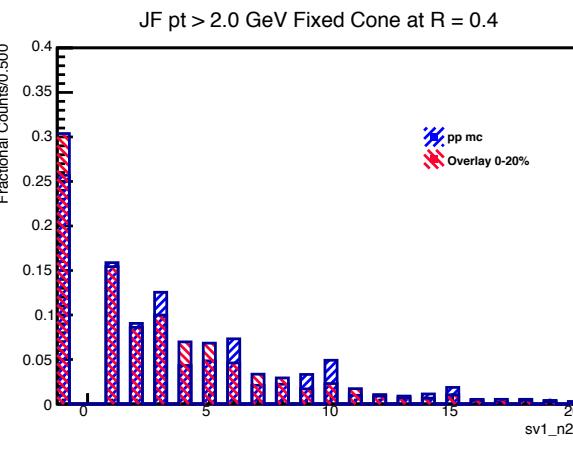
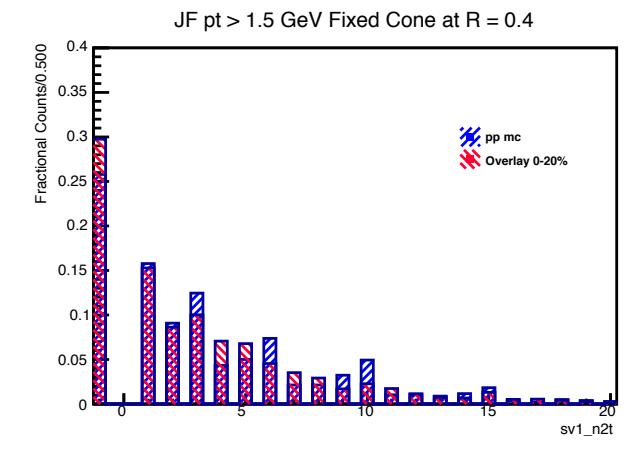
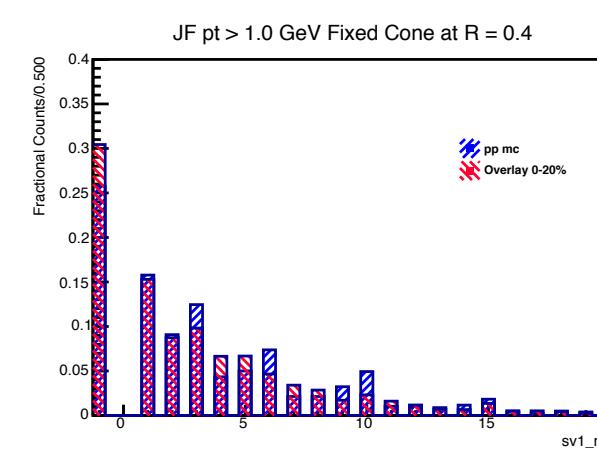
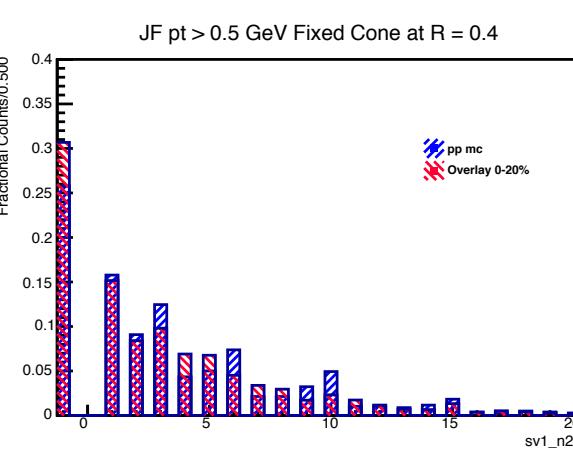
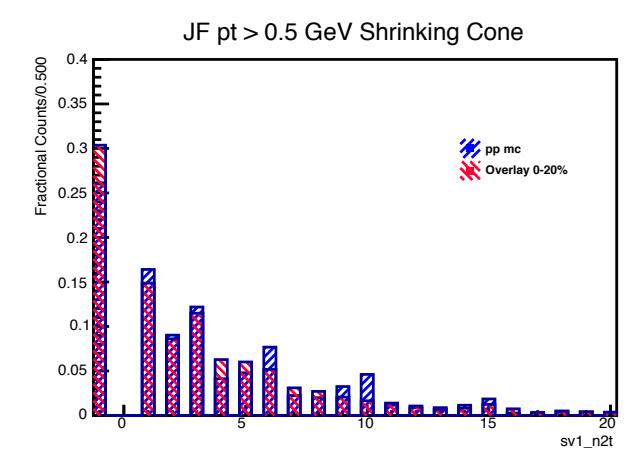


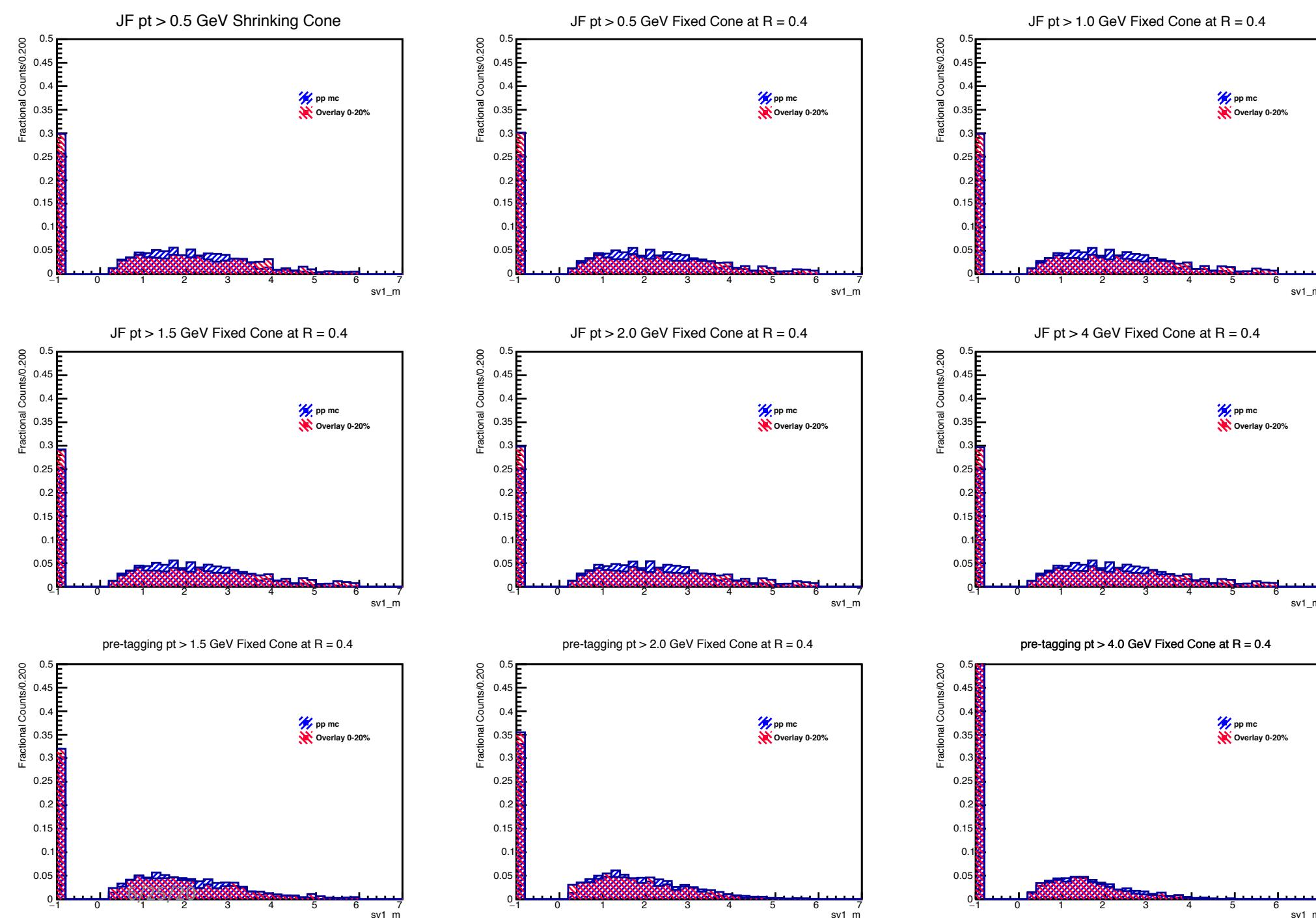
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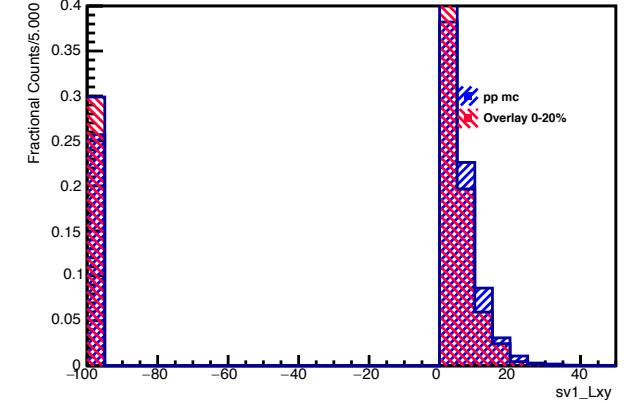
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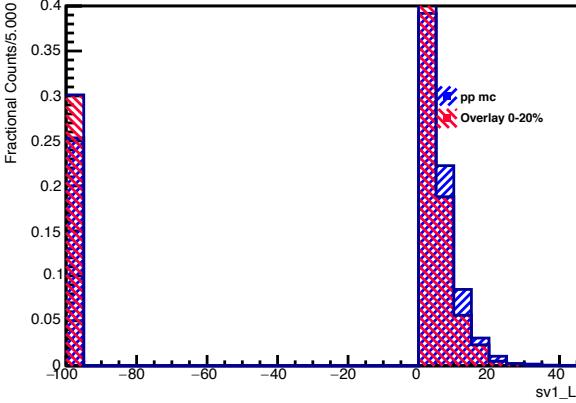




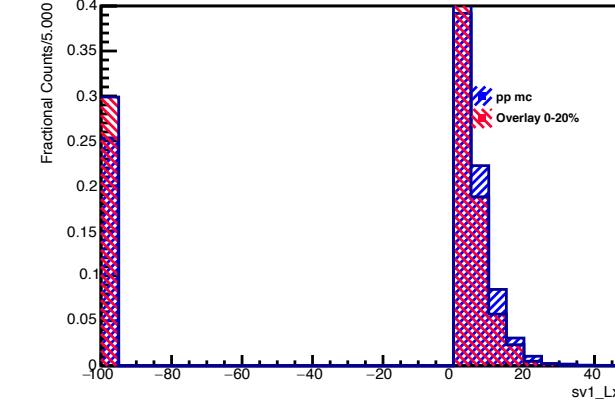
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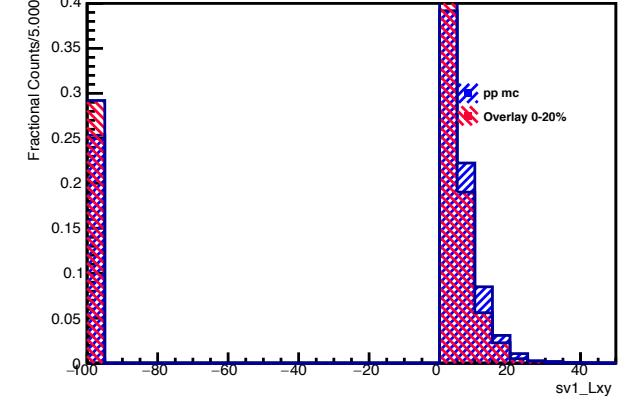
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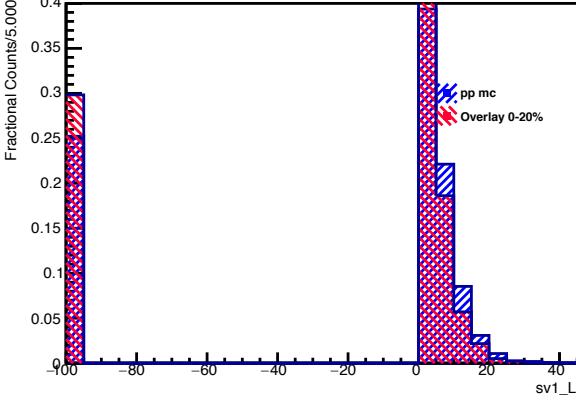
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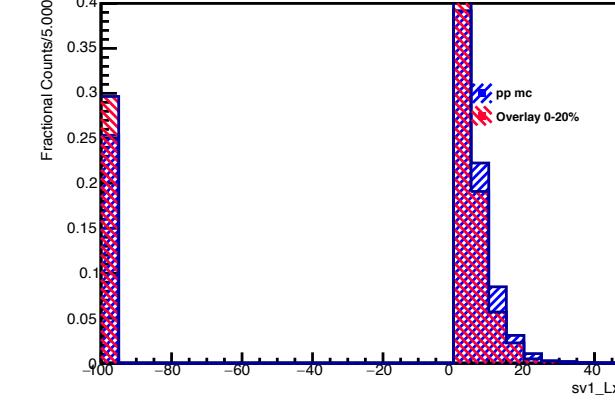
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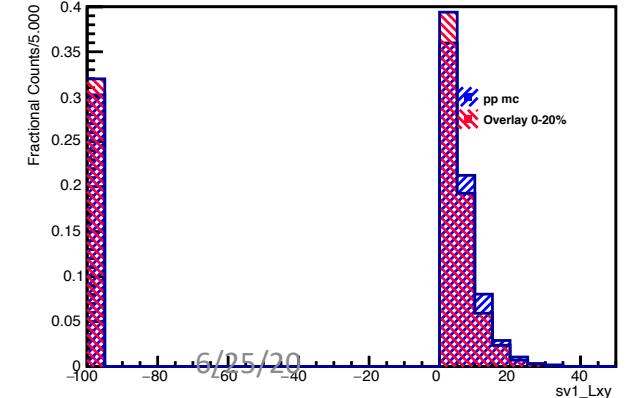
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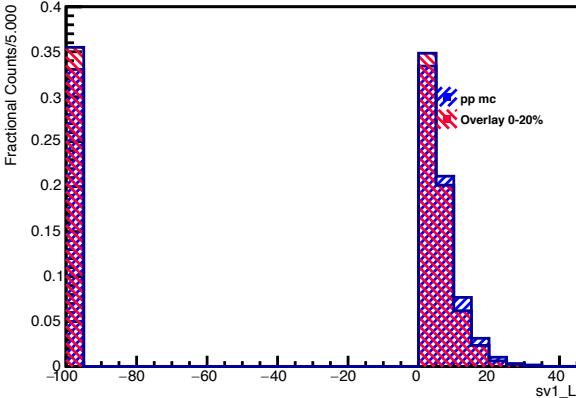
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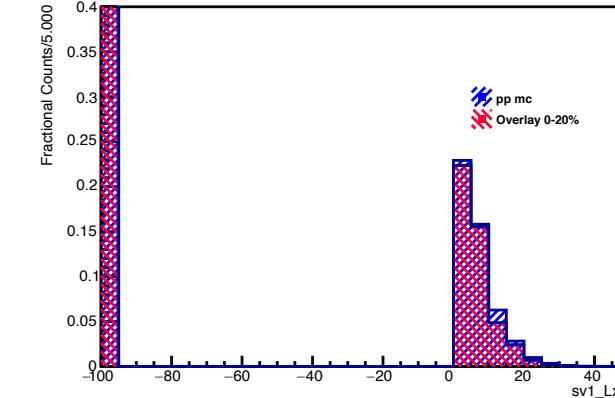
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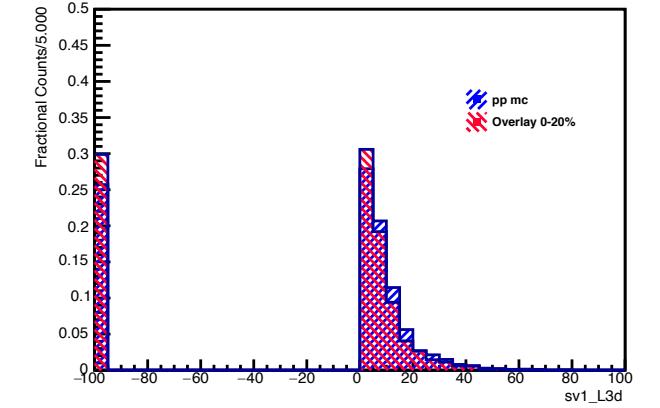
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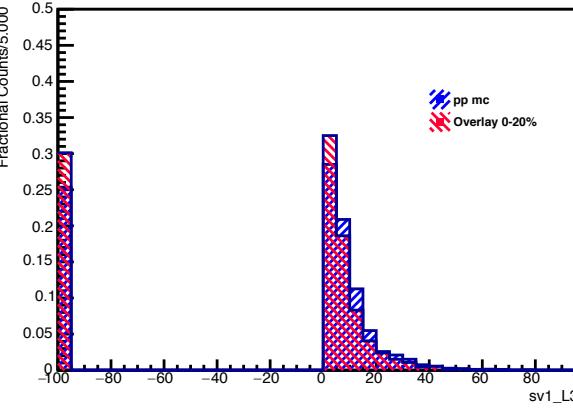
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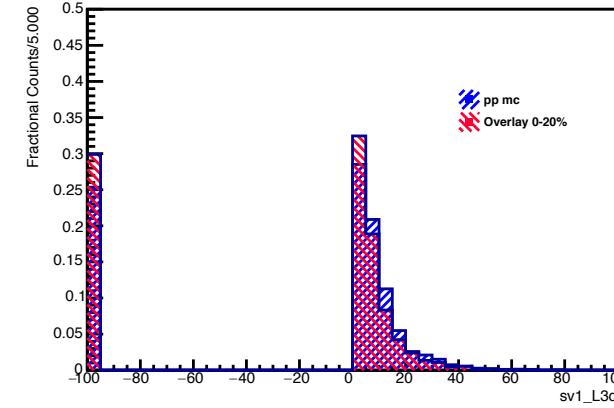
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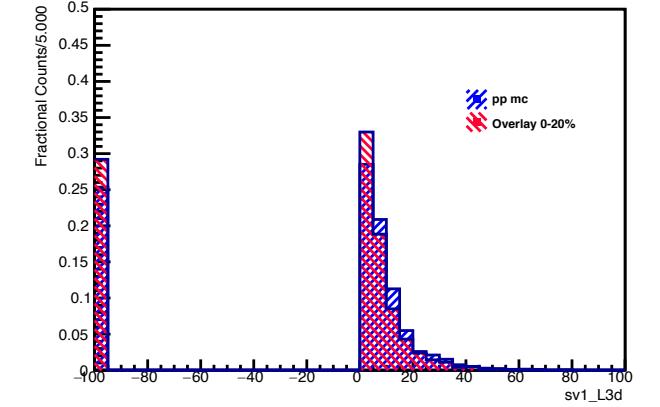
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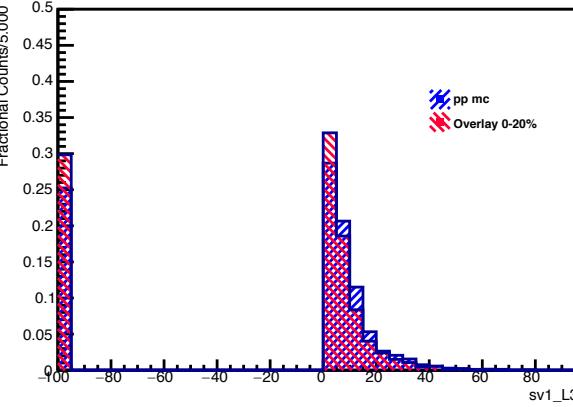
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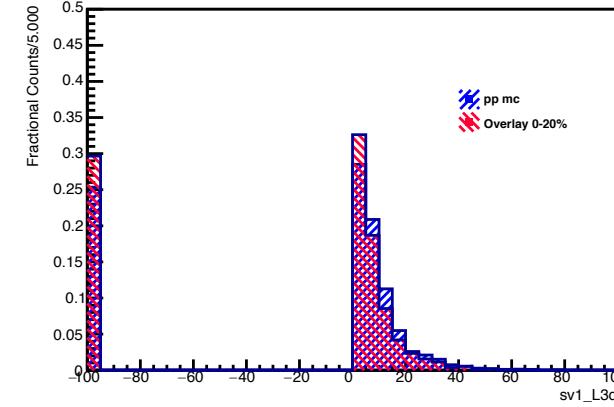
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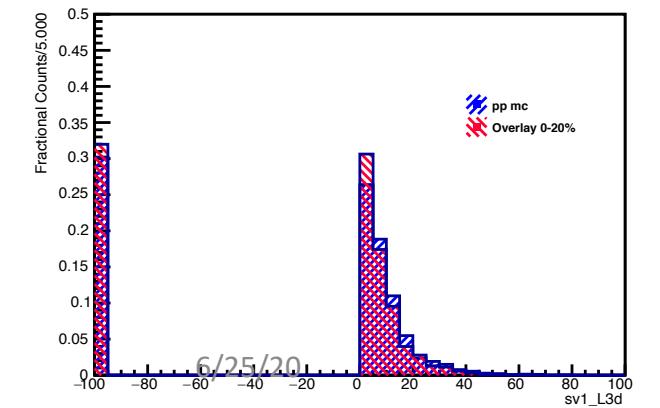
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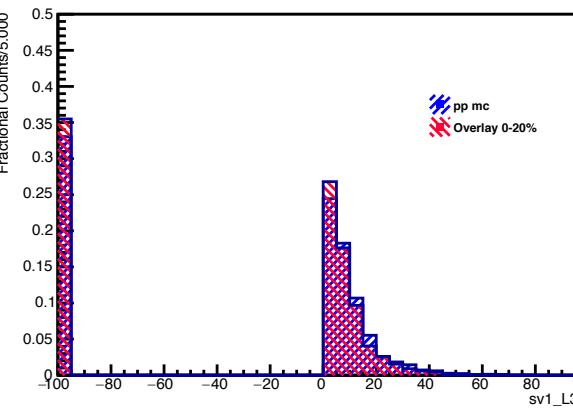
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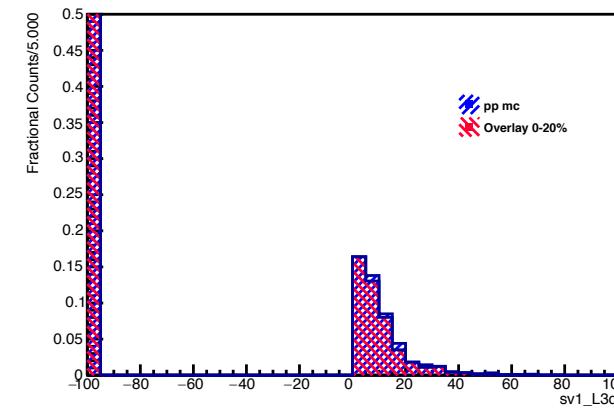
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pre-tagging pt &gt; 2.0 GeV Fixed Cone at R = 0.4

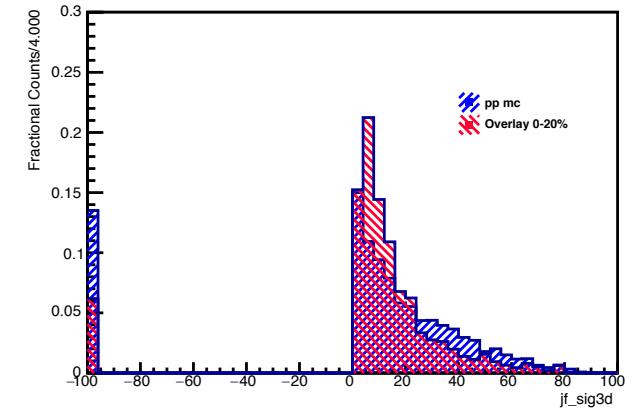


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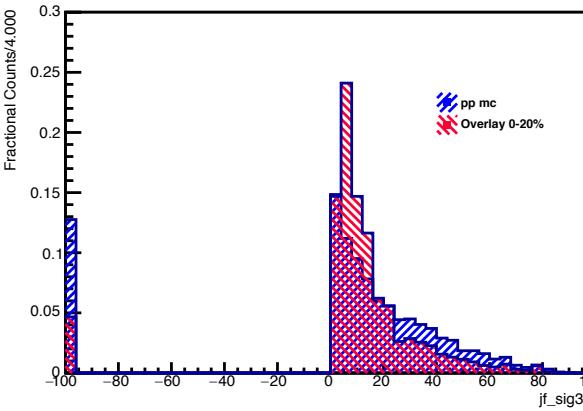


# JetFitter

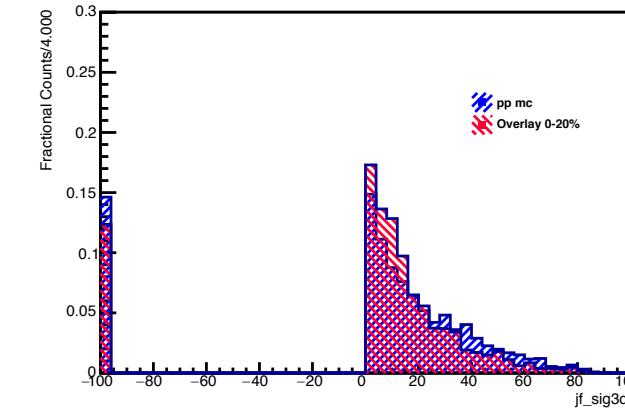
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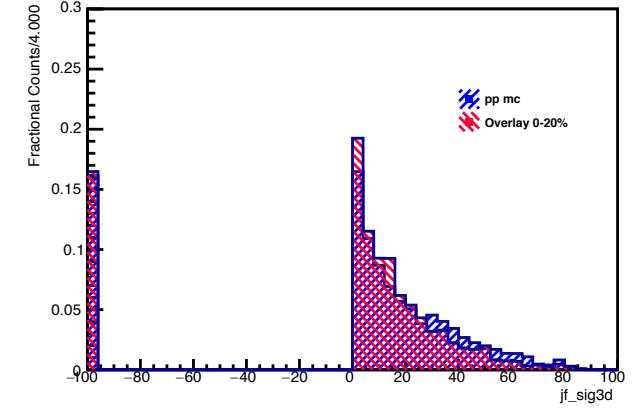
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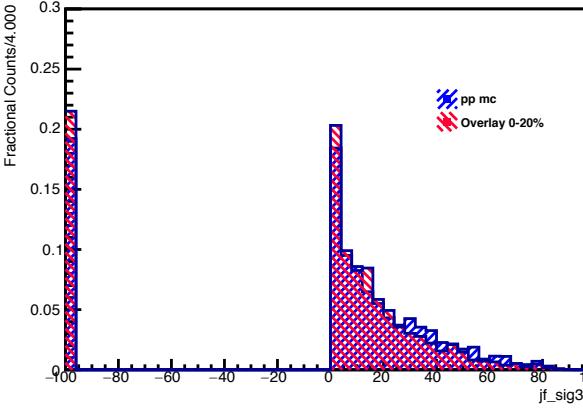
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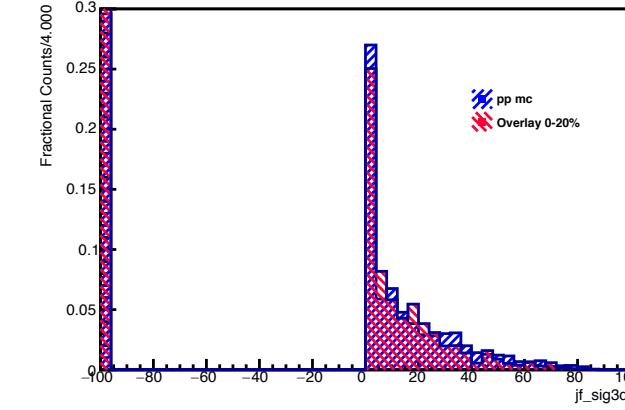
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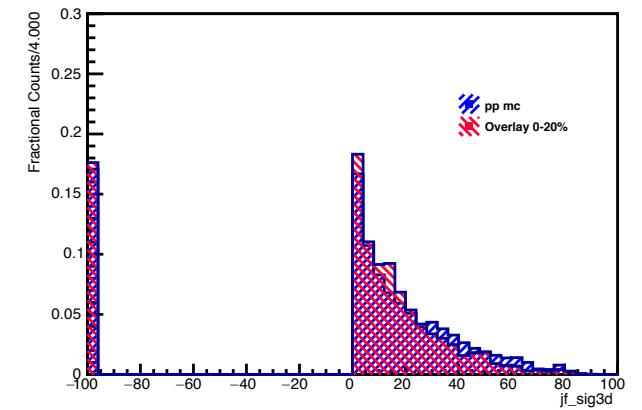
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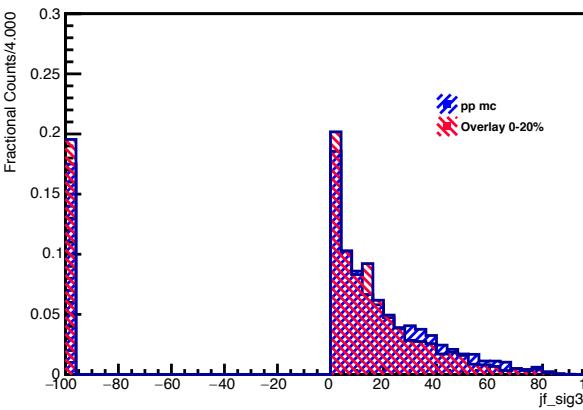
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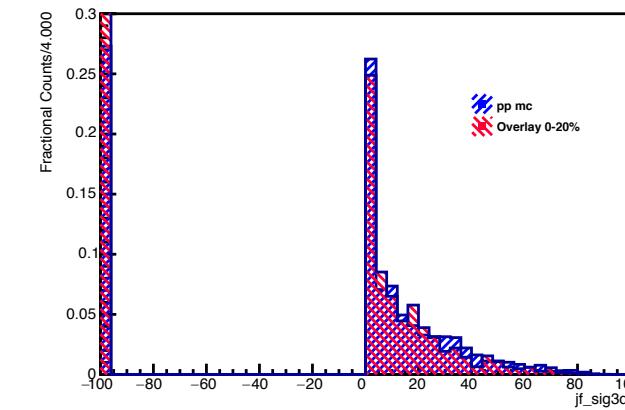
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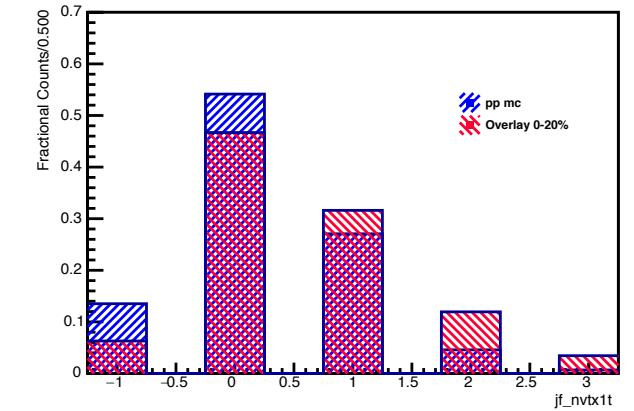
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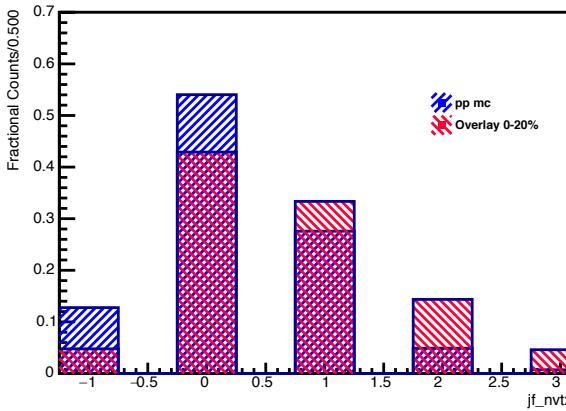
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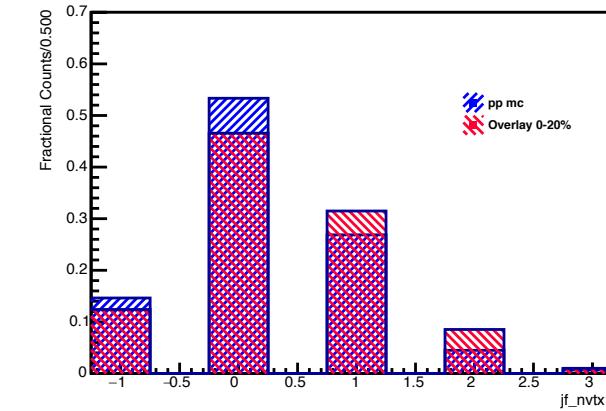
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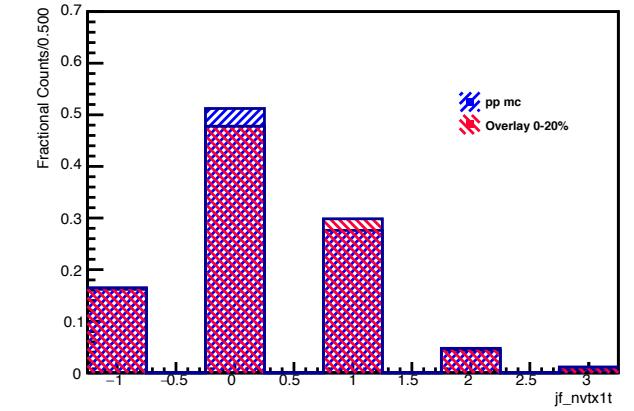
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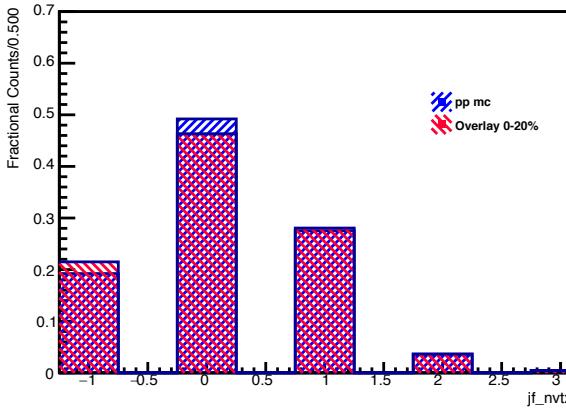
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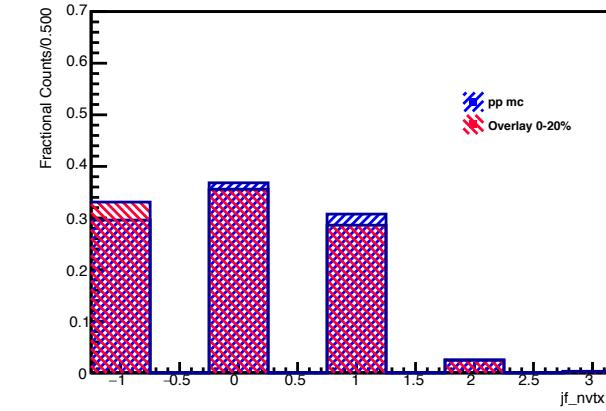
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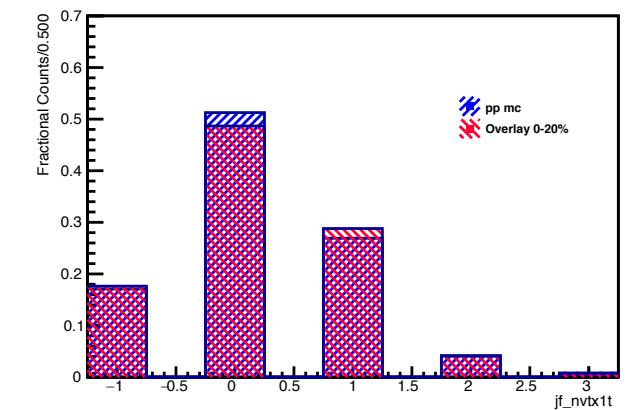
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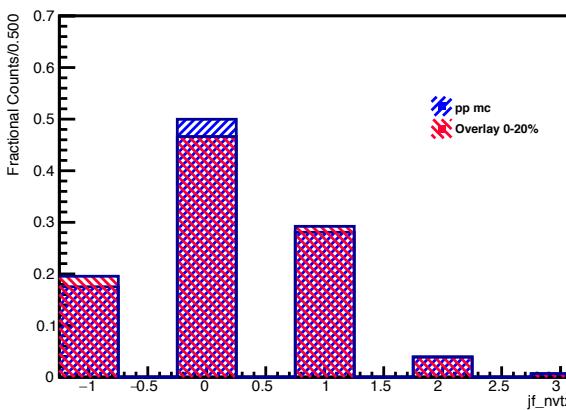
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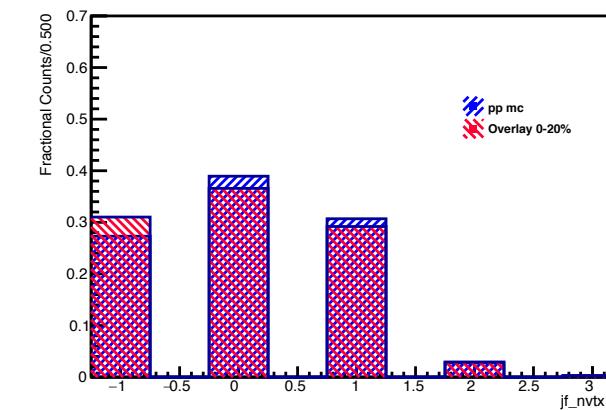
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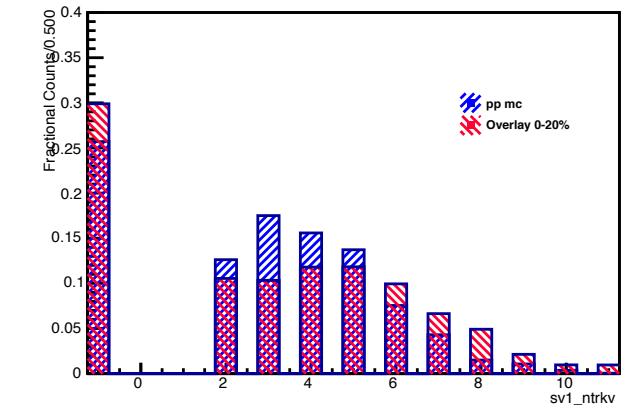
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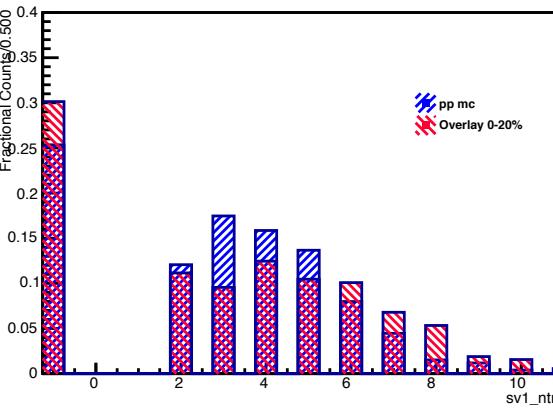
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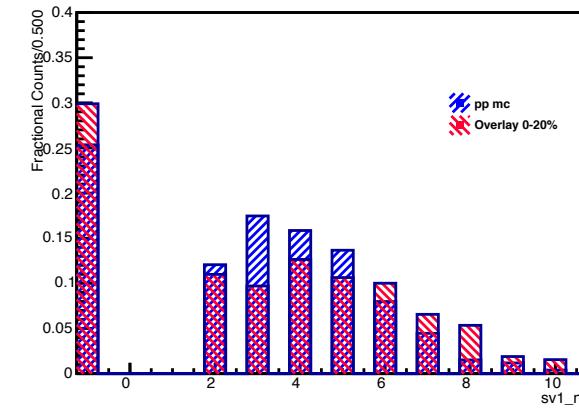
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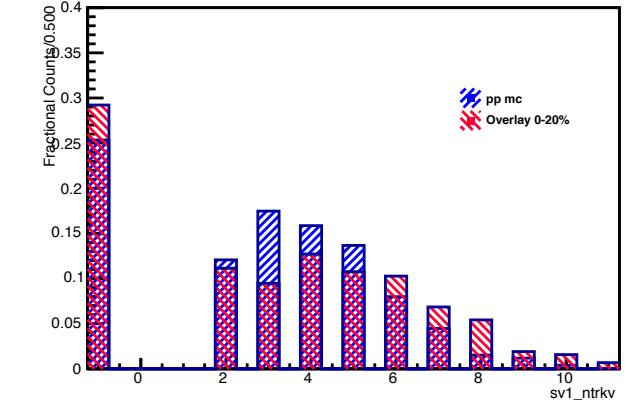
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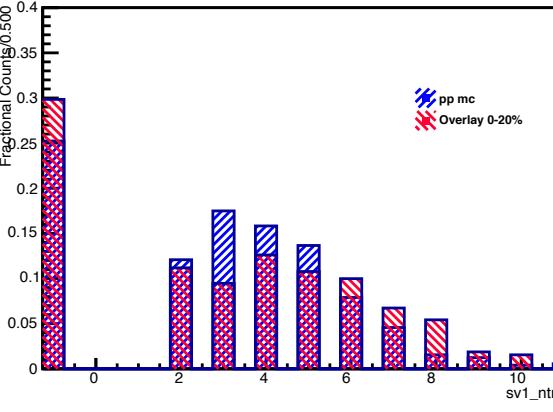
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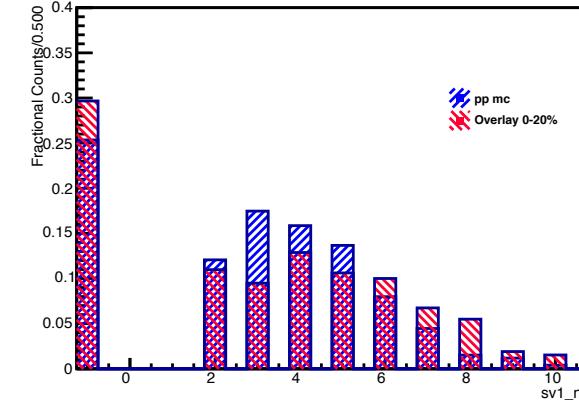
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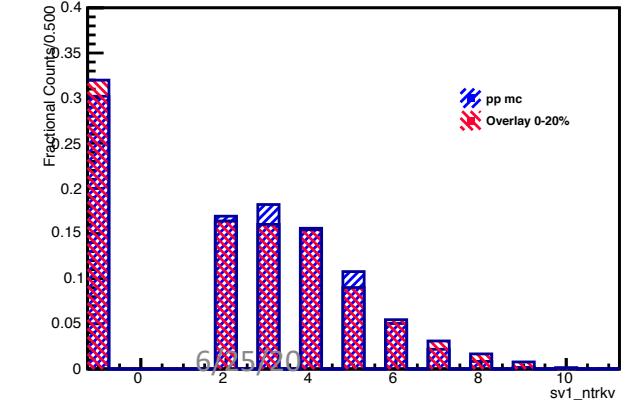
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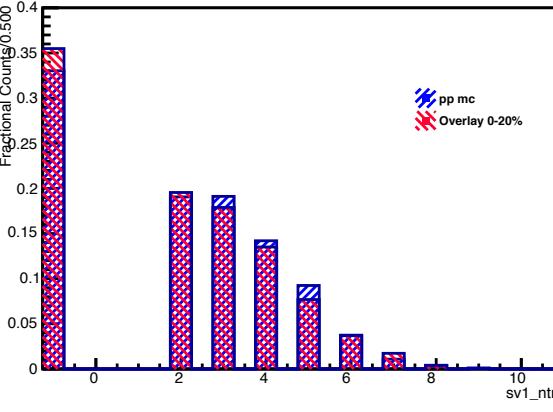
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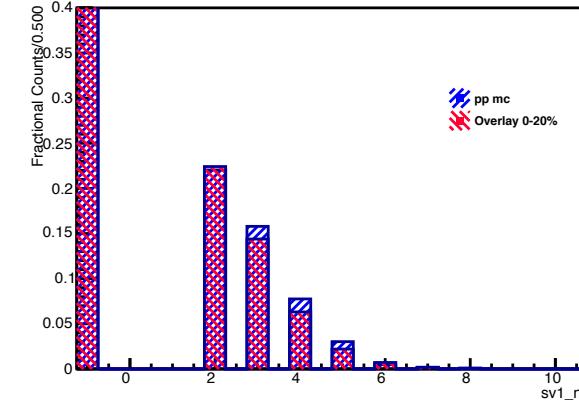
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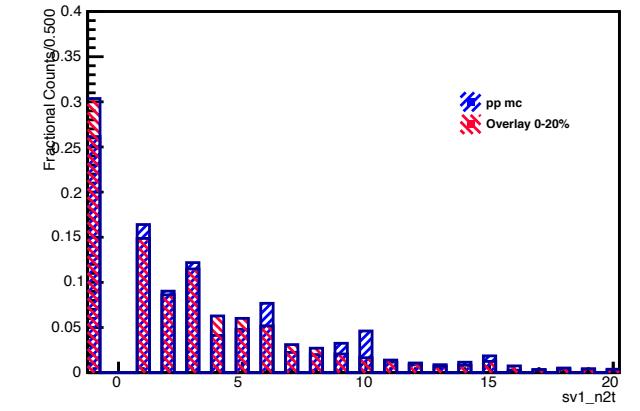
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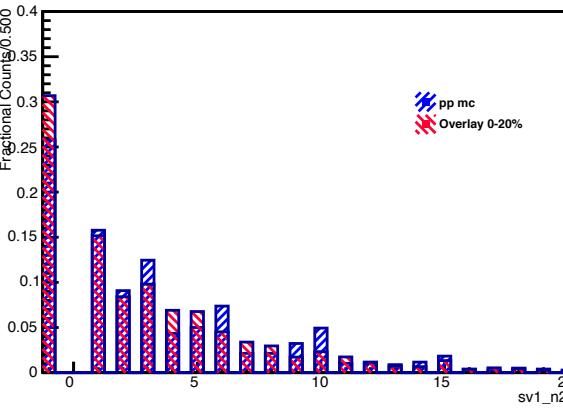
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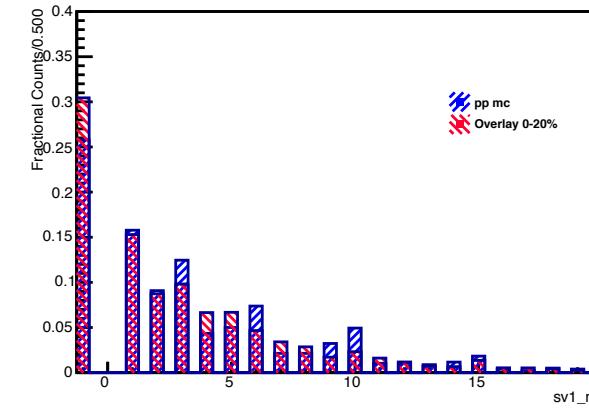
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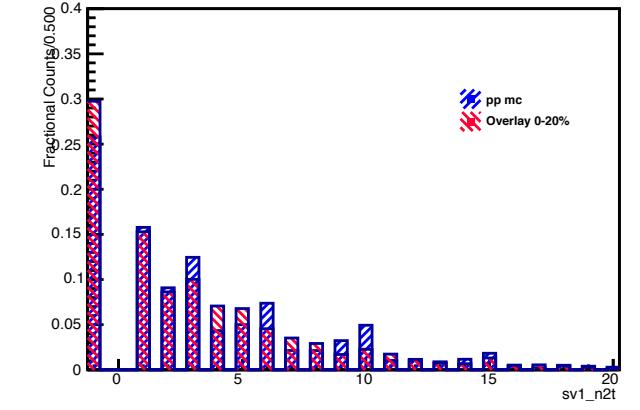
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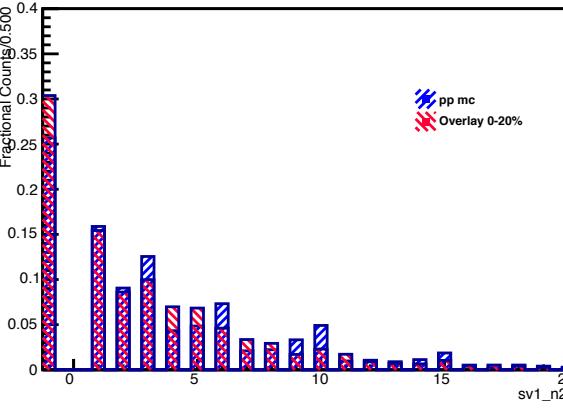
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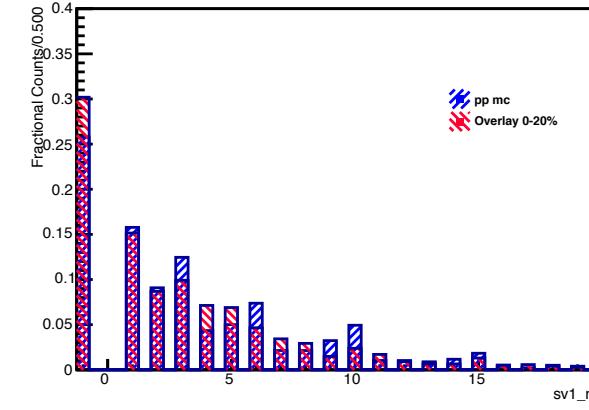
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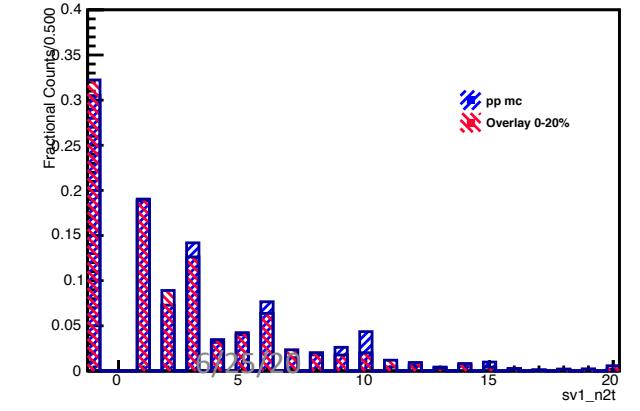
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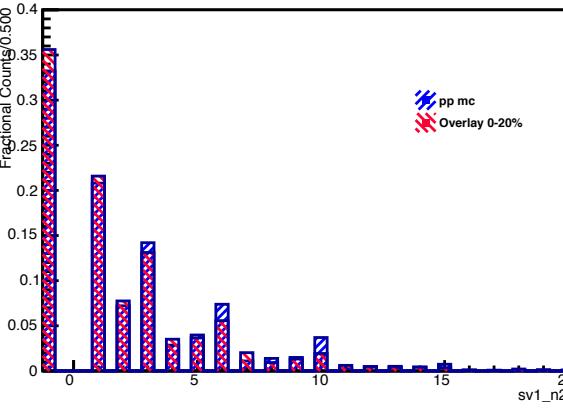
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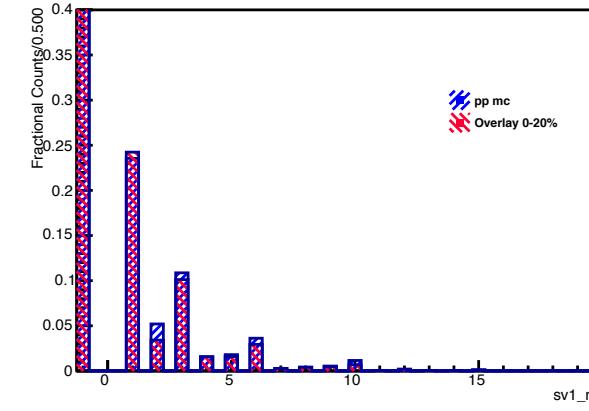
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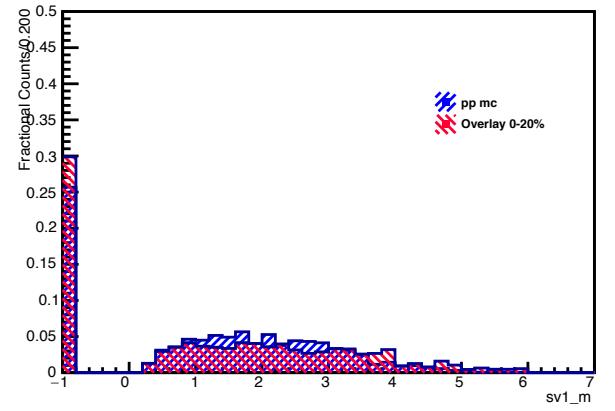
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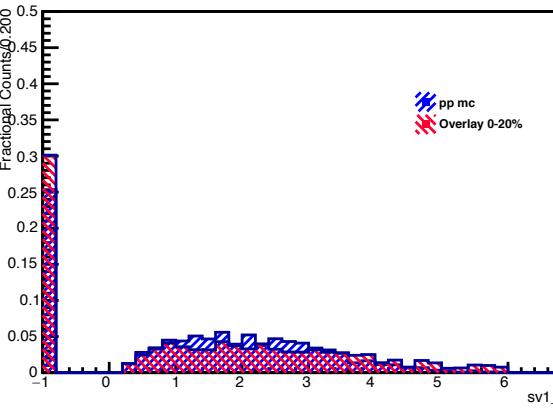
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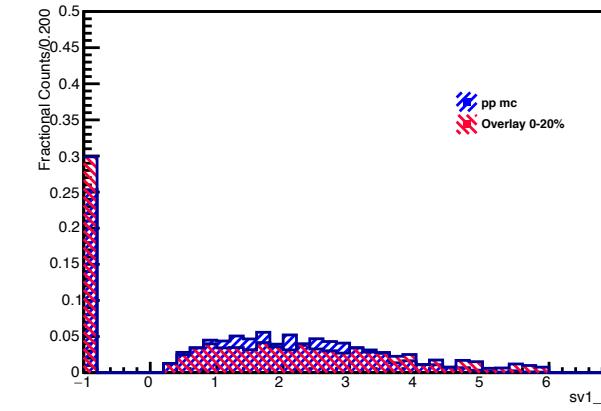
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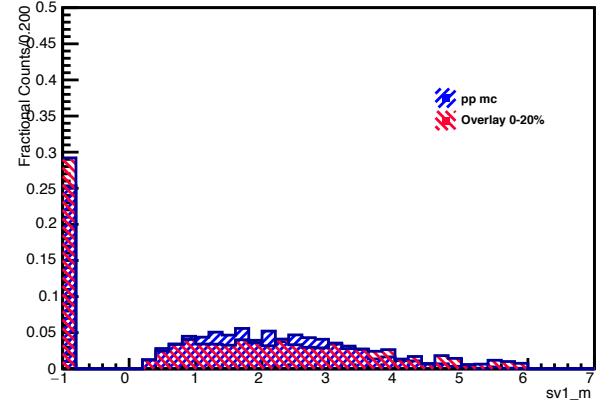
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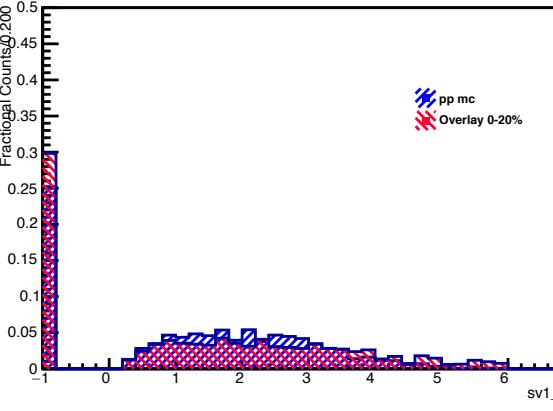
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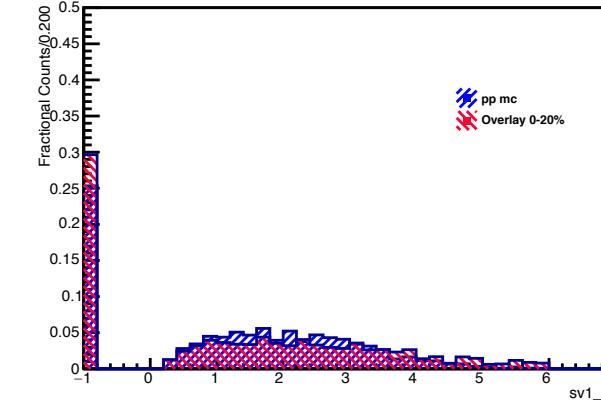
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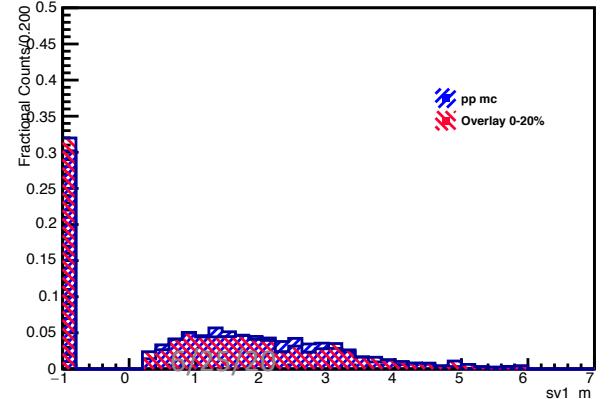
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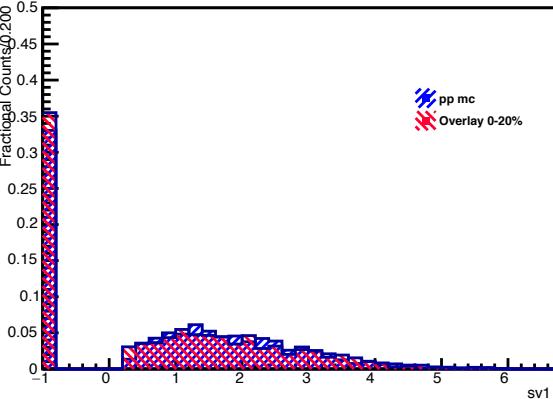
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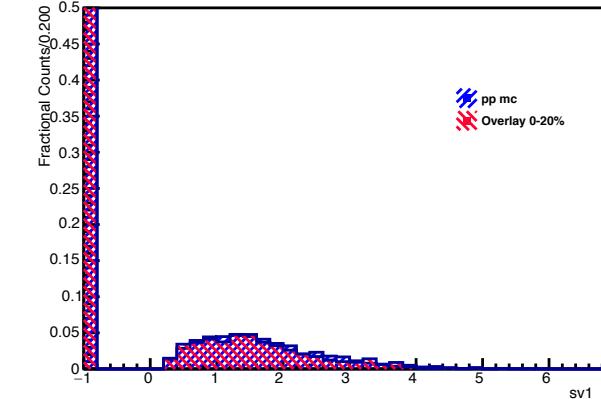
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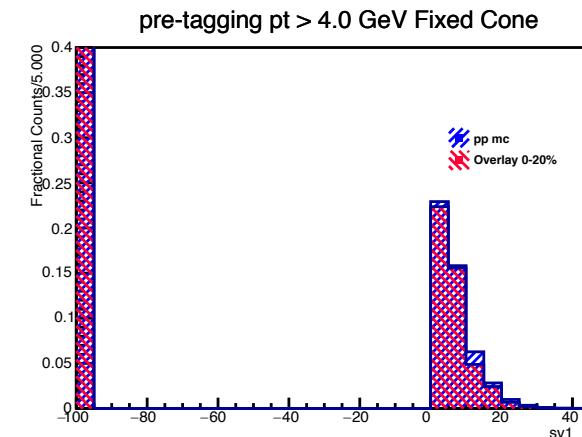
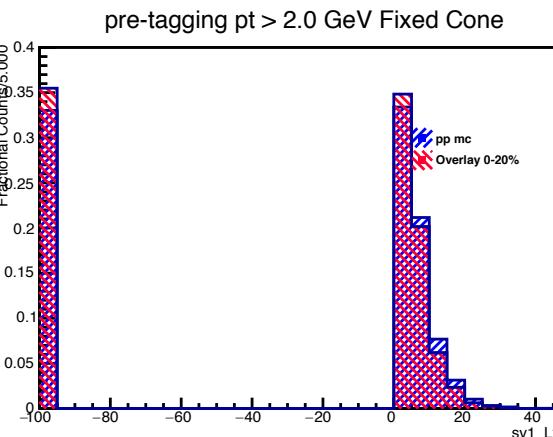
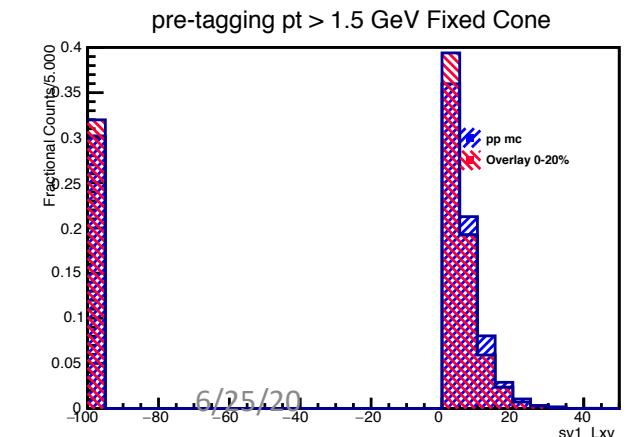
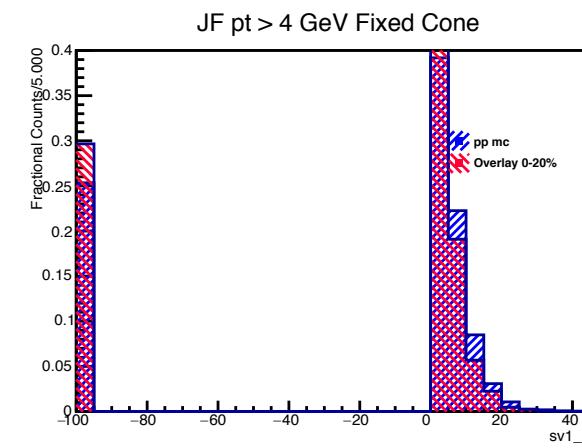
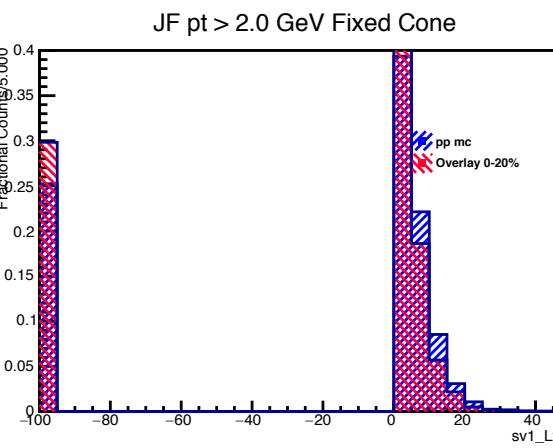
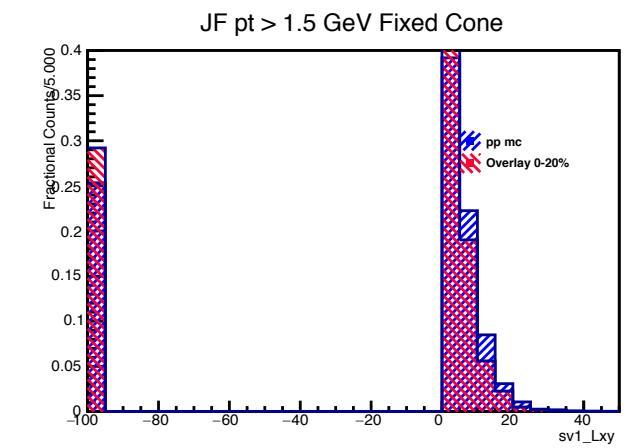
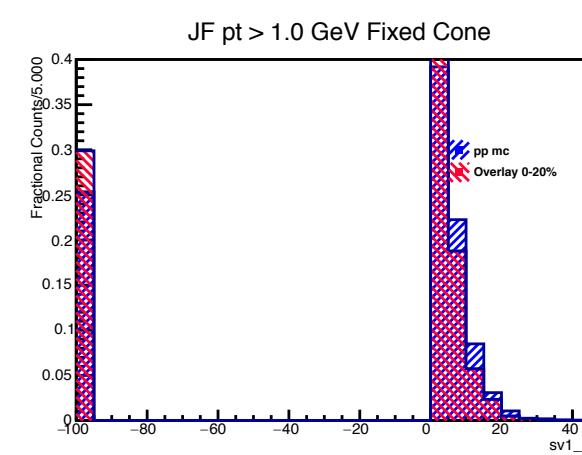
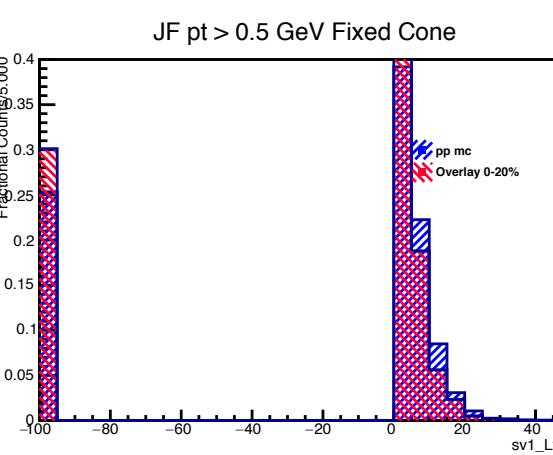
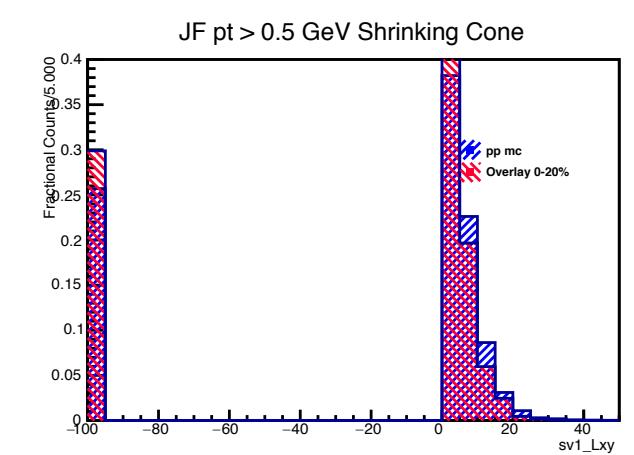


pre-tagging pt &gt; 2.0 GeV Fixed Cone



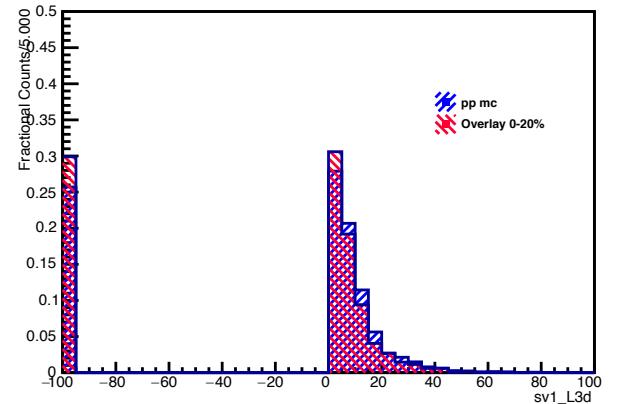
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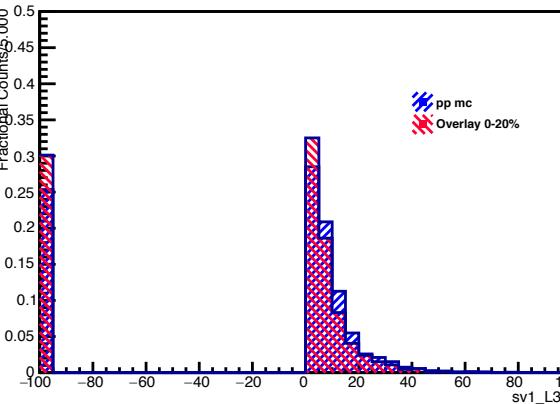


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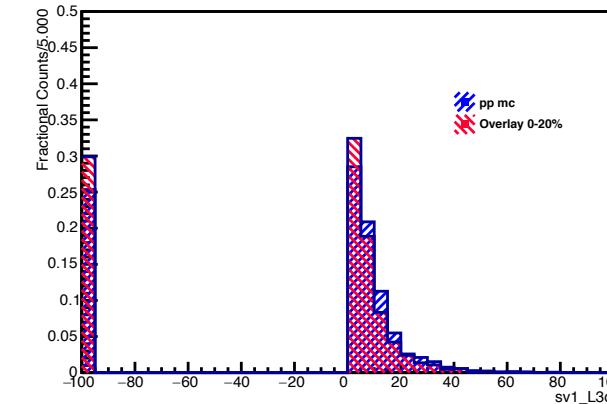
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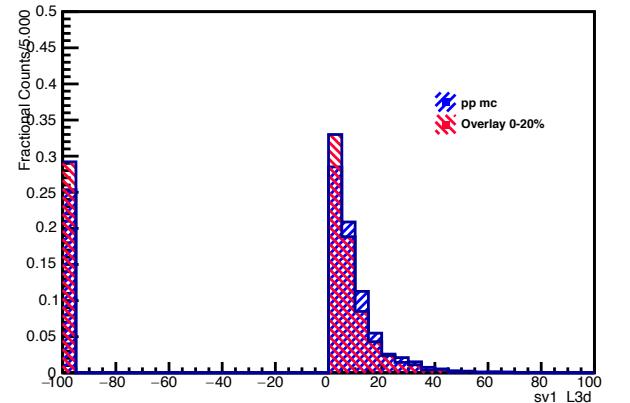
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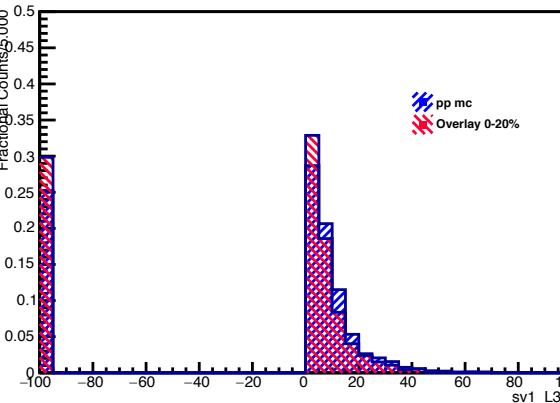
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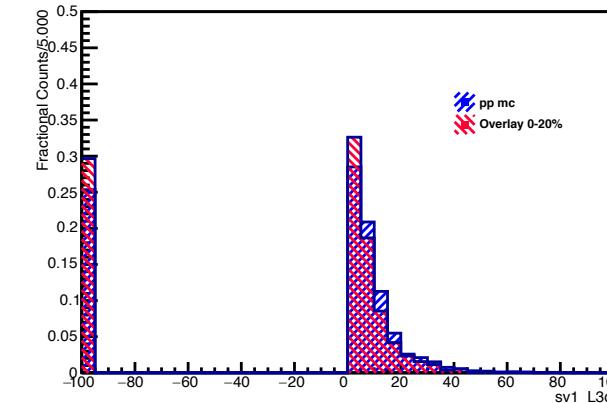
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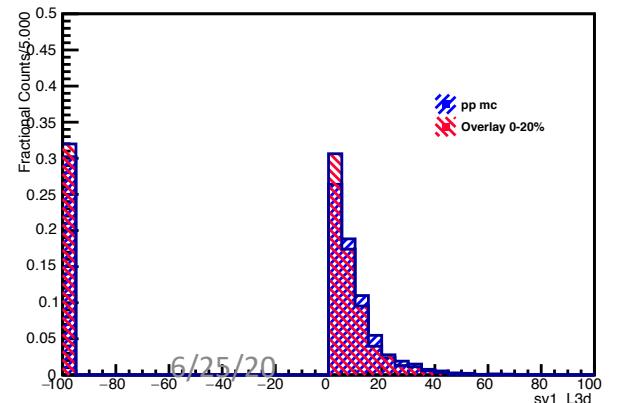
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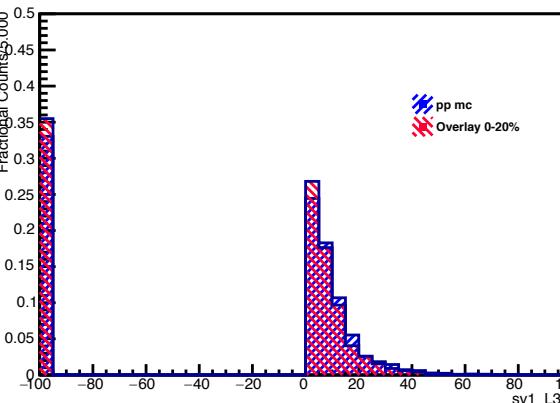
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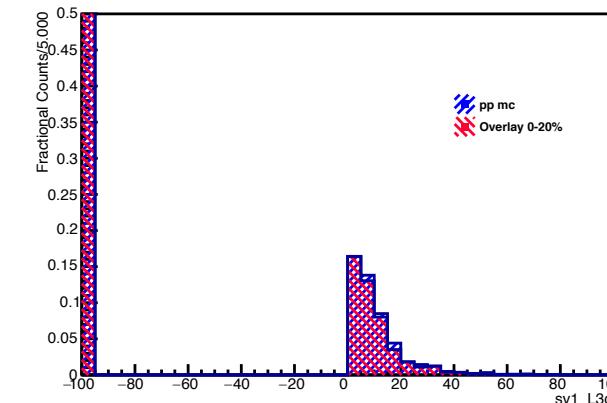
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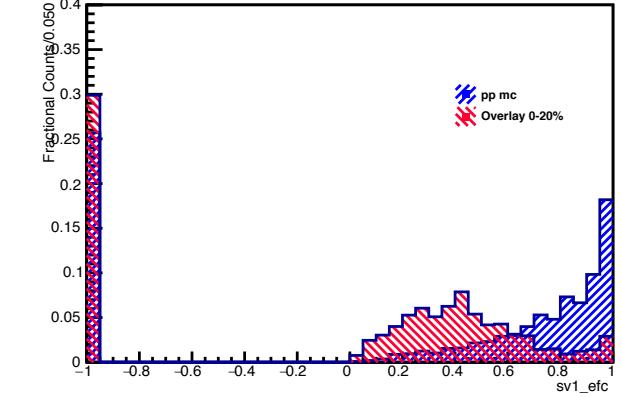
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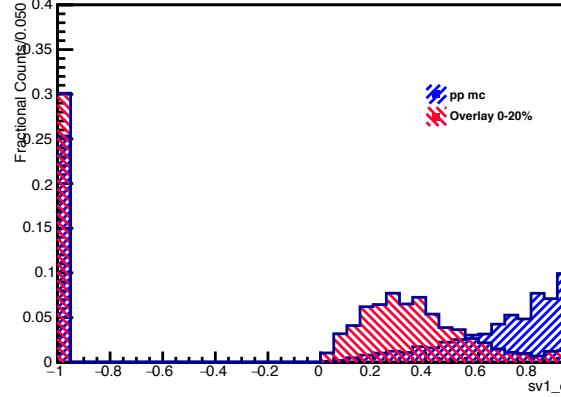
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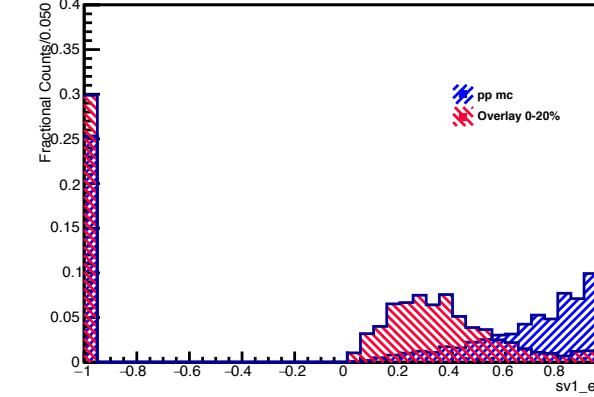
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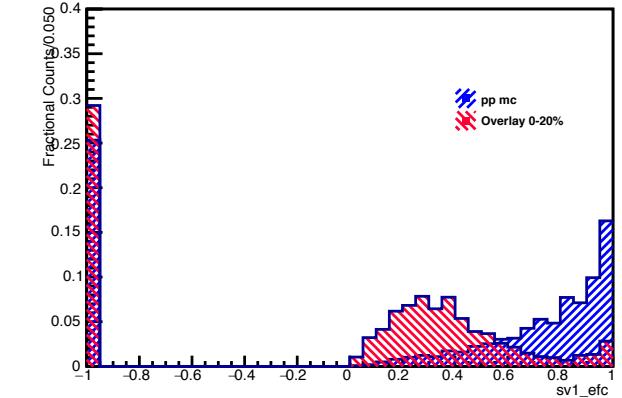
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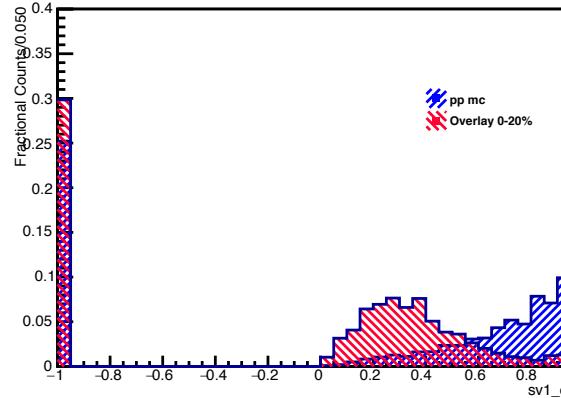
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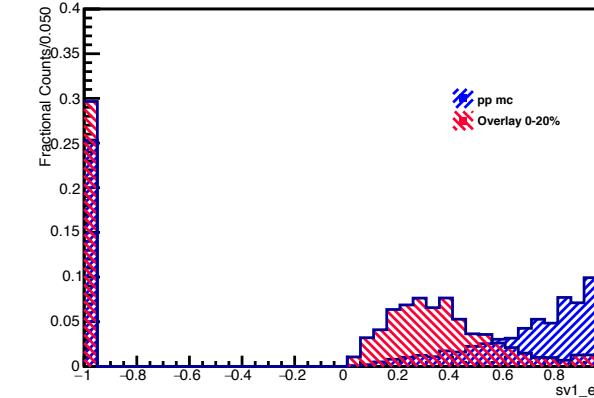
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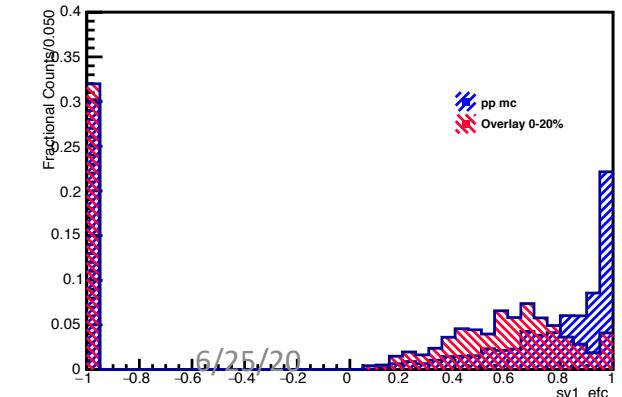
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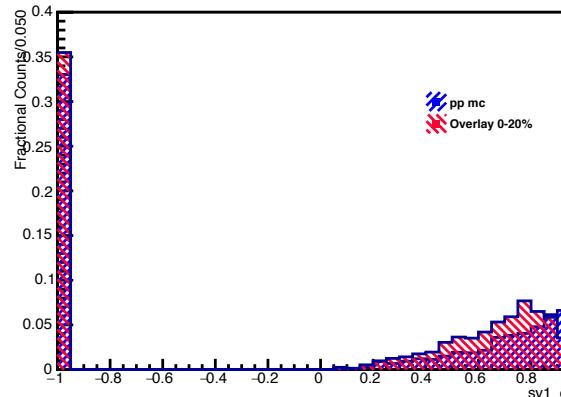
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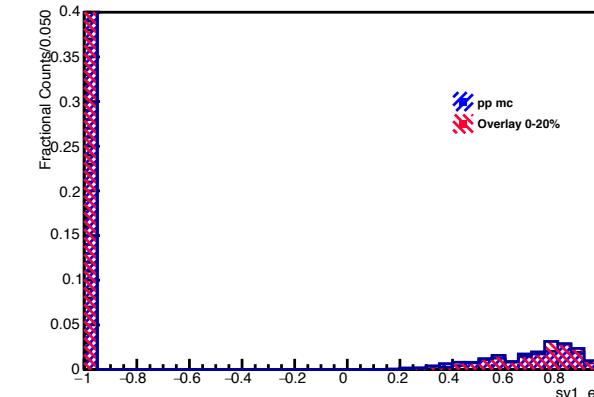
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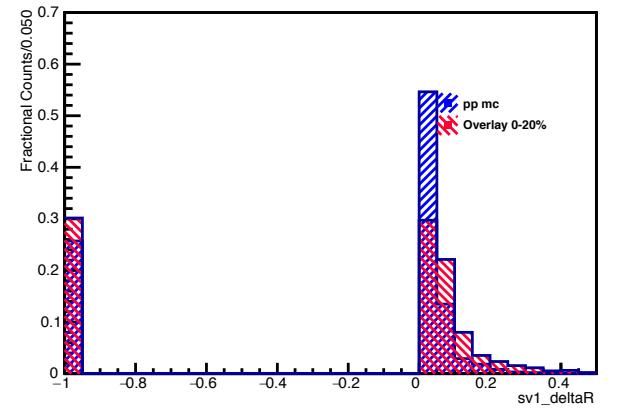
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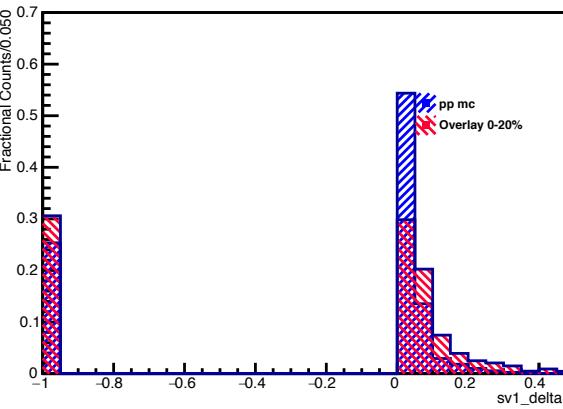
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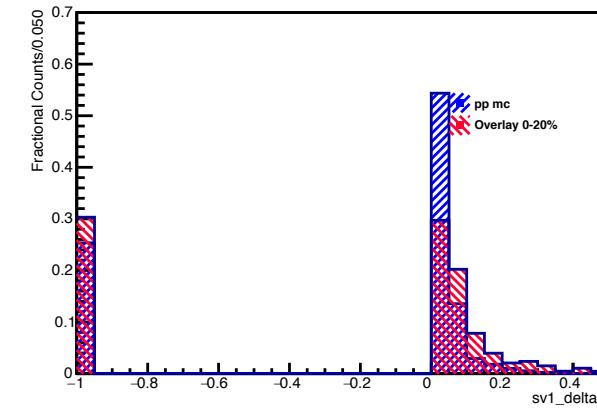
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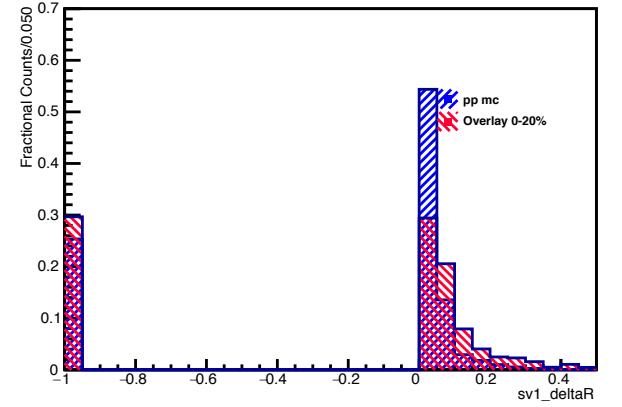
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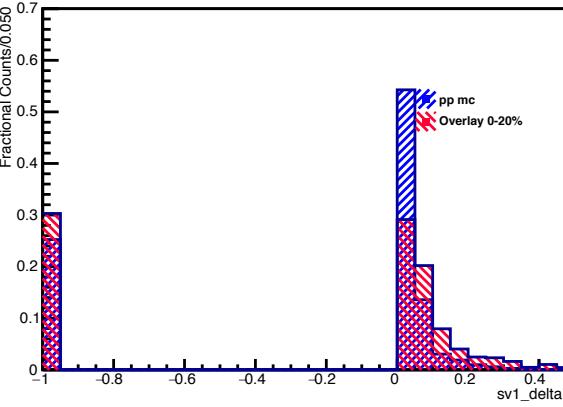
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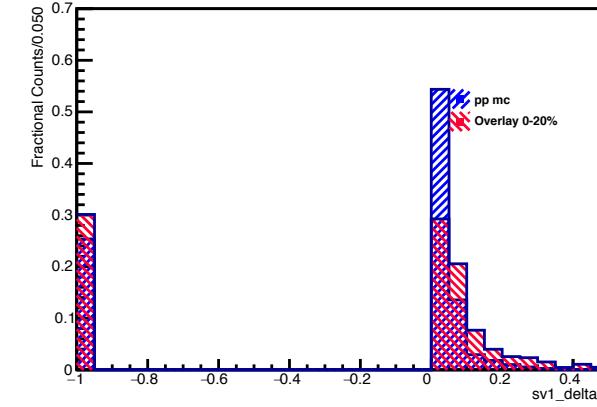
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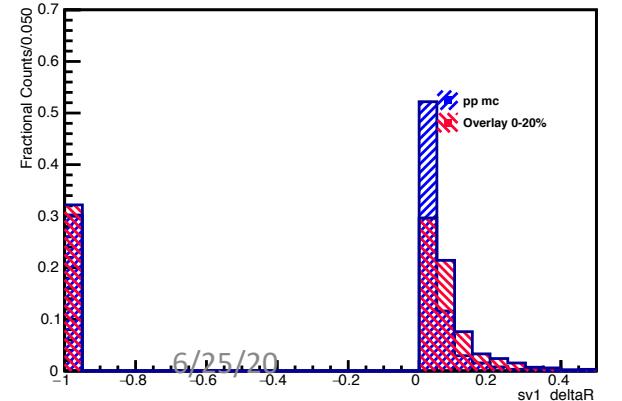
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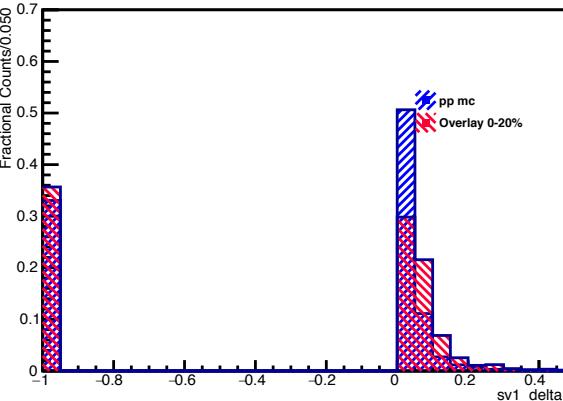
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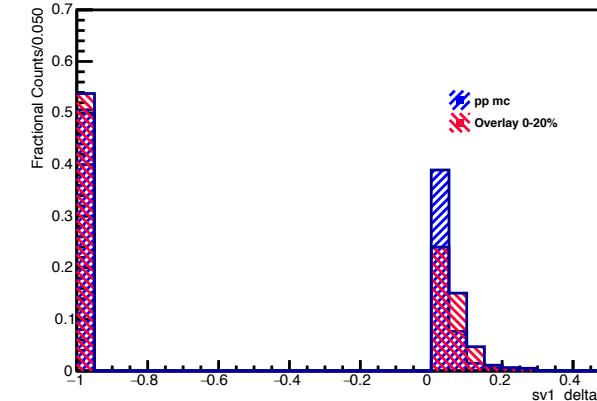
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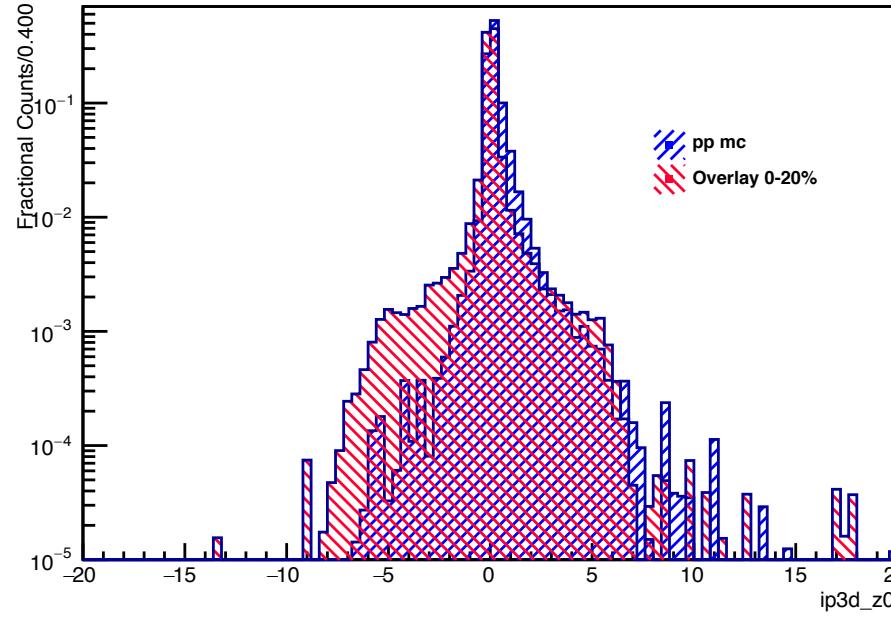


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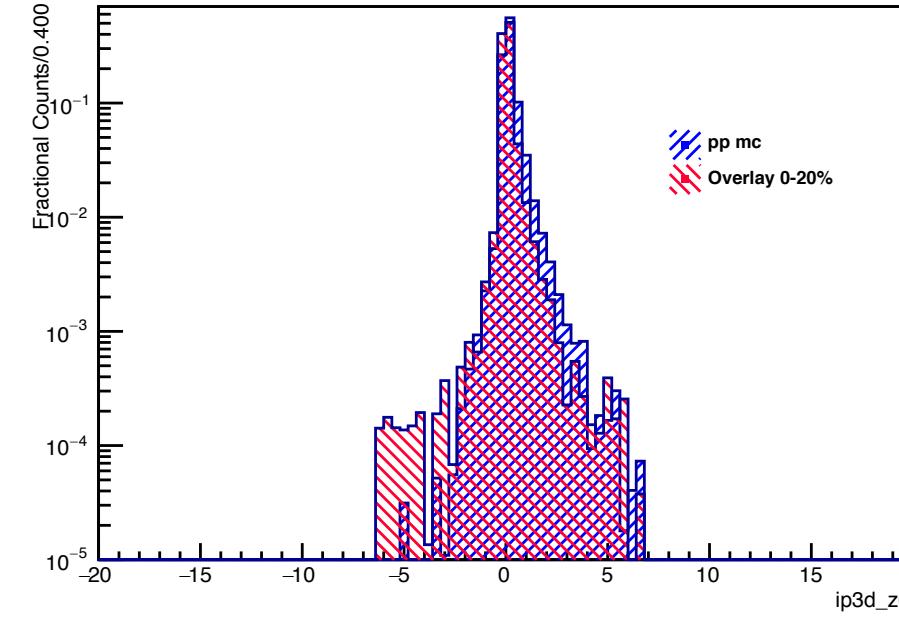


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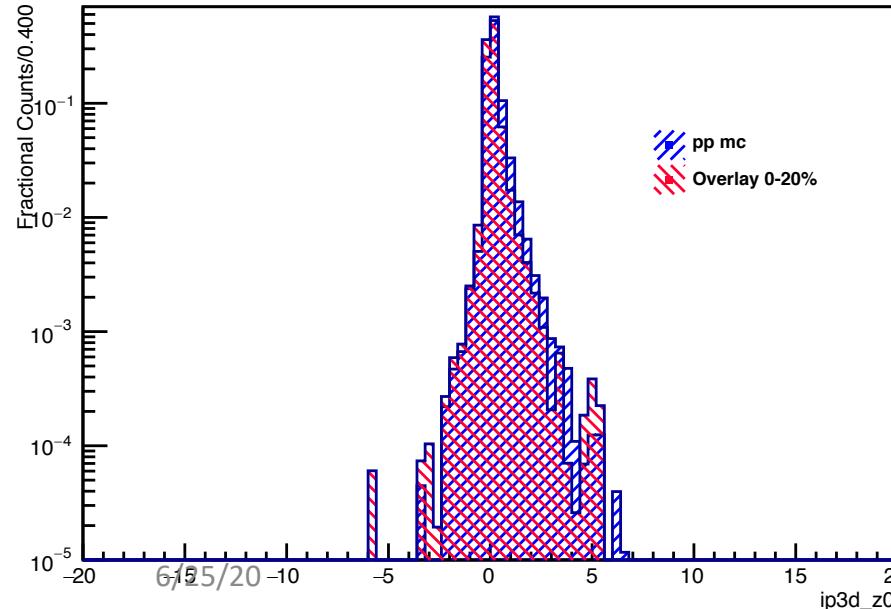
Default Cuts Shrinking Cone



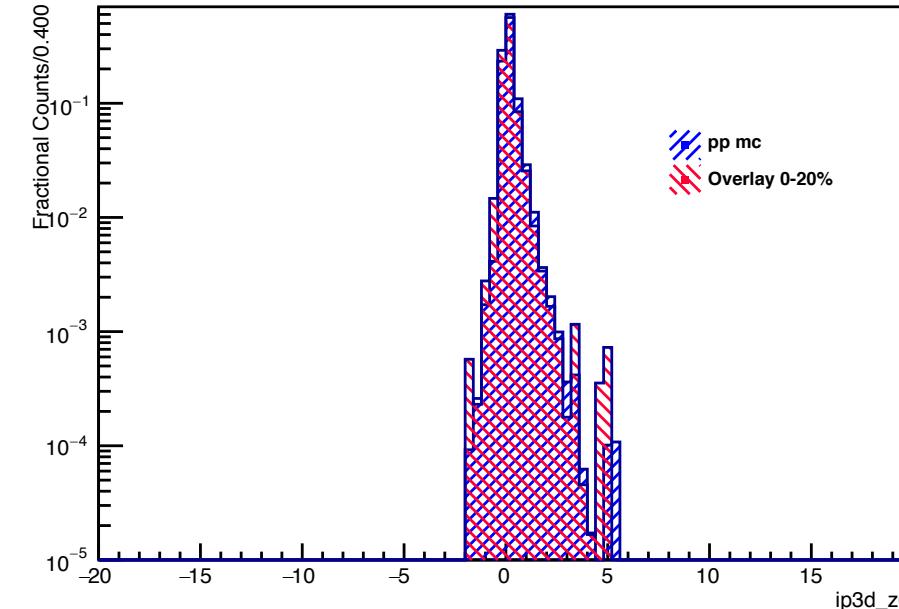
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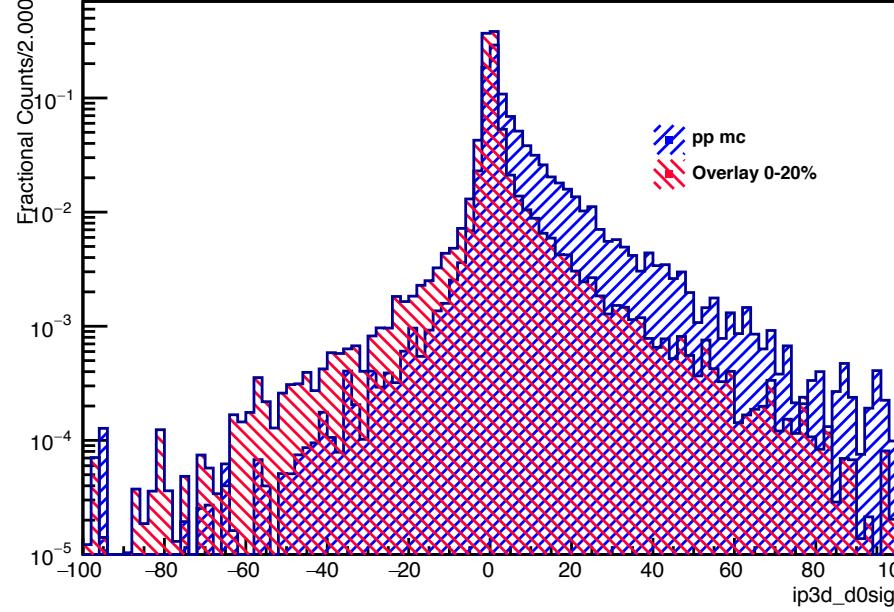
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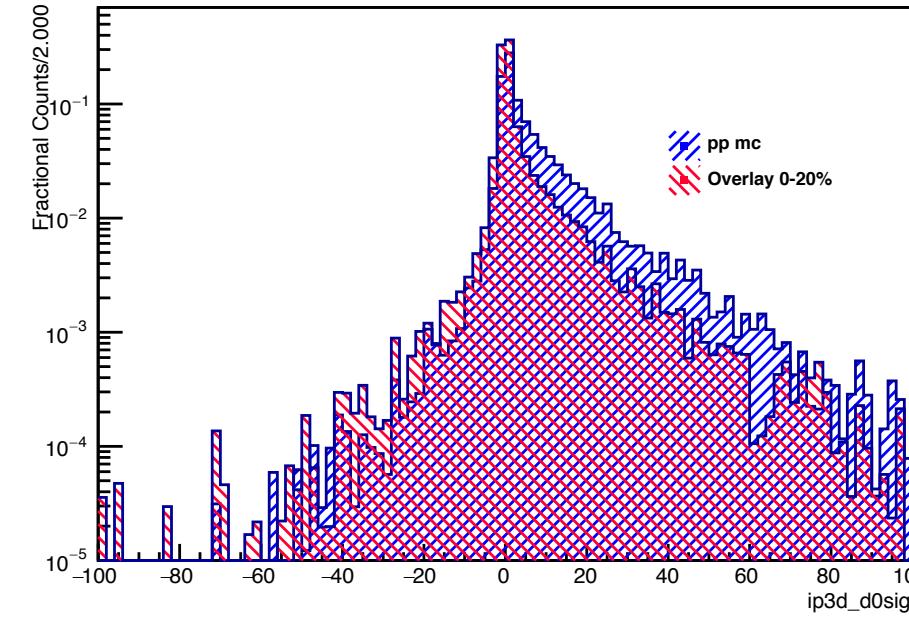
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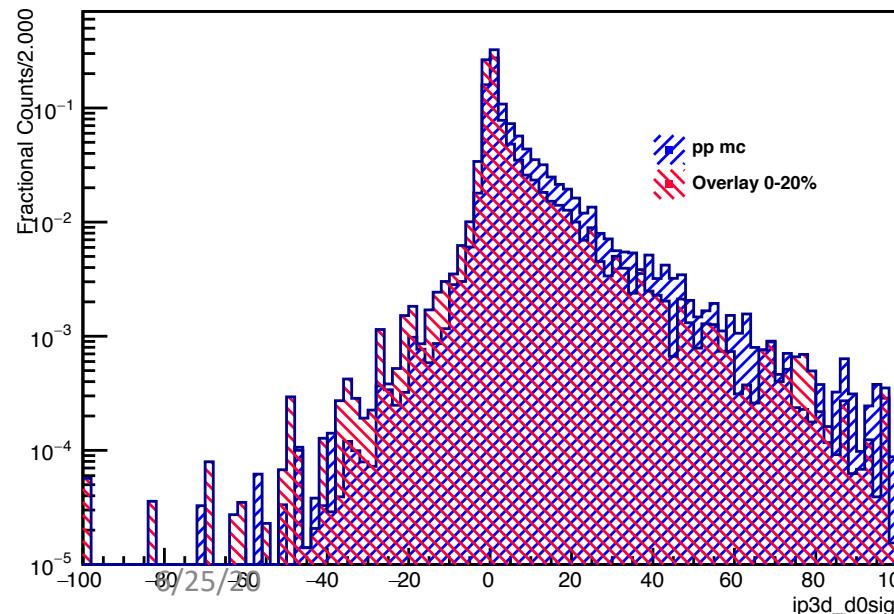
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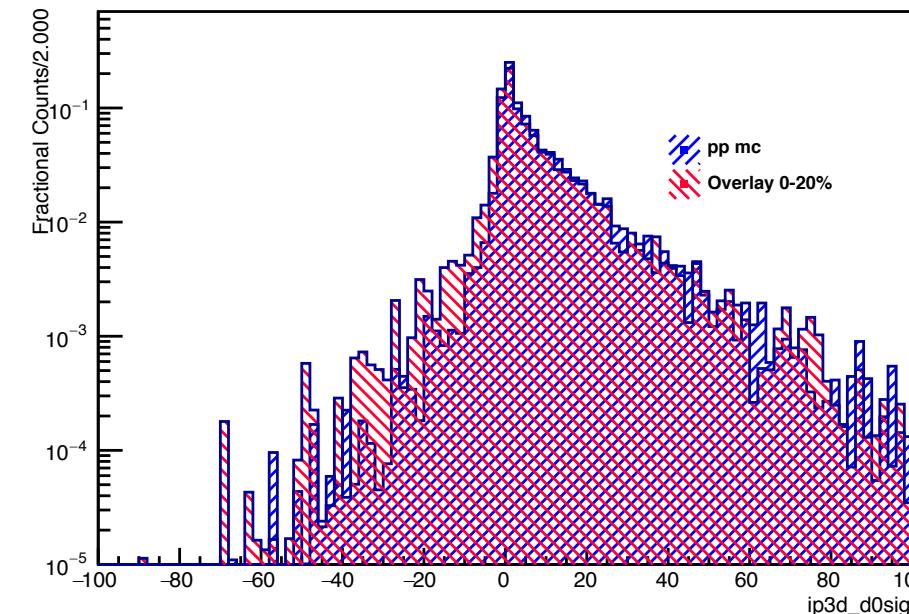
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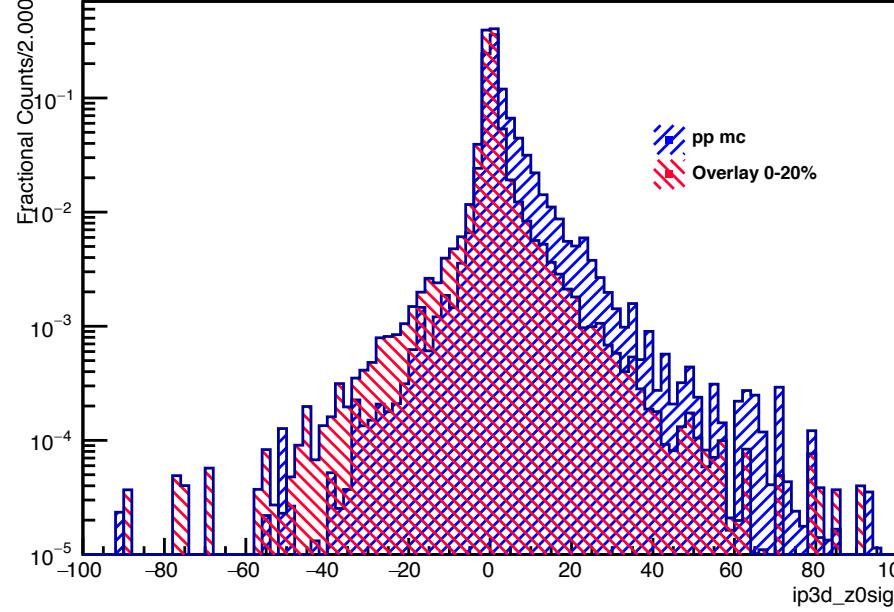
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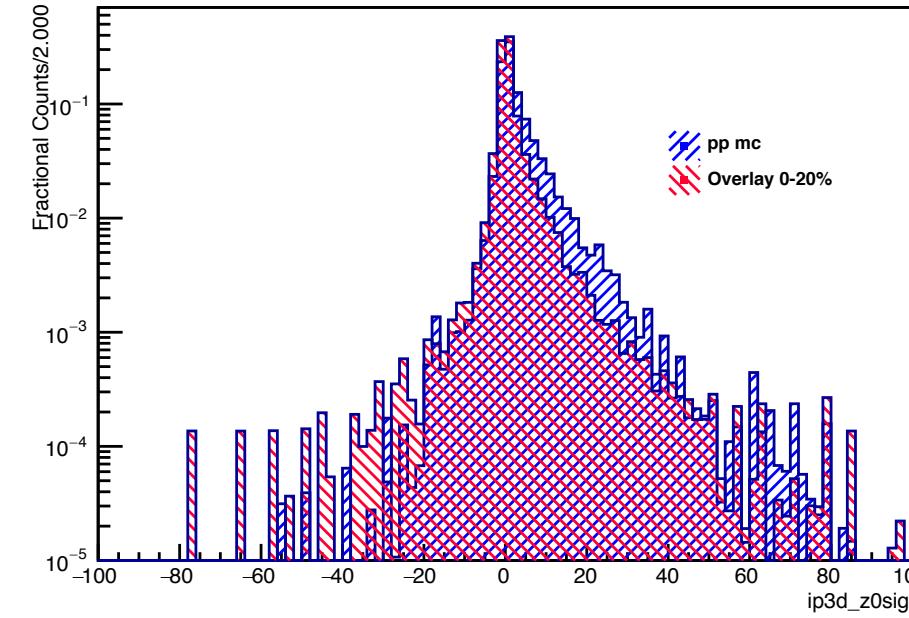
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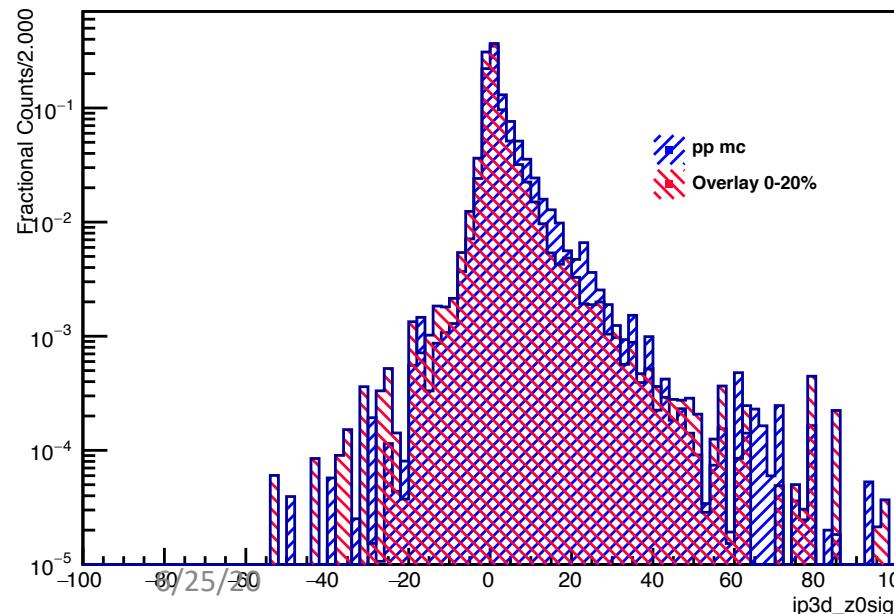
Default Cuts Shrinking Cone



Pre-tagging min pT 1.5 GeV FC4



Pre-tagging min pT 2 GeV FC4



Pre-tagging min pT 4 GeV FC4

