

# TTBar Analysis Update

07/01/20

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# Reports

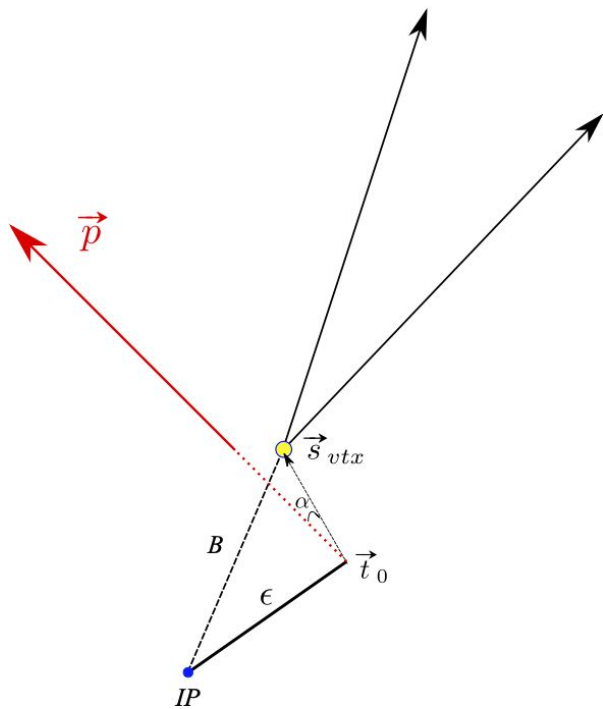
## 1. Vertex Restorer

2. Single Top Tagging

3. TTBar Analysis

# Vertex Recovery

- Correction to the Z0 is added by fixing the primary position.
- $b$  charge purity did not seem to change significantly with the correction.
  - Worked on missed/fake D0 and Z0 plots to see whether this is a bug or Z0 practically add no difference.



# Vertex Recovery

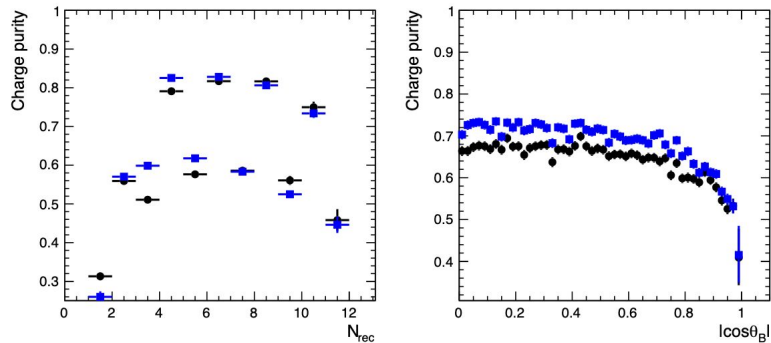
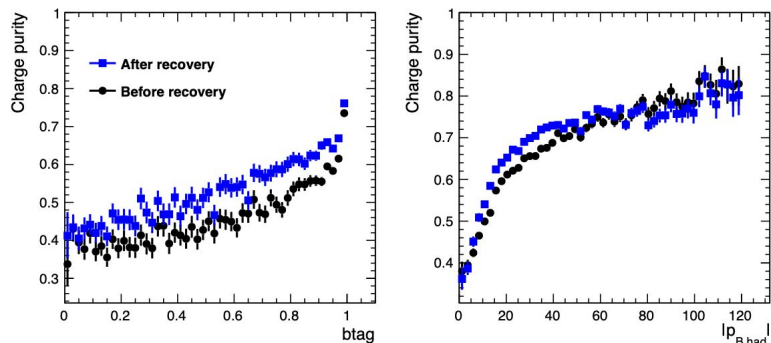


Fig1. Before Z0 correction (D0 only)

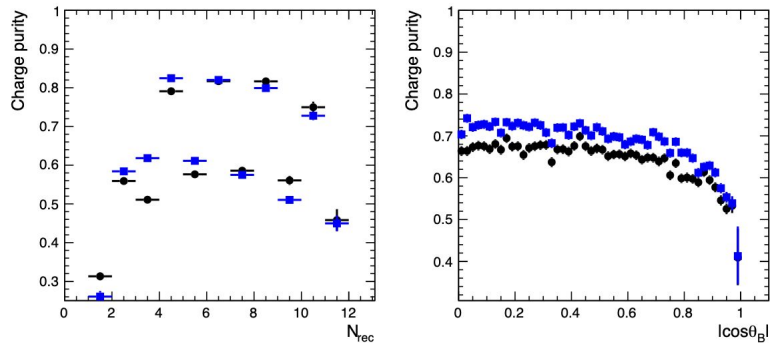
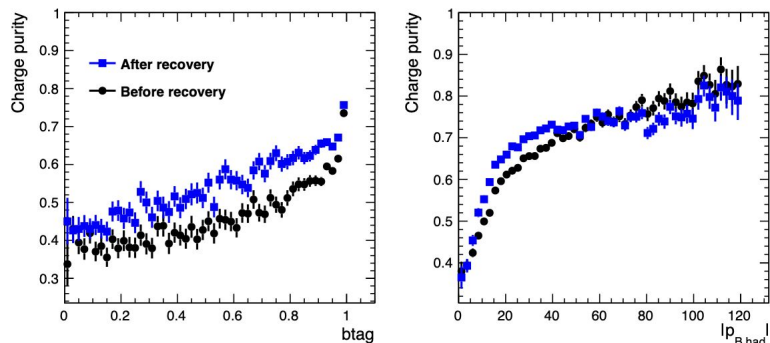


Fig2. After Z0 correction (D0+Z0)

# D0 vs $\alpha$

$$\epsilon/\sigma = D0/\sigma_{D0}$$

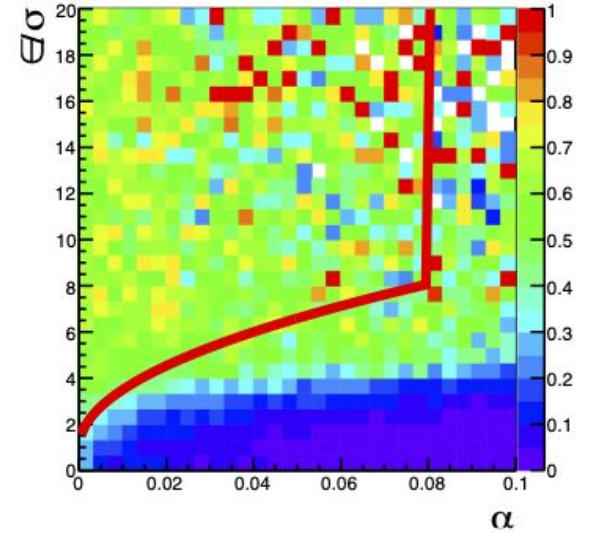
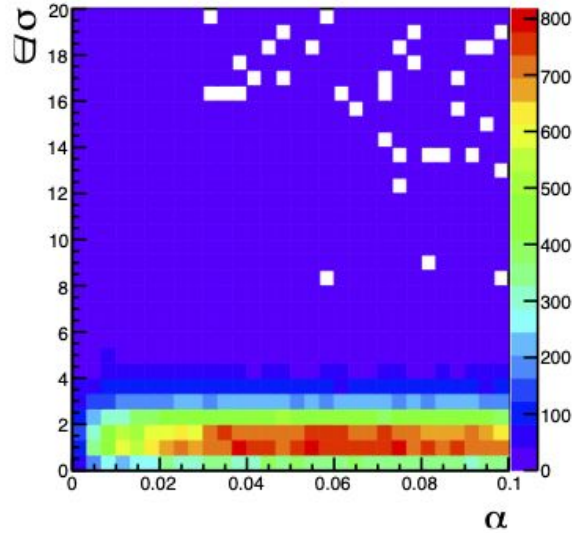
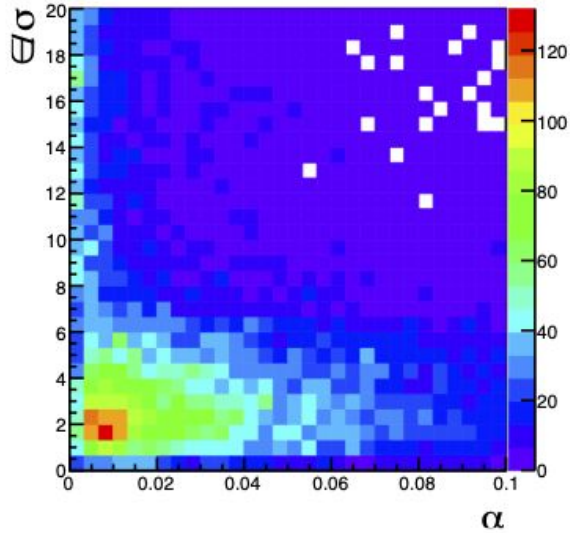


Fig3. Missing particles

Fig4. Background

Fig5. Purity map

Purity map shows the highest concentration of the missing generated prongs as compare to all charged particles. The red line demonstrates the chosen cut function.

# Z0 vs $\alpha$ (before correction)

$$\epsilon/\sigma = Z_0/\sigma_{Z_0}$$

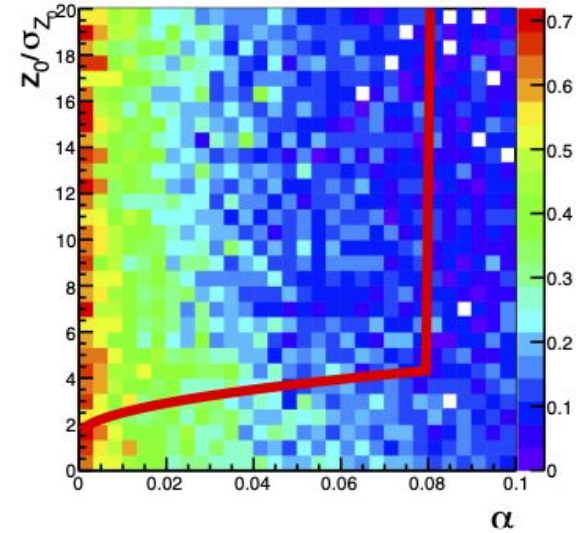
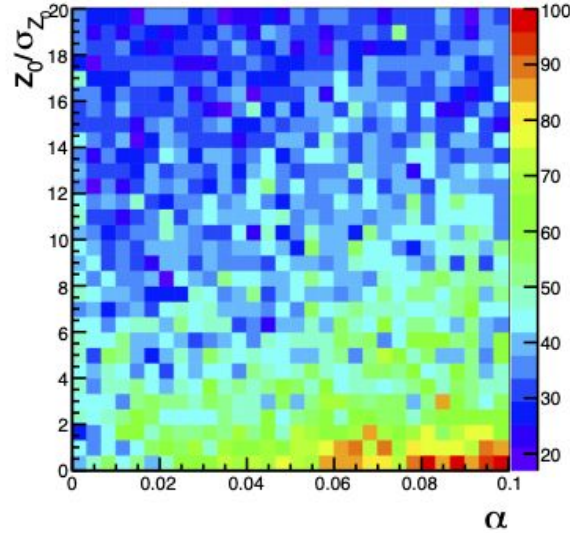
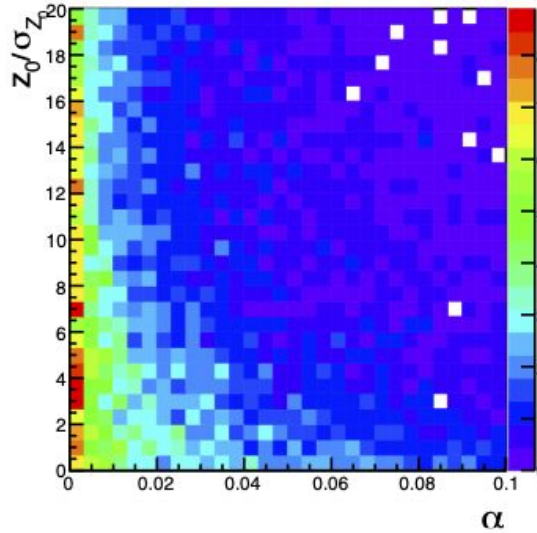


Fig3. Missing particles

Fig4. Background

Fig5. Purity map

Purity map shows the highest concentration of the missing generated prongs as compare to all charged particles. The red line demonstrates the chosen cut function.

# Z0 vs $\alpha$ (after correction)

$$\epsilon/\sigma = Z0/\sigma_{Z0}$$

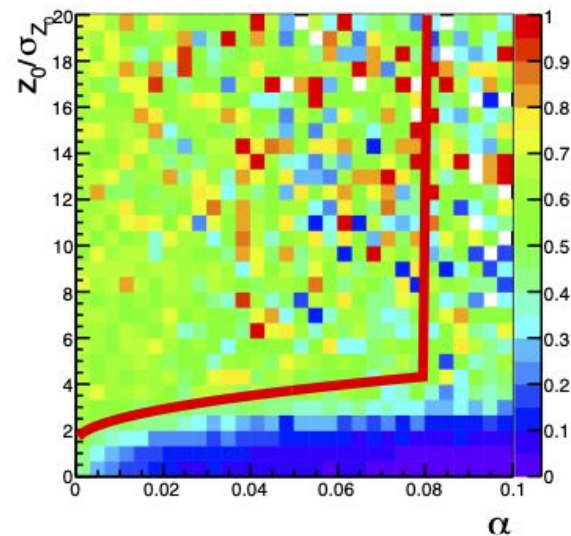
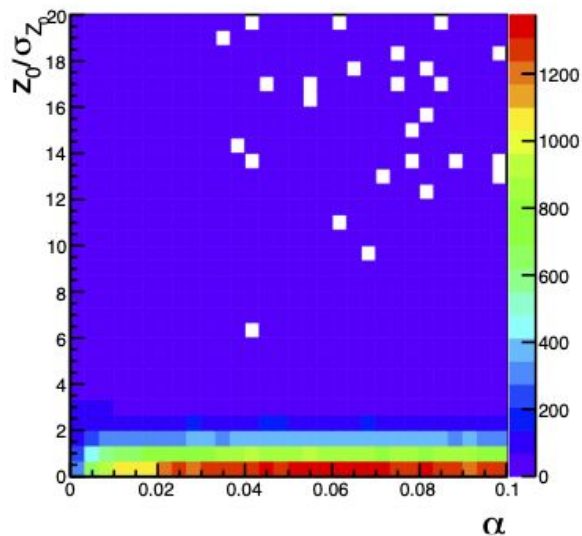
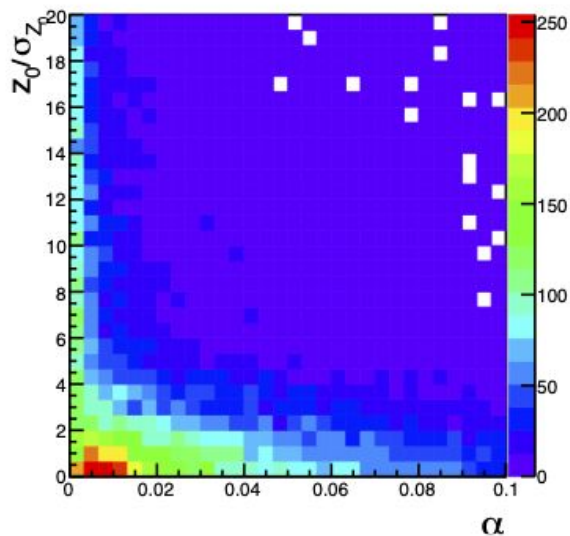


Fig3. Missing particles

Fig4. Background

Fig5. Purity map

Purity map shows the highest concentration of the missing generated prongs as compare to all charged particles. The red line demonstrates the chosen cut function.

# D0+Z0 vs $\alpha$ (after correction)

$$\epsilon/\sigma = D0/\sigma_{D0} + Z0/\sigma_{Z0}$$

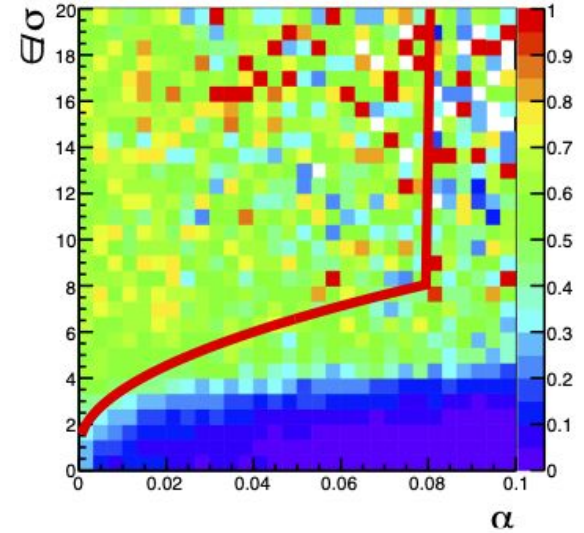
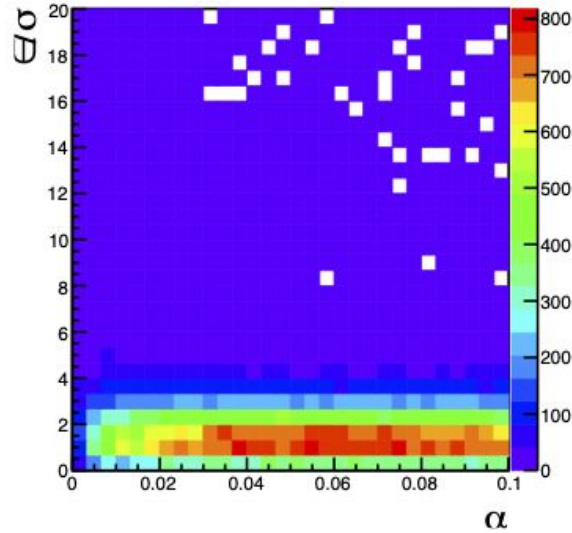
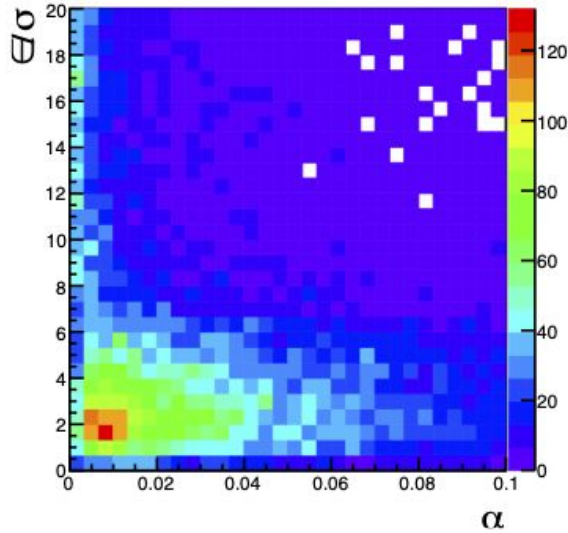


Fig3. Missing particles

Fig4. Background

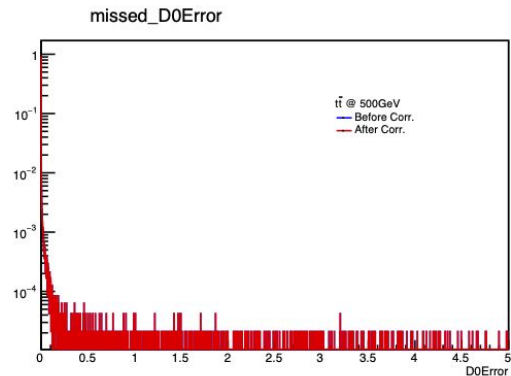
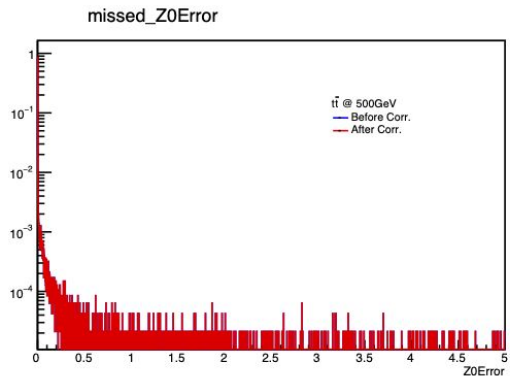
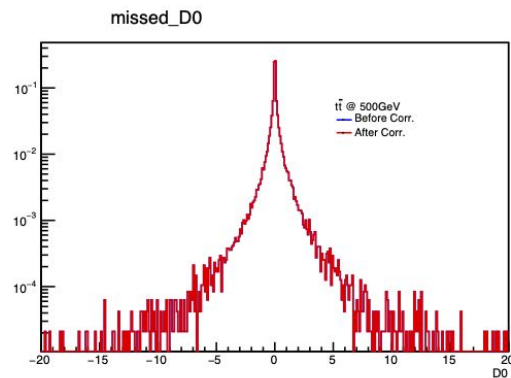
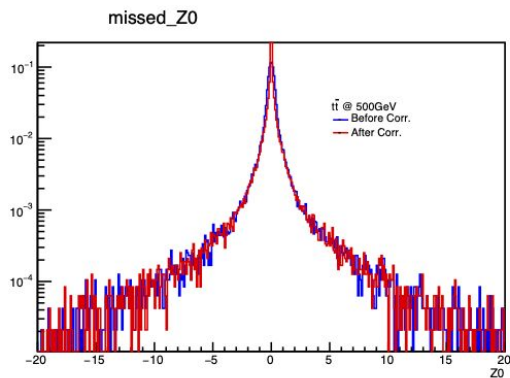
Fig5. Purity map

Purity map shows the highest concentration of the missing generated prongs as compare to all charged particles. The red line demonstrates the chosen cut function.



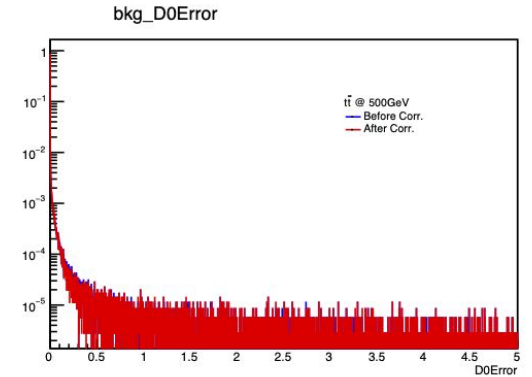
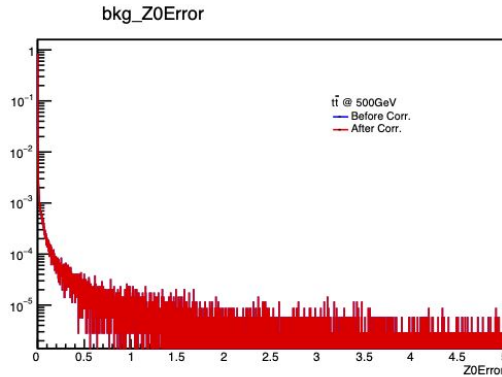
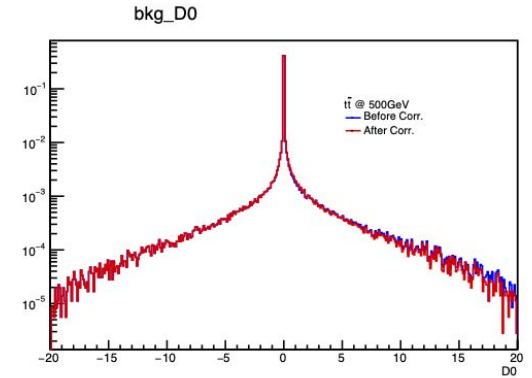
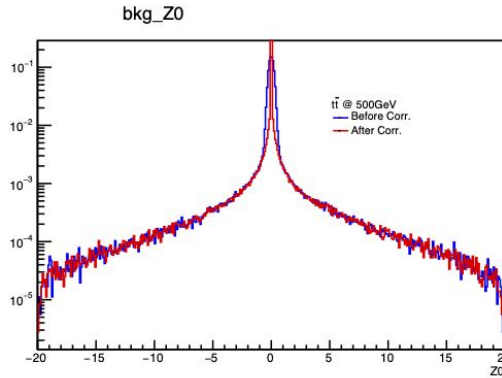
# Missed D0/Z0

- Plot shows the distribution of Z0/D0 corresponding to missing particles.  
(Blue: Before correction, Red: After correction)

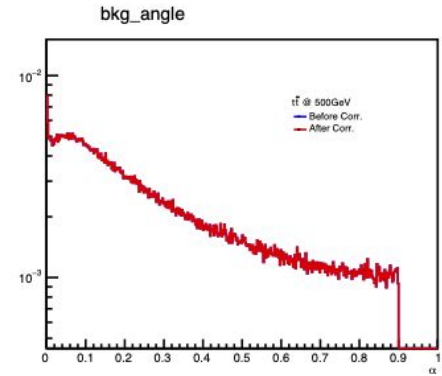
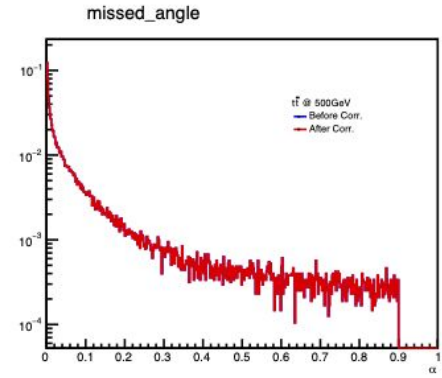
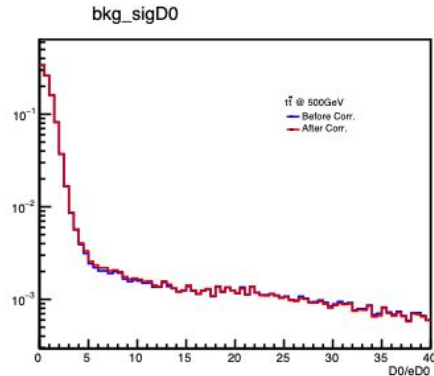
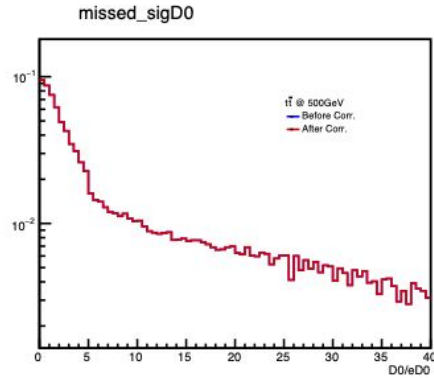
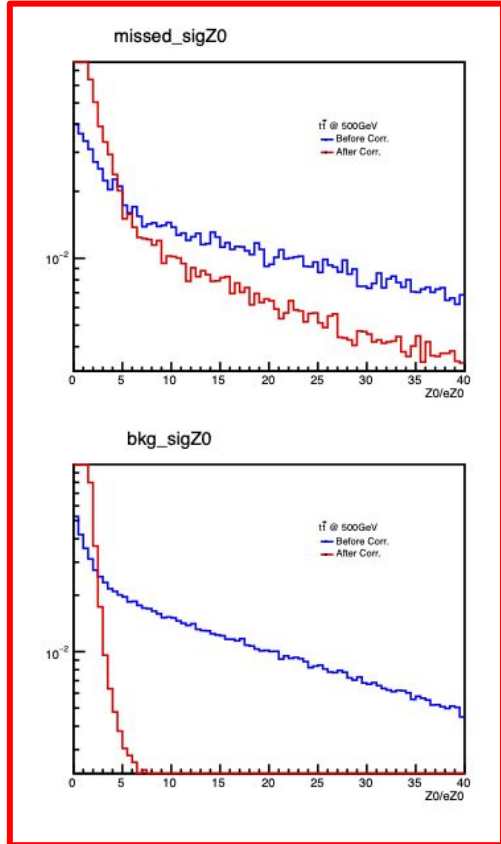


# Background D0/Z0

- Plot shows the distribution of Z0/D0 corresponding to backgrounds.  
(Blue: Before correction, Red: After correction)



# D0+Z0 / $\sigma$



# Vertex Recovery

- Z0 correction is applied
  - The change was clearly observed (slide 7,8), which resembled the D0 distribution.
  - Missed Z0, Missed Z0 Error, do not seem to have big effect before/after the vertex recovery yet missedZ0/ $\sigma$  shows the huge difference in its distribution.
- Combined implementation of D0/Z0 is applied
  - Resembles the same signal shape as D0
  - D0 is dominates the effects on VR?

# Reports

1. Vertex Restorer

## 2. Single Top Tagging

3. TTBar Analysis

# Single Top Tagging

There are two ways which can produce single top events: t-channel, which contains electron neutrino as a mediator and s-channel which W pair from the  $Z^0/\gamma$ .

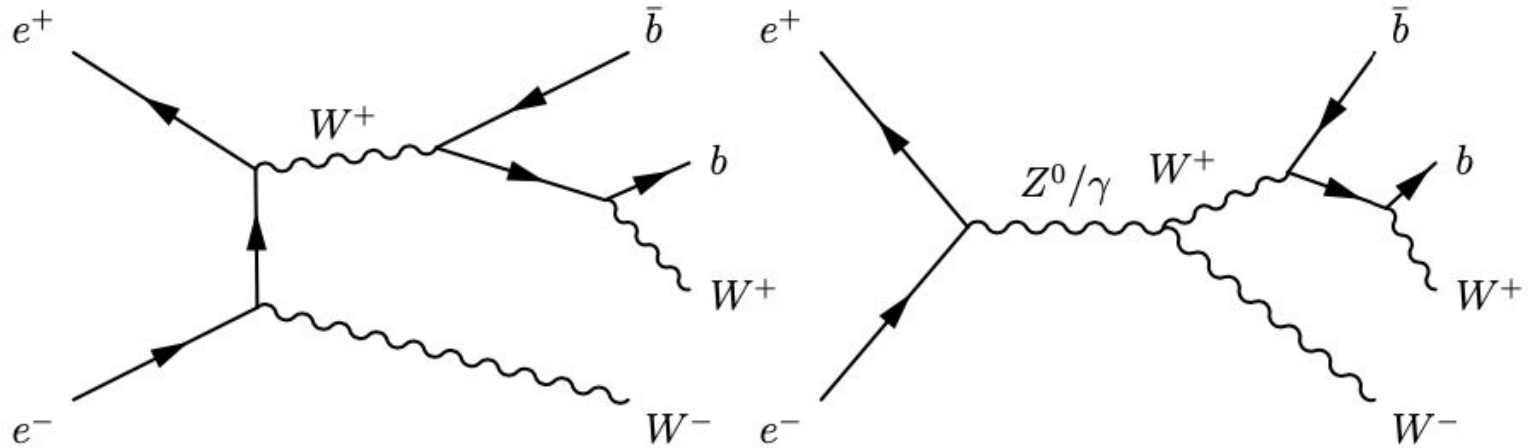


Figure1. t-channel (left) and s-channel (right) of Feynman diagram for single top production.

# Single Top Tagging

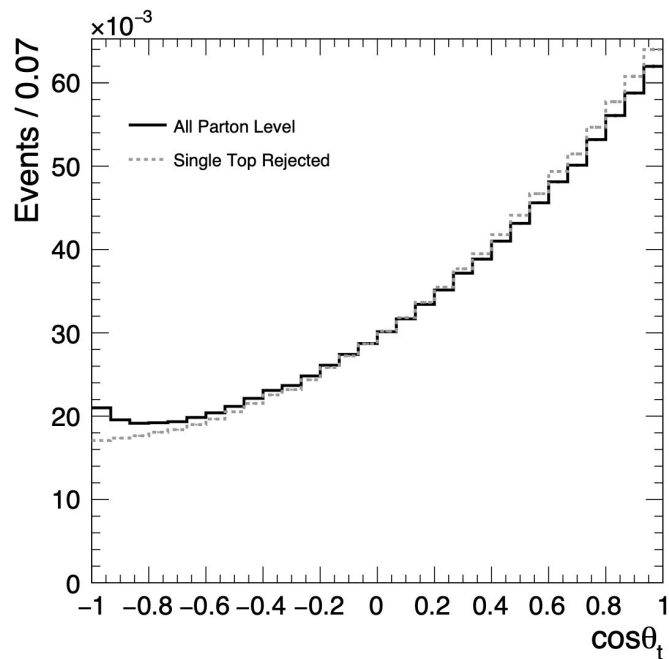


Figure. Polar angle distribution of top quark before and after the single top removal.

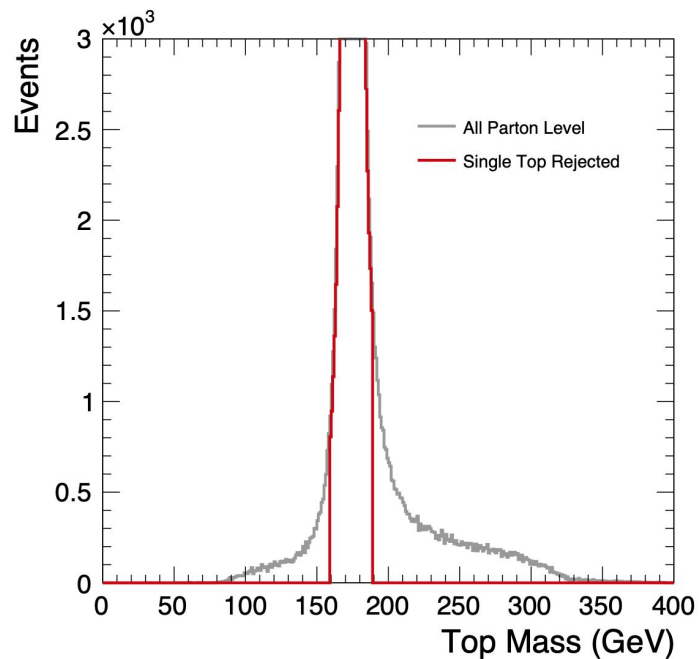


Figure. MC top mass distribution with (red) and without (grey) single top tagging. 12% of all generated events.

# Single Top Tagging

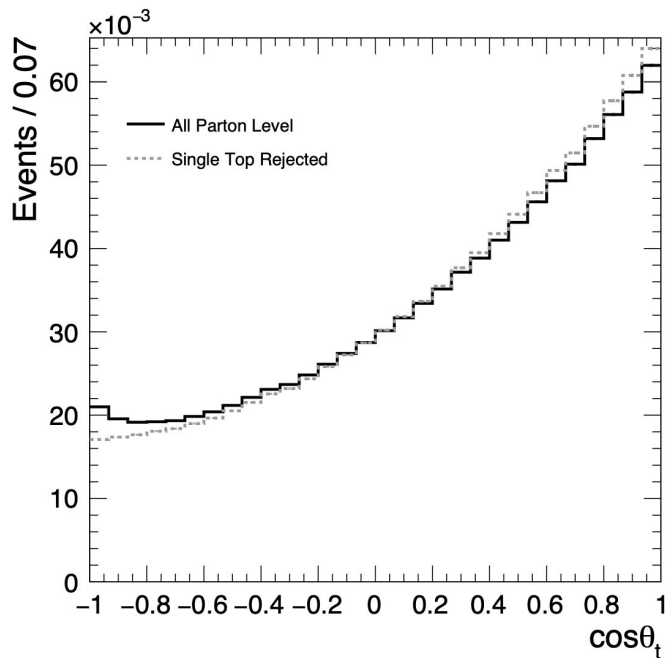


Figure. Polar angle distribution of top quark before and after the single top removal.

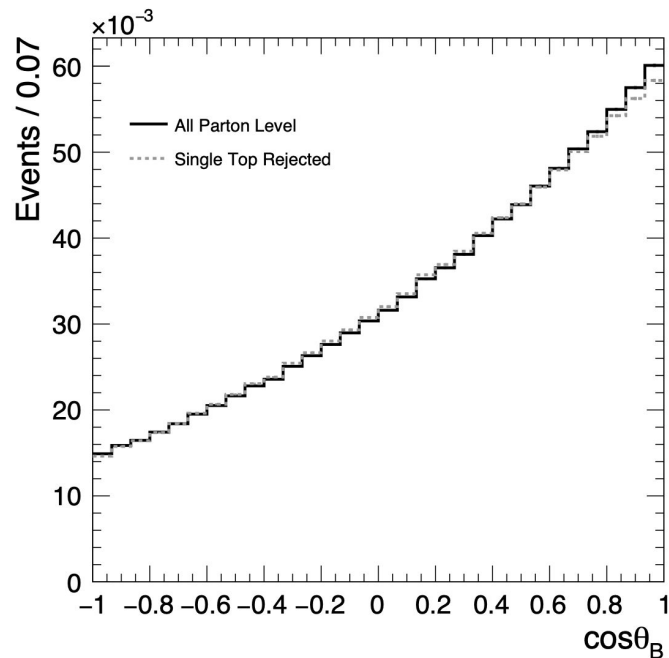


Figure. Polar angle distribution of b quark before and after the single top removal.



# Single Top Tagging

- Cuts were applied to identify (suspicious) single top events hidden in the Gen.
  - Cut:  $|M_{\text{top}}| < 15 \text{ GeV}$
  - 12% of overall Gen events
- Underlying b quark momentum regards to single top events are plotted.
  - Do not seem to have large effect between with/without single top tag.

# Reports

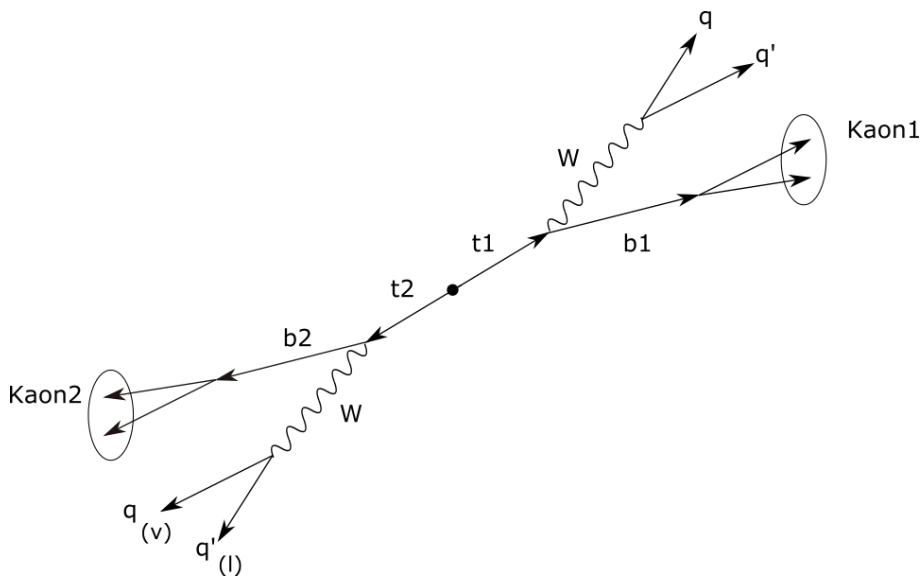
1. Vertex Restorer

2. Single Top Tagging

## 3. TTBar Analysis

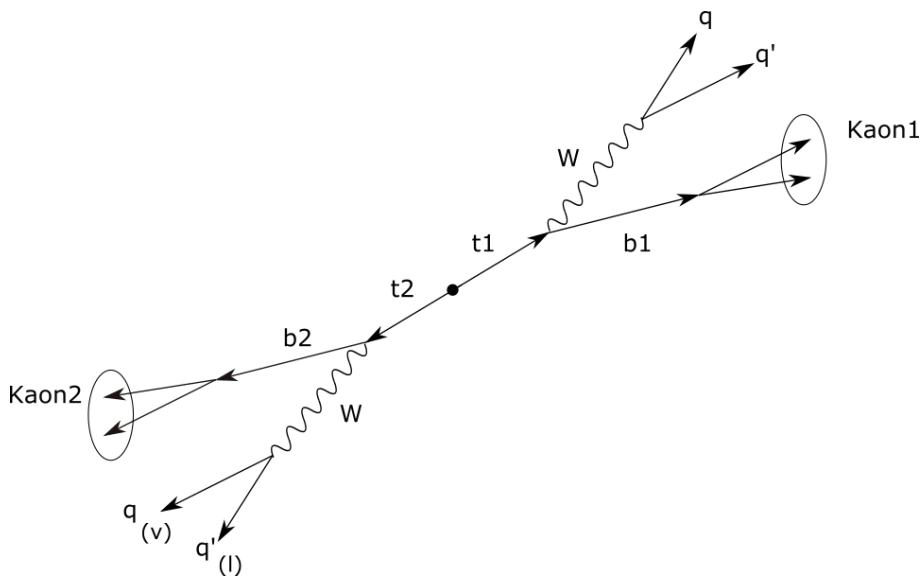
# TTBar Analysis

- Charge combination is prominent way to distinguish t and tbar.
- For the charge identification, kaon, b-jet and isolated lepton charges were used. Each charges were compared with another charge to match with correct ttbar pair.



# TTBar Analysis

Top 1	Top 2	Charge Purity
VTX	VTX	92.9%
Kaon	Kaon	89.8%
VTX	Kaon	91.1%
VTX, Kaon		92.4%
Lepton	VTX	63.9%
Lepton	Kaon	58.2%
Lepton		95.2%



# TTBar Analysis

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VTX	VTX	92.9%
Kaon	Kaon	89.8%
VTX	Kaon	91.1%
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Lepton	VTX	63.9%
Lepton	Kaon	58.2%
Lepton		95.2%

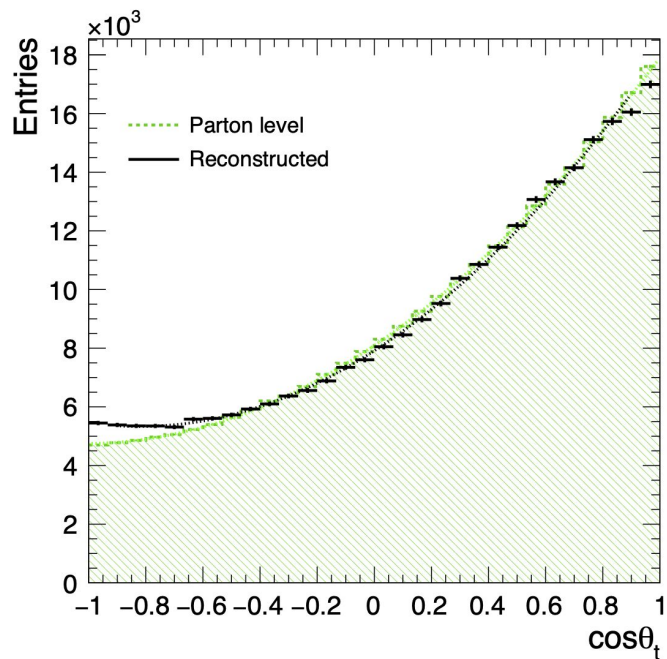


Figure. Polar angle distribution of  $t\bar{t}$ , single top rejected.  
(method 1/2/3/4/5/6/7)

# TTBar Analysis

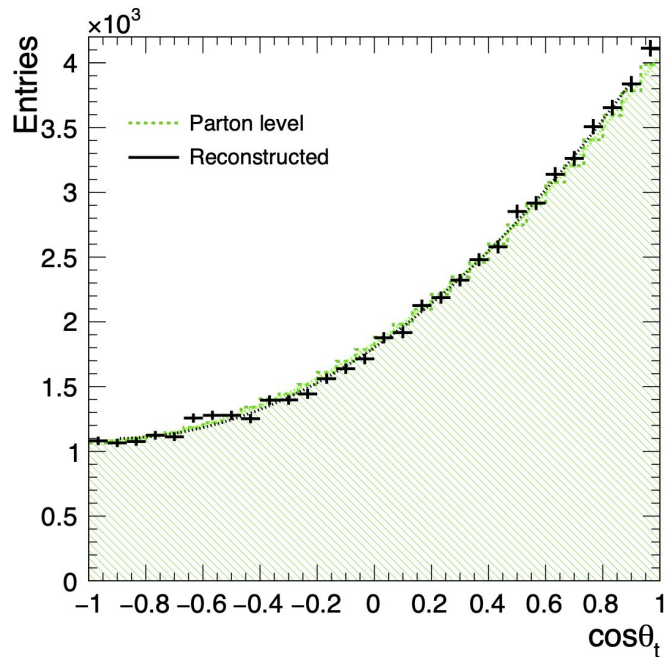


Figure. Polar angle distribution of  $t\bar{t}$ bar, single top rejected.  
(method 1)

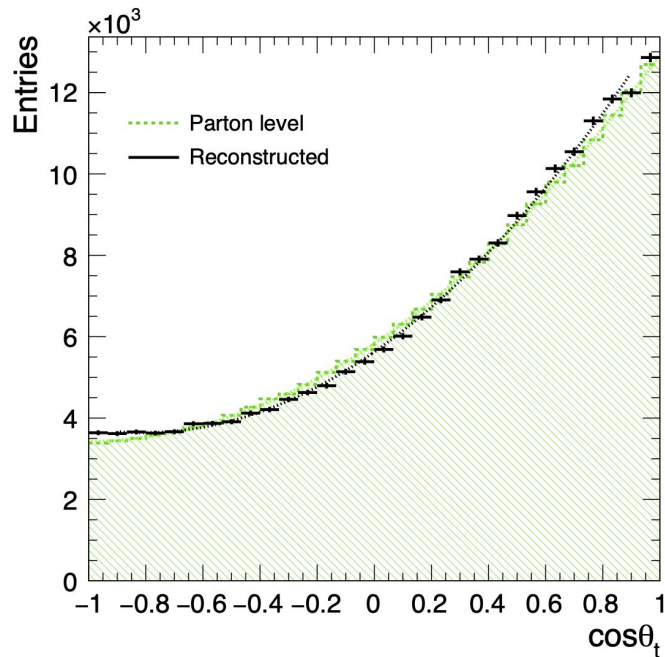


Figure. Polar angle distribution of  $t\bar{t}$ bar, single top rejected.  
(method 7)

# TTBar Analysis

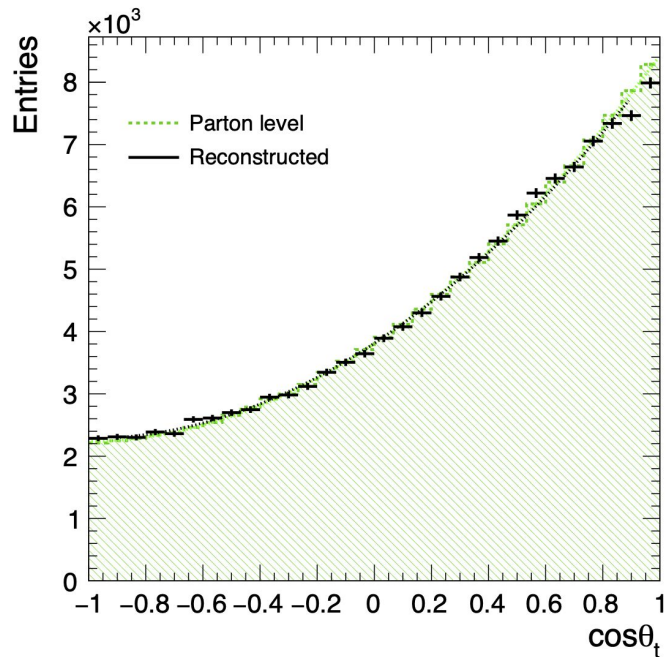


Figure. Polar angle distribution of  $t\bar{t}$ , single top rejected.  
(method 1/2/3/4)

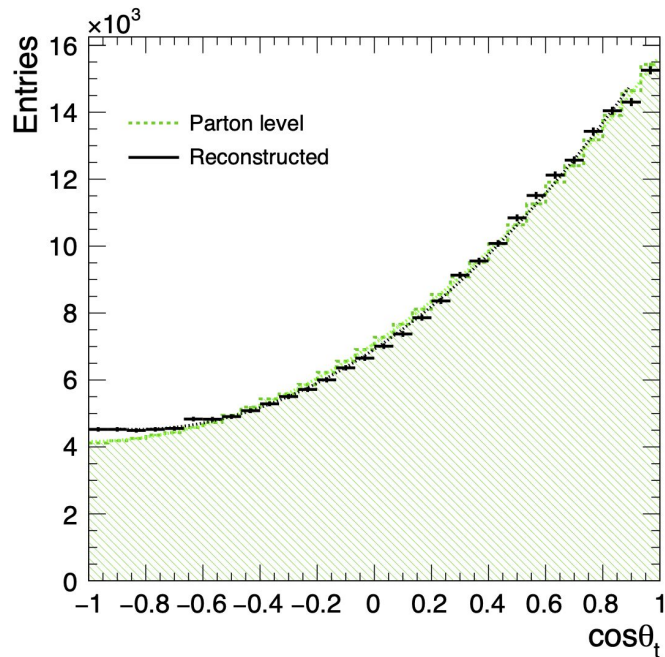


Figure. Polar angle distribution of  $t\bar{t}$ , single top rejected.  
(method 1/2/3/4/7)

# TTBar Analysis

- Charge comparison with Vtx chg, Kaon chg, Lepton chg were used.
  - 6 combination methods + 1 Lepton ID
  - Performance of charge purity test are ideal with method 1 (vtx x vtx) and method 7 (lepton), with 95.2% and 92.9% purity, respectively.
- Comparison methods with Kaon chg 'dilutes' the purity
  - Revisit to particle ID processor may necessary?
  - Use the weights to each methods upon decision making for the charge ID of top.