



인하대학교  
INHA UNIVERSITY



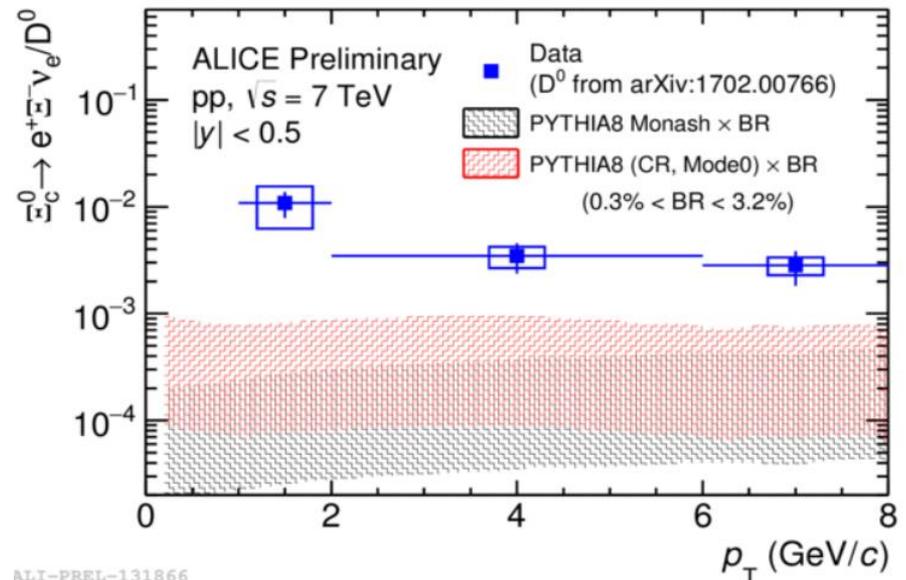
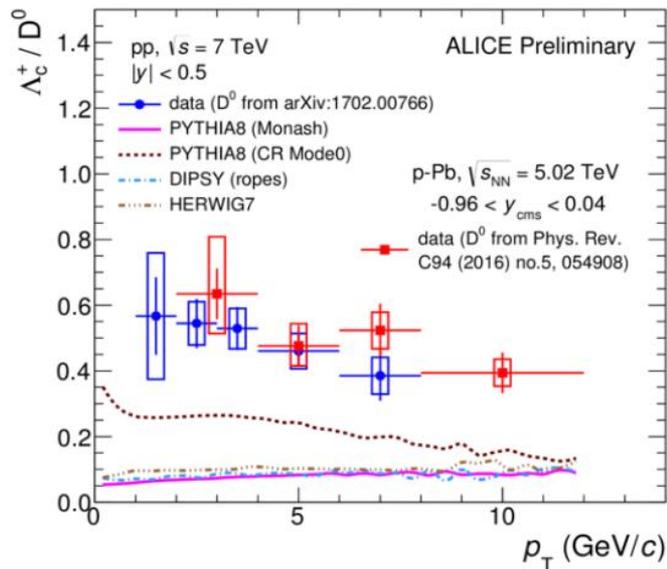
# Status of $\Xi_c^+$ Hadronic Channel topological study

2019. 11. 16

Jaehyeon Do

# Charmed baryon

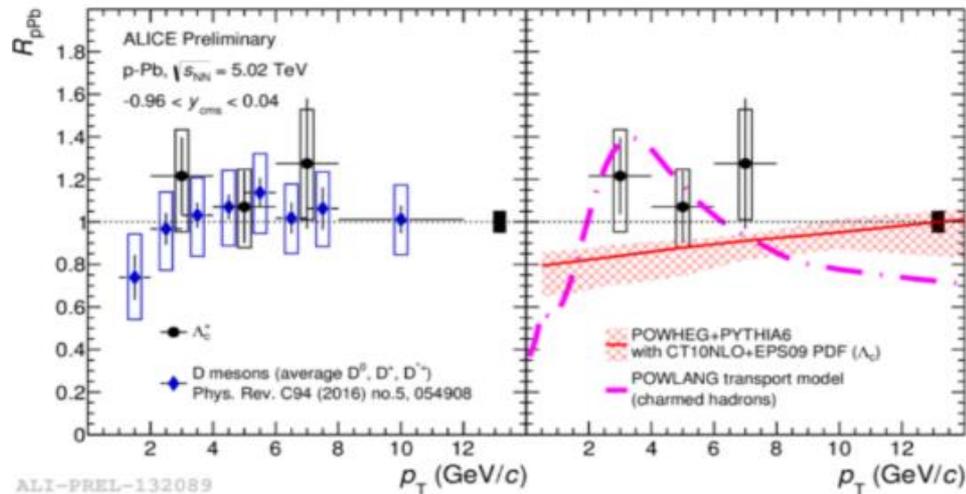
- Fragmentation into charm baryons are well studied in e+e collisions
  - Fragmentation would be same in pp (or pPb, PbPb) system?
  - Interaction with surrounding partons (like color reconnection) can enhance baryons
  - Recent analysis reported charm baryon enhancement from model prediction, even with CR



ALI-PREL-131866

# Charmed baryon

- Multiple parton interaction (MPI) and color reconnection (CR) could increase the baryon to meson ratio
  - pp charmed baryon measurement would be reference of bigger system (pPb, PbPb)
  - pPb collisions are further affected by cold nuclear matter effect and final state effect



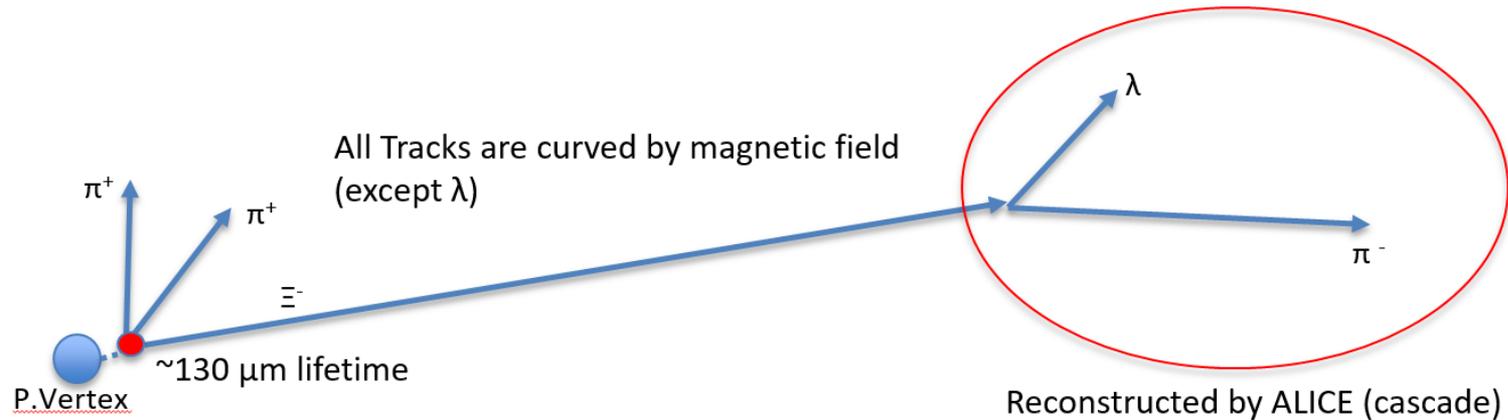
# $\Xi_c^+$ Decay Modes

|                             |  |     |     |
|-----------------------------|--|-----|-----|
| $\Sigma(1385)^+ K^- \pi^+$  | $[b,g] < 0.3$                                      | 90% | 678 |
| $\Sigma^+ K^- \pi^+$        | $[g] 0.94 \pm 0.11$                                |     | 811 |
| $\Sigma^+ \bar{K}^*(892)^0$ | $[b,g] 0.81 \pm 0.15$                              |     | 658 |
| $\Sigma^0 K^- \pi^+ \pi^+$  | $[g] 0.29 \pm 0.16$                                |     | 735 |
| $\Xi^0 \pi^+$               | $[g] 0.55 \pm 0.16$                                |     | 877 |
| $\Xi^- \pi^+ \pi^+$         | $[g] \text{ DEFINED AS } 1$                        |     | 851 |
| $\Xi(1530)^0 \pi^+$         | $[b,g] < 0.1$                                      | 90% | 750 |
| $\Xi^0 \pi^+ \pi^0$         | $[g] 2.34 \pm 0.68$                                |     | 856 |
| $\Xi^0 \pi^+ \pi^+ \pi^-$   | $[g] 1.74 \pm 0.50$                                |     | 818 |
| $\Xi^0 e^+ \nu_e$           | $[g] 2.3 \begin{matrix} +0.7 \\ -0.9 \end{matrix}$ |     | 884 |
| $\Omega^- K^+ \pi^+$        | $[g] 0.07 \pm 0.04$                                |     | 399 |

## Cabibbo-suppressed decays

|   |                       |     |     |
|---|-----------------------|-----|-----|
| $p K^- \pi^+$   | $[g] 0.21 \pm 0.03$   |     | 944 |
| $p \bar{K}^*(892)^0$                                    | $[b,g] 0.12 \pm 0.02$ |     | 828 |
| $\Sigma^+ K^+ K^-$                                      | $[g] 0.15 \pm 0.07$   |     | 580 |
| $\Sigma^+ \phi$   | $[b,g] < 0.11$        | 90% | 549 |
| $\Xi(1690)^0 K^+, \Xi(1690)^0 \rightarrow \Sigma^+ K^-$ | $[g] < 0.05$          | 90% | 501 |

# Motivation

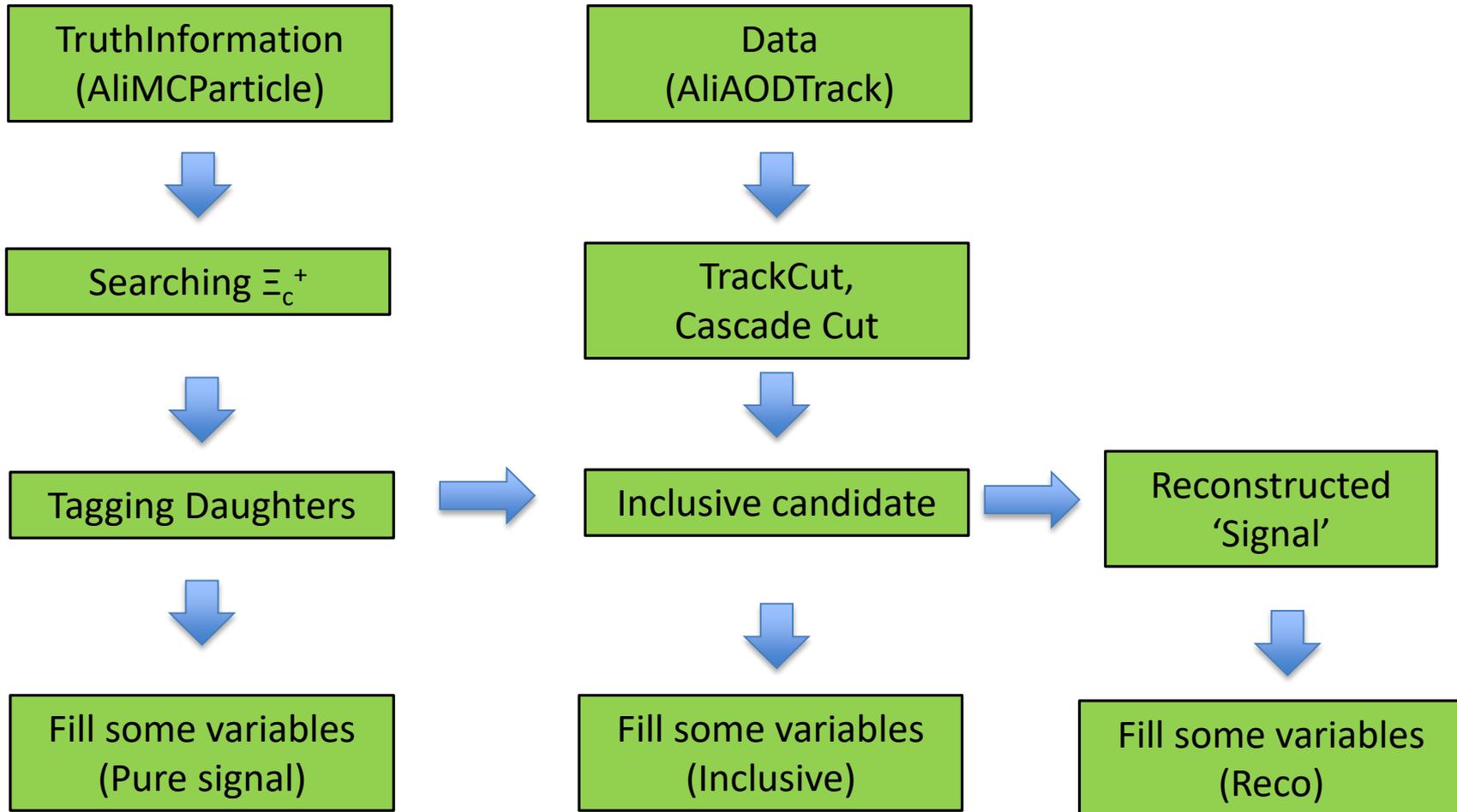


- $\Xi^-$ ,  $\pi^+$ ,  $\pi^+$  vs  $K^-$ ,  $\pi^+$ ,  $P$
- Pros :
  - Larger branching ratio (x5)
  - Resonance channel provide further constraints on signal selection (Mass window cut)
- Cons :
  - Has more 5 daughter particles (Harder to reconstruct, introduce more combinatorics)

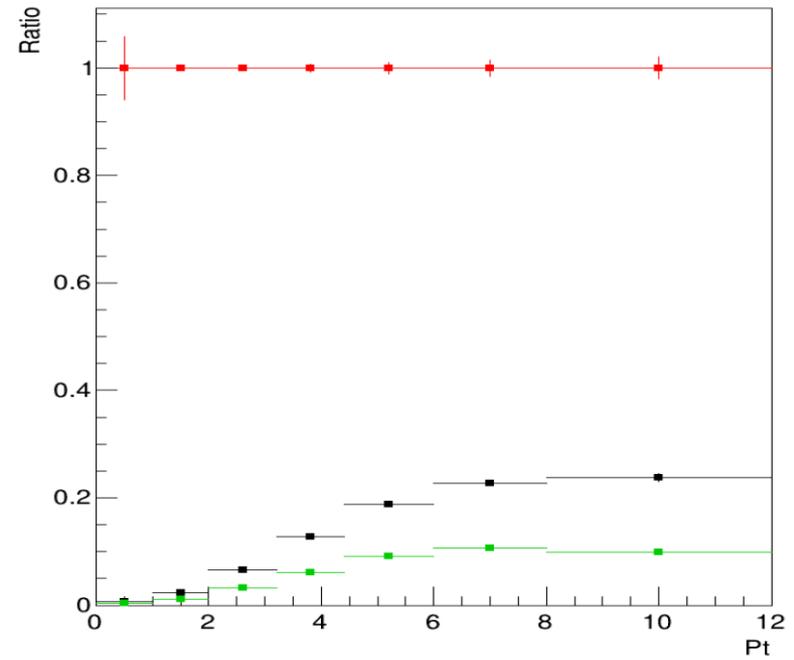
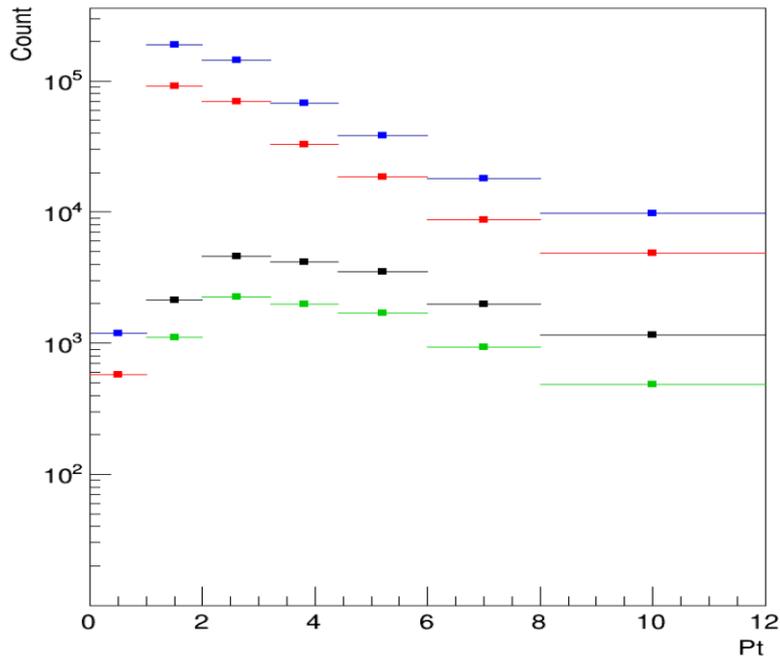
# DataAnalysis

- DataSet LHC19g6a2, LHC19g6b2, LHC19g6c2 (pp 13TeV, MC)
  - 3M events were selected
  - $\Xi_c^+$ ,  $\Xi_c^0$  embedded (Heavy flavor enhanced event)
  - Interested physics  $\Xi_c^+$  decayed into  $\Xi^- + \pi^+ + \pi^+$
  - $\Xi_c^+ \rightarrow \Xi^- + \pi^+ + \pi^+ (\sim 90\%)$
  - $\Xi_c^+ \rightarrow \Xi^{*+} + \pi^+ \rightarrow \Xi^- + \pi^+ + \pi^+ (\sim 10\%)$
- Minimum trackcut applied
  - Mass window cut on cascade (12MeV)
  - 4 sigma TPC PID cut for Pions
  - 500 $\mu$ m PiPi DCAcut
- $\Xi_c^+$  Signals are tagged by truth information

# Code detail



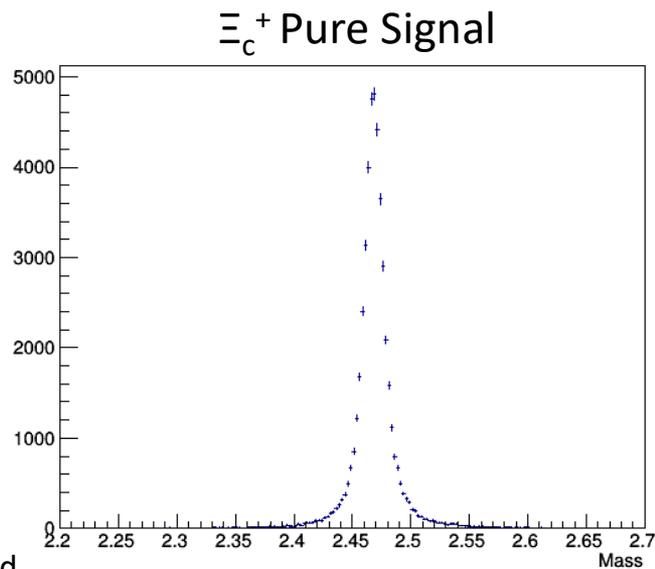
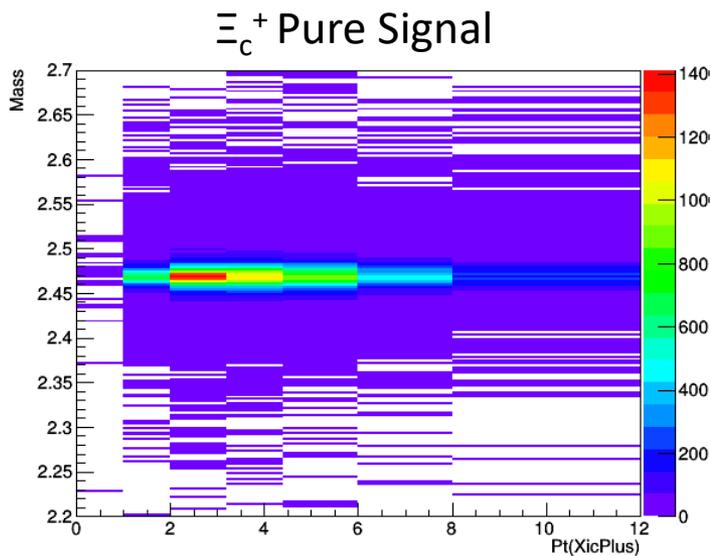
# $\Xi_c^+$ Generated Spectrum



- ①
- ① & ②
- ① & ② & ③
- ① & ② & ③ & ④

- ① :  $\Xi_c^+$  Generated  $|y| < 0.8$
- ② :  $\Xi_c^+ \rightarrow \Xi^- + \pi^+ + \pi^+$
- ③ :  $\Xi_c^+$  All Daughter are found
- ④ :  $\Xi_c^+$  Cut passed

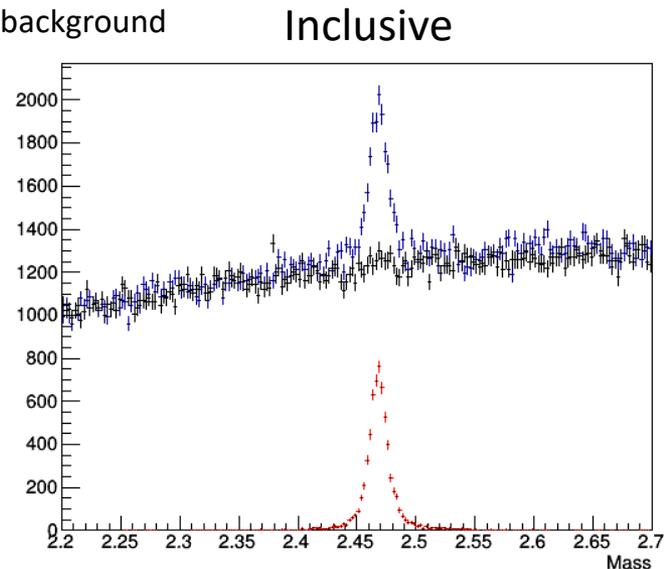
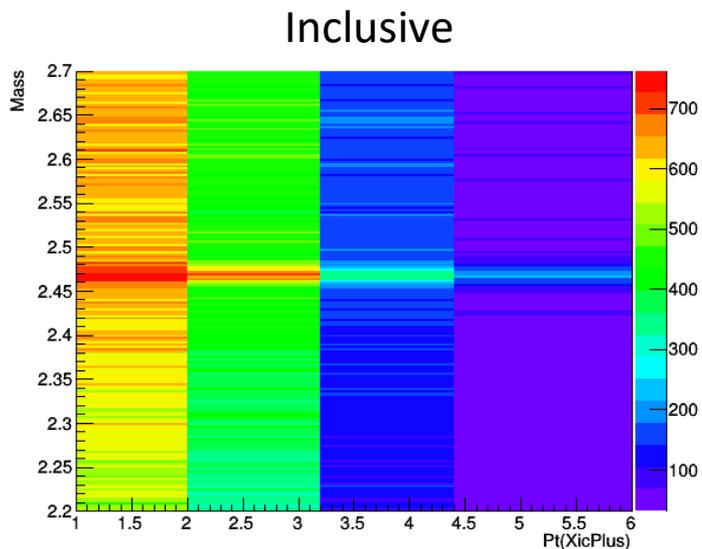
# $\Xi_c^+$ Reconstructed Mass (Pt : 1-5 GeV)



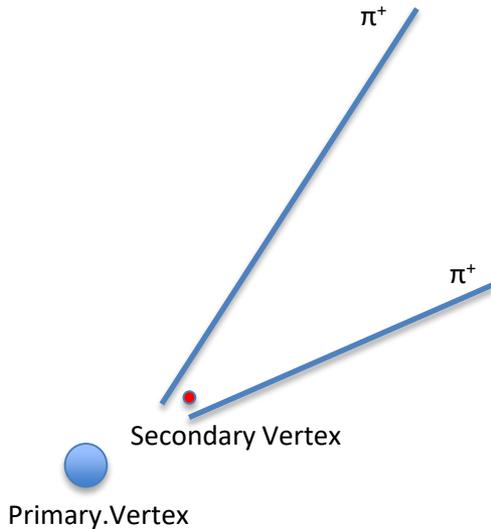
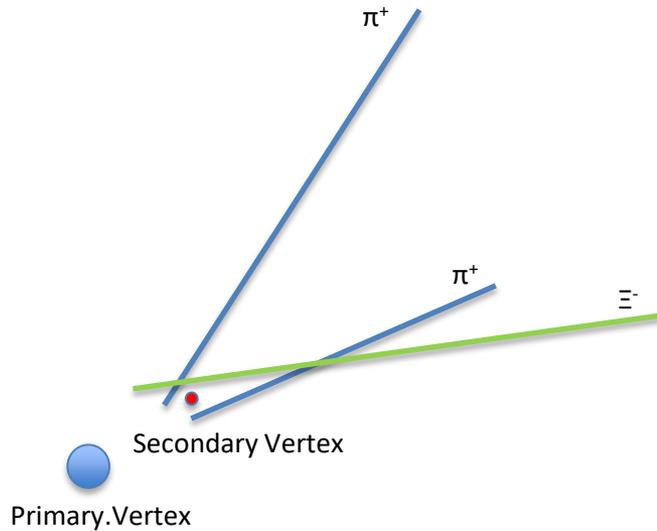
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Signal Tagged

Wrong sign background

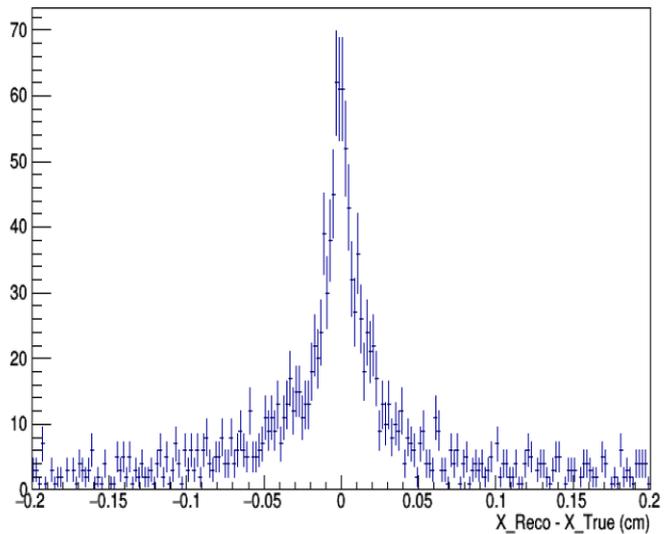
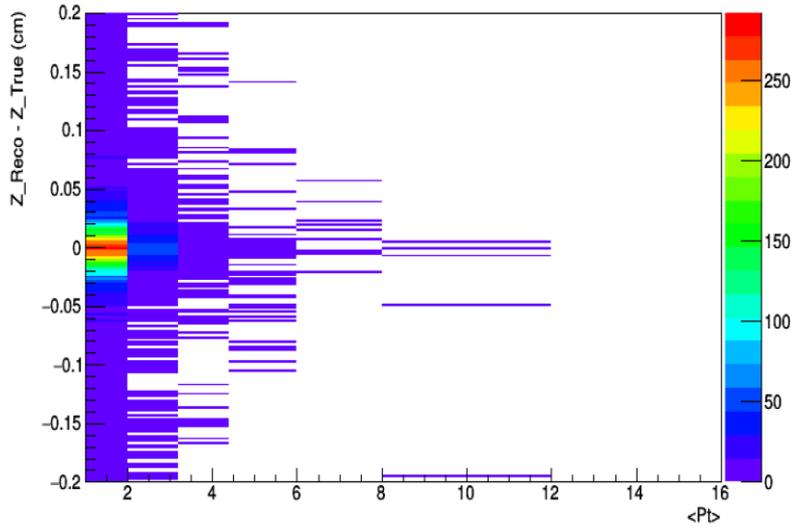
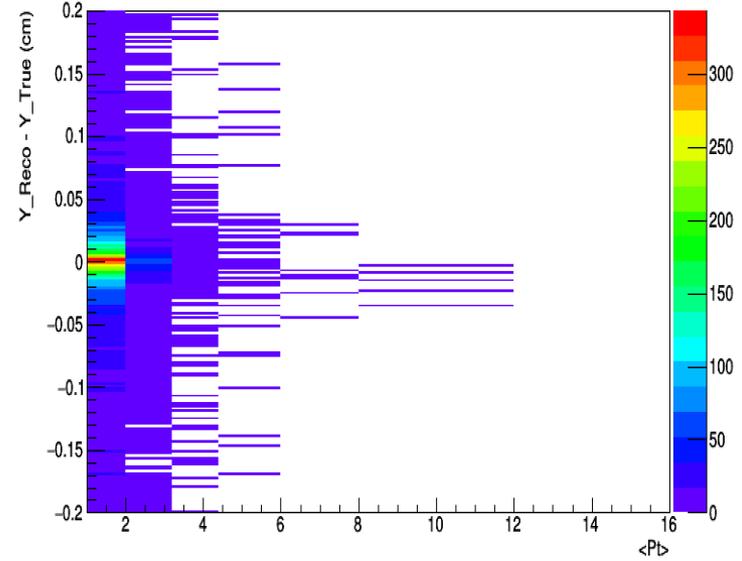
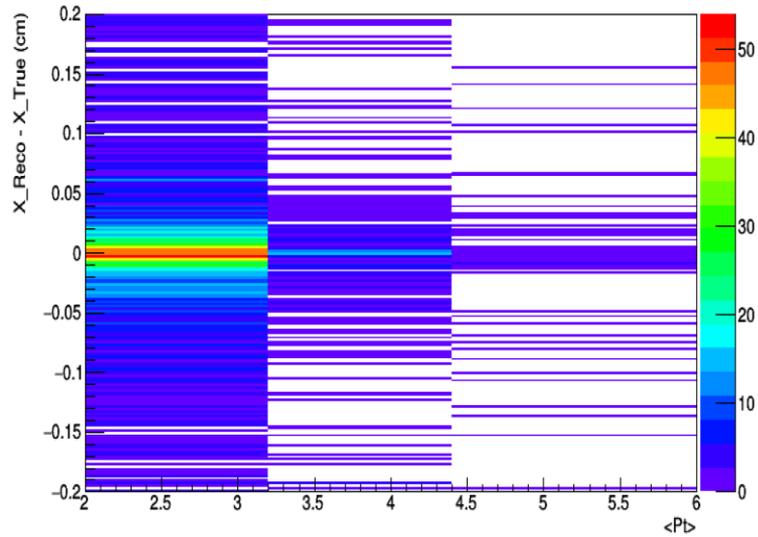


# Secondary Vertex

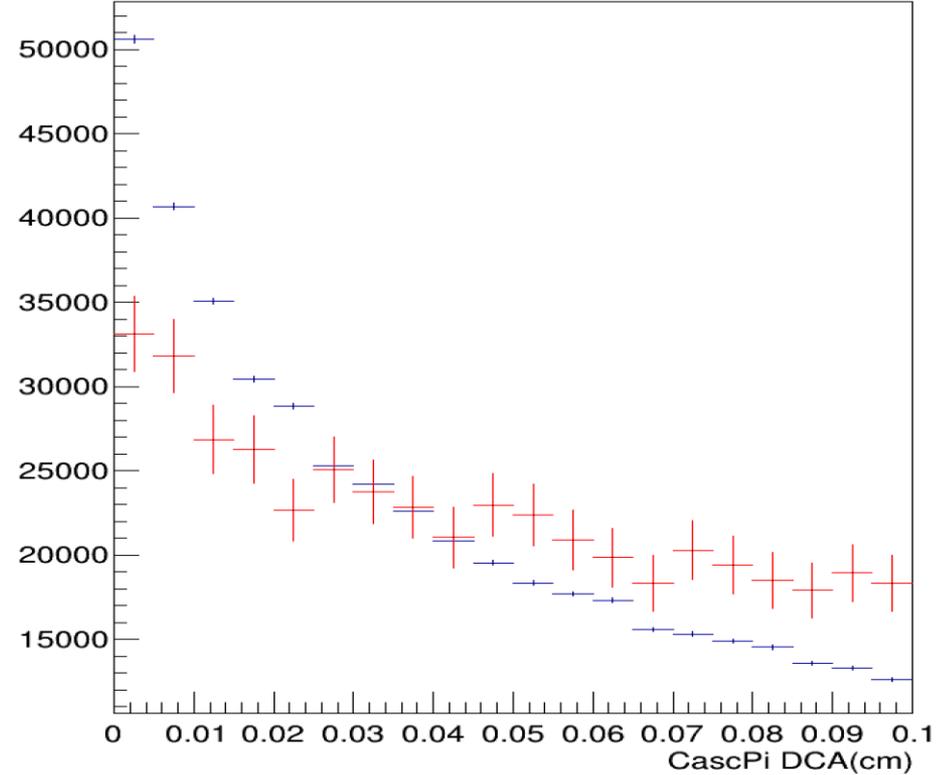
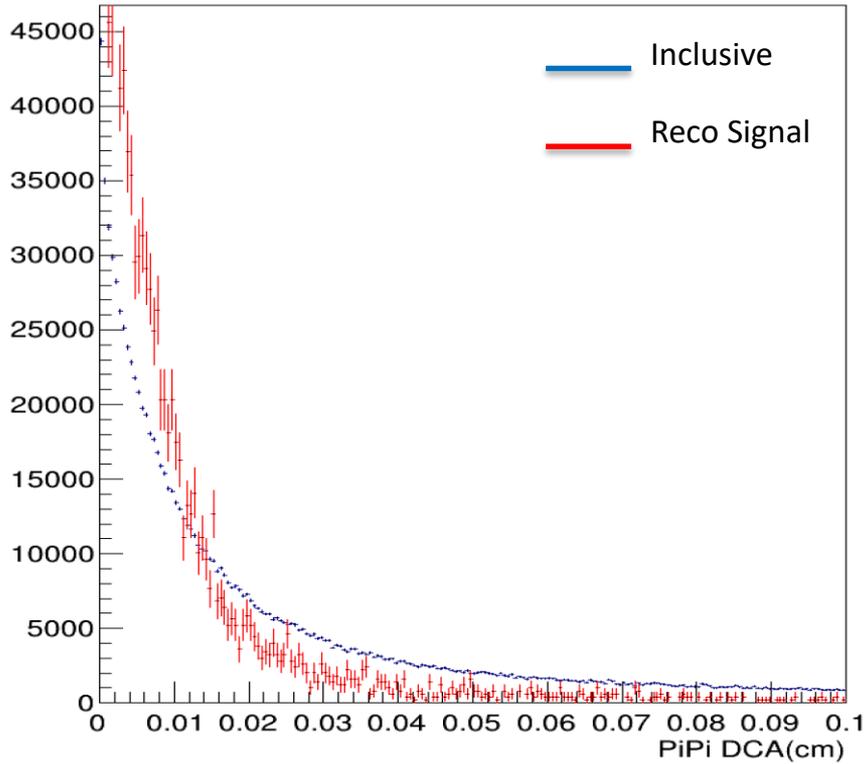


- AliVertexerTracks is used for searching vertex
  - Algorithm : 1 (Default)
  - Little bit Efficiency costly : sometimes fails to find vertex
- Cascade has much worse vertex resolution
  - Not causing too much problem since vertexer take into account track resolution

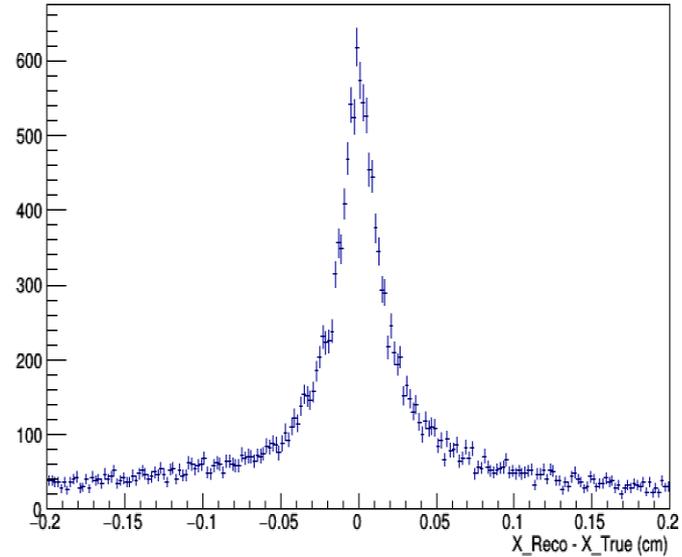
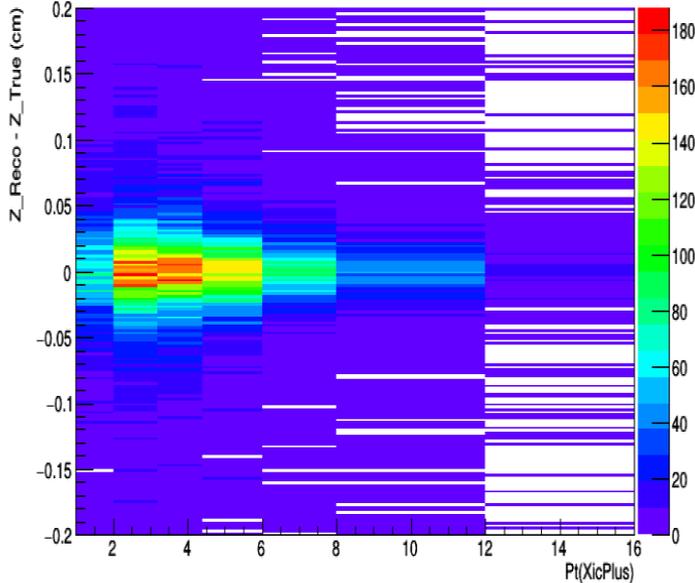
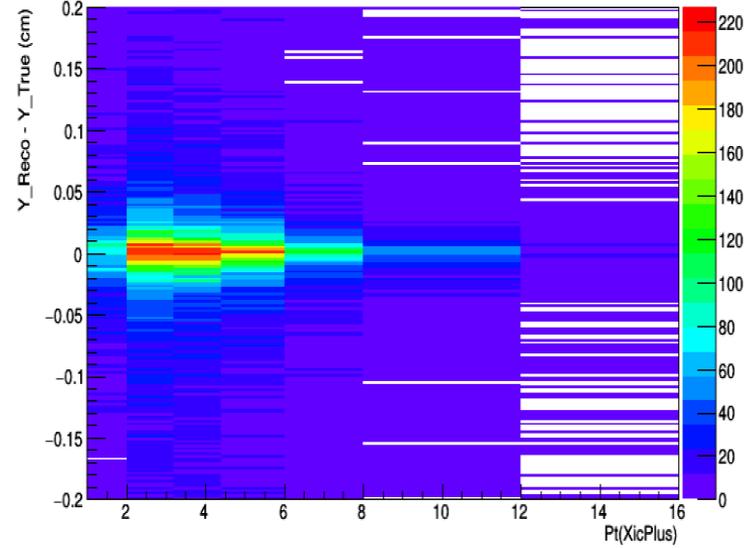
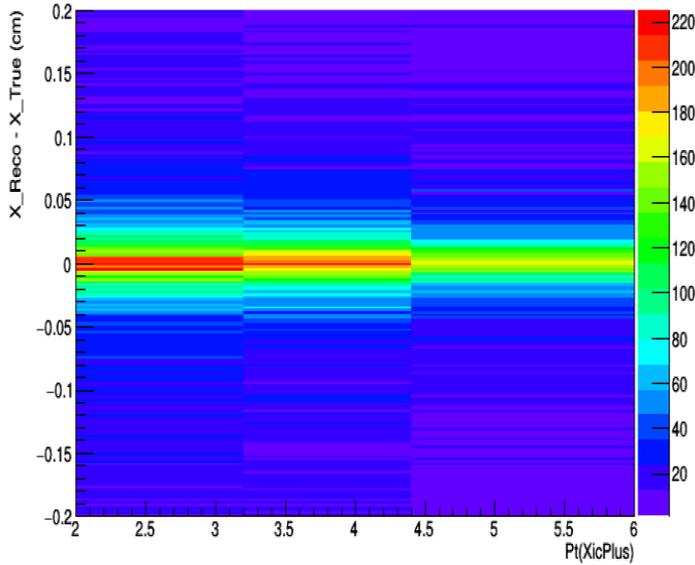
# Two Track Vertex (Pt : 1-5GeV)



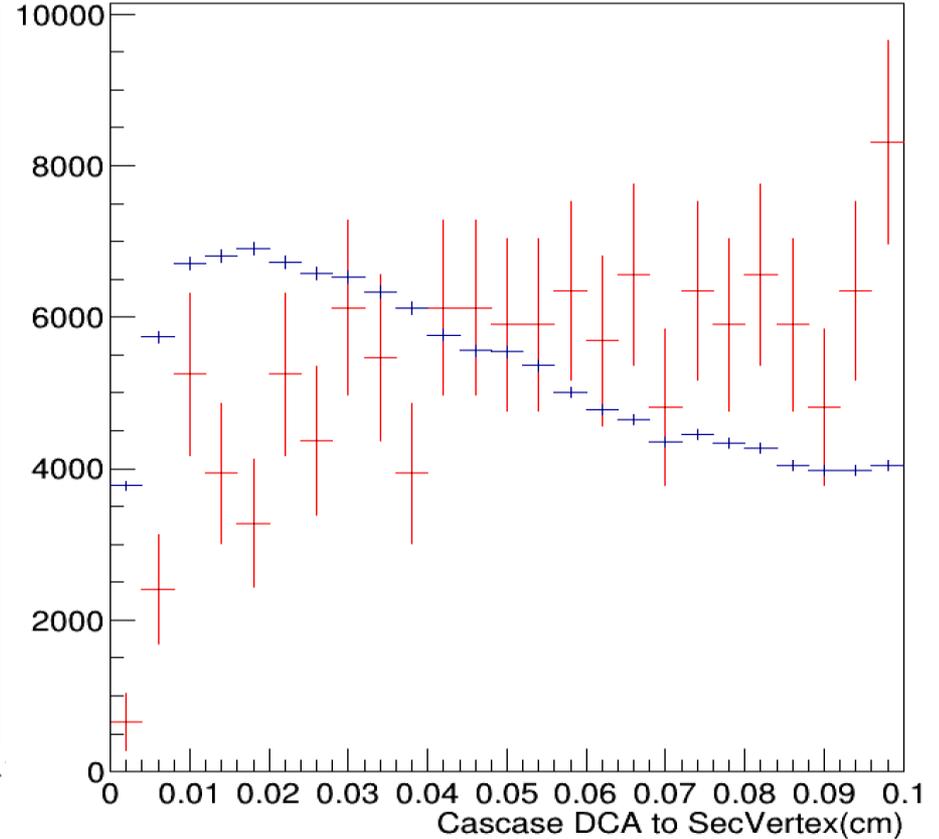
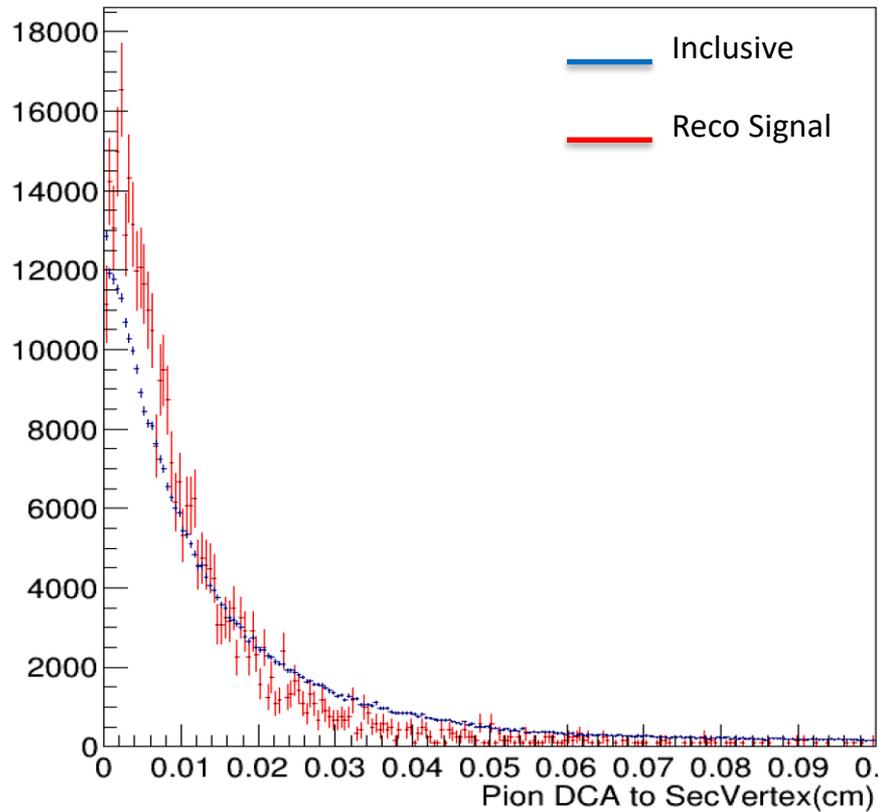
# Two Track Vertex (Pt : 1-5GeV)



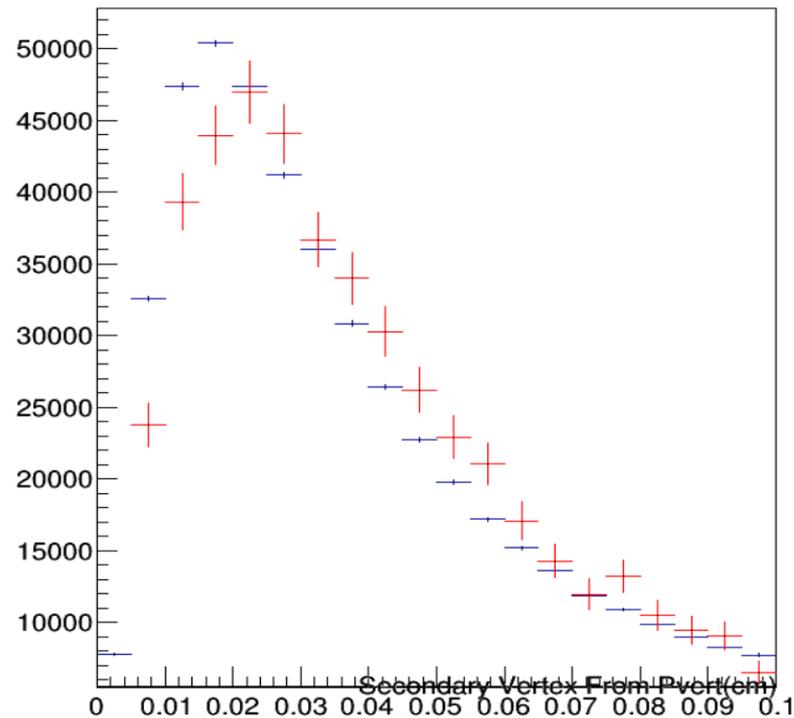
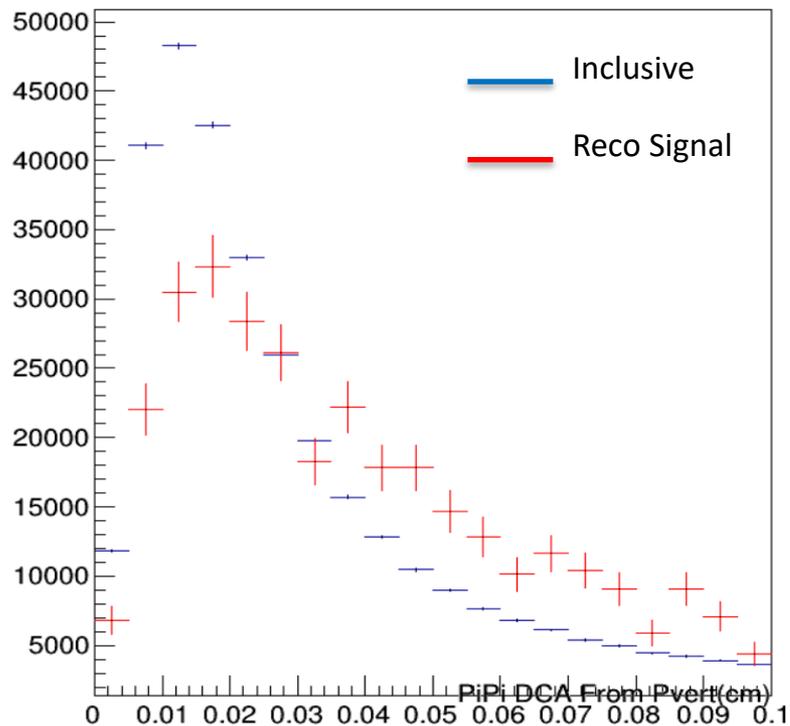
# Three Track Vertex (Pt : 1-5GeV)



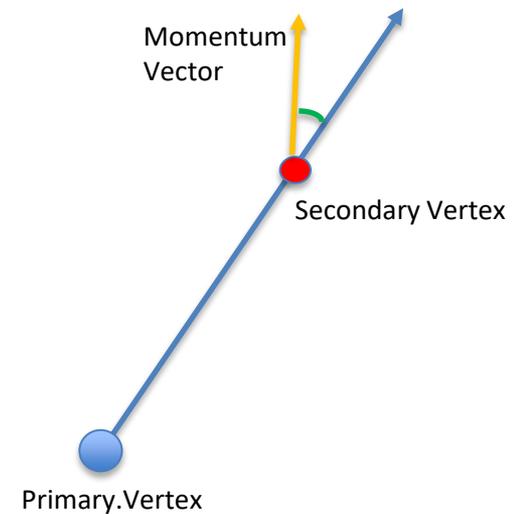
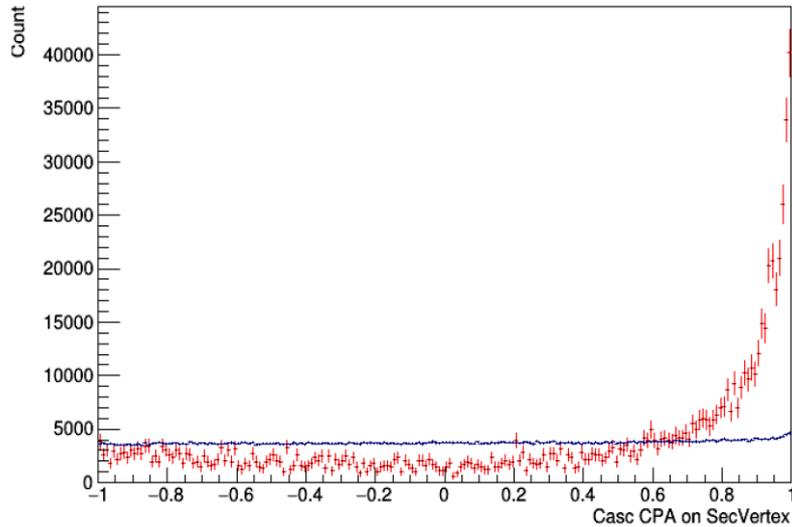
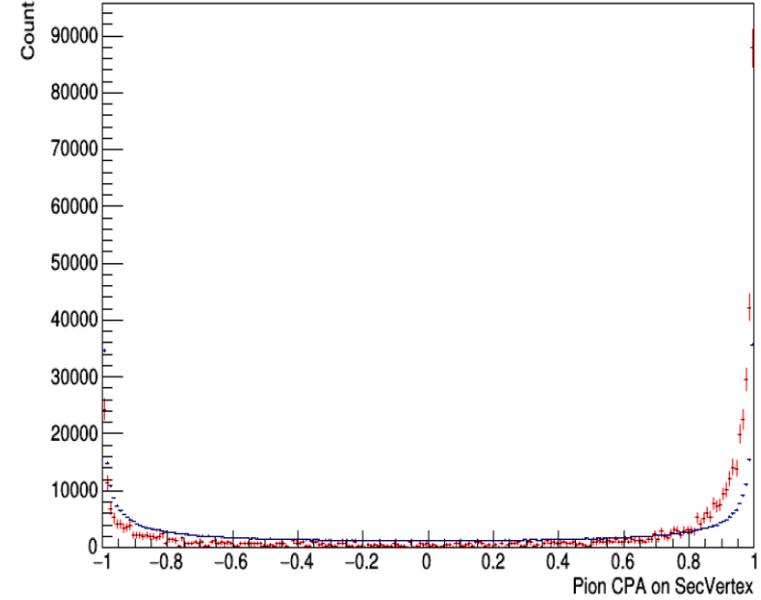
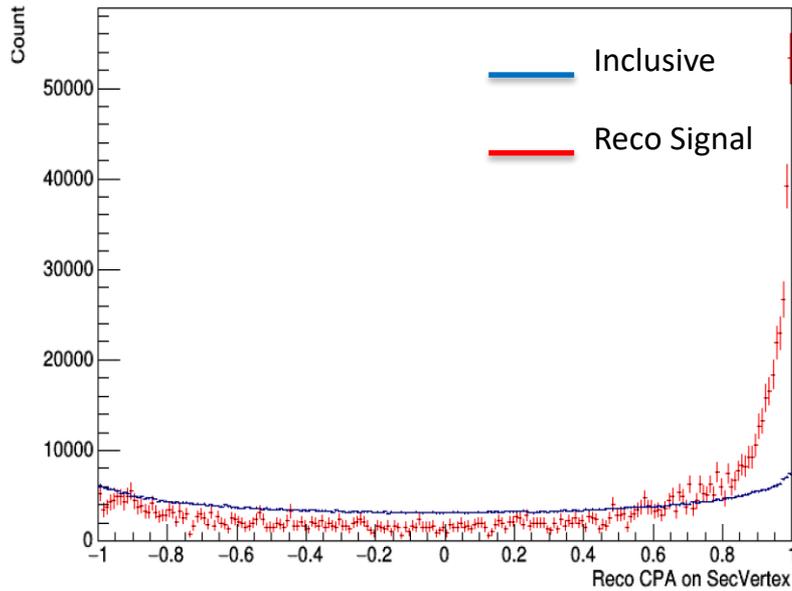
# Three Track Vertex (Pt : 1-5GeV)



# SecVertex distance from PV(Pt : 1-5GeV)

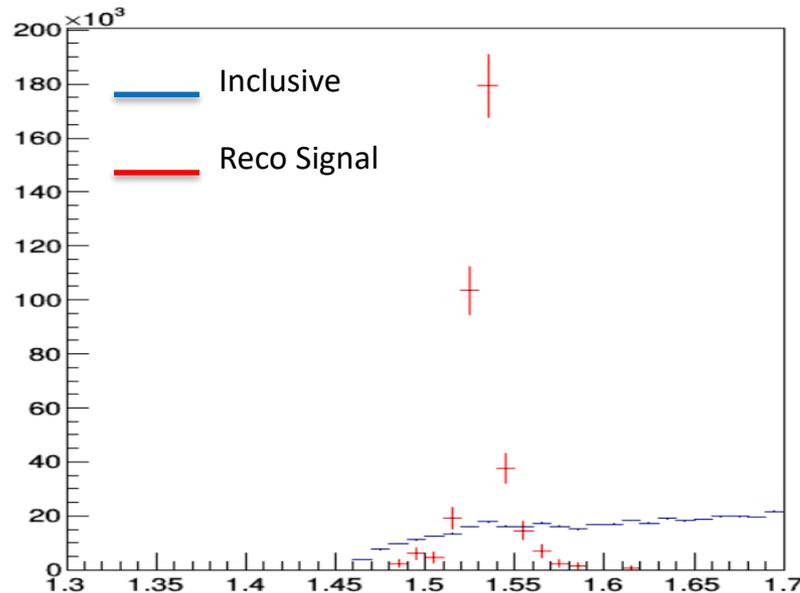


# Cosine Pointing Angle at SecVertex



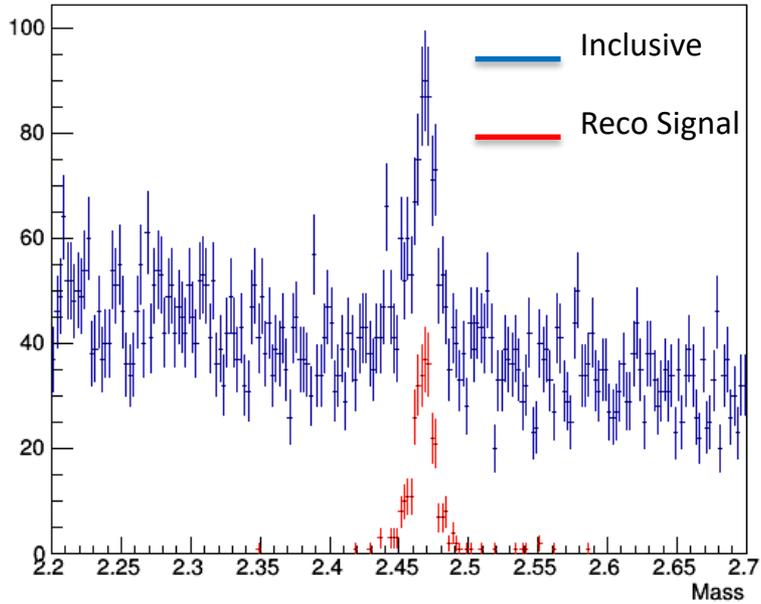
# Resonance channel decay

- $\Xi(1530)$  Can be reconstructed by pairing  $\pi^+$  and  $\Xi^-$ , we can apply additional mass cut (12MeV for now)
  - Expected further enhancement on S/B ratio
- Data has about 10% Resonance channel compared to total  $\Xi^-, \pi^+, \pi^+$  decay mode

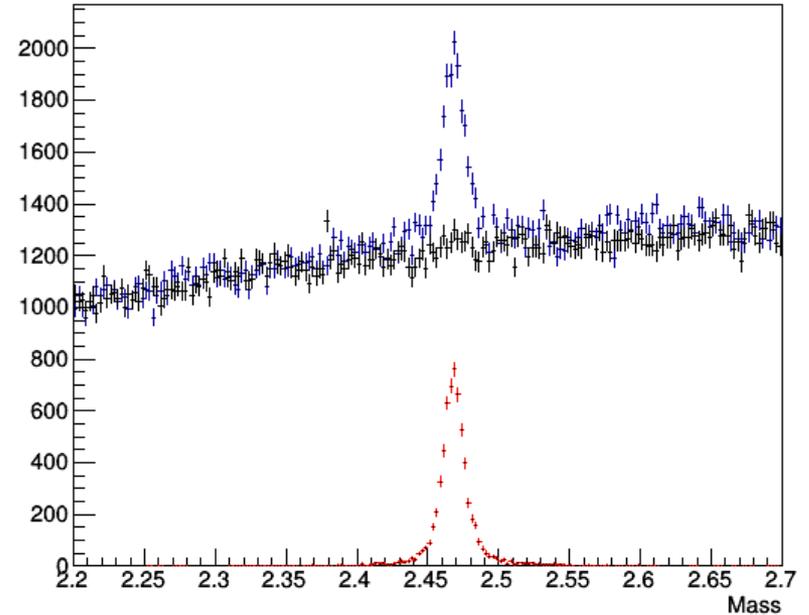


# Resonance channel Reconstruction

Resonance cut Applied



Inclusive



# Next Step

- Real data is very good background sample to comparison
- Searching optimal S/B by using DBT would be interesting
- Performance test on ITS upgrade
  - New MC data is available