Xi Yield and its Feed-down

Dongsheng Li

Outline

- Xi Yield
- Feed-down

Xi Reconstruction

Event selection:
- Vz [-35,25], |Vz-VpdVz| < 3
- good run
- pile-up rejection
- Apply centrality weight (StRefMultCorr from Kaifeng and Yan)

#Events (0-80%): 0.95 B

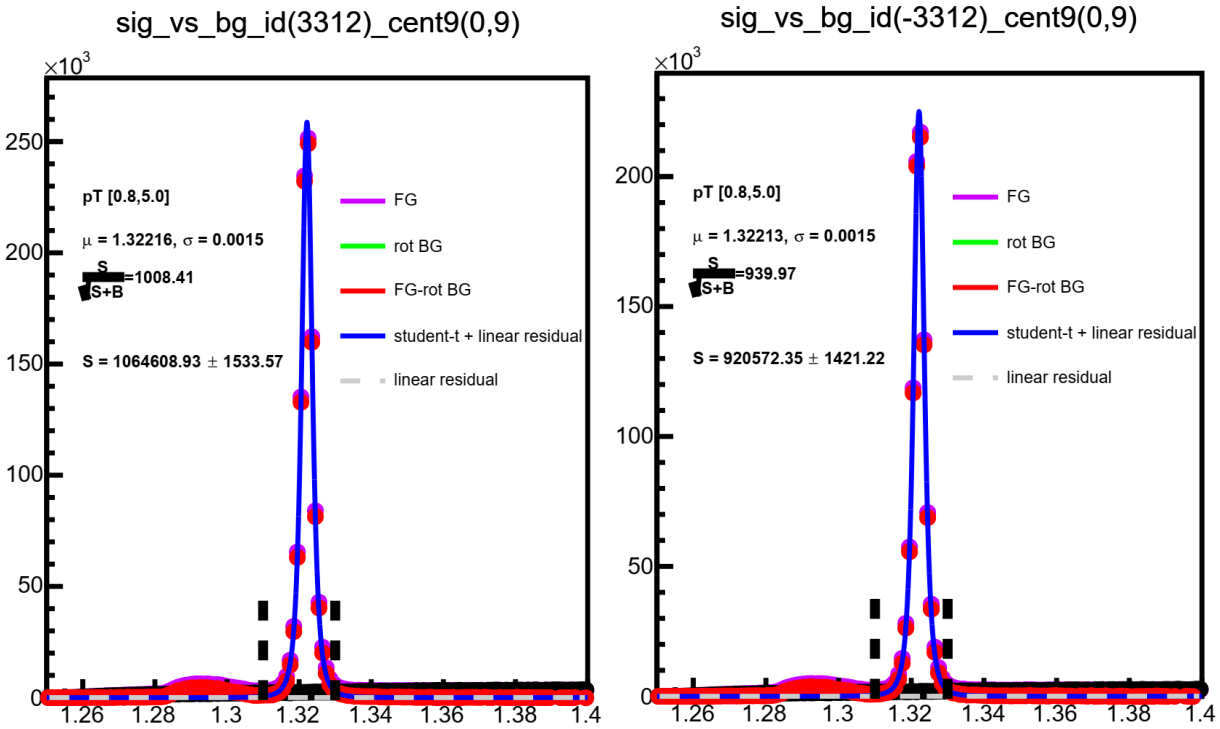
Track quality:
- Daughter pT > 0.1, eta [-1.5,1.5]
- Nhitsdedx>=5, nhits >=15 , nhitsfit/nhitsmax>0.52
- Dedxerror [0.01,0.25]

Signal extraction:
- Mass width depends on pT
- Temporarily we use constant mass cut

Analysis cuts	default
Chi2topo	<=5
Chi2ndf	<=5
Chi2primary_pi	>=10
Chi2primary_bach	>=14
Chi2primrary_proton	>= 7
Ld_chi2ndf	<=10
Ldl	>=6
L	>=3
L_Ld	>=L
Nhits	>= 17

Xi Reconstruction

- Rotational background (pion, 180 degrees)
- For each centrality, get normalization factor of Rot_BG with sideband [1.36,1.4]
- For each centrality and pT bin, Fit the linear residual:
  - RES = FG-Rot_BG, remove its bin-contents within [1.27,1.35]
- Get spectra with SIG = FG-BG-RES



A bump near the Xi peak:

Xi -> Lambda + pi_bach -> (pi_bach + pi_ld) + proton_ld

Misidentification of pi_bach -> pi_ld will lead to the bump

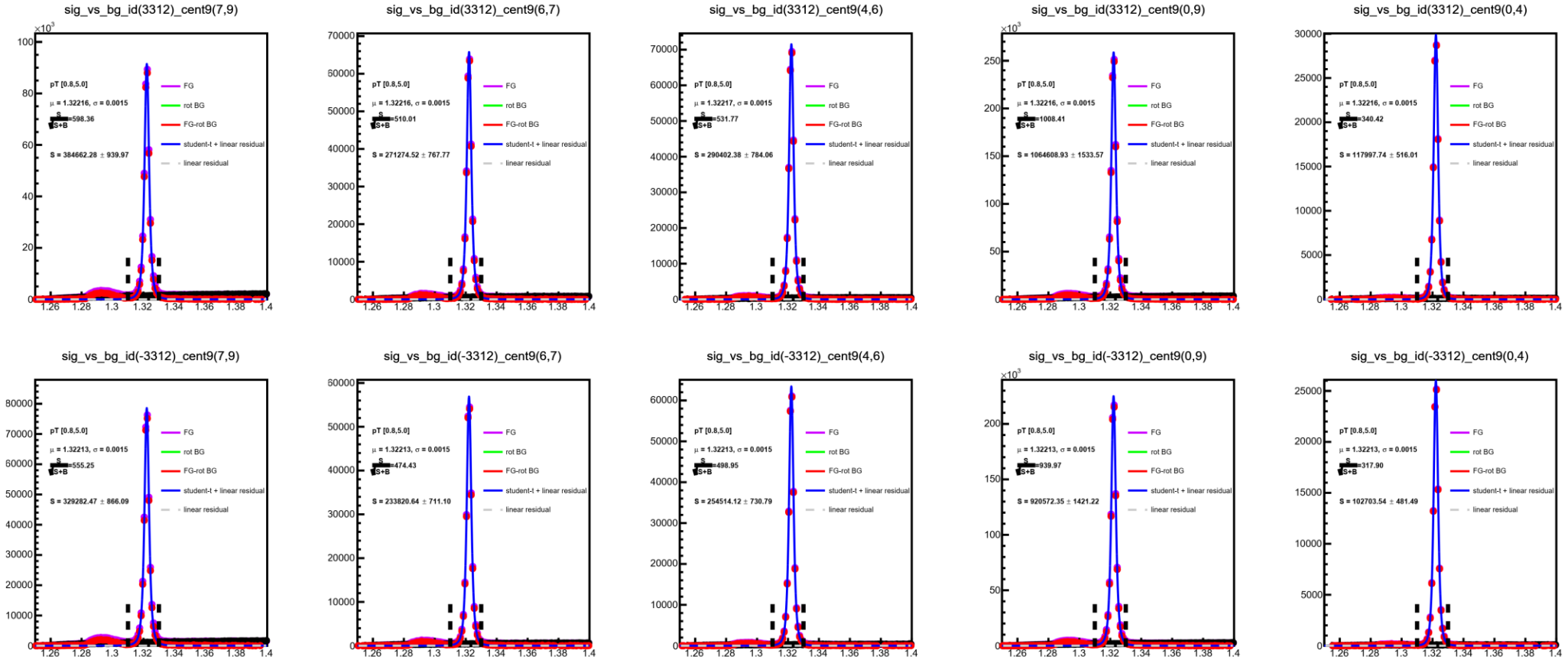
Can be removed through a veto cut:

| inv_mass (pi_bach, proton_ld) – M_Lambda | < 0.01

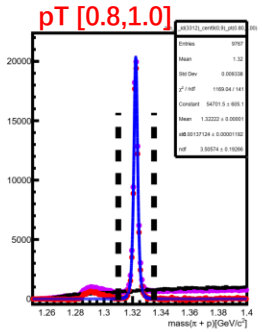
https://drupal.star.bnl.gov/STAR/system/files/Workshop_Xi_Production_at_AuAu_3p2GeV.pdf

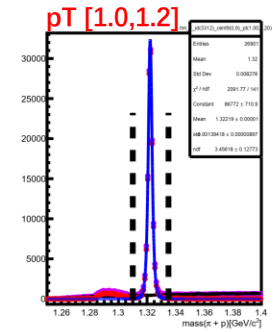
Lambda Reconstruction

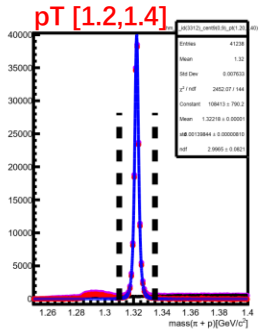
Normalization in each centrality for lambda / lambda_bar

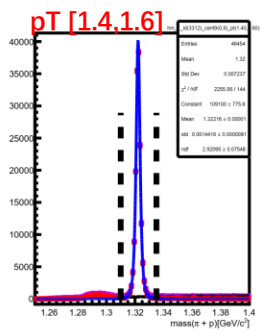


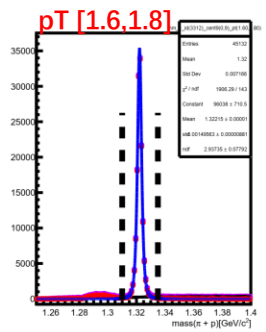
Lambda Reconstruction

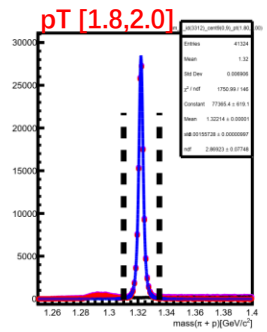


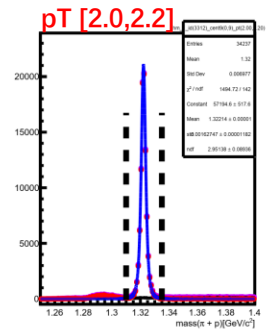


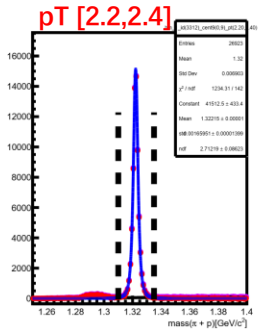


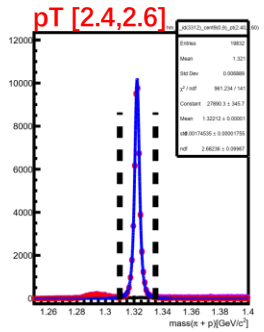


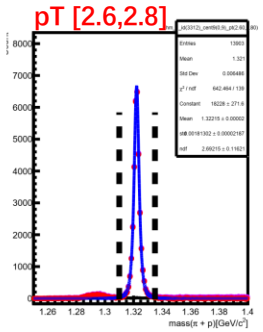


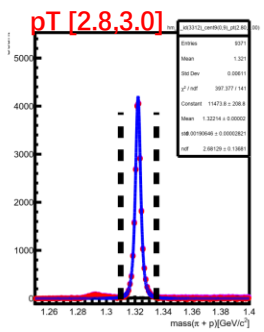


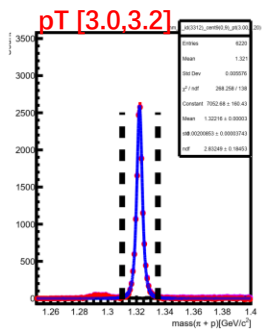


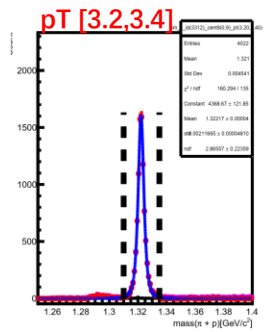


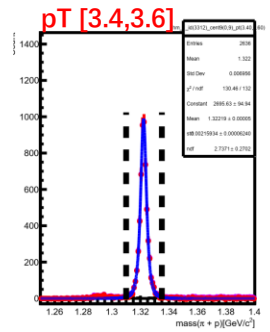


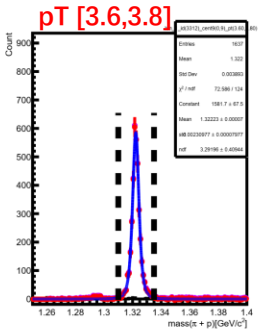


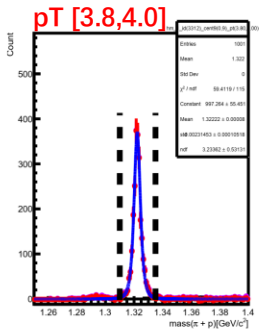


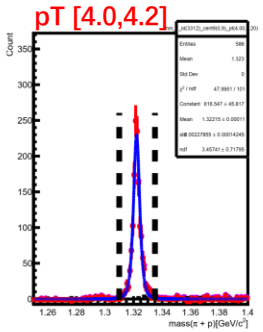


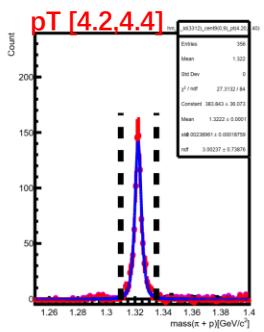


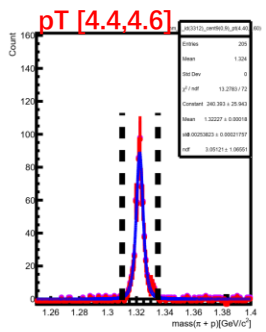


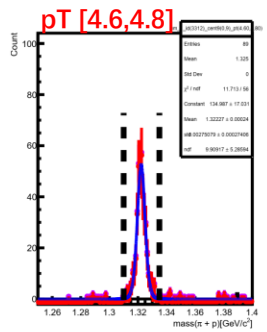


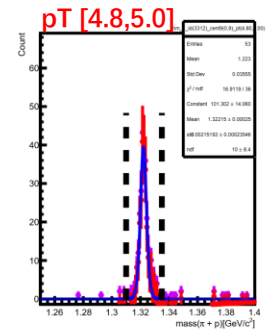












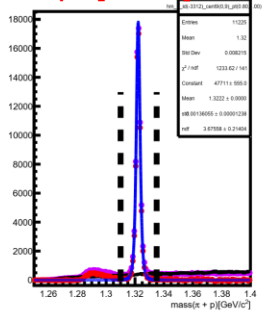
Xi in 0-80%
pT 0.8~5.0

Violet: FG
Black: Rot_BG
Red: FG – Rot_BG - RES
Blue: student-t fit

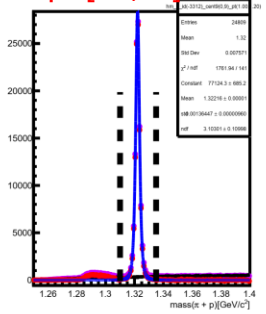
Higher pT with larger mass width

Lambda Reconstruction

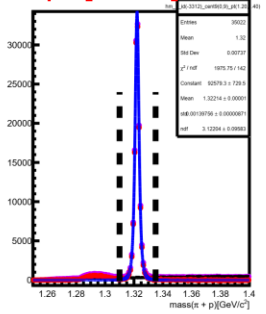
pT [0.8,1.0]



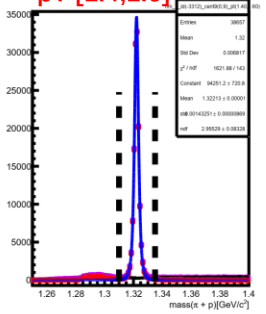
pT [1.0,1.2]



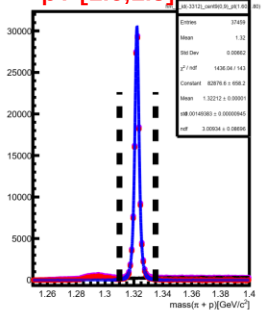
pT [1.2,1.4]



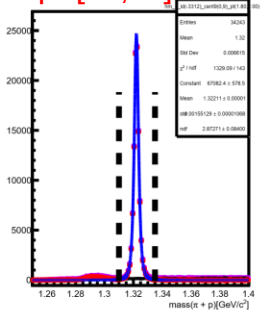
pT [1.4,1.6]



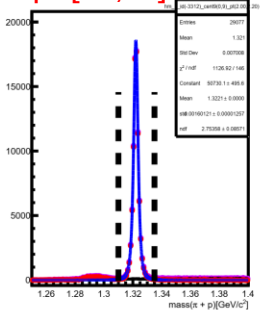
pT [1.6,1.8]



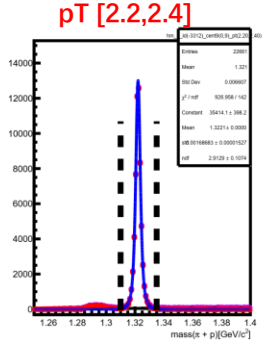
pT [1.8,2.0]



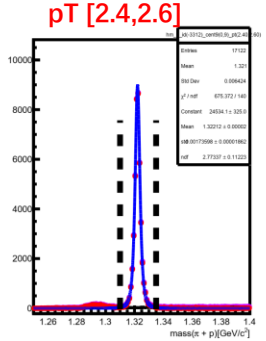
pT [2.0,2.2]



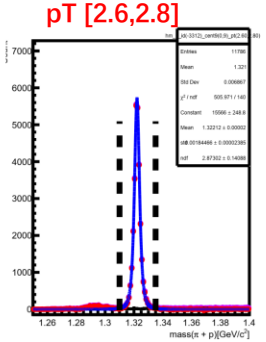
pT [2.2,2.4]



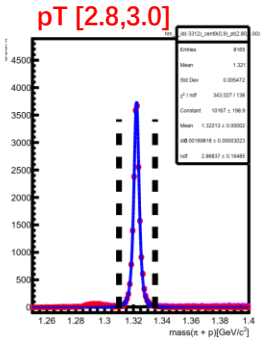
pT [2.4,2.6]



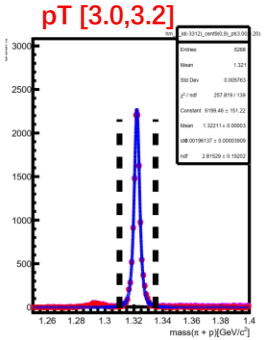
pT [2.6,2.8]



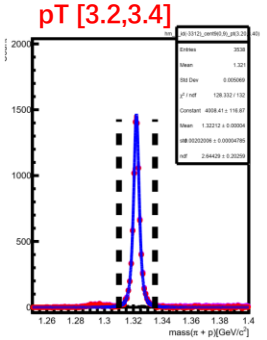
pT [2.8,3.0]



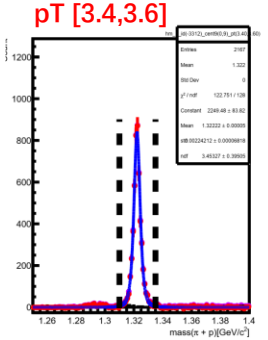
pT [3.0,3.2]



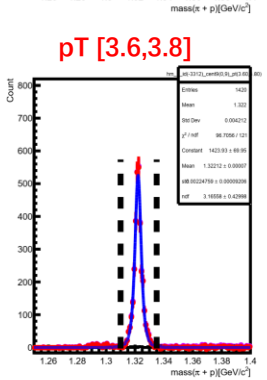
pT [3.2,3.4]



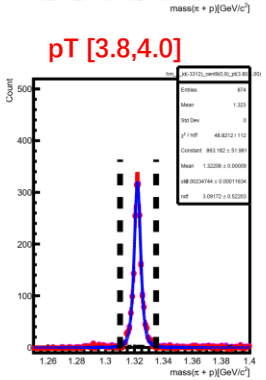
pT [3.4,3.6]



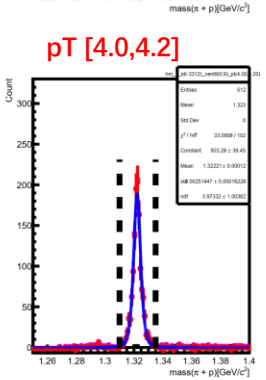
pT [3.6,3.8]



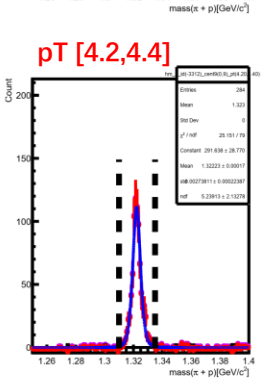
pT [3.8,4.0]



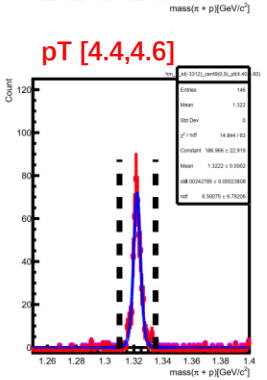
pT [4.0,4.2]



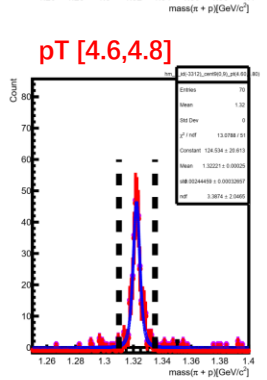
pT [4.2,4.4]



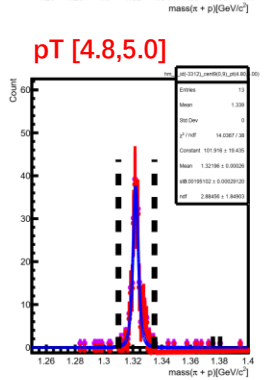
pT [4.4,4.6]



pT [4.6,4.8]



pT [4.8,5.0]



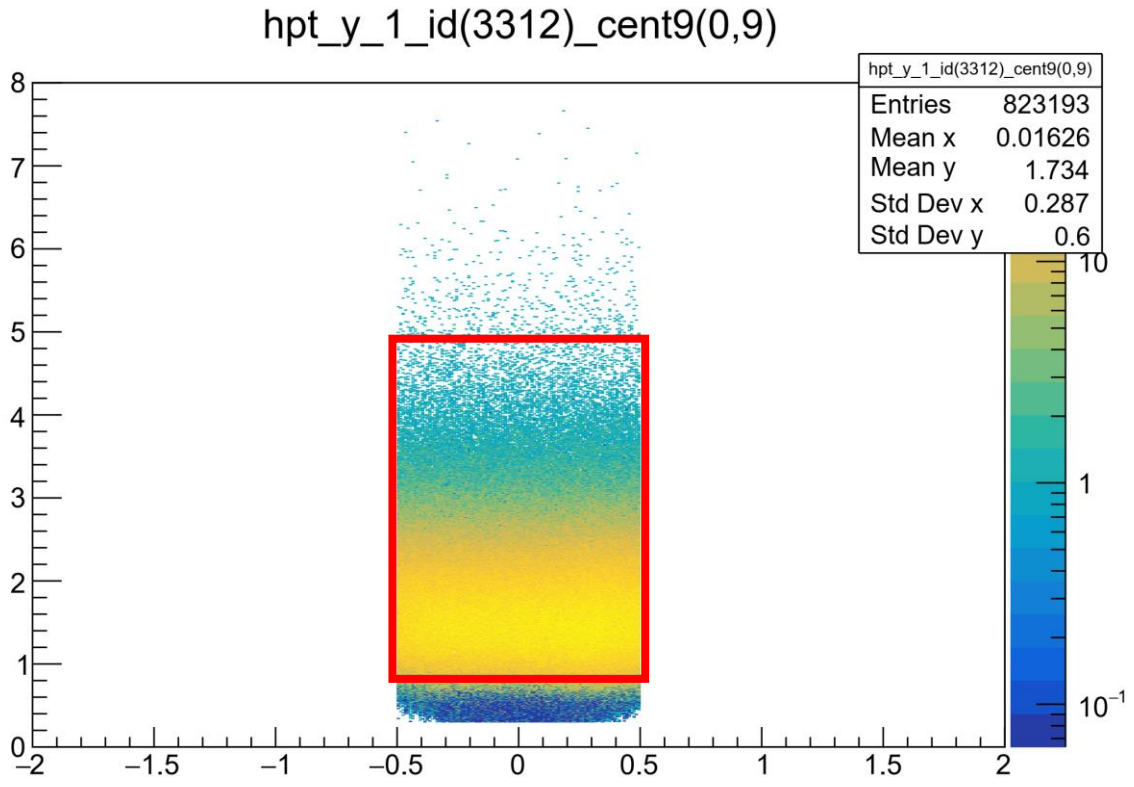
Xi_bar in 0-80%
pT 0.8~5.0

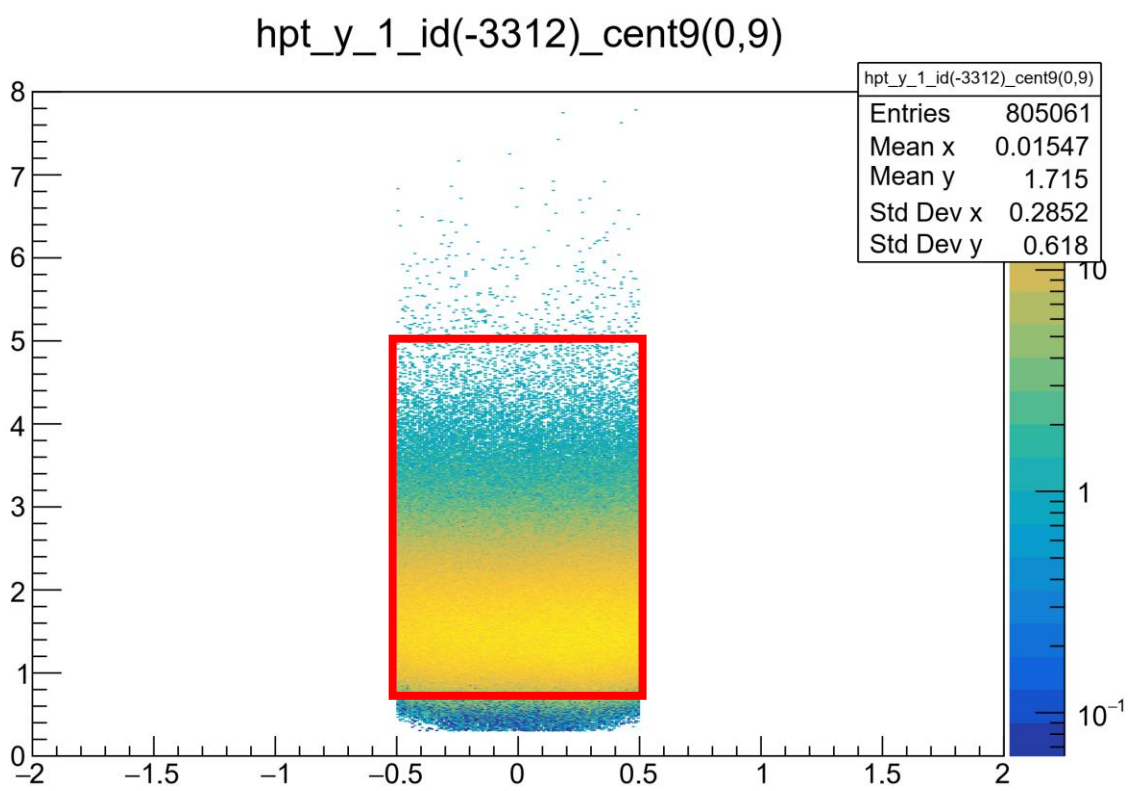
Violet: FG
Black: Rot_BG
Red: FG – Rot_BG - RES
Blue: student-t fit

Higher pT with larger mass width

Lambda Reconstruction

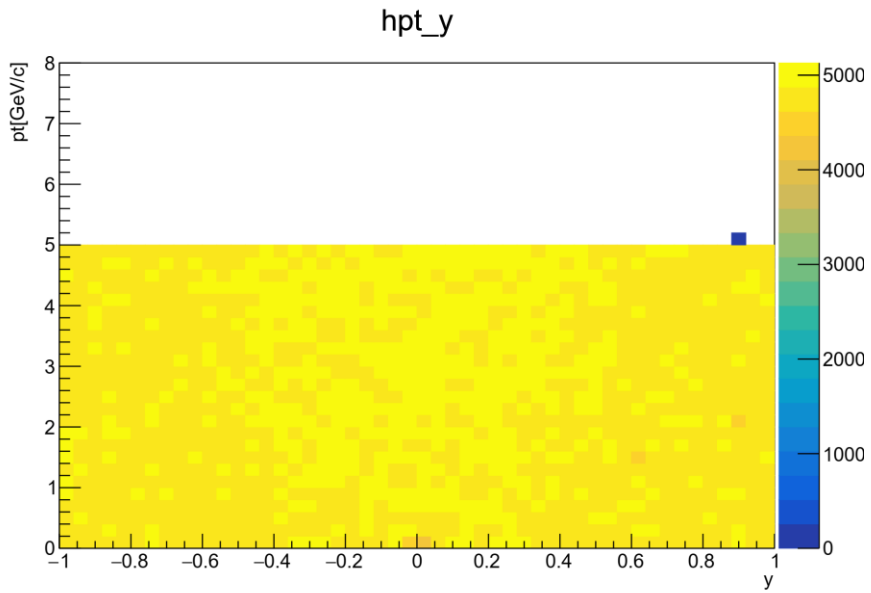
- **Acceptance**
  - **We will report yield within y[-0.5,0.5] x pT [0.8,5.0]**



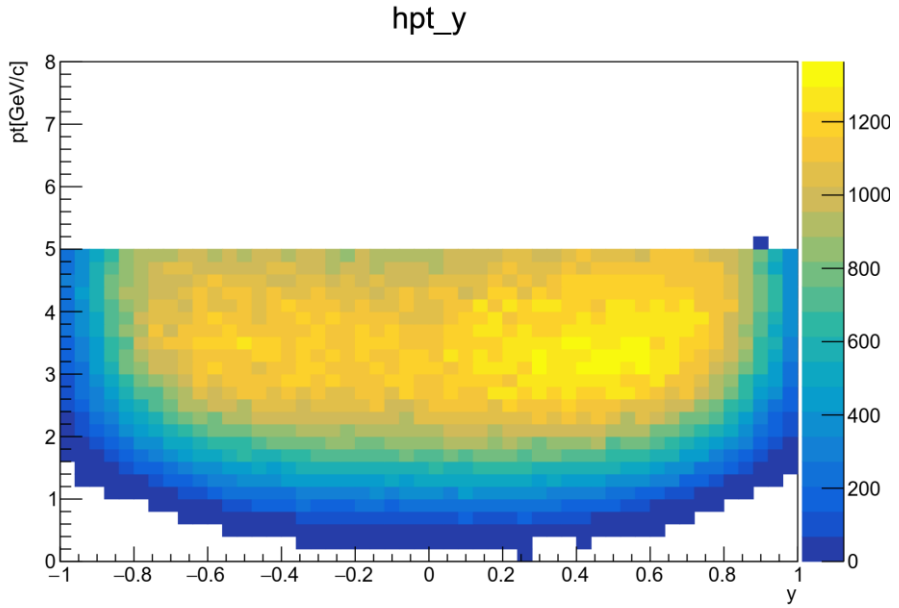


Lambda Efficiency

- MC before weighting
  - pT,y flat



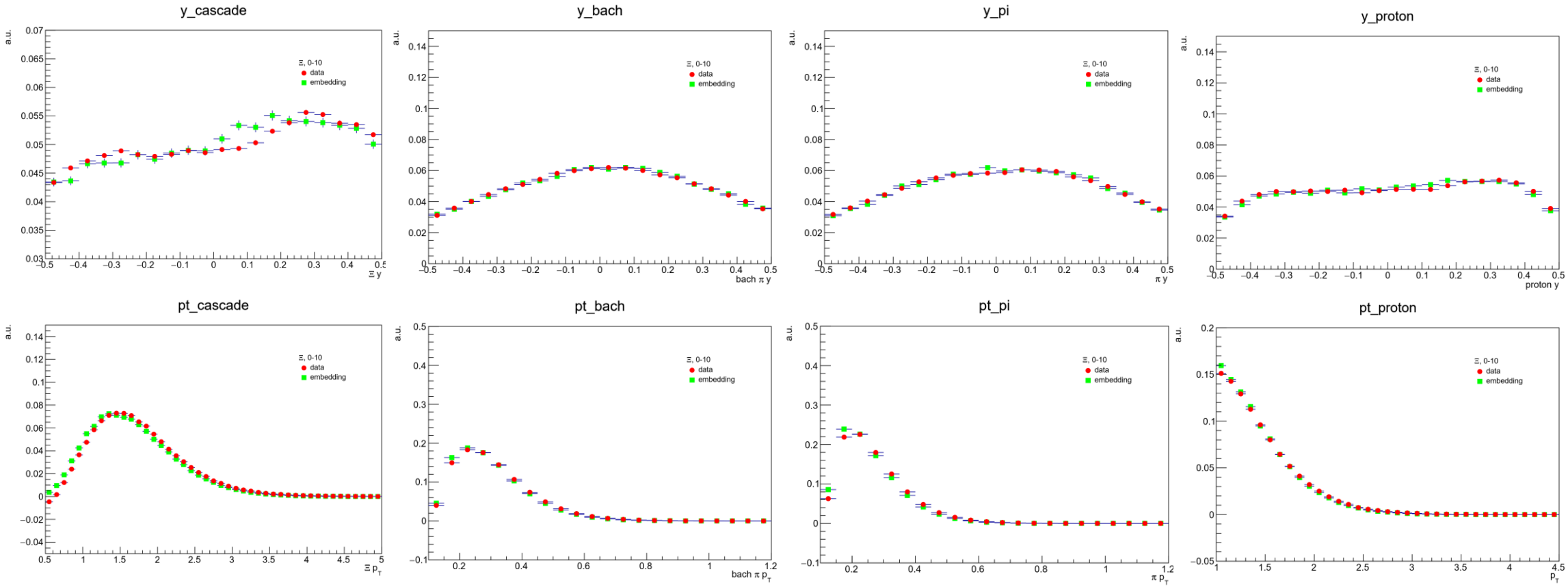
all-raw-mc



reco-mc with pre-cuts when producing the minitree

Xi Efficiency

- pT&y weighted
  - pT-Boltzmann, y-quadratic (Iteration)
- reco-data and reco-mc almost consistent



Xi Efficiency

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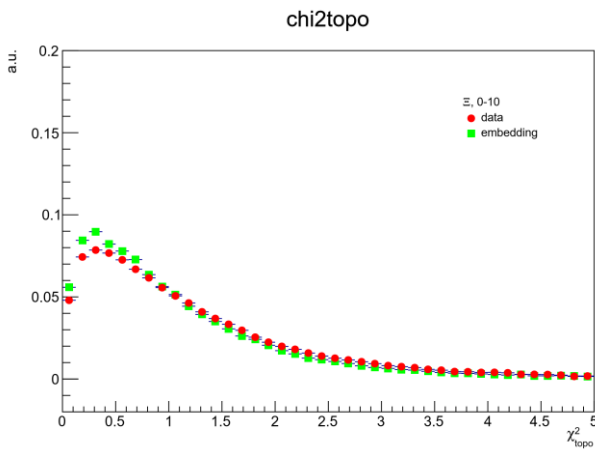
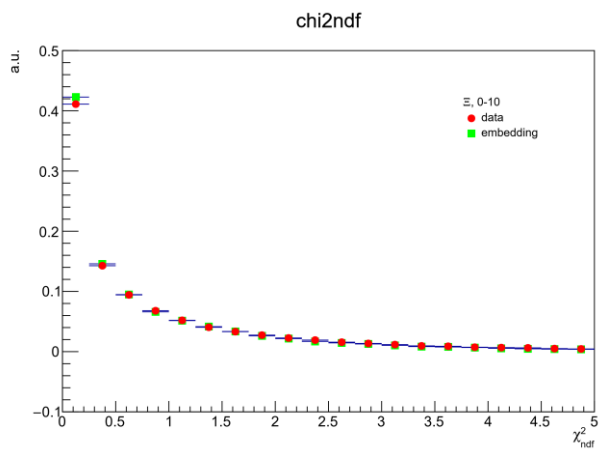
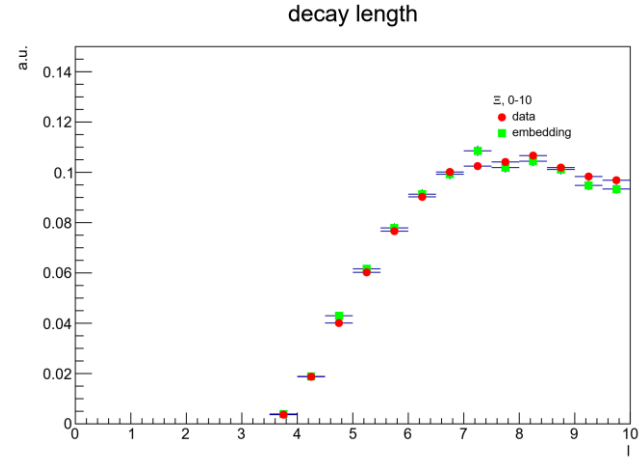
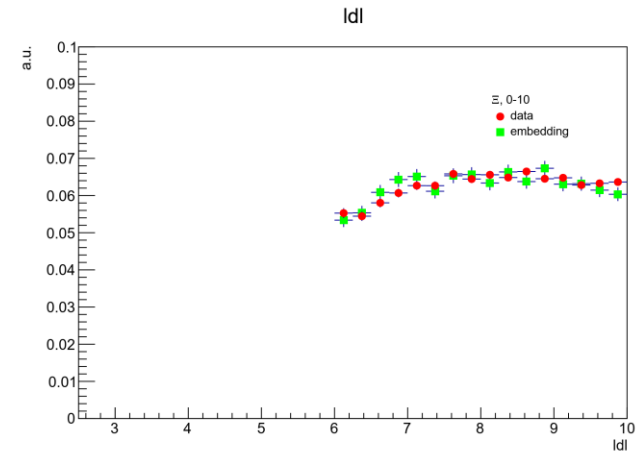
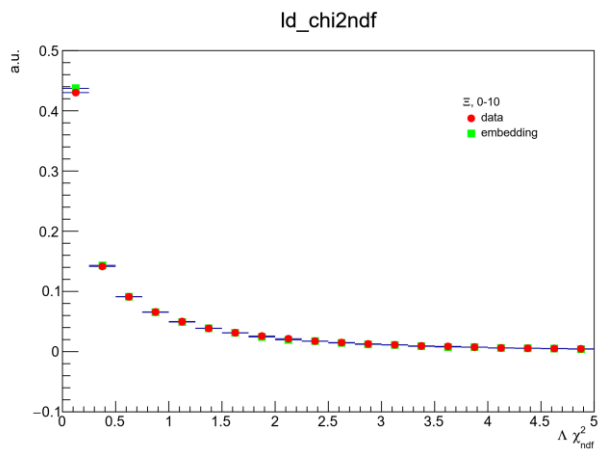
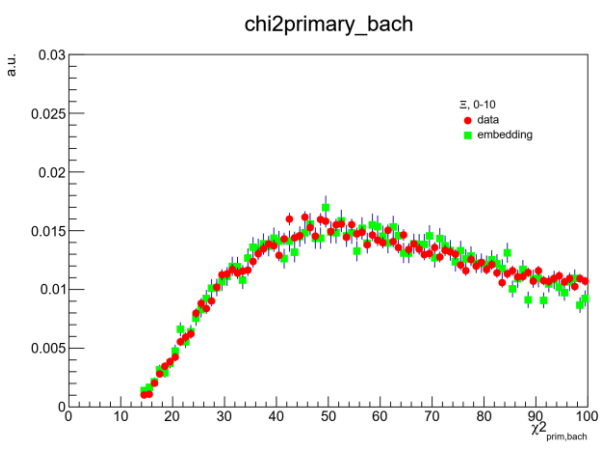


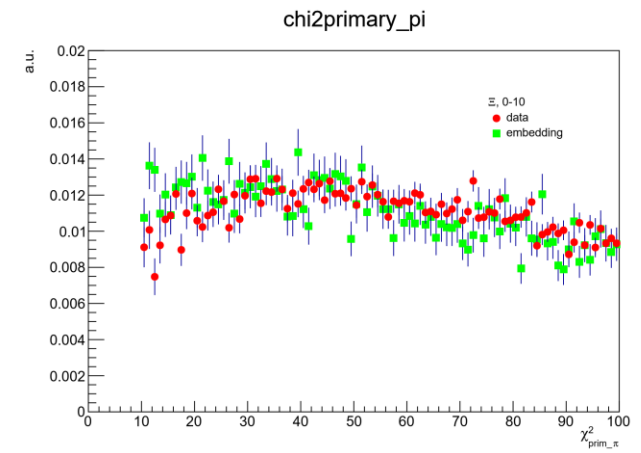


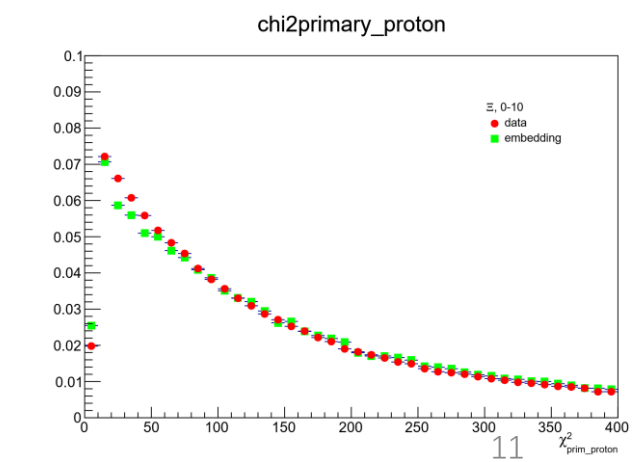






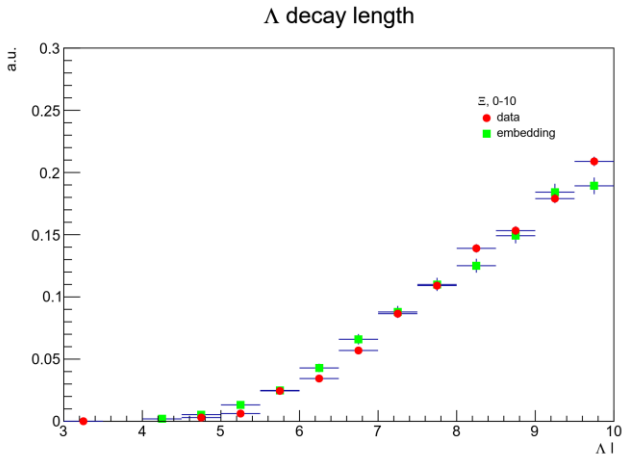






Xi Efficiency

- pT&y weighted
  - pT-Boltzmann, y-quadratic (Iteration)
- reco-data and reco-mc almost consistent

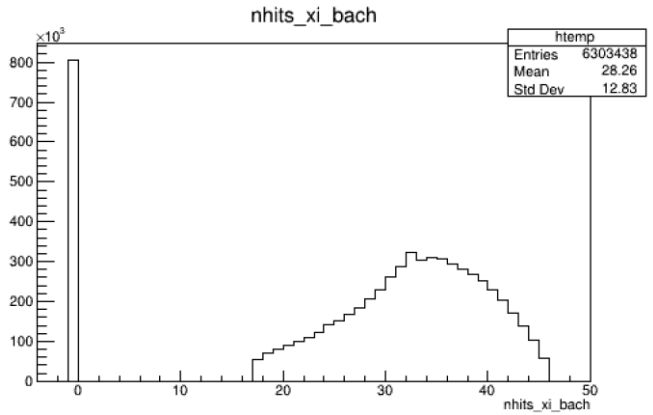


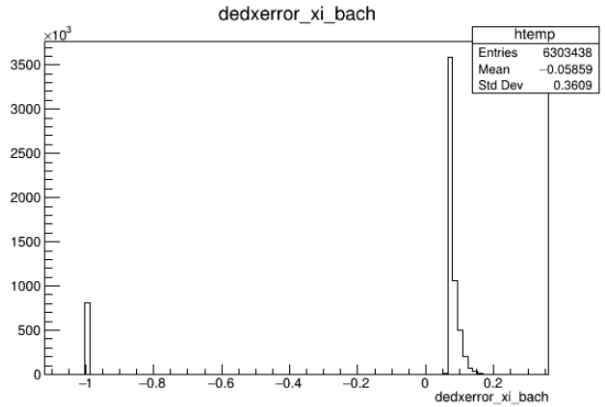
We are not showing nhits distribution for pi/p/bach_pi

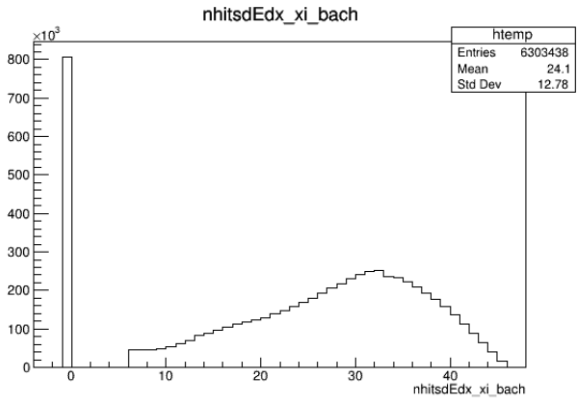
because the KFParticle is not saving those quantities properly when we run Xi reconstruction with data or MC

Sometimes Nhits/Nhitsdedx/dedxerror are saved as -1 or 0 in the KFParticle, even when I apply a cut before reading those quantities to KFParticle

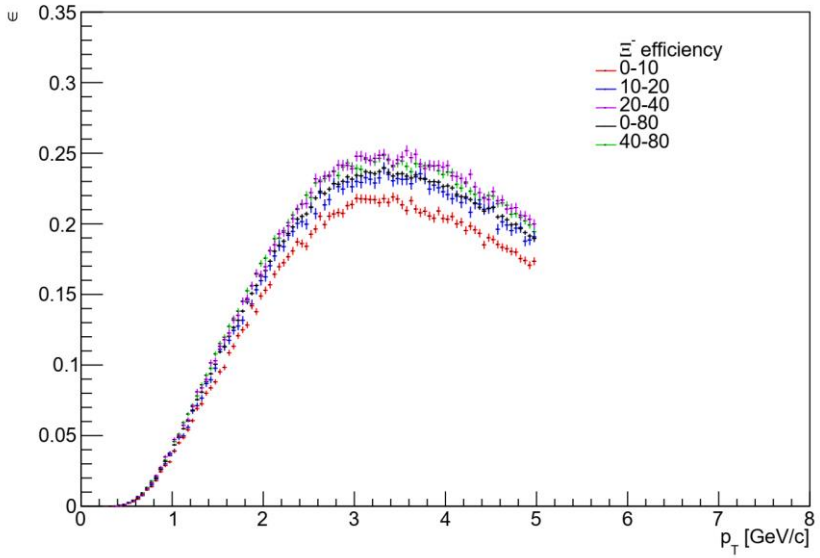
We cannot ignore this problem and apply related cuts directly using tree entries. Related cuts are applied before reading those quantities to KFParticle.

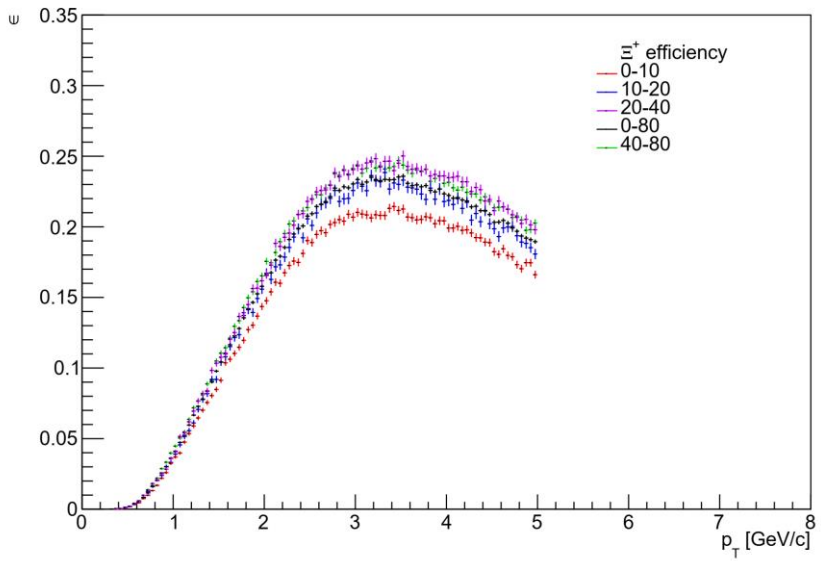






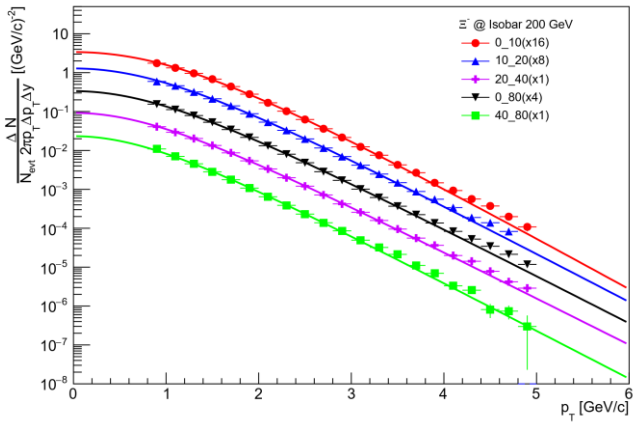
Xi Efficiency

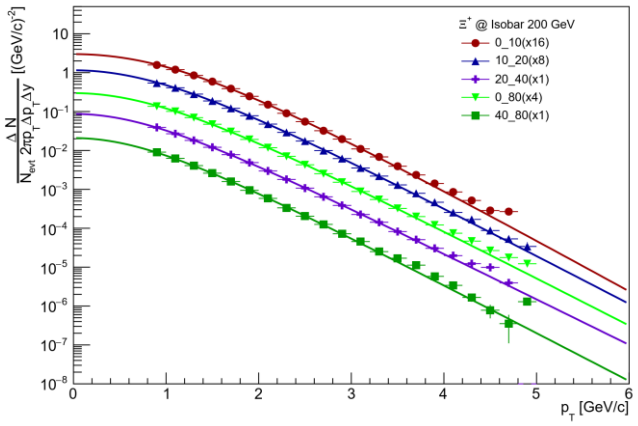


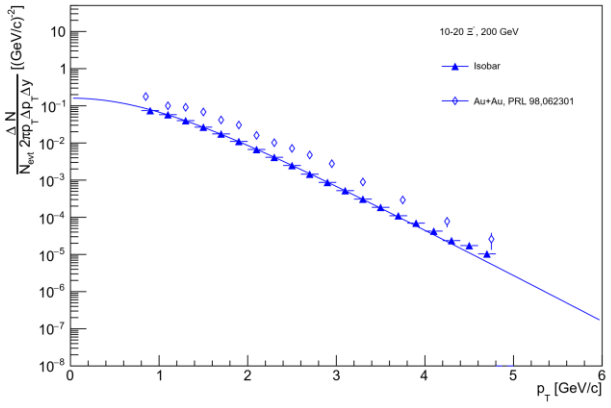


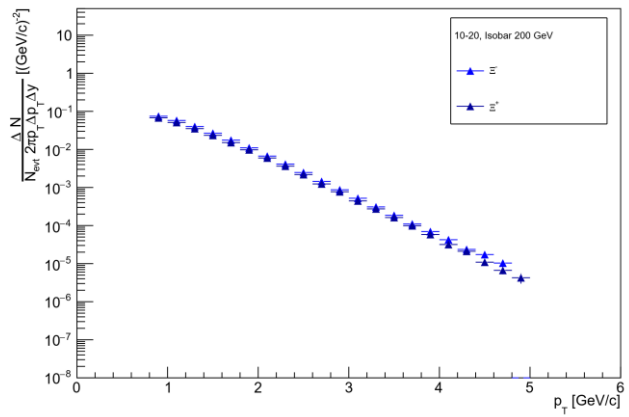
- **Efficiencies for Xi^{-} and Xi^{+} are calculated, respectively**
  - **Similar efficiency**

Xi Spectra









- We fill all histograms again. Weight = the pT-dependent efficiency inverse x centrality reweight
- B.R.(Lambda->p+pi) = 0.641, B.R.(Xi->Lambda+pi) = 0.99887
- Fitted with blast-wave function
- Need check the last few Xi^{+} points

Feed-down

There are several methods on how to calculate feed-down of Xi->Ld:

Dingwei/Yixuan (proton):

weight MC of different hadrons and subtract the decay protons from the corrected inclusive proton spectra

https://drupal.star.bnl.gov/STAR/system/files/Preliminary_yxjin.pdf
https://drupal.star.bnl.gov/STAR/system/files/20201221_protonFD_Dingwei_0.pdf

Matthew (proton):

UrQMD, subtract decay protons from the corrected inclusive spectra

https://drupal.star.bnl.gov/STAR/system/files/LFS_QM23Prelim_Harasty_2023_08_15.pdf

Yi Fang/Anthony (strangeness):

weight MC of Xi/Omega, and subtract decay lambda that pass analysis cuts from raw counts

https://www.star.bnl.gov/protected/strange/atimmins/FeeddownCorrectionCuCu/page.html
https://drupal.star.bnl.gov/STAR/system/files/fang_strangeness_0814_0.pdf

My consideration:

We only have efficiency for primary Lambda, we cannot directly get a proper inclusive spectra
We must do correction to the raw counts
Estimated Xi^{0} -> Ld with Xi^{-} -> Ld

Feed-down

Technical problem with KFParticle:

1. how to know whether secondary particles such as Xi->Lambda are MC tracks or not. I'm trying to save a lambda tree with Xi embedding (Solved, by modifying KFTopoPerformance.cxx)

2. how to associate MC Lambda to its mother Xi, so that we can apply weights to it (Solved, by adding one interface function)

Problem with Xi embedding:

The kinematics is not enough for feed-down calculation (at least there is momentum smearing around pT~5)

Autumn Plan

- Wait embedding reproduction
- Feed down
- Lambdabar/Lambda in Zr/Ru
- H3L bg reproduction with more statistics
- H3L TMVA