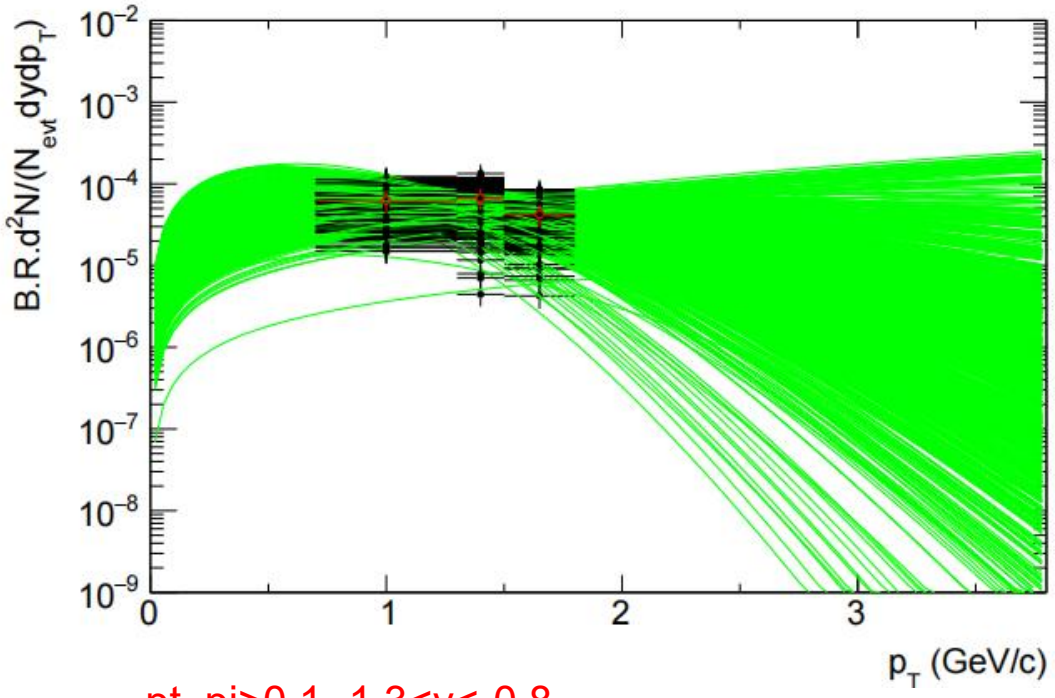
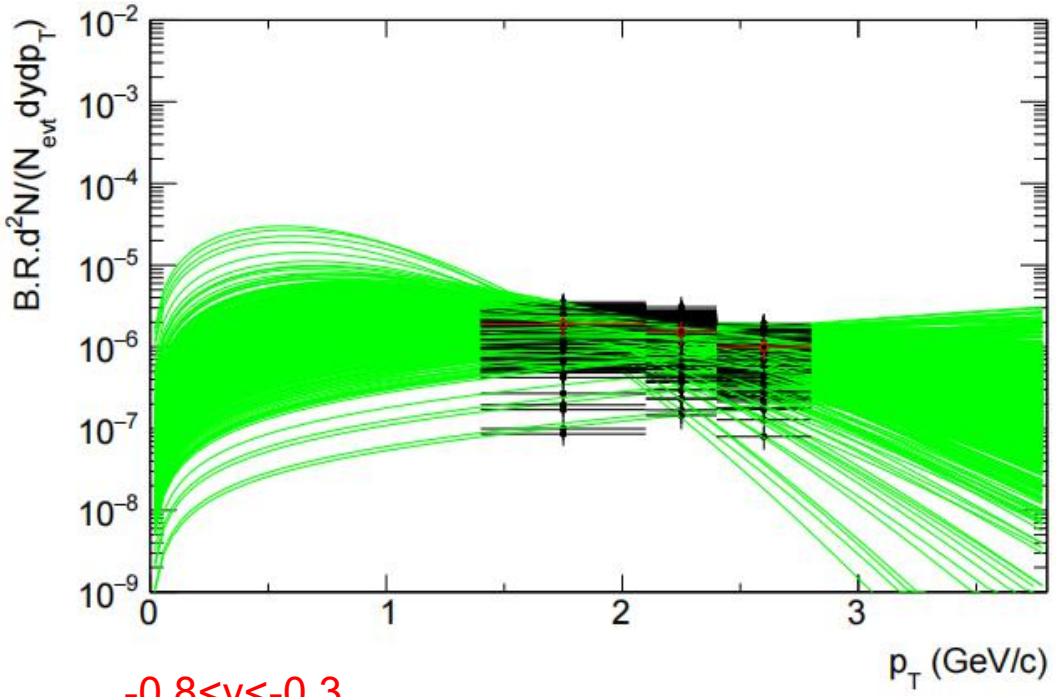
Update of signal reconstruction($^{3}_{\Lambda}H$) in Run2020 FXT Au-Au 5.2GeV

yulou

Boostrap 10-40%



pt_pi>0.1,-1.3<y<-0.8



-0.8<y<-0.3

1000次，boostpoint = tRandom->Gaus(mean[i][j],error[i][j]); i:rap j:pt
h_sgct_corr_dndydpt_boostrap[i][k]->SetBinContent(j+1,boostpoint); k:第k次
h_sgct_corr_dndydpt_boostrap[i][k]->SetBinError(j+1,boostpoint*dndy_err[i][j]/dndy_mean[i][j]);

dNdy 10-40%

•default function:boltzmann

methods (boltzmann)	meanpt(0-10%,-1.3~-0.8)±error(scal
cutmode61(minitsfit)	1.10995
cutmode62	1.08917
cutmode71(lifetime)	1.11189
cutmode72	1.10367
cutmode2_cut10002(prim_pi)	1.09561
cutmode2_cut20002	1.11118
cutmode2_cut01002(1放弃)	1.10791（放弃）
cutmode2_cut02002	1.10722
cutmode2_cut00102(chi2topo)	1.09577
cutmode2_cut00202	1.10473
cutmode2_cut00012(chi2ndf)	1.06648
cutmode2_cut00022	1.09528
cutmode2_cut00001(pt_pi)	1.14848
cutmode2_cut00002	1.10791
cutmode2_cut00000	1.11627
fit boostrap	1.11456±0.11571
fit function style	0.089618
methods (boltzmann)	meanpt(0-10%,-0.8~-0.3)±error(scal
cutmode61(minitsfit)	1.73842
cutmode62	1.86699
cutmode71(lifetime)	1.7734
cutmode72	1.75594
cutmode2_cut10002(prim_pi)	1.70088
cutmode2_cut20002	1.73716
cutmode2_cut01002(1放弃)	1.76474（放弃）
cutmode2_cut02002	1.76486
cutmode2_cut00102(chi2topo)	1.75297
cutmode2_cut00202	1.73667
cutmode2_cut00012(chi2ndf)	1.52756
cutmode2_cut00022	1.47999
cutmode2_cut00001(pt_pi)	1.64594
cutmode2_cut00002	1.76474
cutmode2_cut00000	1.62181
boostrap	1.67366±0.365096
fit function style	0.02237

	100%(cen:0-10%;-1.3~-0.8)	100%(cen:0-10%;-1.3~-0.8)
H3L Lifetime	0.37%	0.37%
Tracking efficiency	2.06%	0.94%
		1.83%
Topological cuts	2.07%	0.70%
		0.06%
		0.55%
		1.87%
Extrapolation	13.21%	10.44%
		8.09%
Raw count extraction	0.52%	0.43%
		0.29%
	100%(cen:0-10%;-0.8~-0.3)	100%(cen:0-10%;-0.8~-0.3)
H3L Lifetime	0.49%	0.49%
Tracking efficiency	5.45%	3.64%
		4.05%
Topological cuts	8.31%	1.81%
		0.01%
		0.80%
		8.07%
Extrapolation	20.73%	20.69%
		1.27%
Raw count extraction	2.16%	0.26%
		2.15%

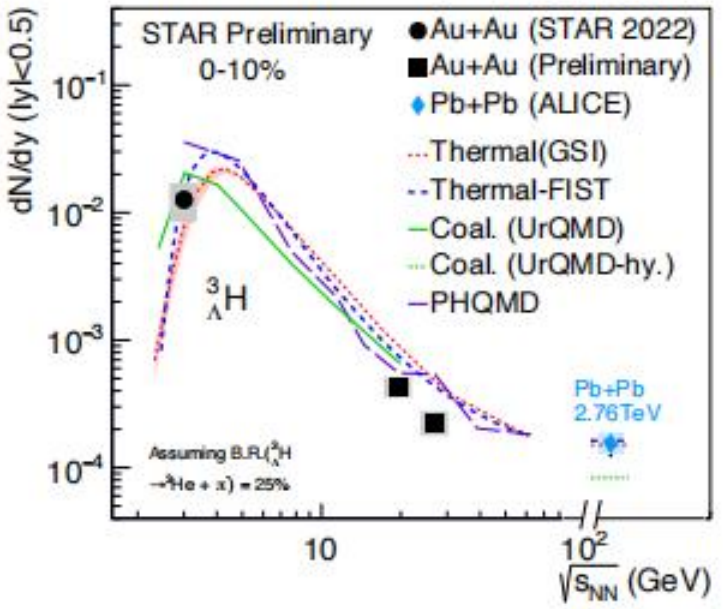
$^{3}_{\Lambda}H$ production in Run2020 FXT Au+Au 5.2 GeV

Yulou Yan(USTC)

LFUPC PWG meeting

Motivation

- Hypernuclei production yield in heavy ion collisions
    - Y-N interaction
    - EOS of compact stars
- Production mechanism
    - Thermal model or coalescence model?
- Observables:
- Energy dependence of yields at mid-rapidity
- Rapidity dependence of hypernuclei yields



Dataset and event selection

- Run 2020 FXT Au+Au 5.2 GeV
    - production_13p5GeV_fixedTarget_2020
- Trigger: 750000
- Badrun:21034002,21034007

- Rapidity convention: y = -1*(y_lab-y_cm),
  y_cm = -1.68 at FXT 5.2 GeV

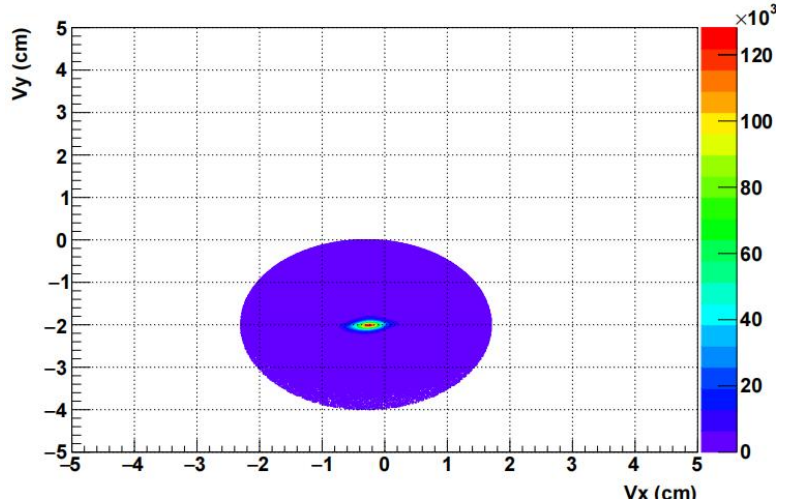
- Vertex cuts:
  198 < Vz < 202 cm,

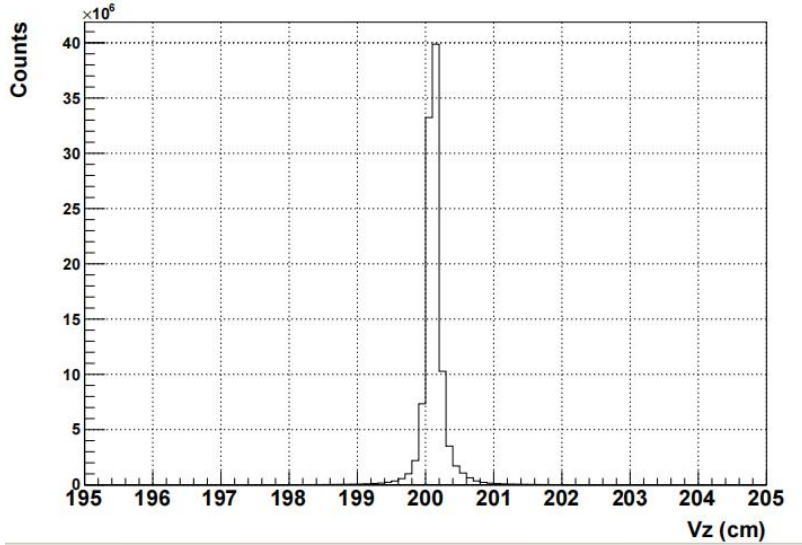
$$\sqrt{(Vx+0.3)*(Vx+0.3)+(Vy+2)*(Vy+2)} < 2$$

- Centrality definition& pileup rejection:

https://drupal.star.bnl.gov/STAR/system/files/2023_0718_AuAu5p2Cent.pdf

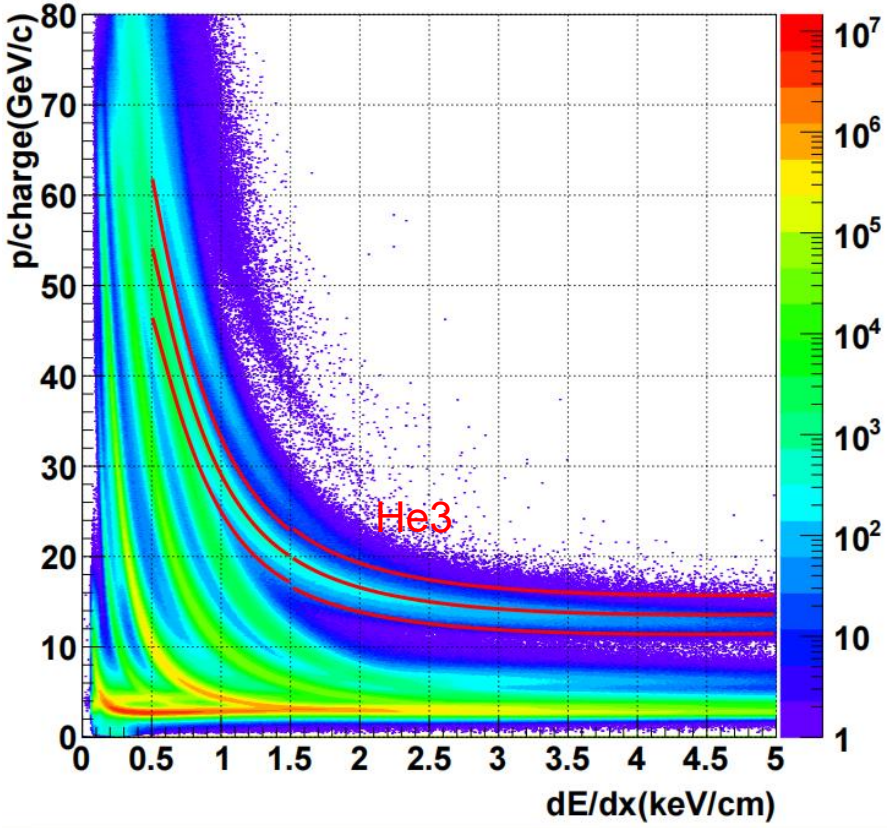
- 0-80% centrality: ~ 51M events





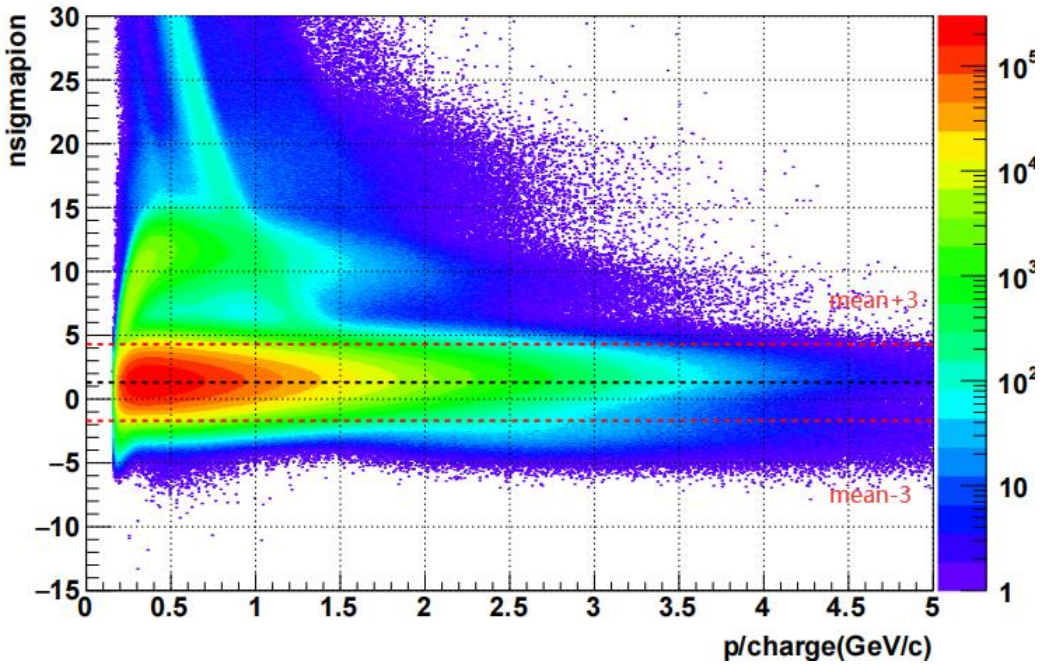
PID recalibration

- Using TPC information
  - He3
    - p/q>0.4GeV/c: ±3σ dEdx band



- Pion:
  - |dEdXPULL_pion($n\sigma_\pi$) -mean |<3(about 2.24σ,σ=1.335)

will use 3σ in new data(SL23e)



Signal reconstruction

- Reconstructed by KFParticle package

- Background reconstruction
- Rotate pion 30°-330° randomly, 30 times statistics

- Basic track cuts:
  pi pT >0.1 GeV/c
  3He p >0.4 GeV/c
  nHitsFit>15
  dedxerror:0.01~0.15

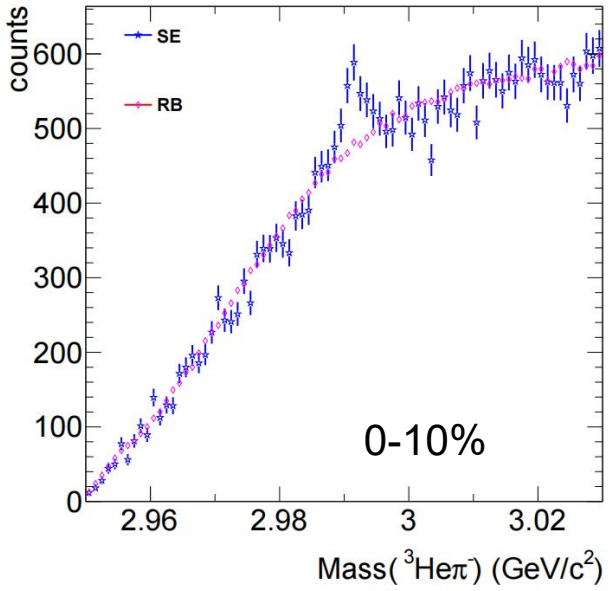
no nHitsDedx>5 cut

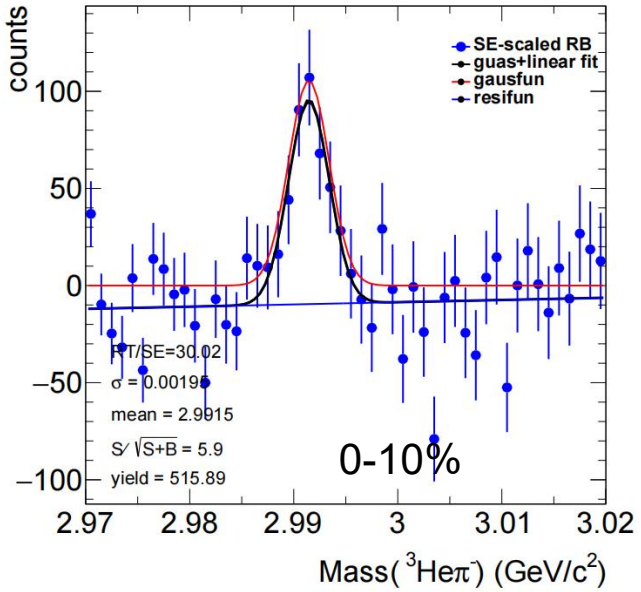
nHitsDedx>5 cut will be used in new data

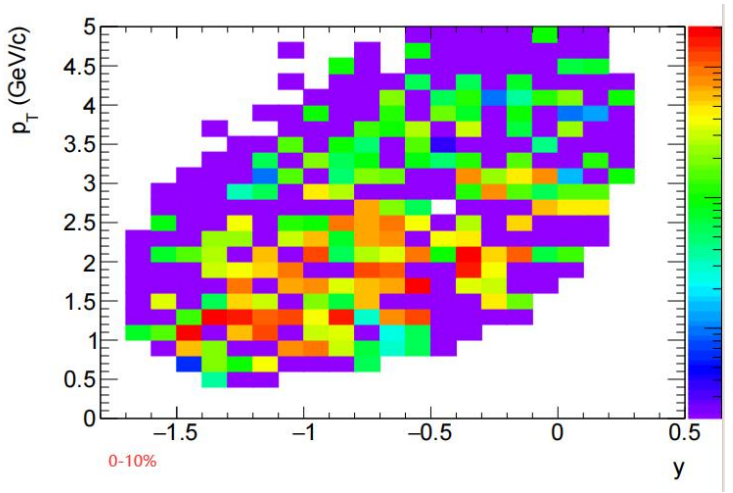
- Topological cuts (Run 2020, Au+Au 5.2 GeV)

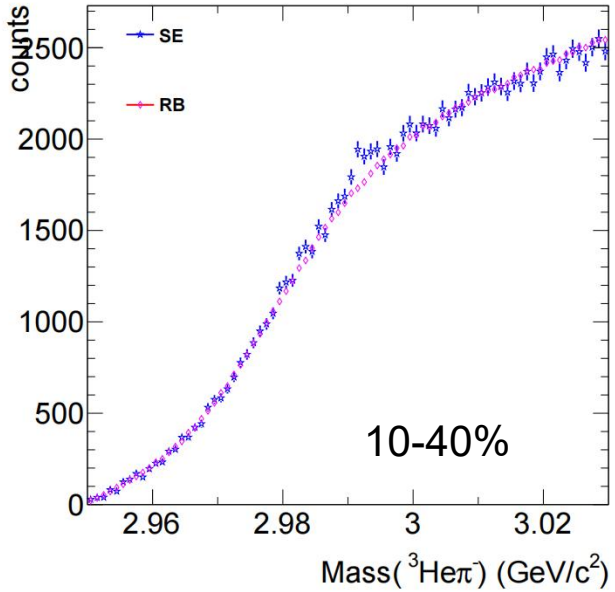
0-10%	10-40%
l >1	l>1
ldl>6	ldl >1,
chi2topo<5	chi2topo<5
chi2ndf<2.2	chi2ndf<4
chi2primary_pi>5	chi2prim_pi>11
chi2prim_he>0	chi2prim_he>0

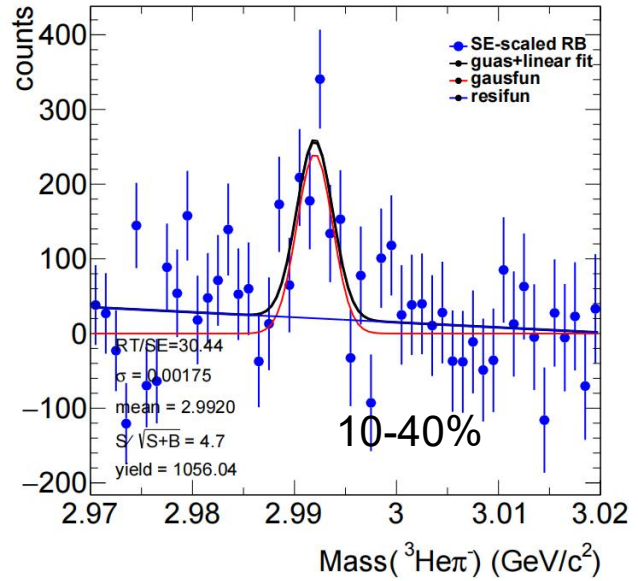
Signals extraction 0-10% (Run2020 5.2 GeV)

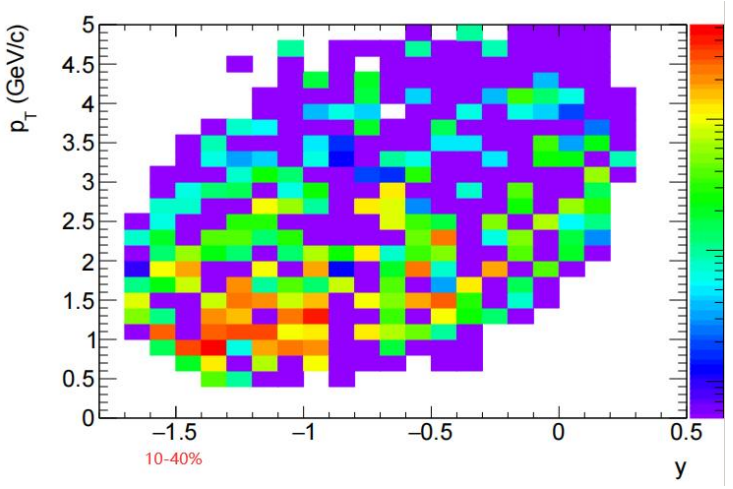




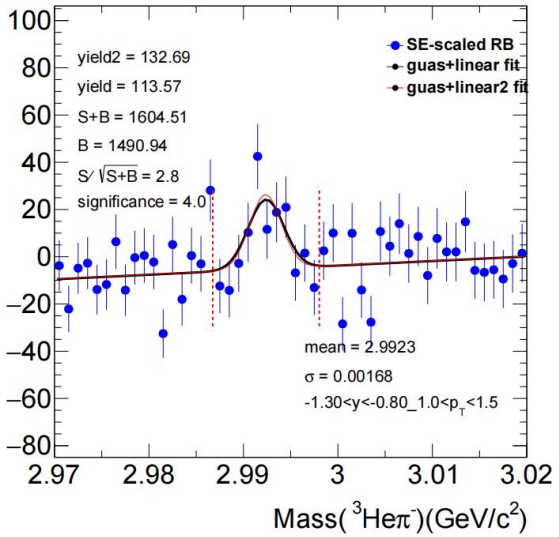


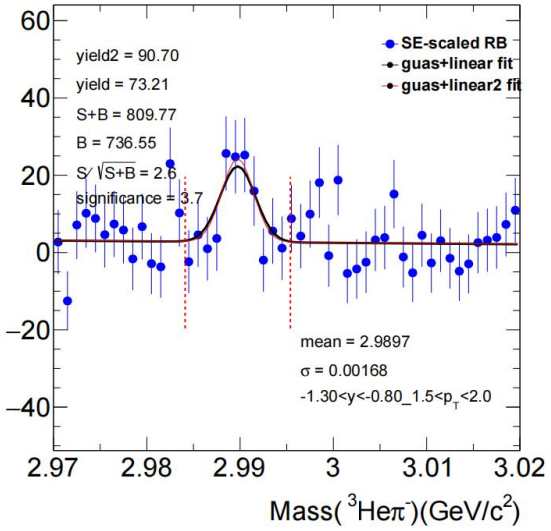


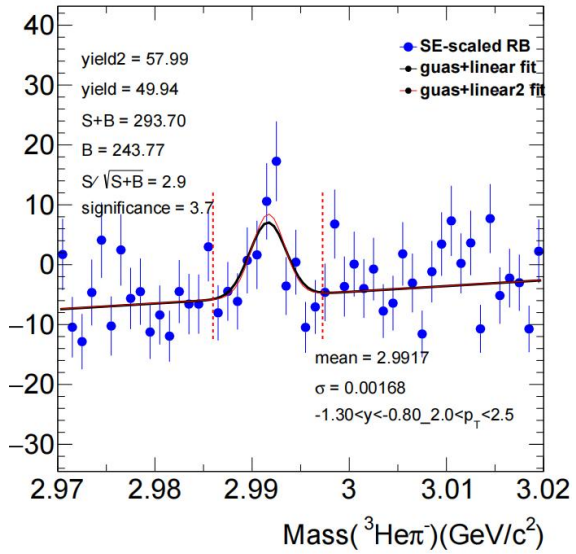




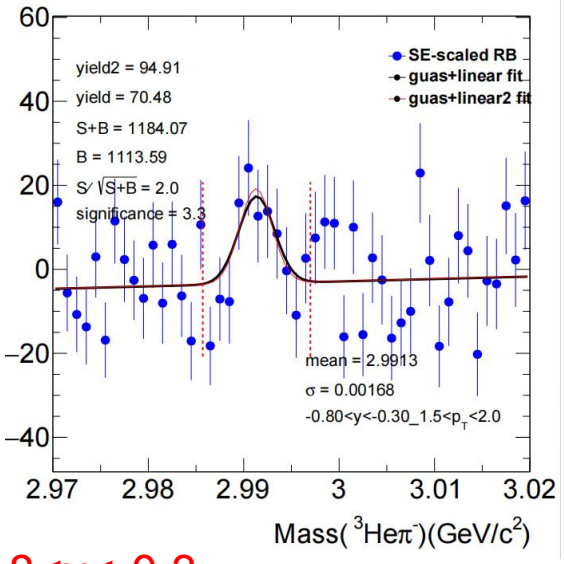
Signals extraction 0-10% (Run2020 5.2 GeV)

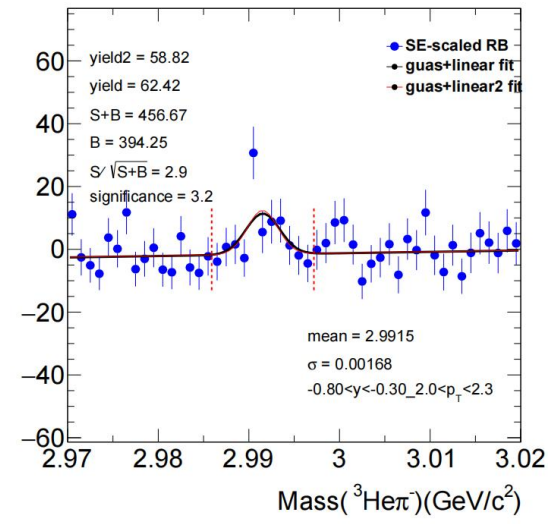


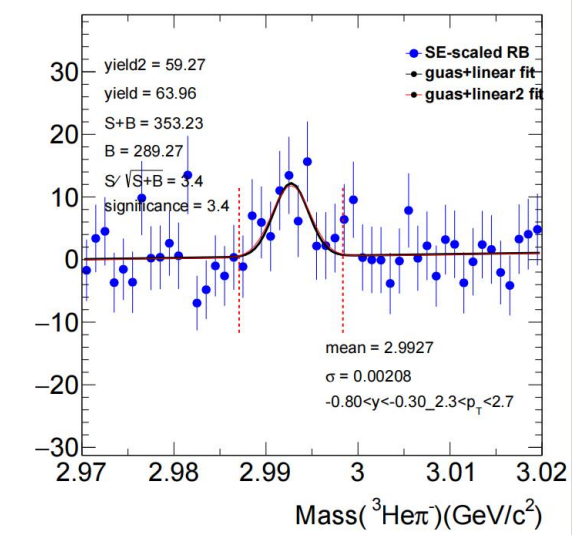




-1.3<y<-0.8

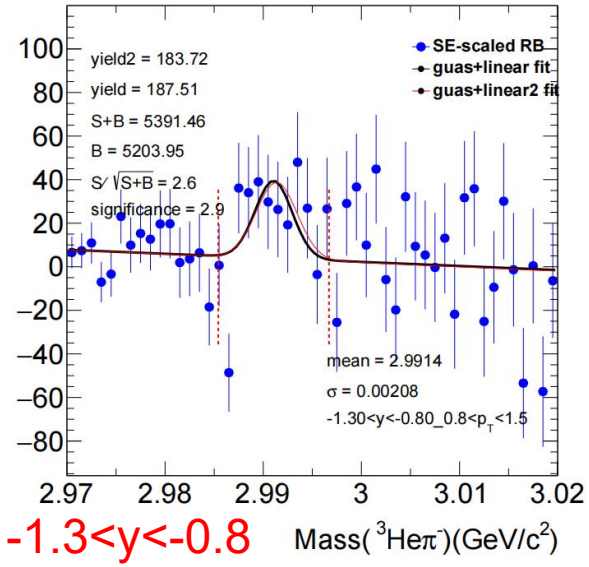




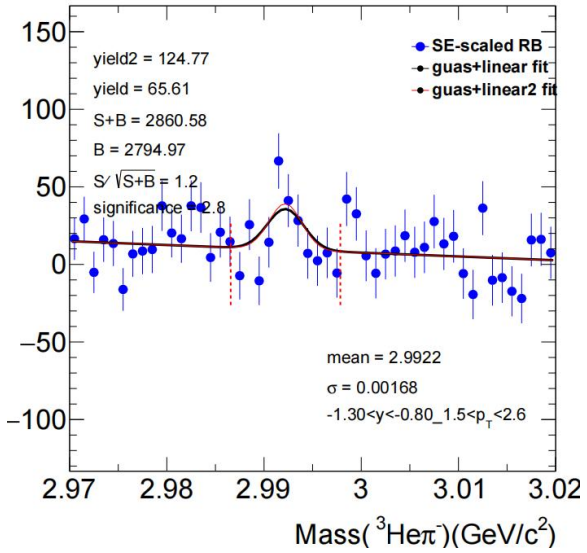


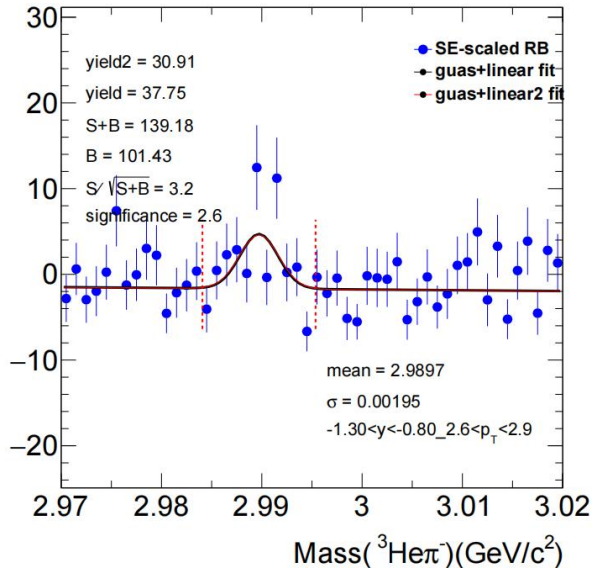
-0.8<y<-0.3

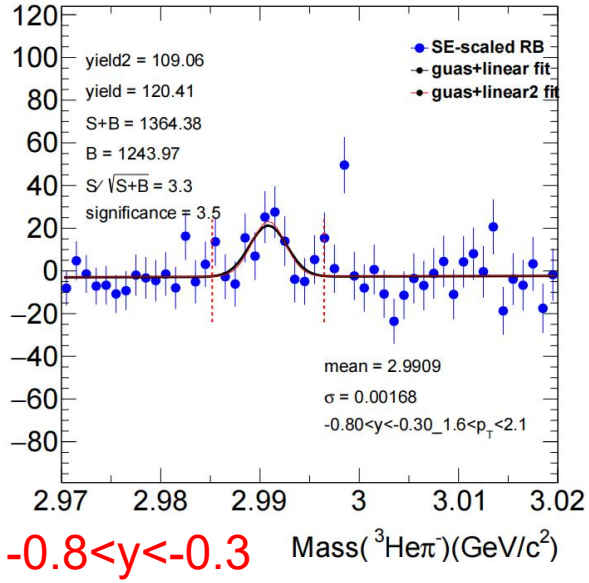
Signals extraction 10-40% (Run2020 5.2 GeV)



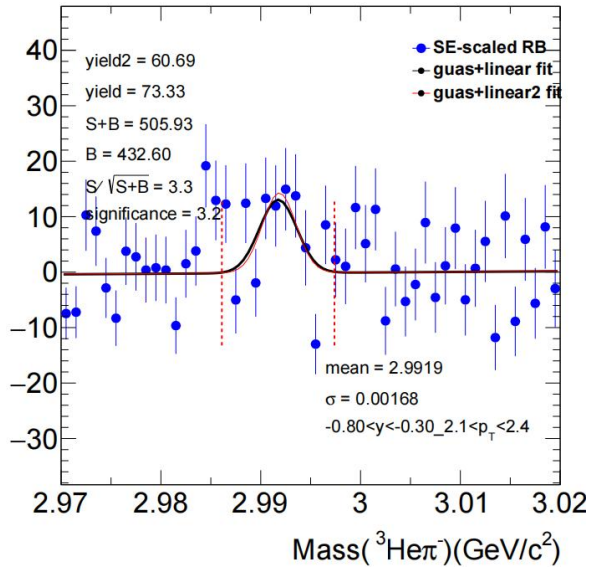
-1.3<y<-0.8

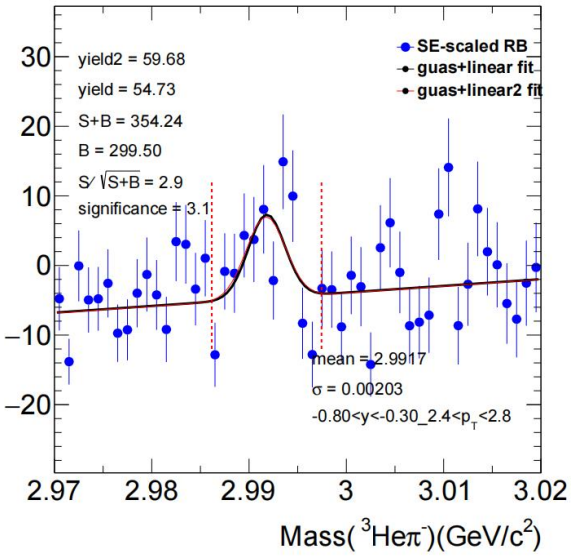






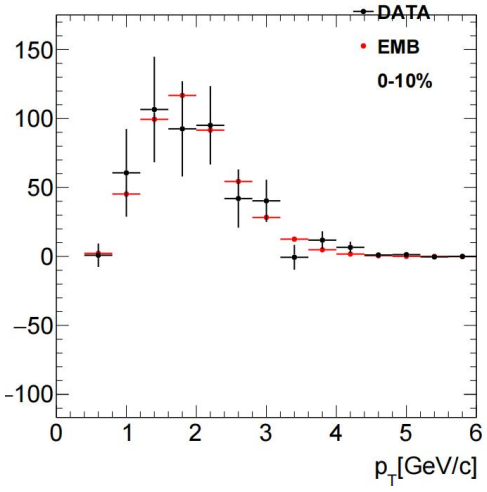
-0.8<y<-0.3

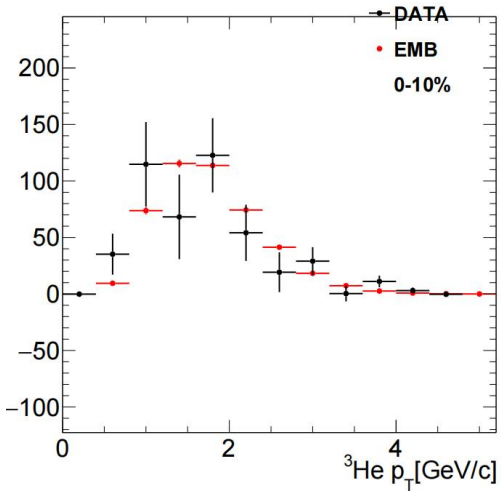


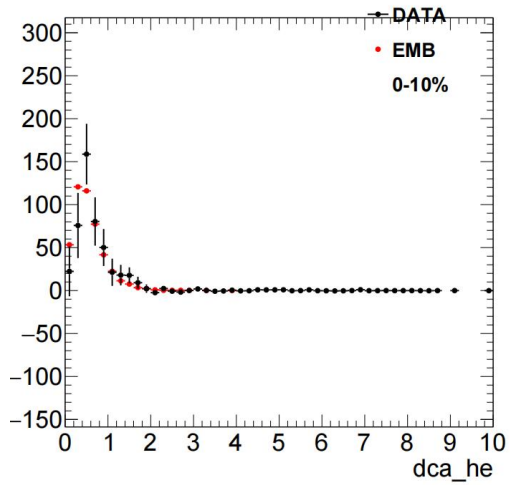


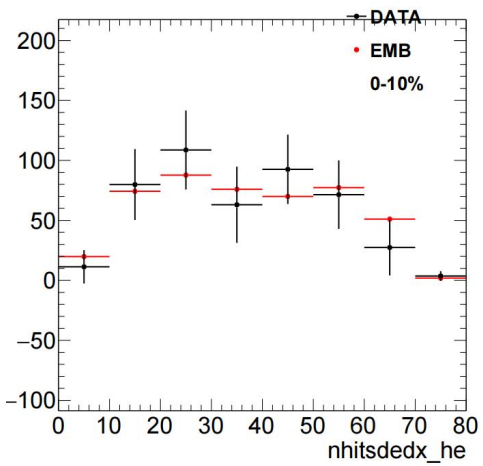
Embedding data comparison

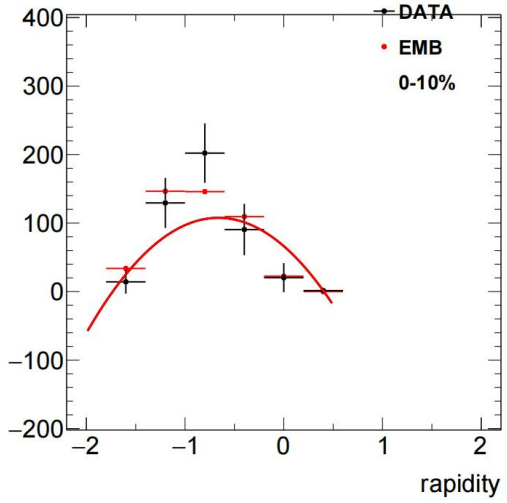
- 3.2 GeV(2019) H3L embedding: https://drupal.star.bnl.gov/STAR/starsimrequests/2022/Jul/30/hypernuclei-FXT-AuAu-32-GeV

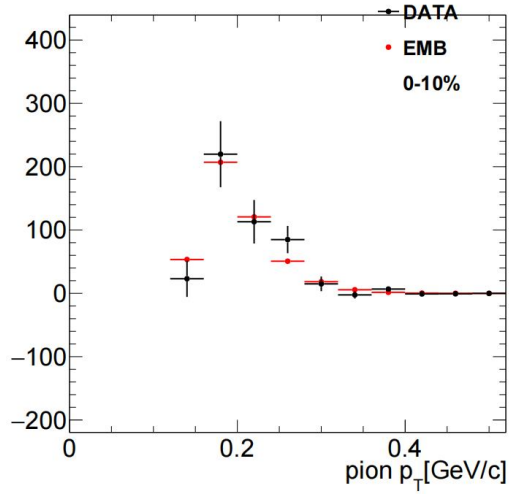


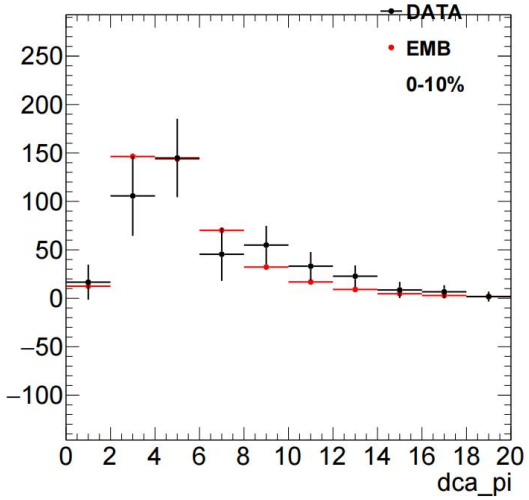


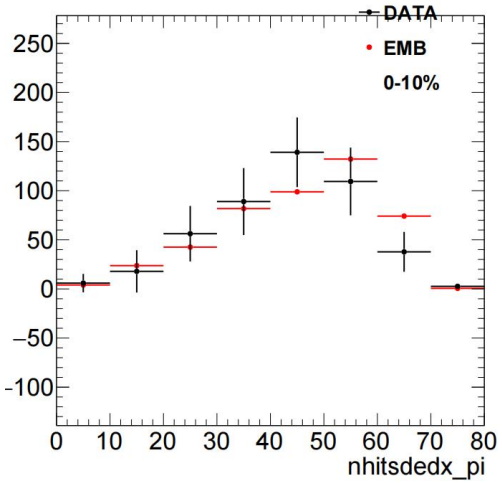






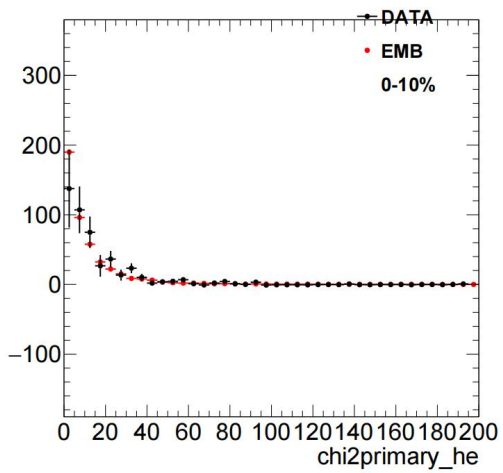


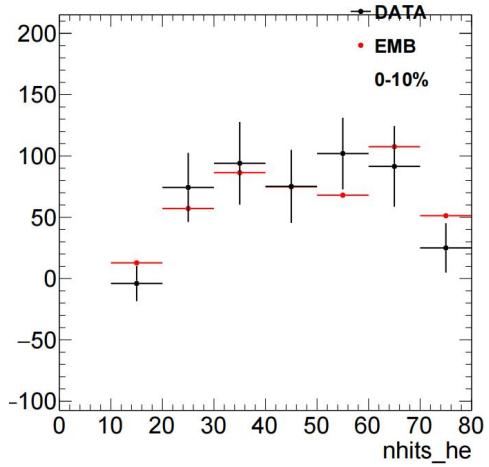


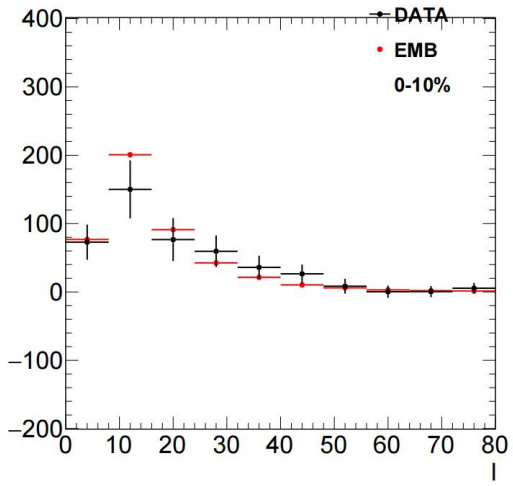


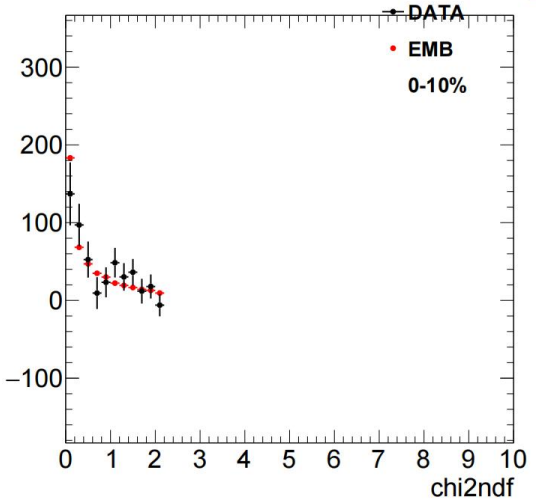
Embedding data comparison

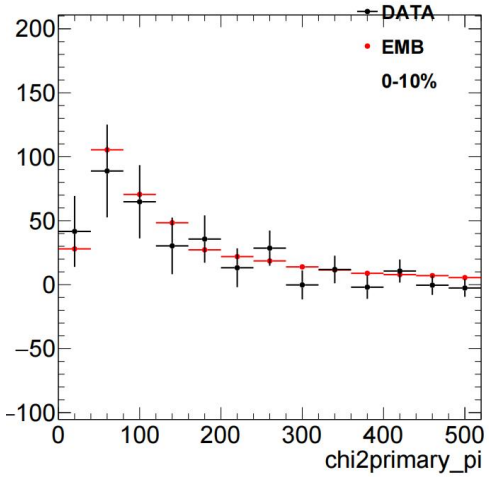
- 3.2 GeV(2019) H3L embedding: https://drupal.star.bnl.gov/STAR/starsimrequests/2022/Jul/30/hypernuclei-FXT-AuAu-32-GeV

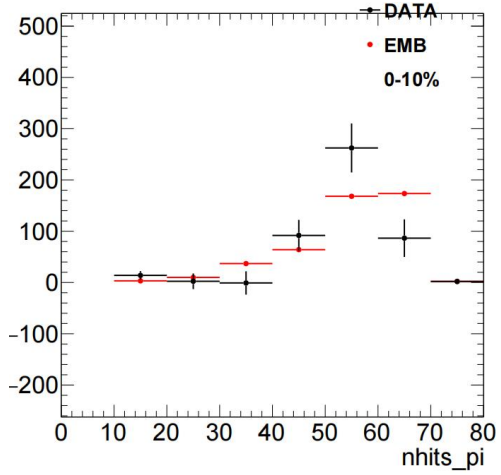


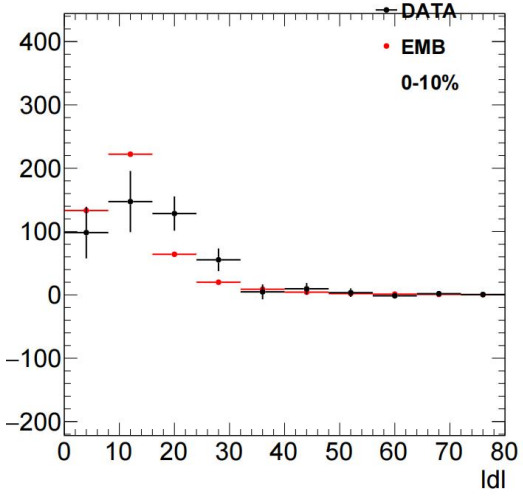


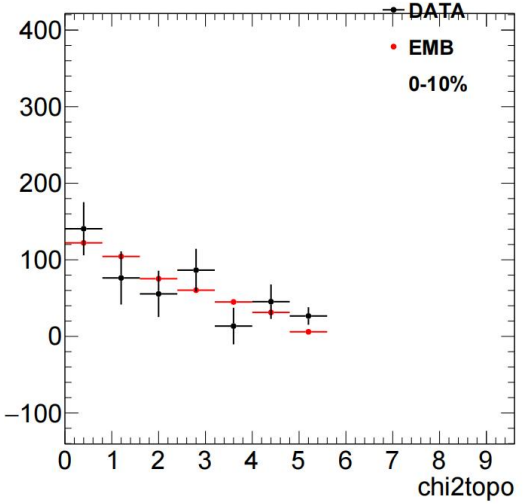




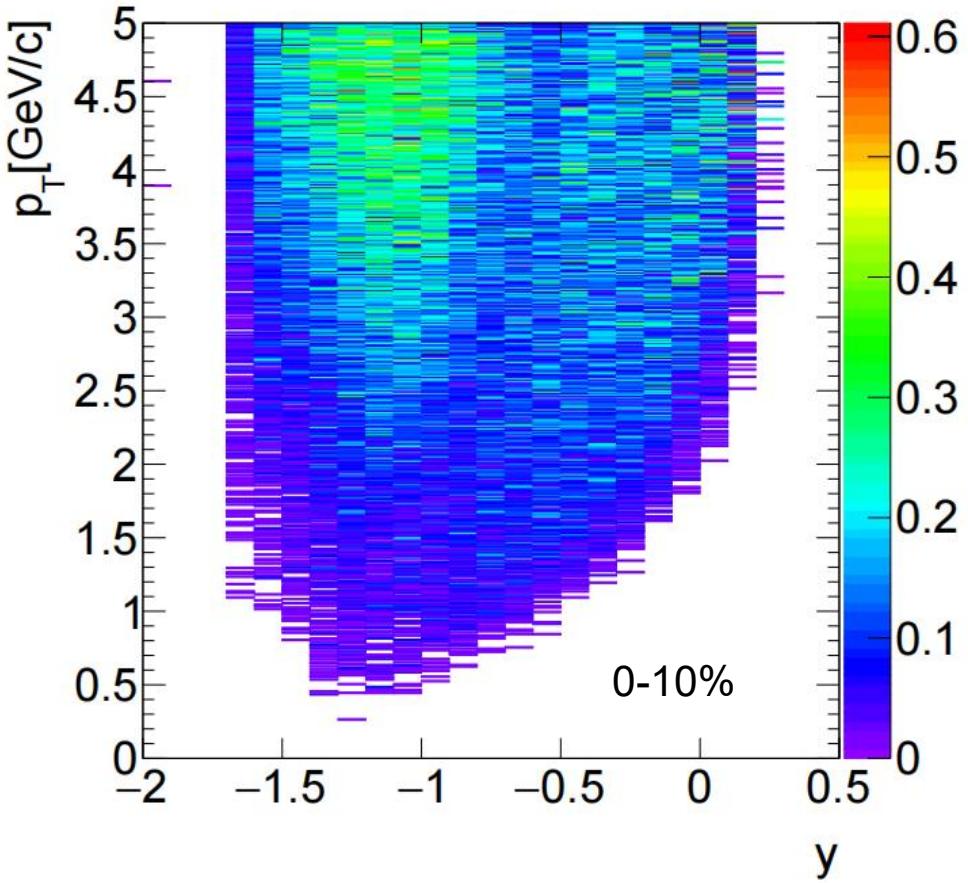


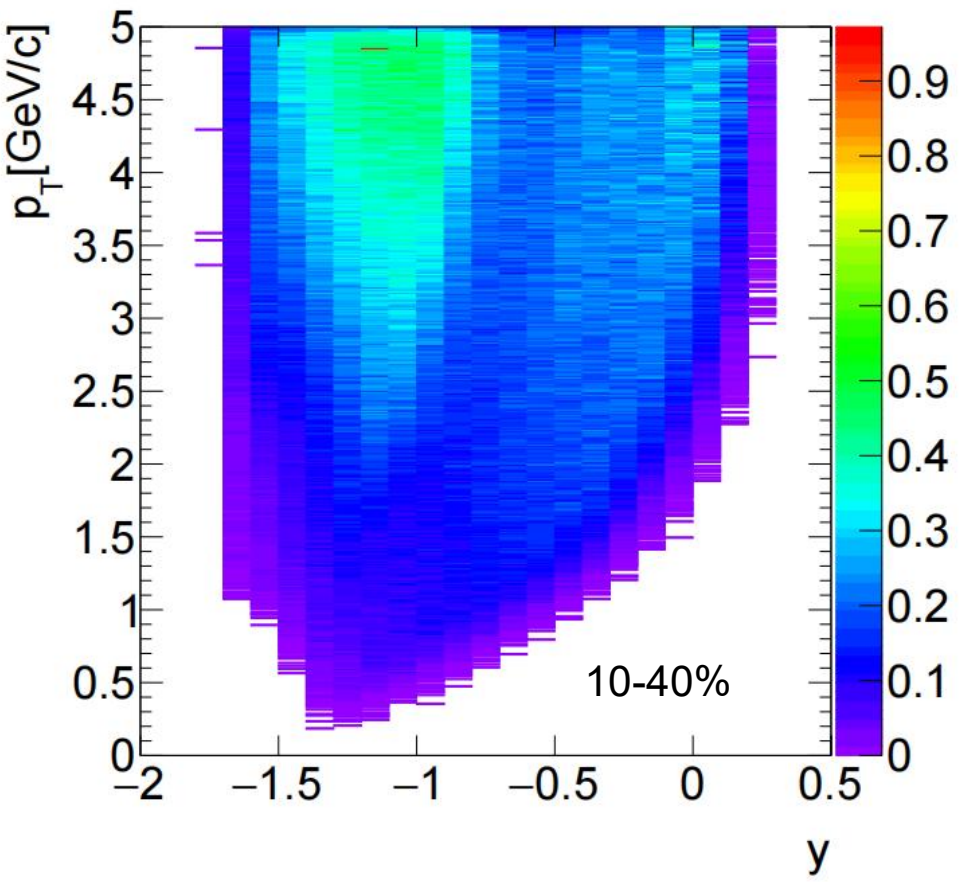






Reconstuction efficiency

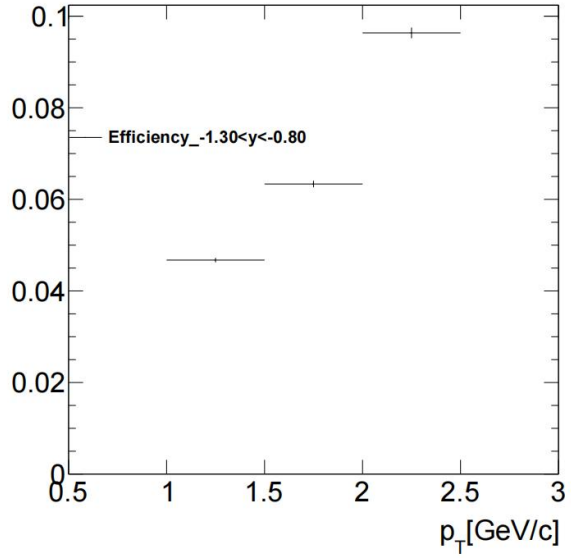


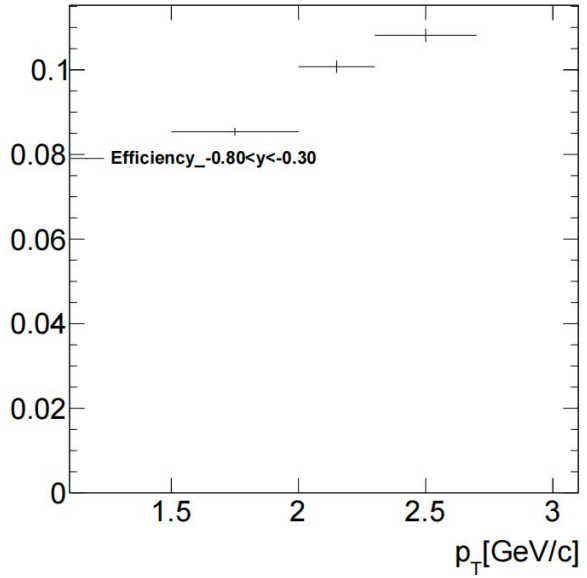


- MC particle's pt distribution are weighted by measured spectra(iteration)
- MC particle's y distribution are weighted by measured spectra(iteration)
- Lifetime weighted to H3L world average lifetime 228.3ps

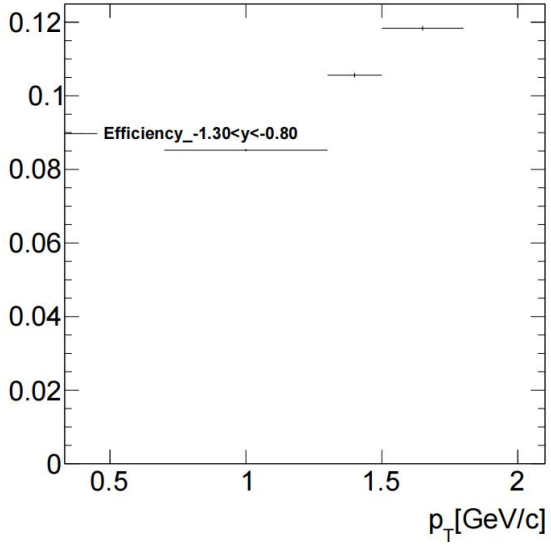
Reconstuction efficiency

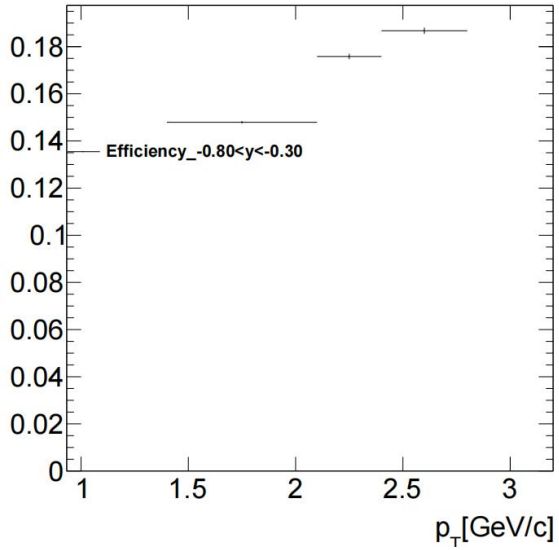
0-10%



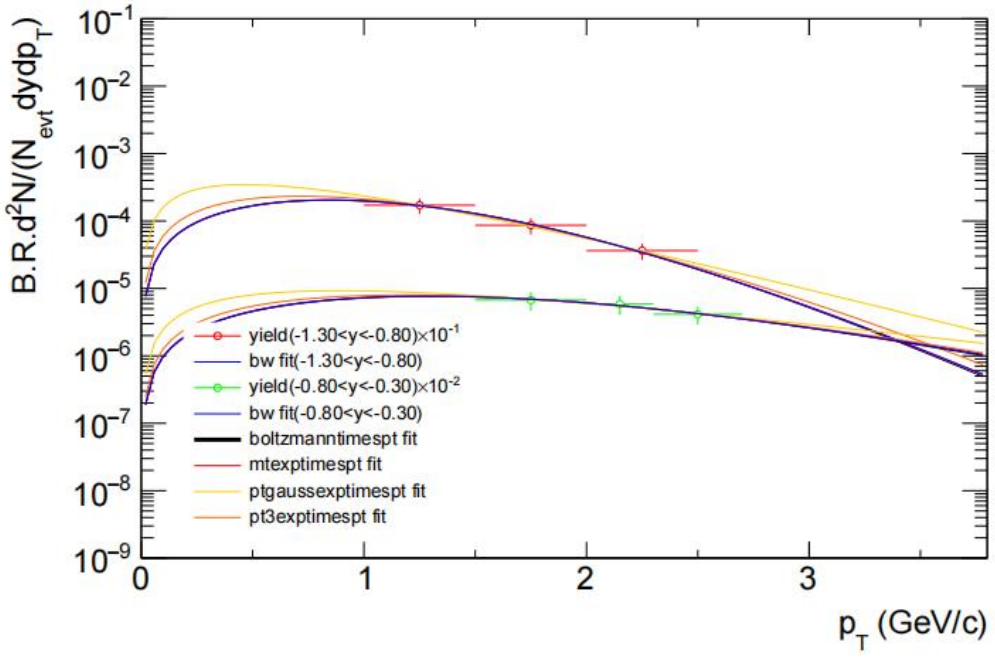


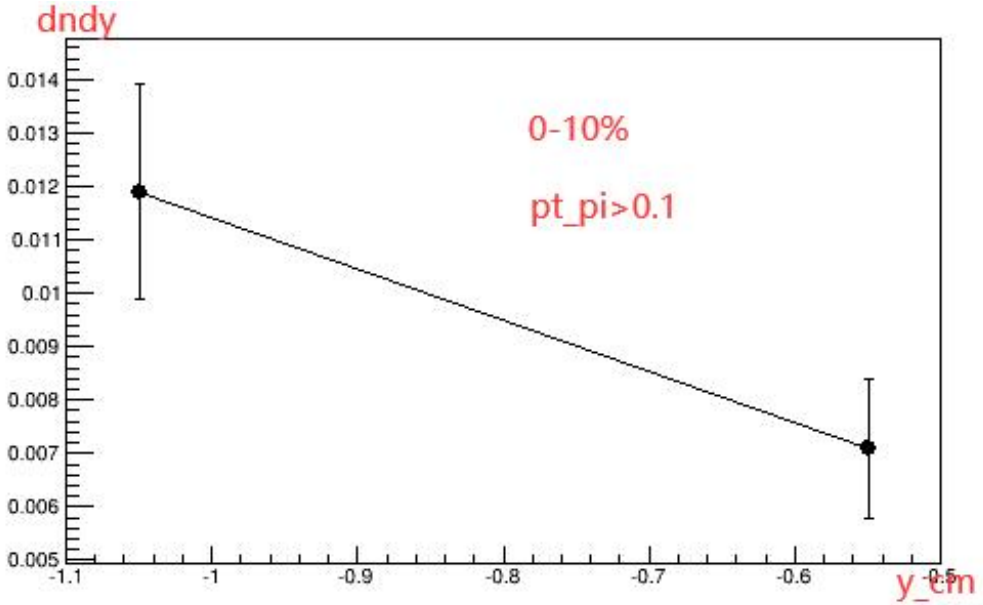
10-40%





H3L spectra and yield 0-10%

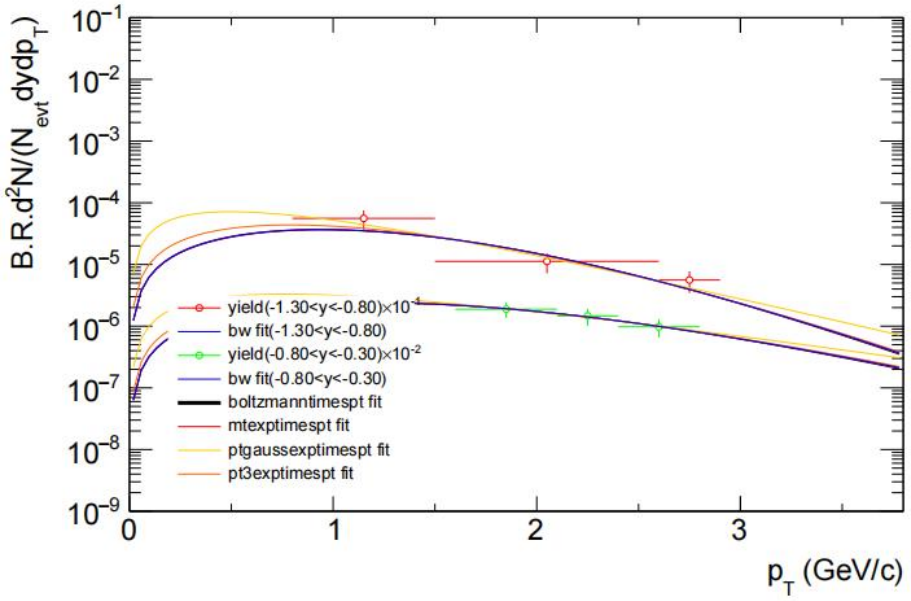


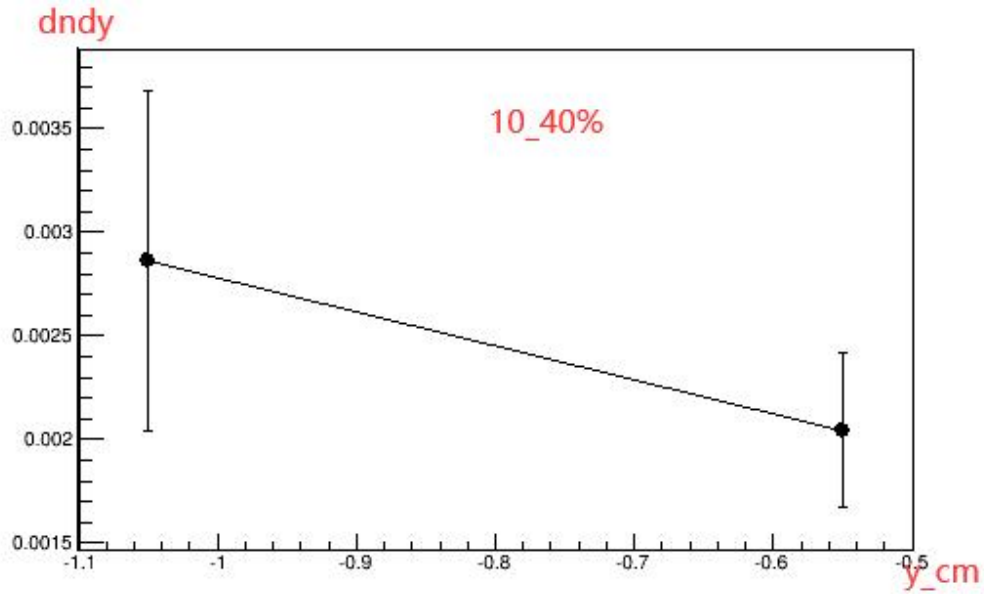


draw again with other style?

- dN/dy = (sum of the yields in measured region/fraction
- Fraction = Integral yields in measured region / Integral yields [0,10GeV/c]

H3L spectra and yield 10-40%





draw again with other style?

- dN/dy = (sum of the yields in measured region/fraction
- Fraction = Integral yields in measured region / Integral yields [0,10GeV/c]

Systematic uncertainty

- Vary nHitsFit: nHitsFit>15, 20, 25
- Vary global average Lifetime: H3L= 228.3±12.5 [ps]
- Vary raw count extraction
- VaryExtrapolation
- Vary the topological cuts

0-10%
| >1,3
 |dl>6
chi2topo<3,4,5
chi2ndf<2.2,3,4
chi2primary_pi>3,5,7
chi2prim_he>0

10-40%
|>1, 3
|dl >1,
chi2topo<3,4,5
chi2ndf<3,4,5
chi2prim_pi>8,11,15
chi2prim_he>0

- If {default,var1}
- sys.err = |default-var1|
- If {default,var1,var2}
- sys.err = (max-min)*0.5
- Total sys.err added quadratically

Red denotes cuts variations in systematic uncertainty study.

Summary of uncertainties （0-10%）

	100%(cen:0-10%;-1.3~-0.8)	100%(cen:0-10%;-1.3~-0.8)	cuts
H3L Lifetime	6.16%	6.16%	lifetime
Tracking efficiency	14.02%	5.44%	nihitfit>15,20,25
		8.18%	pt_pi>0.06,0.1,0.15
		10.00%	single track efficiency
Topological cuts	10.88%	3.61%	prim_pi>3,5,7
		0.13%	l>1,3
		8.62%	chi2topo<3,4,5
		5.57%	chi2ndf<2.2,3,4
Extrapolation	28.33%	15.93%	boltzmann bootstrap
		23.43%	function style
Raw count extraction	2.98%	0.67%	rotate_background
		2.90%	fit_background
		100%(cen:0-10%;-0.8~-0.3)	cuts
H3L Lifetime	4.93%	4.93%	lifetime
Tracking efficiency	18.99%	2.81%	nihitfit>15,20,25
		14.43%	pt_pi>0.06,0.1,0.15
		10.00%	single track efficiency
Topological cuts	13.26%	1.75%	prim_pi>3,5,7
		0.01%	l>1,3
		12.89%	chi2topo<3,4,5
		2.58%	chi2ndf<2.2,3,4
Extrapolation	20.20%	15.36%	boltzmann bootstrap
		13.13%	function style
Raw count extraction	0.55%	0.21%	rotate_background
		0.50%	fit_background

dN/dy=0.0119056±0.00203043(stat)±0.004063022(sys)　　$-1.3<y<-0.8$

dN/dy=0.00708285±0.00131243(stat)±0.002153844(sys)　　$-0.8<y<-0.3$

yuliou

Summary of uncertainties （10-40%）

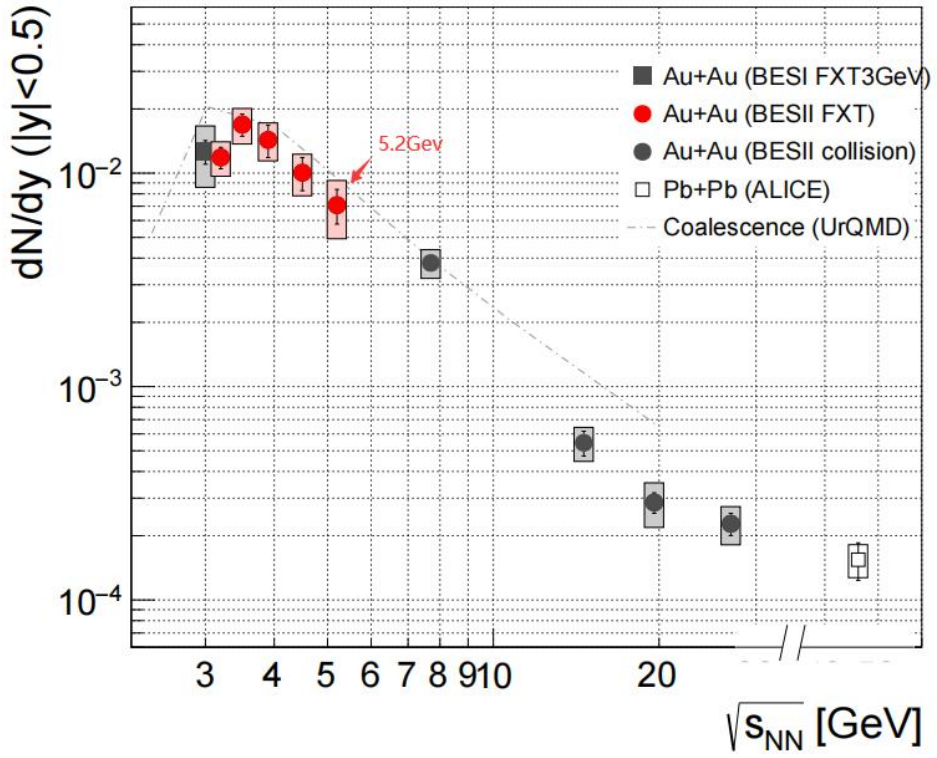
	100%(cen:10-40%;-1.3~-0.8)	100%(cen:10-40%;-1.3~-0.8)	cuts
H3L Lifetime	3.56%	3.56%	lifetime
Tracking efficiency	13.05%	2.09%	nihitfit>15,20,25
		8.13%	pt_pi>0.06,0.1,0.15
		10.00%	single track efficiency
Topological cuts	17.17%	5.42%	prim_pi>3,5,7
		5.52%	l>1,3
		15.02%	chi2topo<3,4,5
		3.02%	chi2ndf<2.2,3,4
Extrapolation	13.26%	0.73%	boltzmann bootstrap
		13.24%	function style
Raw count extraction	4.50%	0.07%	rotate_background
		4.50%	fit_background
		100%(cen:10-40%;-0.8~-0.3)	cuts
H3L Lifetime	2.91%	2.91%	lifetime
Tracking efficiency	13.22%	4.21%	nihitfit>15,20,25
		12.19%	pt_pi>0.06,0.1,0.15
		10.00%	single track efficiency
Topological cuts	11.07%	4.96%	prim_pi>3,5,7
		1.34%	l>1,3
		7.99%	chi2topo<3,4,5
		5.69%	chi2ndf<2.2,3,4
Extrapolation	19.75%	14.51%	boltzmann bootstrap
		13.40%	function style
Raw count extraction	5.65%	1.33%	rotate_background
		5.49%	fit_background

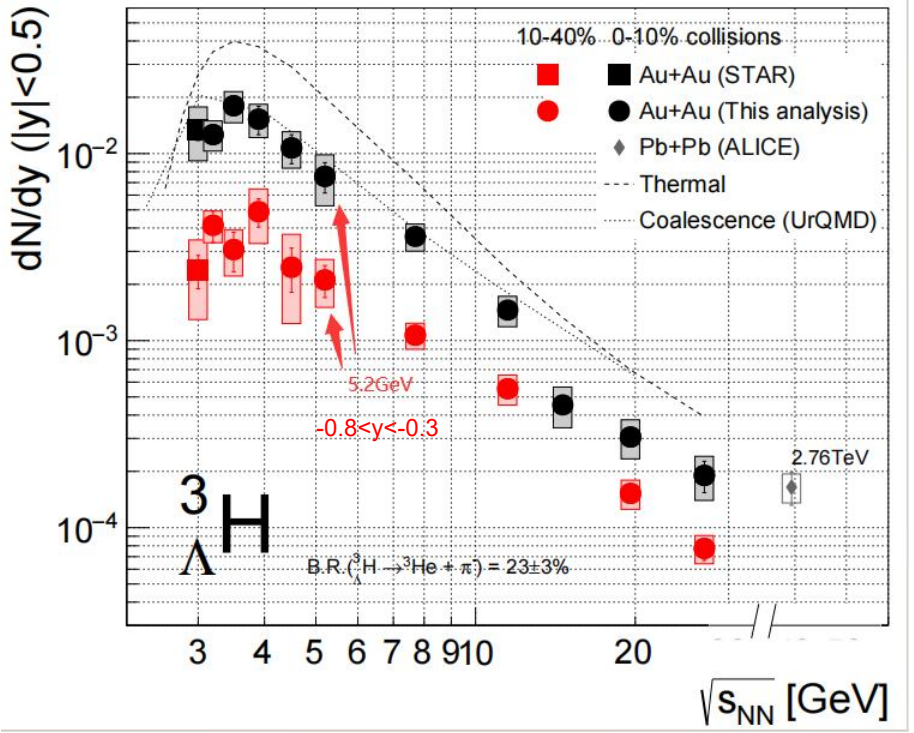
dN/dy=0.00448798±0.000872713(stat)±0.001165038(sys) $-1.3<y<-0.8$

dN/dy=0.00197881±0.000385507(stat)±0.000566387(sys) $-0.8<y<-0.3$

yulou

Hypertriton yields vs $\sqrt{S_{NN}}$





Summary

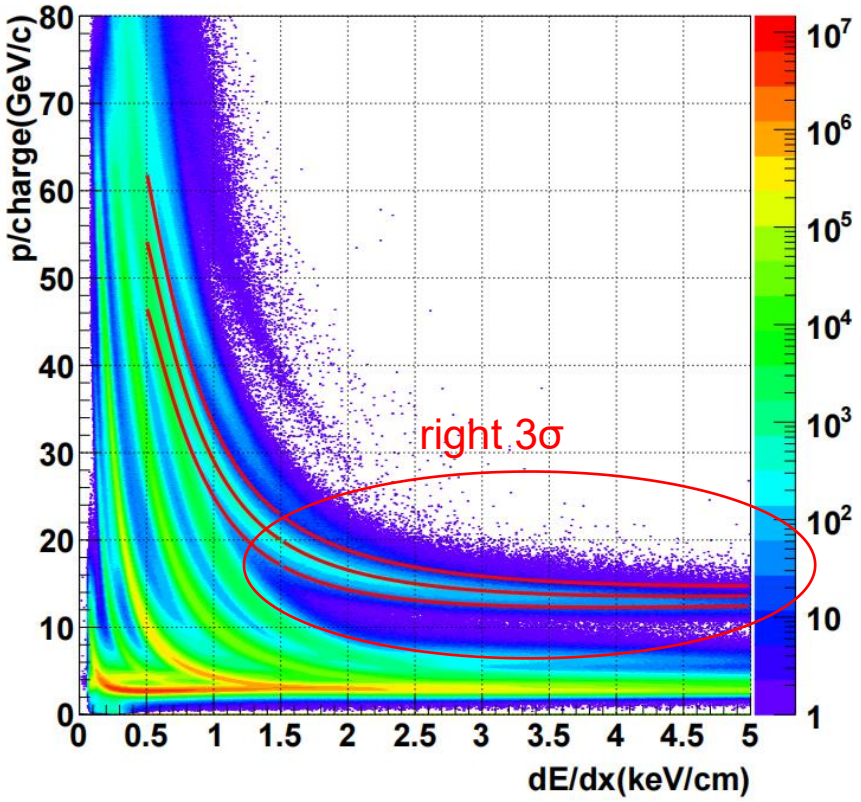
- Get ${}^{3}_{\Lambda}\boldsymbol{H}$'s P_T spectra in 0-10% and 10-40% of Run2020 FXT Au+Au 5.2 GeV
- Get dNdy also systematic error in -0.8<y<-0.3 of 0-10% and 10-40% Run2020 FXT Au+Au 5.2 GeV

To do list

- Loop new data

Bcak up(PID recalibration)

- Using TPC information
  - He3
    - p/q>0.4GeV/c: ±3σ dEdx band



  - Pion:
    - |dEdXPULL_pion($n\sigma_\pi$) - mean |<3(about 2.24σ,σ=1.335)

will use 3σ in new data(SL23e)