Identification of particles and Track Efficiency

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Studens:
Adrian Lara
Francisco Reyes

Supervisors:
Dr. Vadim Kolesnikov
Dra. Ivonne Alicia Maldonado Cervantes
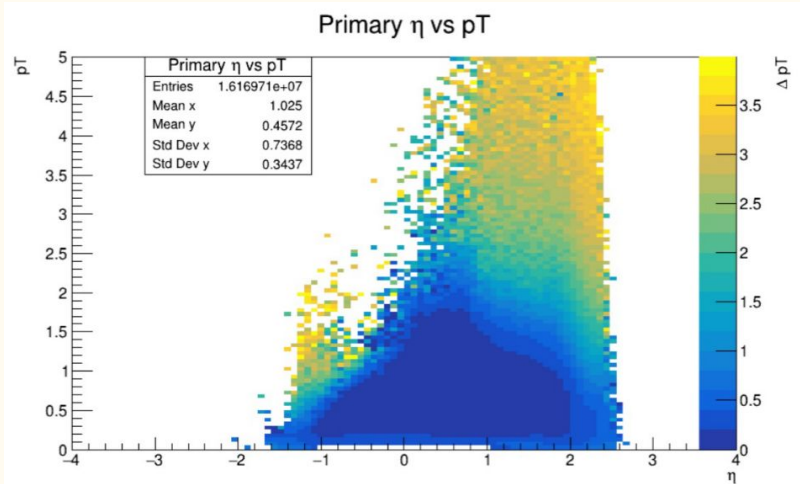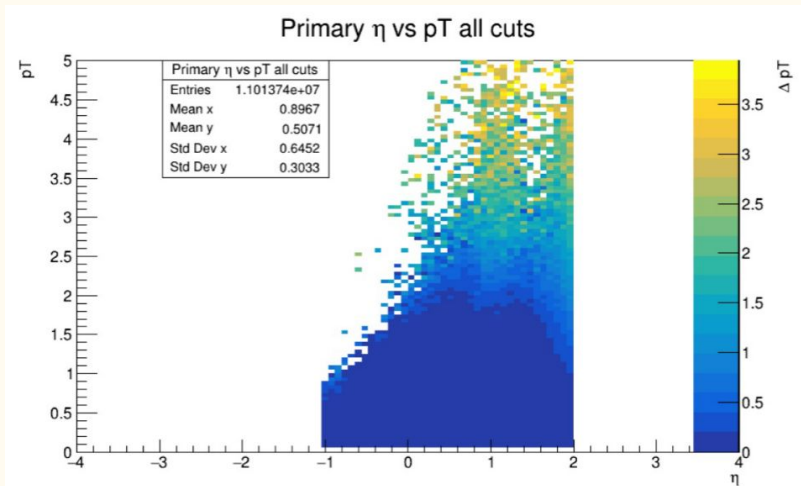Dr. Viktar Kireyeu
Natalia Kolomoyets

Cuts

- Eta (-1 , 2)

- DCA <= 2

- Num of Hits => 20

- Impact parameter b < 13

System

- Fixed Target

- Xe(A = 124) + W(A = 184)
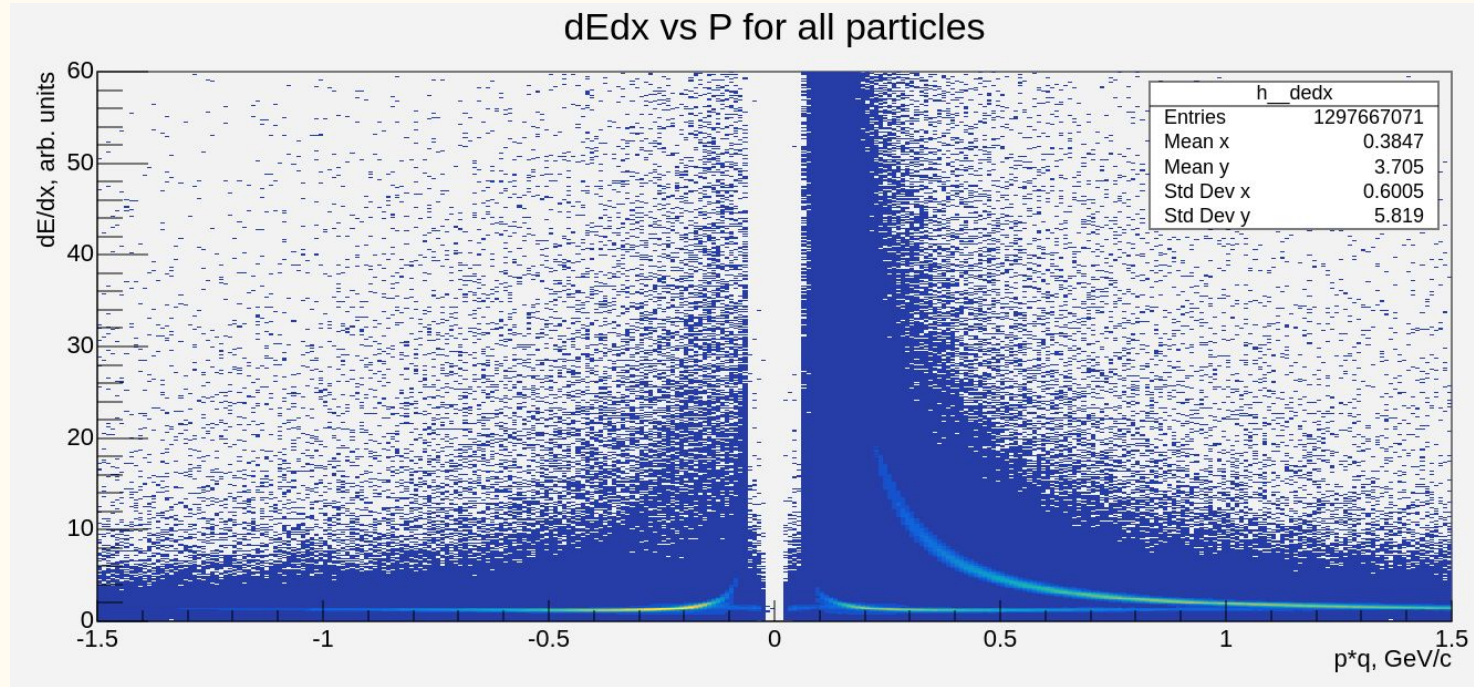
- Events 384,800

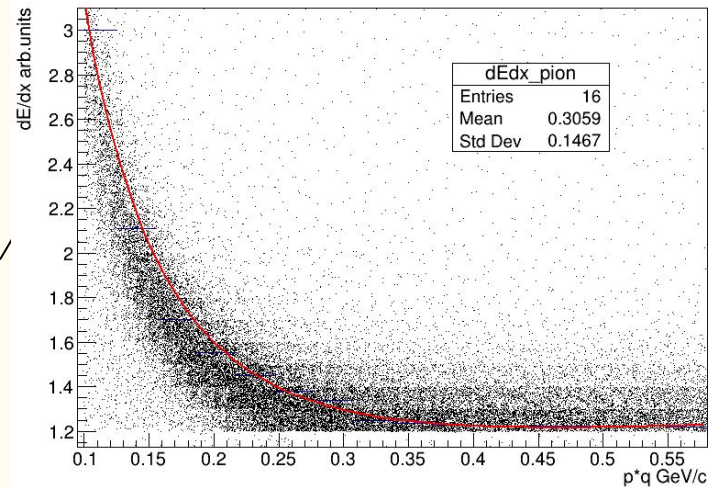

(a) Without cuts

(b) With cuts

Bethe-Bloch equation

Using the Bethe-Bloch equation, adjustments were made for energy loss

$$-\frac{dE}{dx} = \underbrace{2\pi N_A r_e^2 m_e c^2}_{0,1535 \; MeVcm^2/g} \rho \frac{Z}{A} \frac{z^2}{\beta^2} \left[\ln\left(\frac{2m_e \gamma^2 v^2 W_{máx}}{I^2} \right) - 2\beta^2 \right]$$
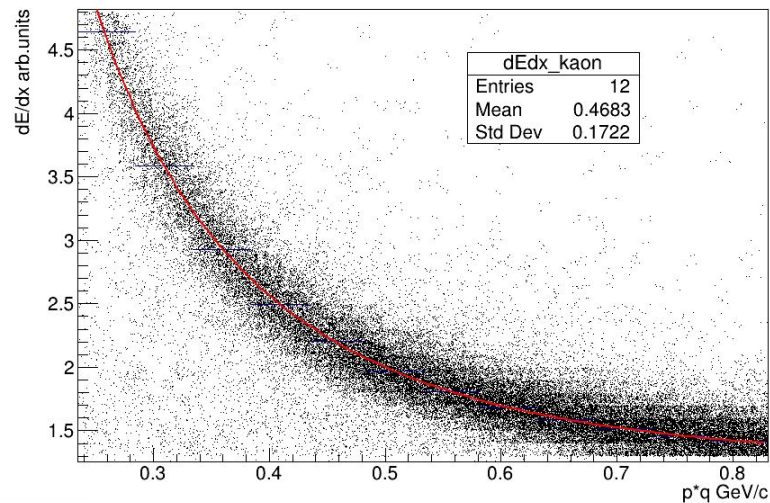
All Particles

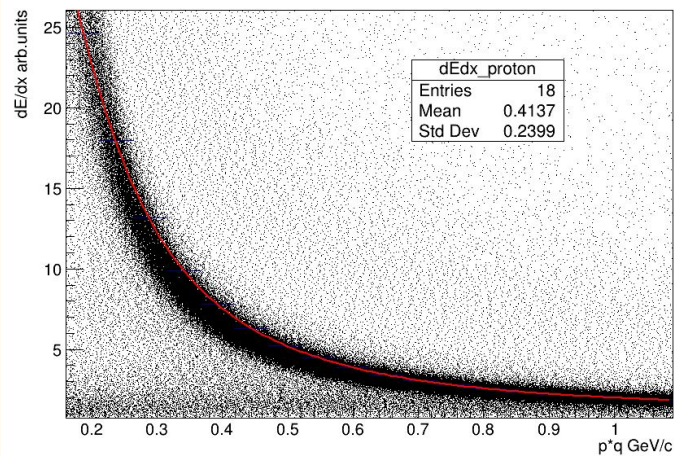dEdx vs P for all particles

h__dedx	
Entries	1297667071
Mean x	0.3847
Mean y	3.705
Std Dev x	0.6005
Std Dev y	5.819

dE/dx parameterization for the pion

dEdx_pion	
Entries	16
Mean	0.3059
Std Dev	0.1467

dE/dx parameterization for the kaon

dEdx_kaon	
Entries	12
Mean	0.4683
Std Dev	0.1722

dE/dx parameterization for the proton

dEdx_proton	
Entries	18
Mean	0.4137
Std Dev	0.2399

Particles

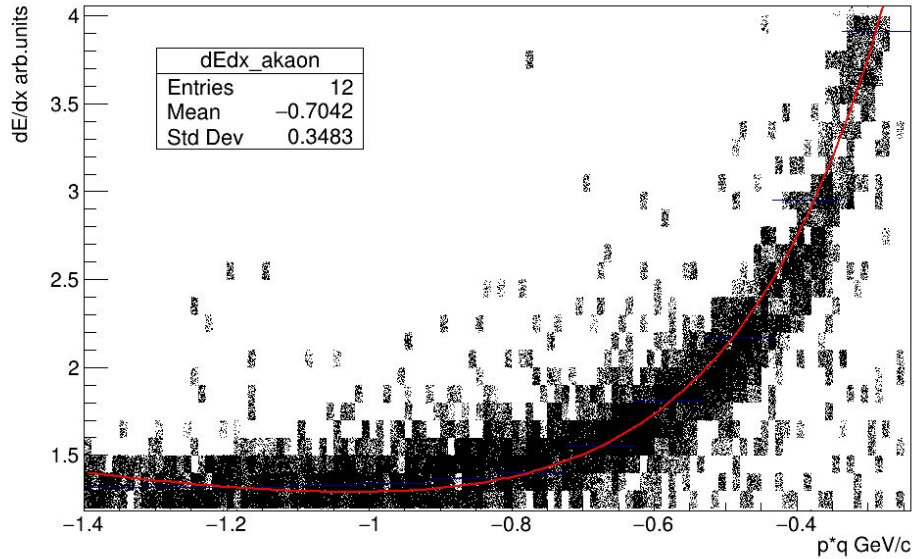## Antiparticles
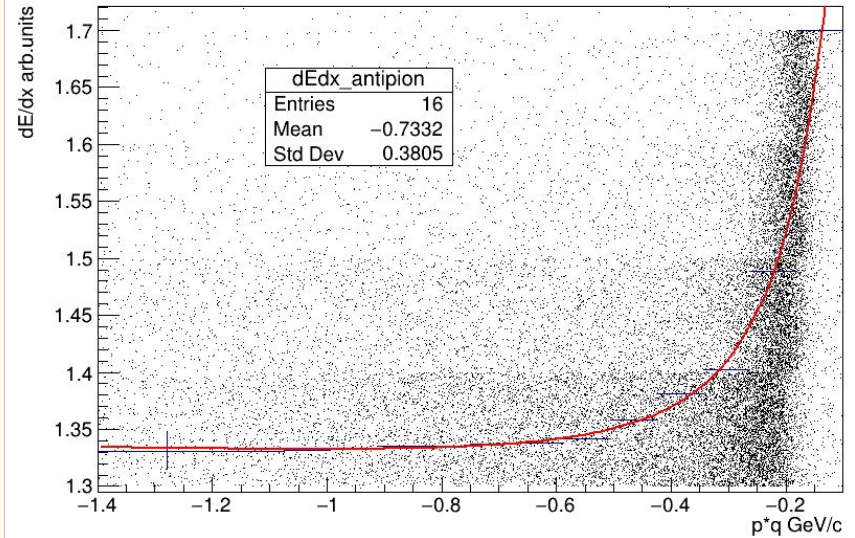
In the case of the simulation to the energy we are using, antiprotons cannot be found

dE/dx parameterization for the antikaon

dEdx_akaon	
Entries	12
Mean	−0.7042
Std Dev	0.3483

dE/dx parameterization for the antipion

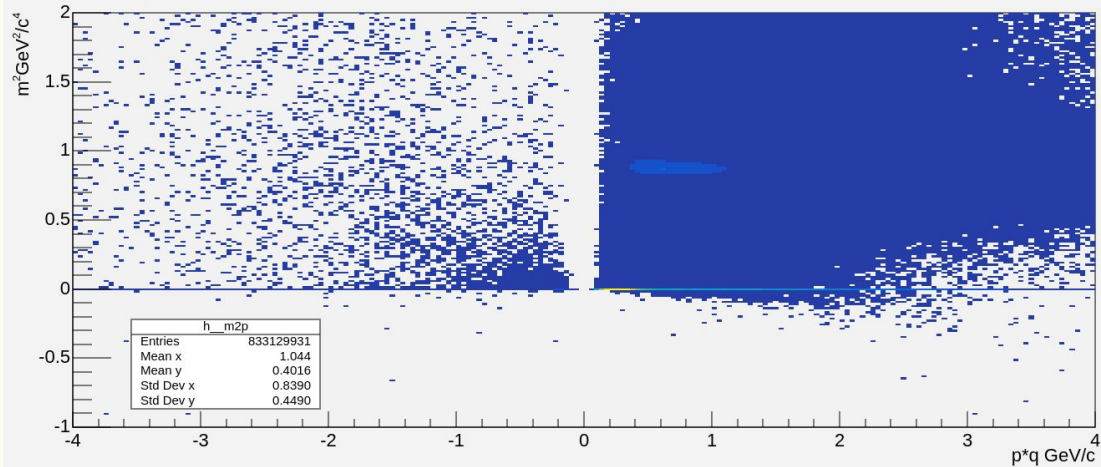| dEdx_antipion	
Entries	16
Mean	−0.7332
Std Dev	0.3805

m²vs P for all particles

Mass^2
All particles
Protons

h__m2
Entries	1297667071
Mean x	0.6434
Mean y	0.2592
Std Dev x	0.9383
Std Dev y	0.4053

m²vs P for the proton

h__m2p
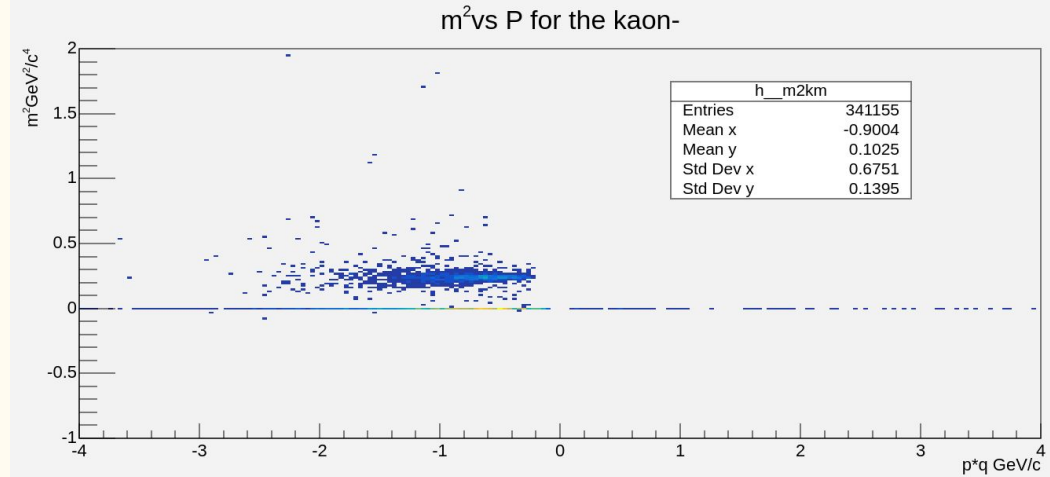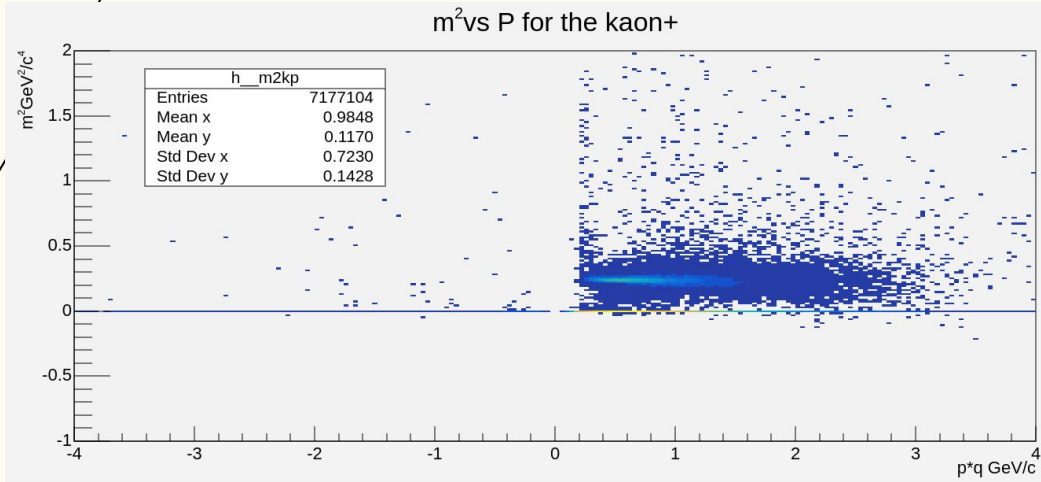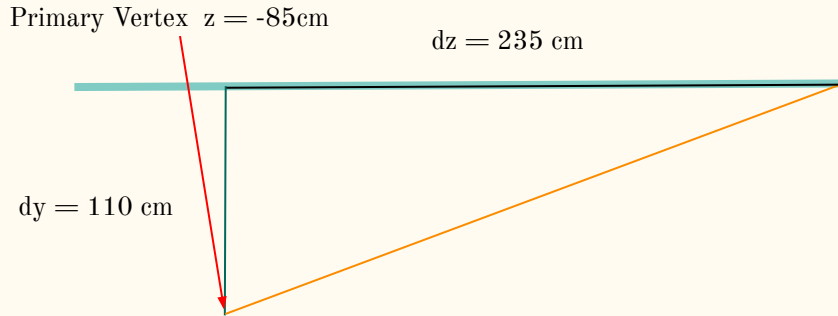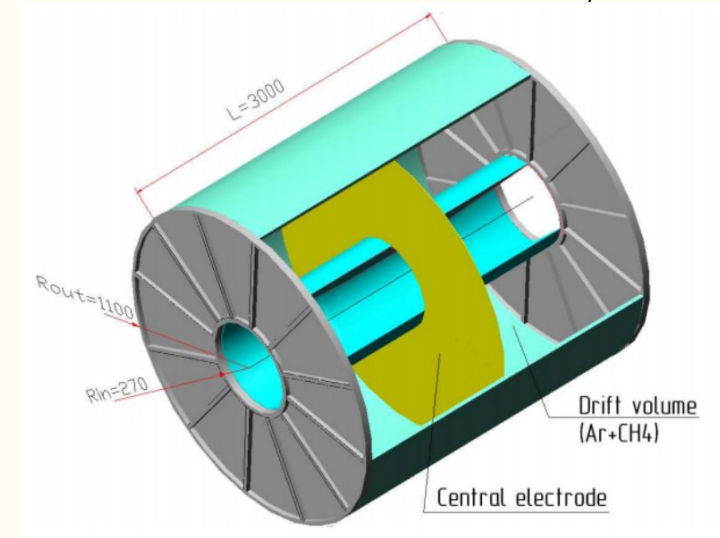|	
Entries	833129931
Mean x	1.044
Mean y	0.4016
Std Dev x	0.8390
Std Dev y	0.4490

Pion and Antipion

Kaon and Antikaon

Geometric cut on pT

Needed Variables

Using as a maximum momentum P, the momentum of a pion that gets all the Energy of the center of mass.

Primary Vertex z = -85cm

dz = 235 cm

dy = 110 cm

TPC dimensions [5]

L=3000

Rout=1100

Rin=270

Drift volume (Ar+CH4)

Central electrode

This is possible because it is a Fixed Target Experiment

Geometric cut on pT

Pion Max momentum

$$P^2 = E_{cm}^2 - m_\pi^2 = (2.9)^2 - (0.139)^2 = 8.3906 \text{ Gev}$$

pT cut:

pT = 3.557 Gev

Equation to Solve:

$$\frac{dy}{dz} = \frac{p_T}{p_z} = \frac{p_T}{\sqrt{P^2 - p_T^2}}$$

$$p_T = \sqrt{\frac{P^2}{\left(\frac{dz}{dy}\right)^2 + 1}}$$

Track Efficiency as a function of pT

Cuts on MC Tracks:

Only Primary Particles
Only Charged particles
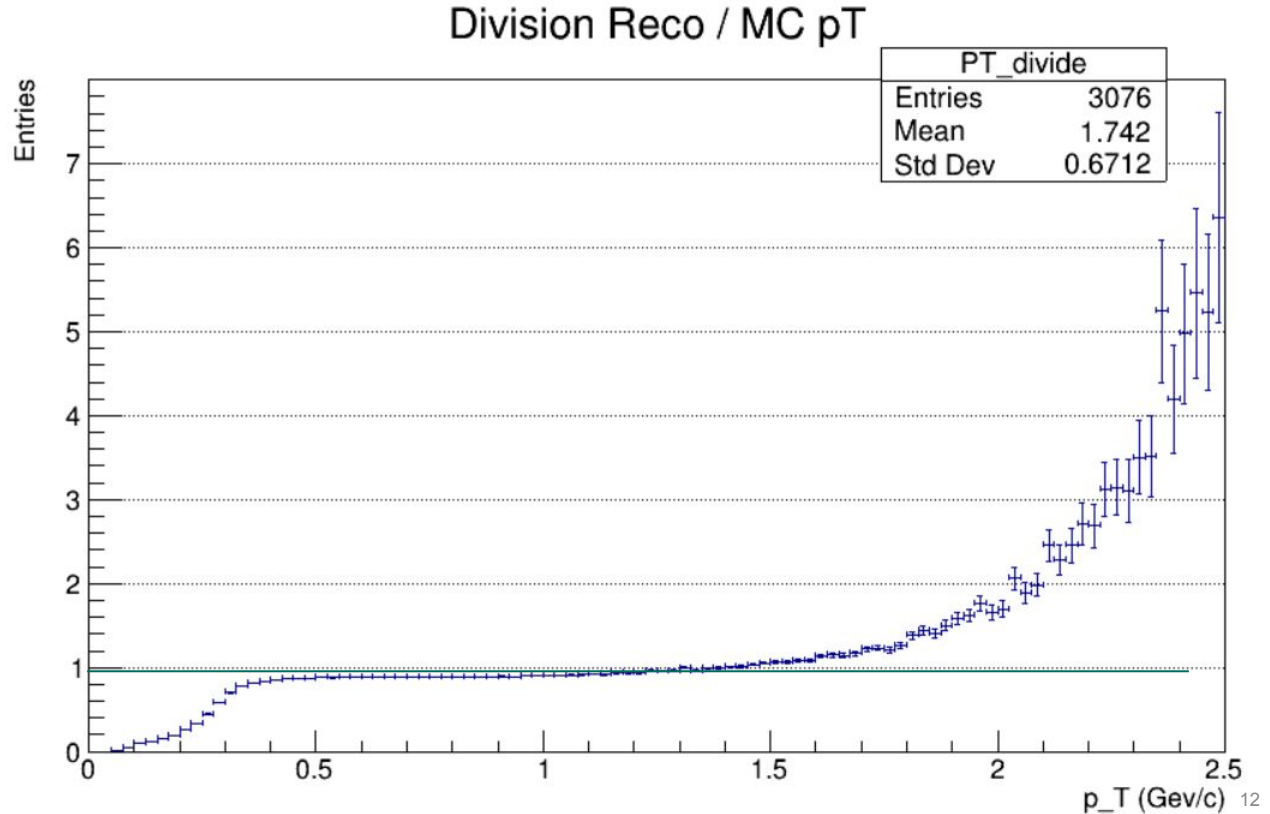eta in (-1, 2)
impact parameter b < 13
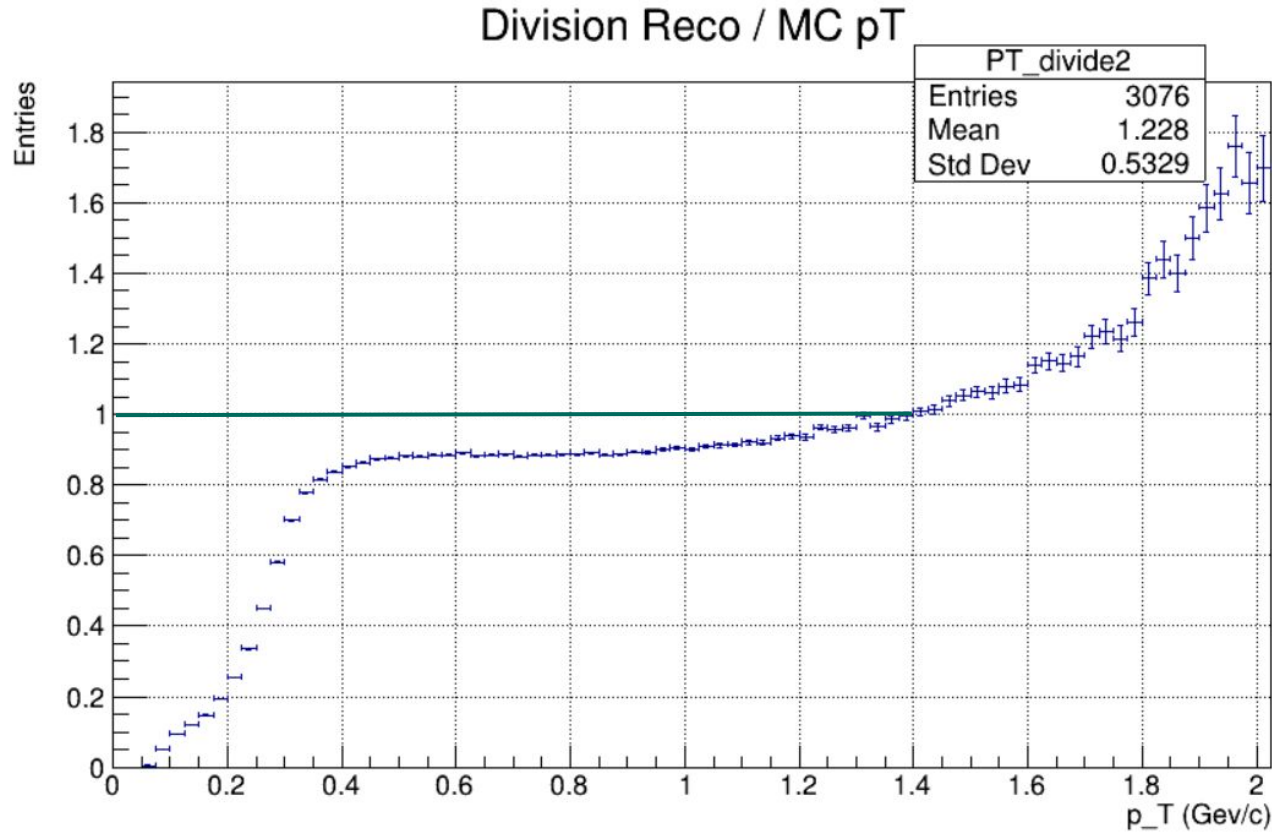
Cuts on Reco Tracks:

Eta (-1 , 2)
DCA <= 2
Num of Hits => 20
Impact parameter b < 13

Division Reco / MC pT

PT_divide	
Entries	3076
Mean	1.742
Std Dev	0.6712

Zoom Track Efficiency as a function of pT

Track Efficiency vs z-Vertex - Eta

Cuts on MC Tracks:

Only Primary Particles
Only Charged particles
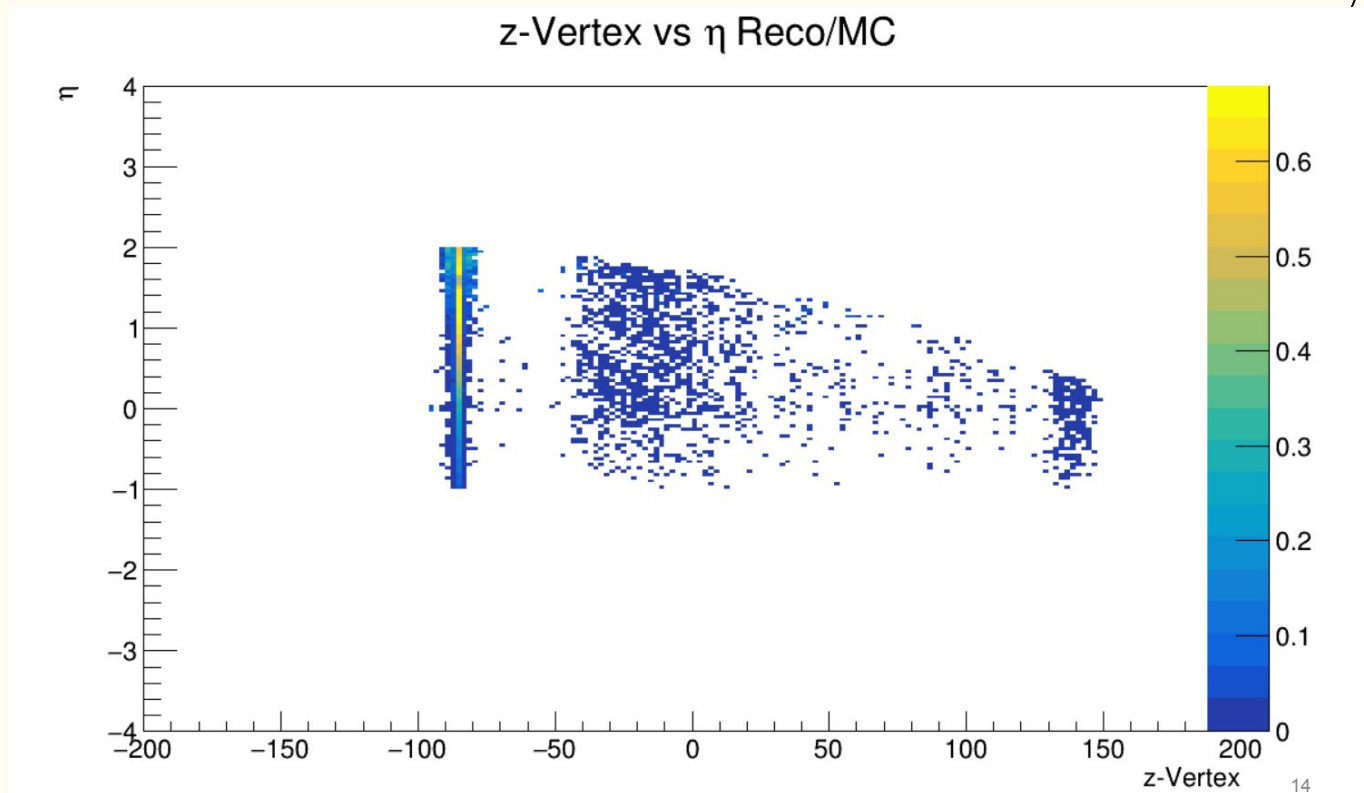eta in (-1, 2)
impact parameter b < 13

Cuts on Reco Tracks:

Eta (-1 , 2)
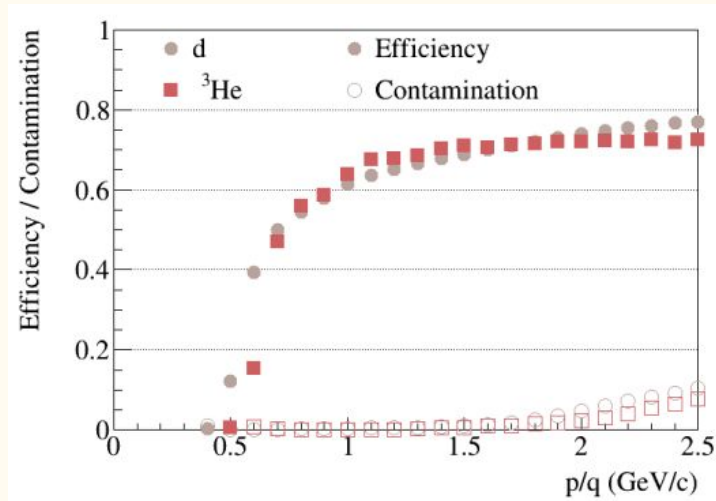DCA <= 2
Num of Hits => 20
Impact parameter b < 13

z-Vertex vs η Reco/MC

Future work

Implement the identification of particles for the use of centrality wagon and use selection by particle species for charged

REFERENCES

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[2] Wolfram:
https://materials.springer.com/googlecdn/assets/sm_lbs/947/sm_lbs_978-3-540-45555-4_76/sm_lbs_978-3-540-45555-4_76.pdf?trackRequired=true&originUrl=/lb/docs/sm_lbs_978-3-540-45555-4_76&componentId=Download%20Chapter

[3] Cross section info: O. Buss, T. Gaitanos, K. Gallmeister, H. van Hees, M. Kaskulov, O. Lalakulich, A. B. Larionov, T. Leitner, J. Weil, and U. Mosel, Phys. Rept. 512, 1 (2012),arXiv:1106.1344 [hep-ph].

[4] https://github.com/FlowNICA/CentralityFramework

[5] NICA - Nuclotron-based Ion Collider FAcility. (s. f.).
https://nica.jinr.ru/projects/mpd.php