Updates on Calculation of Specific Heat in 3 GeV FXT Au+Au

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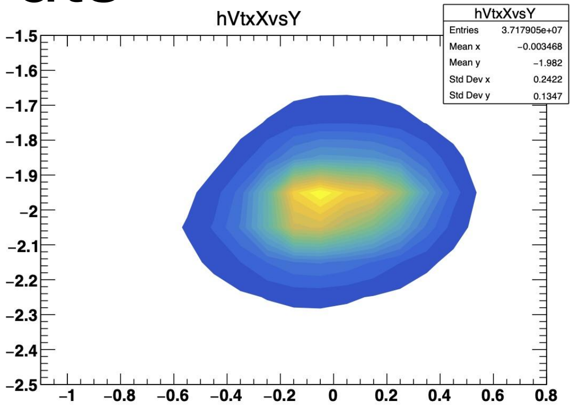
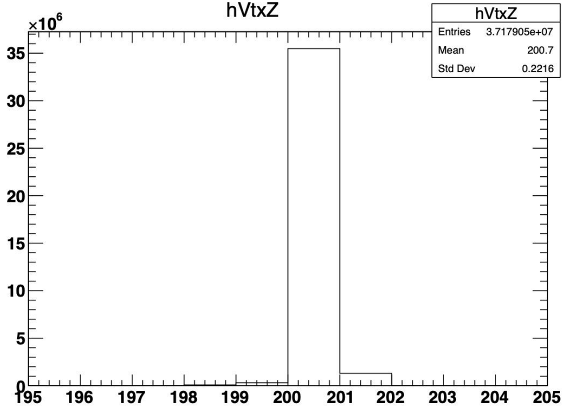
STAR Collaboration CF PWG Meeting

Event and Track Cuts

Acceptance Cuts:

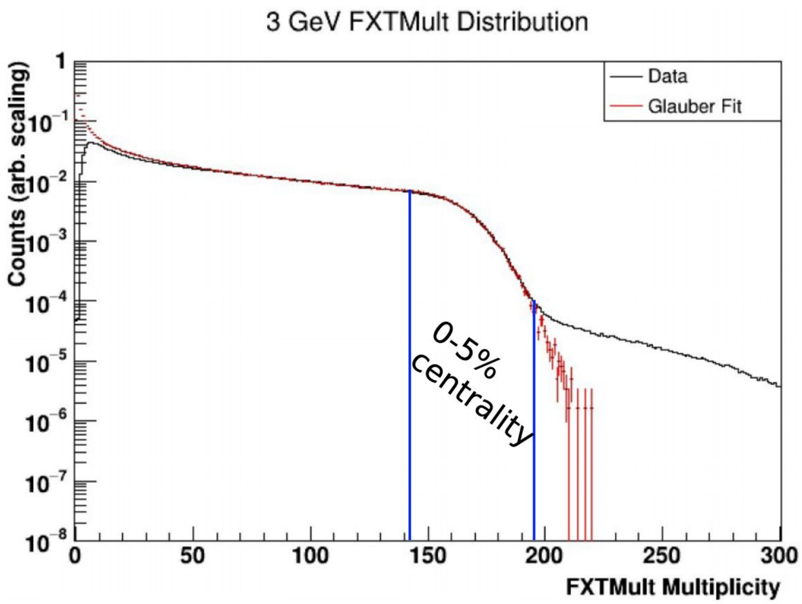
- Fixed Target, run 2018 data production, 3 GeV Au+Au collision, y_c.m. ≈1.045
- 198 <V_z< 202 cm
- V_r<1.5 cm about beam spot centered around [0,-2].
- Trigger ID 620052 and 620053 (Min.Bias)
- DCA < 3.0 cm
- NhitsFit/NHitsMax > 0.51
- Bad runs list : https://drupal.star.bnl.gov/STAR/system/files/Kimelman_3GeV_run_by_run_QA_badRuns.pdf
- 1.5 M Events analysed (Rest ongoing)





Centrality Definition FXTMult

Centrality Definition:



Centrality Bin	FXTMult Cuts (inclusive)
0-5%	195-142
5-10%	141-120
10-20%	119-86
20-30%	85-61
30-40%	60-42
40-50%	41-27
50-60%	26-17
60-70%	16-9
70-80%	8-5

- *Pile-up cut at 195
- https://drupal.star.bnl.gov/STAR/system/files/Sweger_3p0GeV_StandardNewest_fcv2020Nov11.pdf

Brief Overview

- C_v used to quantify dynamical fluctuations with a beam energy scan.
- Effective temperature (T_{eff}).
- Calculated from $<p_T>$ distributions.
- $T_{eff} = T_{kin} + f(\beta_T)$
- T_{kin} obtained from the Blast wave parametrization.

$$\frac{1}{C} = \frac{(<T_{kin}^2> - <T_{kin}>^2)}{<T_{kin}>^2} \approx \frac{(<T_{eff}^2> - <T_{eff}>^2)}{<T_{kin}>^2}$$

- Previous CF talks : https://drupal.star.bnl.gov/STAR/system/files/CF-08_11_22.pdf
- https://drupal.star.bnl.gov/STAR/system/files/Copy%20of%20CF-09_13_22.pdf

Efficiency Correction for <p_T>

Calculating Charged particle efficiencies [$\epsilon(N_{ch}, p_T)$] :

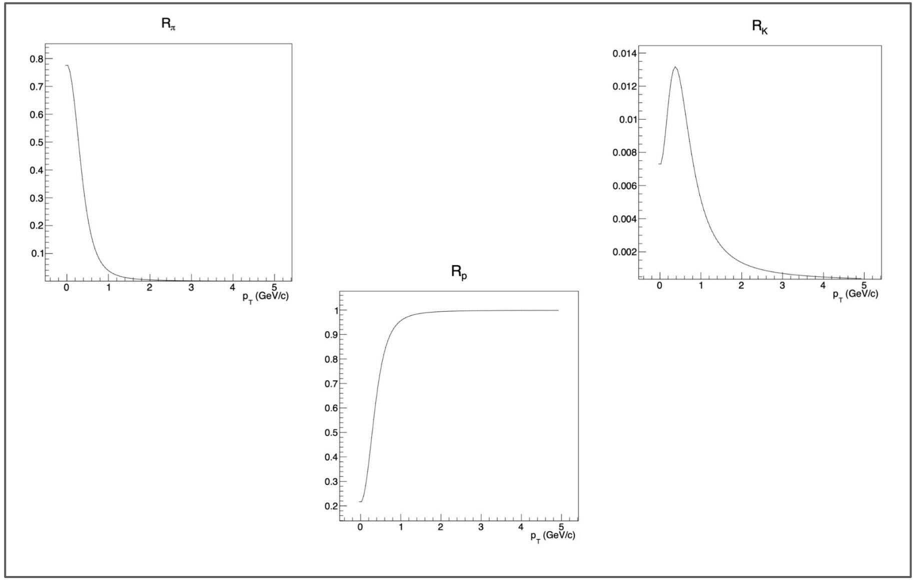
- ❖ We have the identified particle efficiencies, $\epsilon(\pi, p_T)$, $\epsilon(K, p_T)$, $\epsilon(p, p_T)$.
- ❖ Calculate charged particle efficiencies from them and particle ratio using spectra.

$$\epsilon(N_{ch}, p_T) = \epsilon(\pi, p_T) * R_\pi(p_T) + \epsilon(K, p_T) * R_K(p_T) + \epsilon(p, p_T) * R_p(p_T)$$

$$R_\pi = \frac{N_\pi}{N_\pi + N_K + N_p}$$

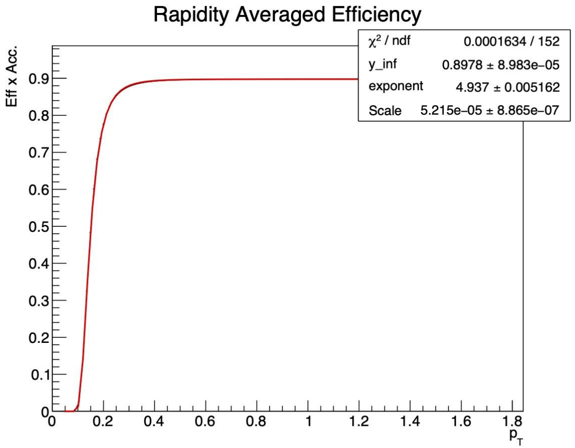
Efficiency Correction for $\langle p_T \rangle$

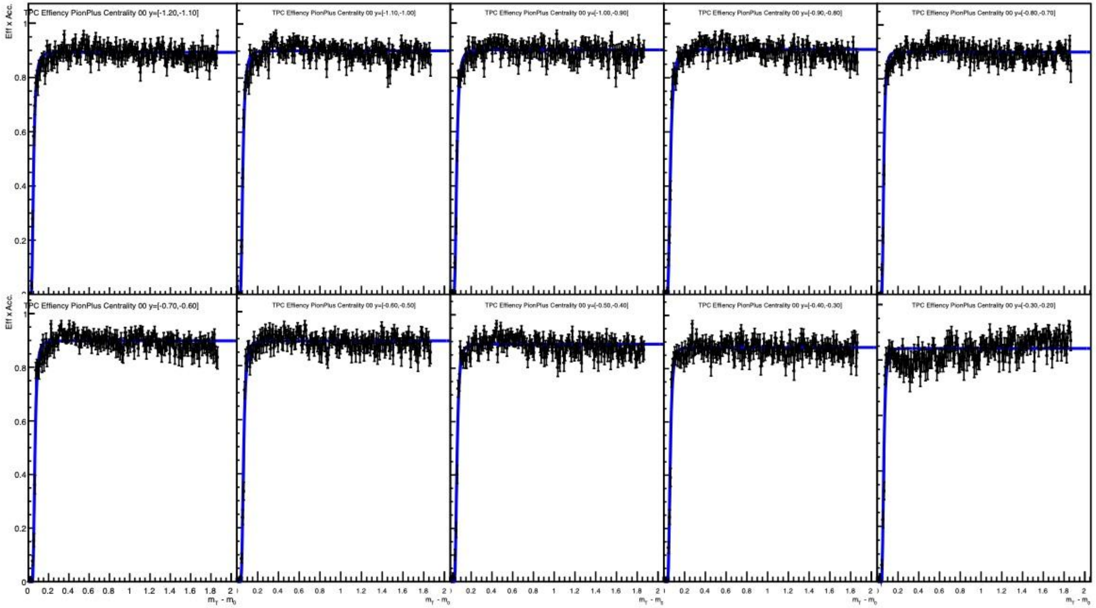
- The ratios are calculated by extrapolating the p_T spectra at $|y-y_{cm}| < 0.05$.
- The extrapolation was done using the Blast wave function.
- The spectra was obtained from Ben Kimelman.



Efficiency Correction for $<p_T>$

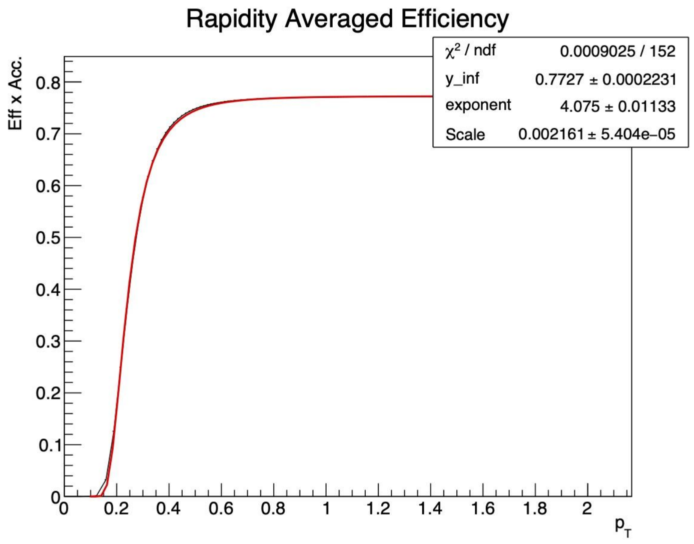
- A sweet spot was identified for the identified particle efficiencies.
- $-1.2 < y < -0.2$

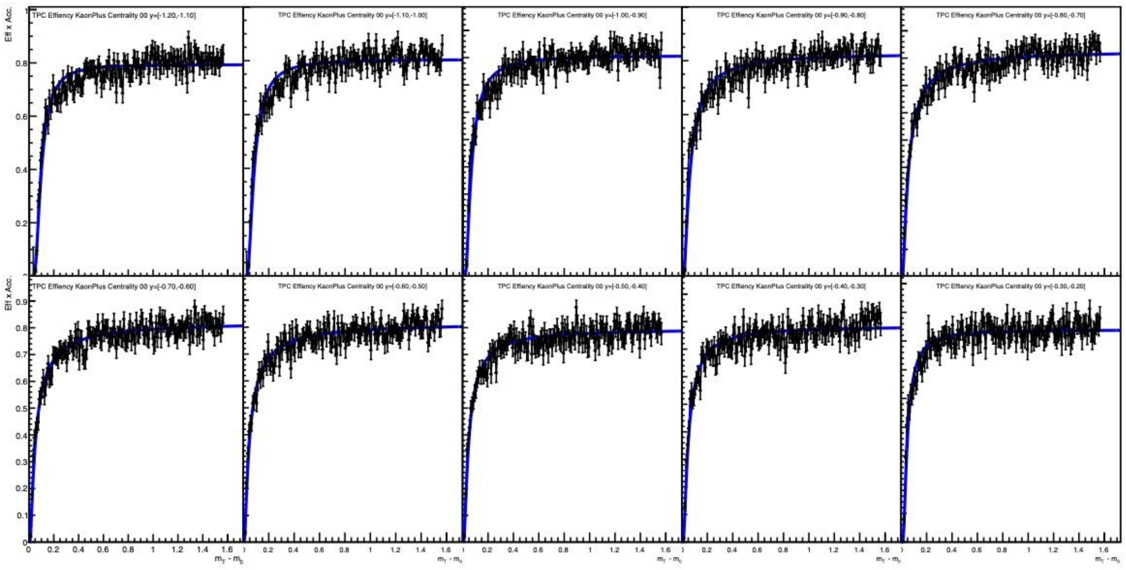




Pion (+) Efficiencies

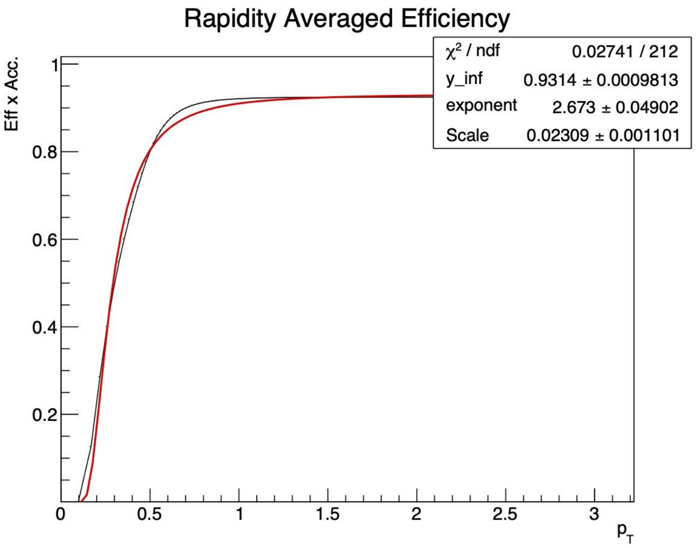
Efficiency Correction for $<p_T>$

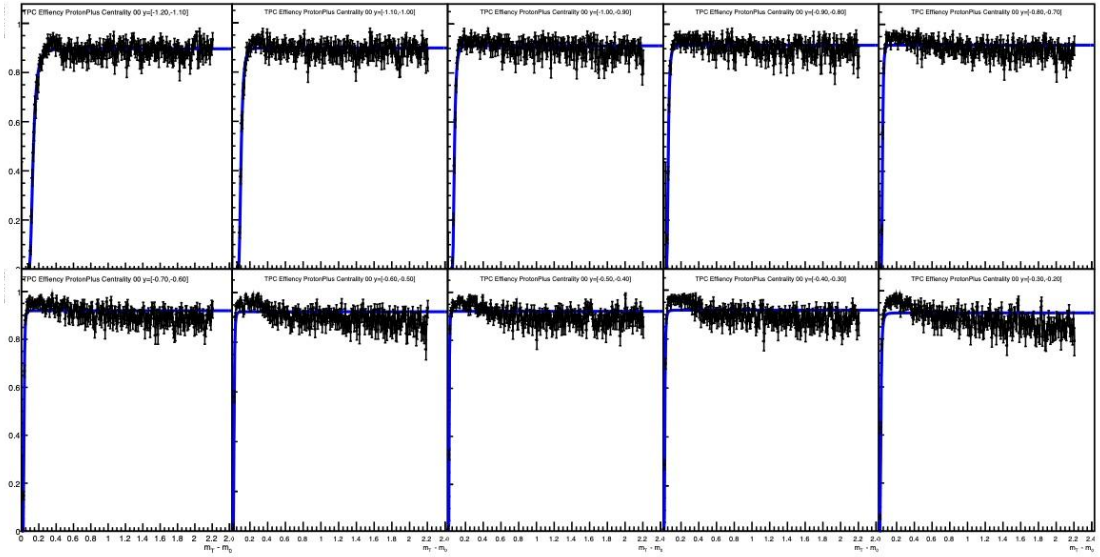




<u>Kaon (+) Efficiencies</u>

Efficiency Correction for <p_T>

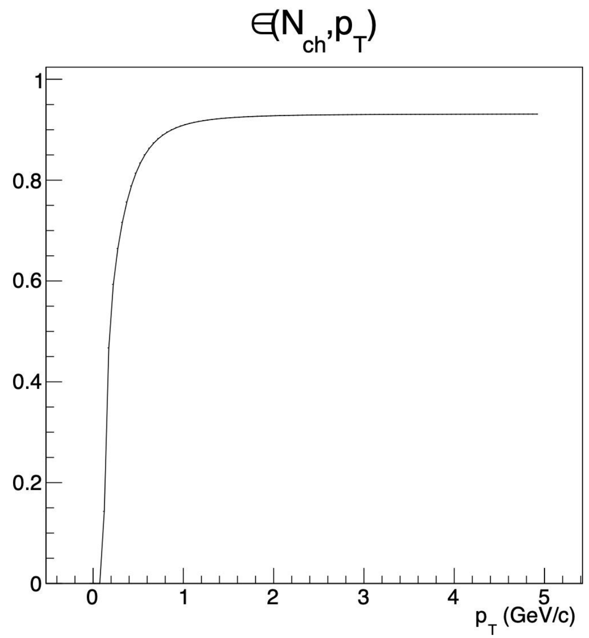




Proton Efficiencies

Efficiency Correction for $<p_T>$

- Charged particle efficiency is calculated.
- Ideally the ratios have to be from the same rapidity window as well.
- $-1.2 < y < -0.2$



Efficiency Correction for <p_T>

- The efficiency correction was done E-by-E.
- Correct the N_{ch} (multiplicity) in each p_T bin.

$$< p_T >= \frac{p_T^1 + p_T^2 + p_T^3 + \ldots}{N_{ch}}$$

$$< p_T >= \frac{p_T^1/\epsilon(p_T^1) + p_T^2/\epsilon(p_T^2) + p_T^3/\epsilon(p_T^3) + \ldots}{N_{ch}^1/\epsilon(p_T^1) + N_{ch}^2/\epsilon(p_T^2) + N_{ch}^3/\epsilon(p_T^3) + \ldots}$$

Closure Test for Efficiency Correction

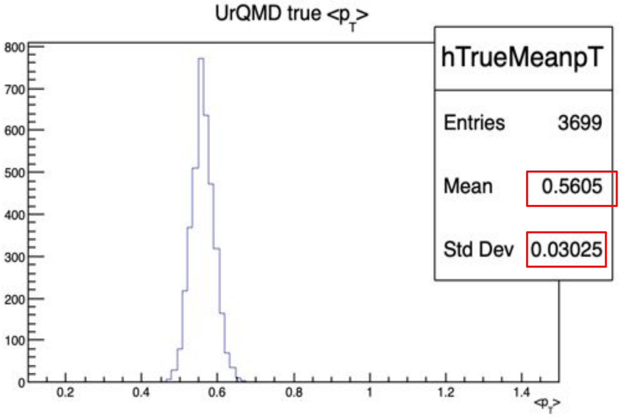
- A Closure test was performed on UrQMD Data for the aforementioned efficiency correction.
- For the Closure test, the detector like events had to be made:

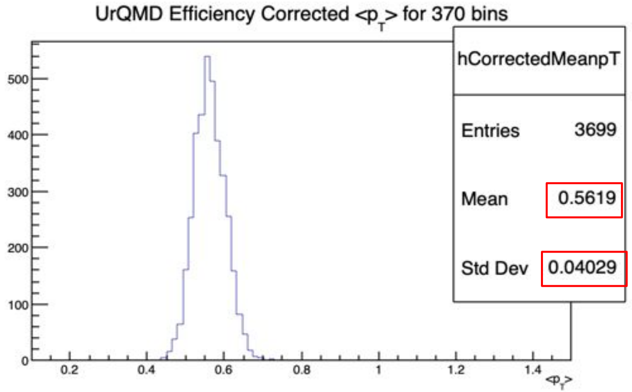
Step 1	Step 2	Step 3
Calculate efficiency as a function of Pid and p_T, for a track. (ε)	Generate a random number between [0,1]. (r)	Add the particle to the detector like event if efficiency is greater than the random number. ($r < \varepsilon$)

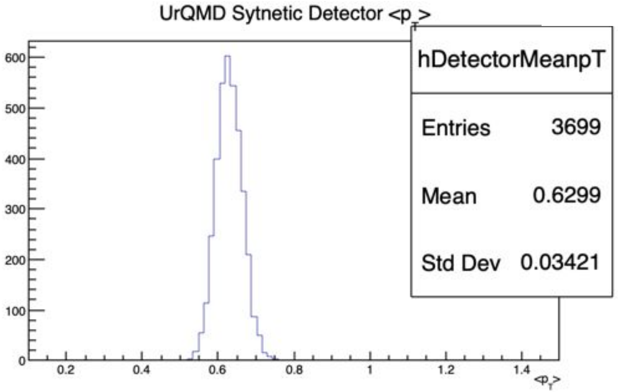
Detector Like Events for UrQMD

- The correction effectiveness was affected by the bin size chosen.
- For the closure test, a bin size of 5 MeV was used, in actual data we would be limited by tracking resolution.

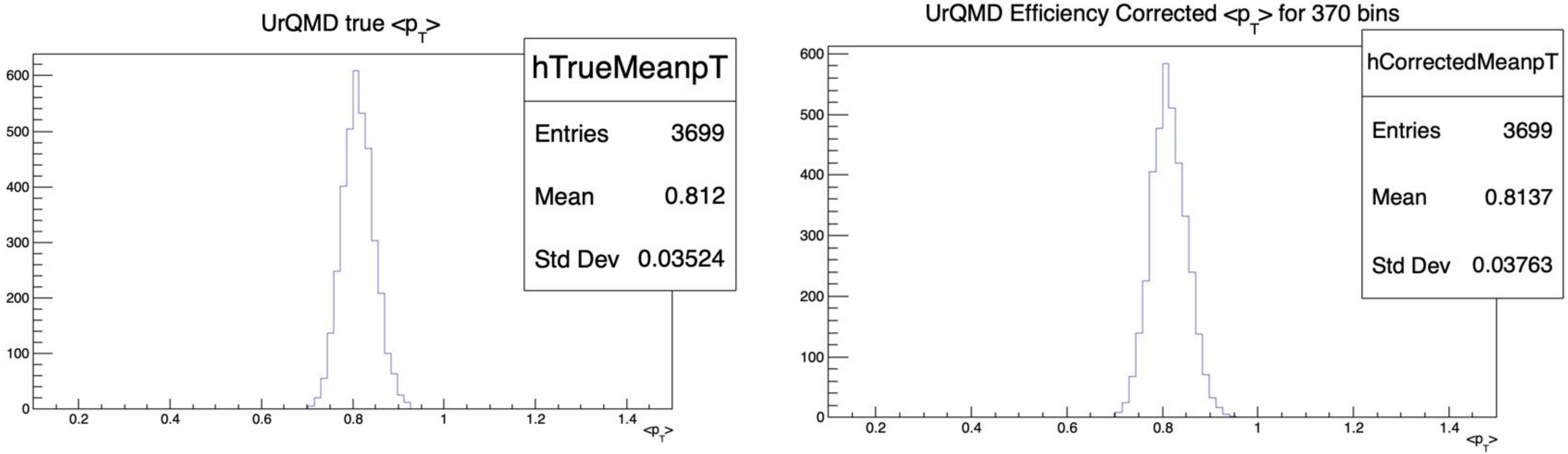
Closure Test for Efficiency Correction







Closure Test for Efficiency Correction

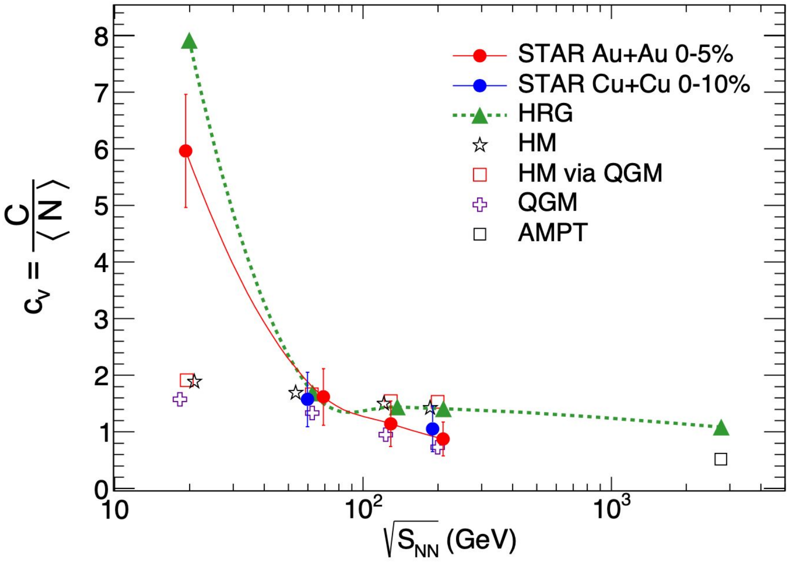


$0.5 < p_T < 2.0$ (GeV/c)

Next Steps

Working on:

1. Running on RCF (all events)
2. Working on i-HRG to obtain baseline
3. Systematics
4. Cross check at other energies

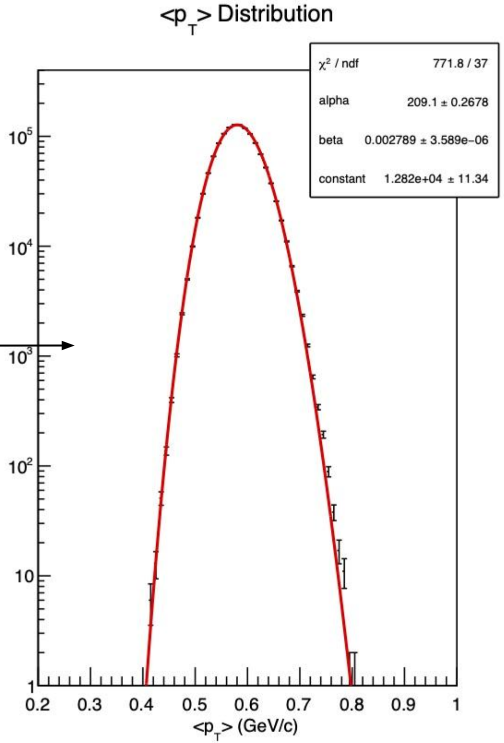


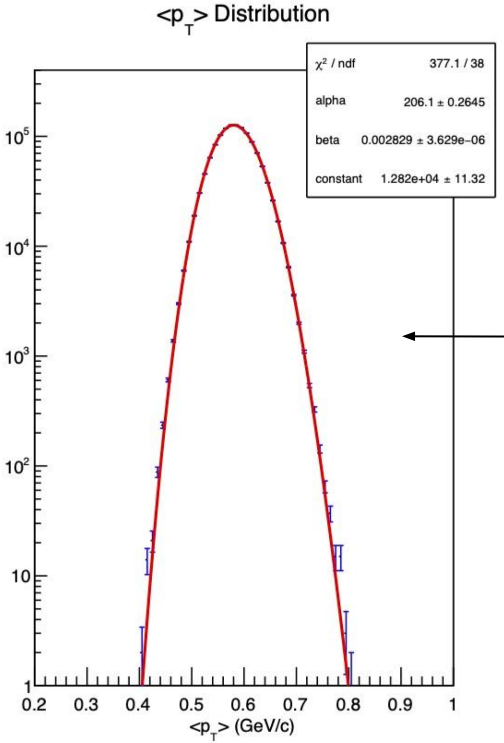
Phys. Rev. C 94, 044901 (2016)

Thank you for your attention

Backup Slides

DATA



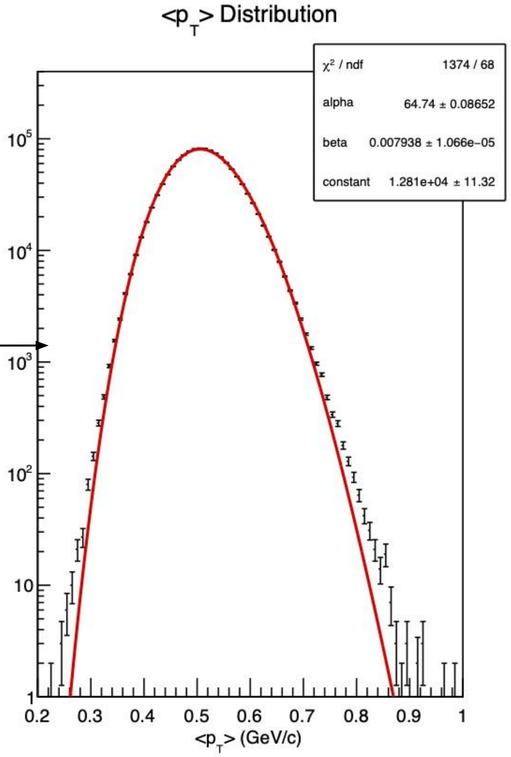


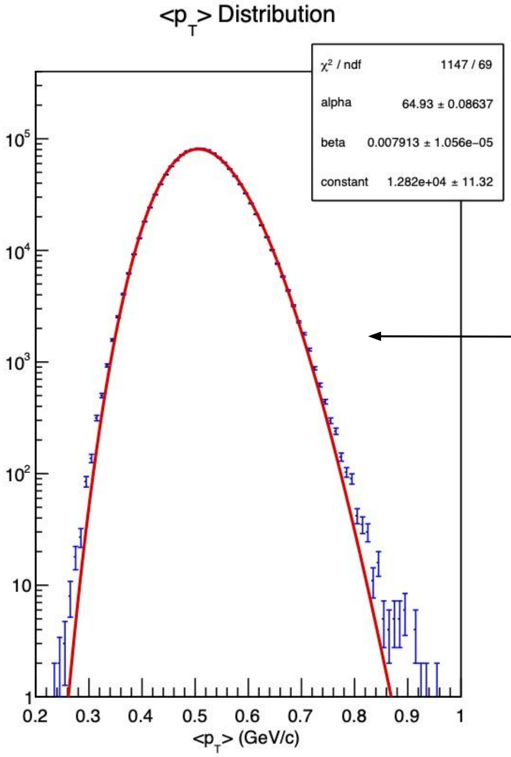
MIXED

❖ $-1 < \eta < 0$

Backup Slides

DATA





MIXED

- $-0.5 < \eta < 0$

Backup Slides

- A small subset of 27 GeV is taken for analysis.
- The event cuts and track cuts are from Chun-Jian. (https://drupal.star.bnl.gov/STAR/system/files/BES_20054_27_meanpT_0119.pdf)