Charged hadron production and two-particle correlation in ^{3}He+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV measured with PHENIX detector

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Motivation & Goal

Motivation

- Measurements in p+A and d+A collision systems
  - have been considered to study cold nuclear matter effects without QGP formation

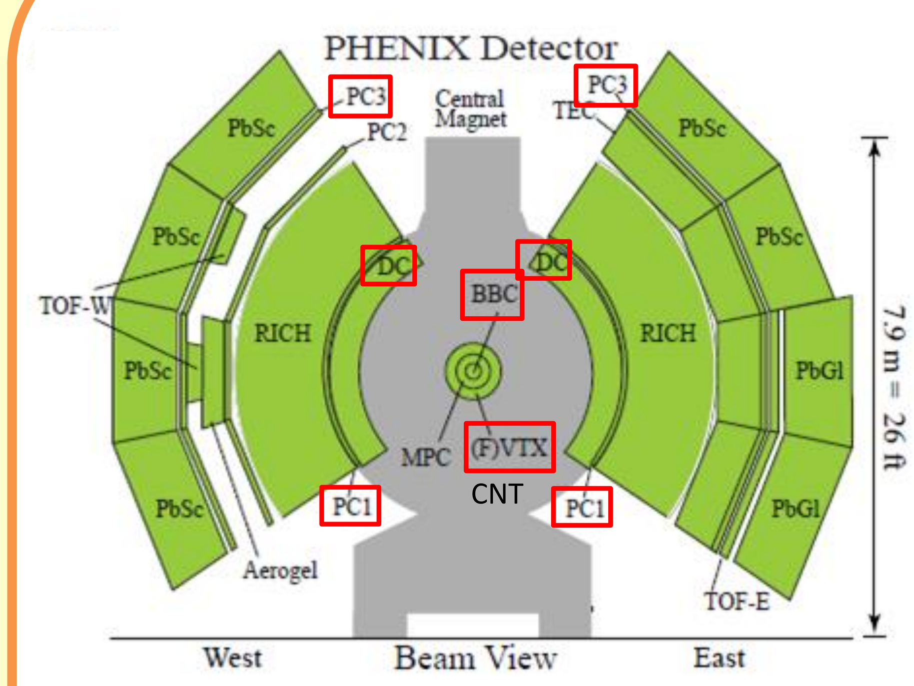
However,

- hydrodynamic flow and long-range angular correlations in p+A and d+A collisions
  - indicated that small but high-density systems could be produced
- ^{3}He+Au collisions
  - in order to perform a systematic study of small systems having spatial anisotropy at initial stage
- The high p_T hadron suppression in heavy ion collisions
  - one of the evidences of Quark-Gluon-Plasma (QGP)

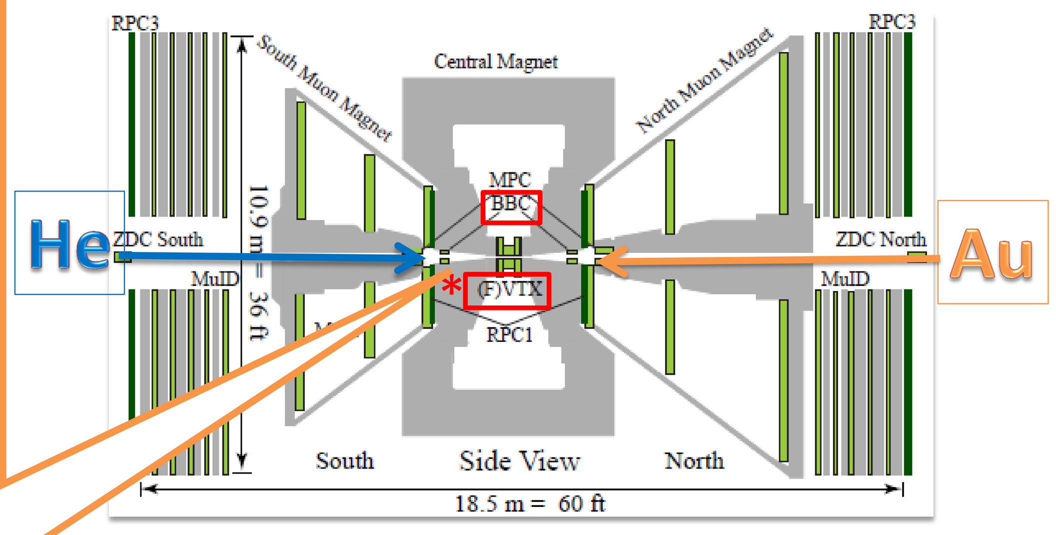
Goal

- Charged hadron production and two-particle correlation measurements in ^{3}He+Au collisions at $\sqrt{s_{NN}}$ = 200 GeV
- Look for evidences of QGP formation via measurement of high p_T hadron production

PHENIX detectors



- For track reconstruction, Central arm spectrometers (CNT, east and west arms) are used.
  - $|\eta| < 0.35$, $\Delta\phi = 90°$
  - Track reconstruction with drift chamber and first layer of the pad chamber (DC-PC1), and additional track confirmation by requiring an associated hit in the third layer of pad chamber (PC3)
  - Momentum resolution ~1.5% (at p_T = 1 GeV/c)

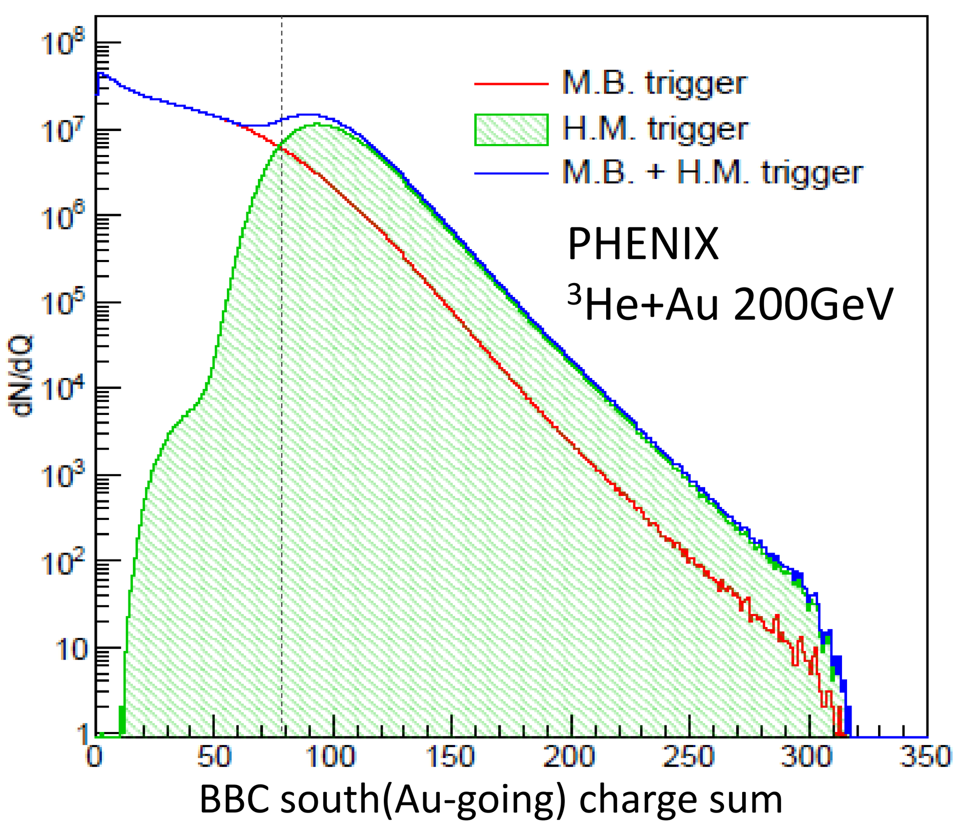


*VTX = SVX, ≠FVTX(Forward VTX)

- For determination of event information such as collision vertex position or centrality, Beam Beam Counter (BBC) is used.
  - $3.0 < |\eta| < 3.9$, $\Delta\phi = 360°$
  - Z = +144.35 cm (north), -144.35 cm (south)
  - BBC has 64 elements of 3 cm quarts Cherenkov radiator with meshed dynode photo multiplier tubes (PMTs) .

Centrality determination

- In 2014 data taking period, ^{3}He+Au collisions, centrality is defined by BBC charge at south arm based on Glauber Monte Carlo Simulation.



(BBC narrow trigger ; |z vertex| <10)

2 types of triggers;

- Minimum Bias (M.B.) trigger
  - all of events with |z_vtx|<10
- High Multiplicity (H.M.) trigger
  - select more central events
  - require [BBC PMT tubes > 48 or 49 hits]

- Number of events for *Centrality 0-5% is 10 times larger in H.M. triggered sample compared to M.B. one.

  *Centrality 0-5%

  BBC(south) charge sum > about 80

p_T distribution & track cut process

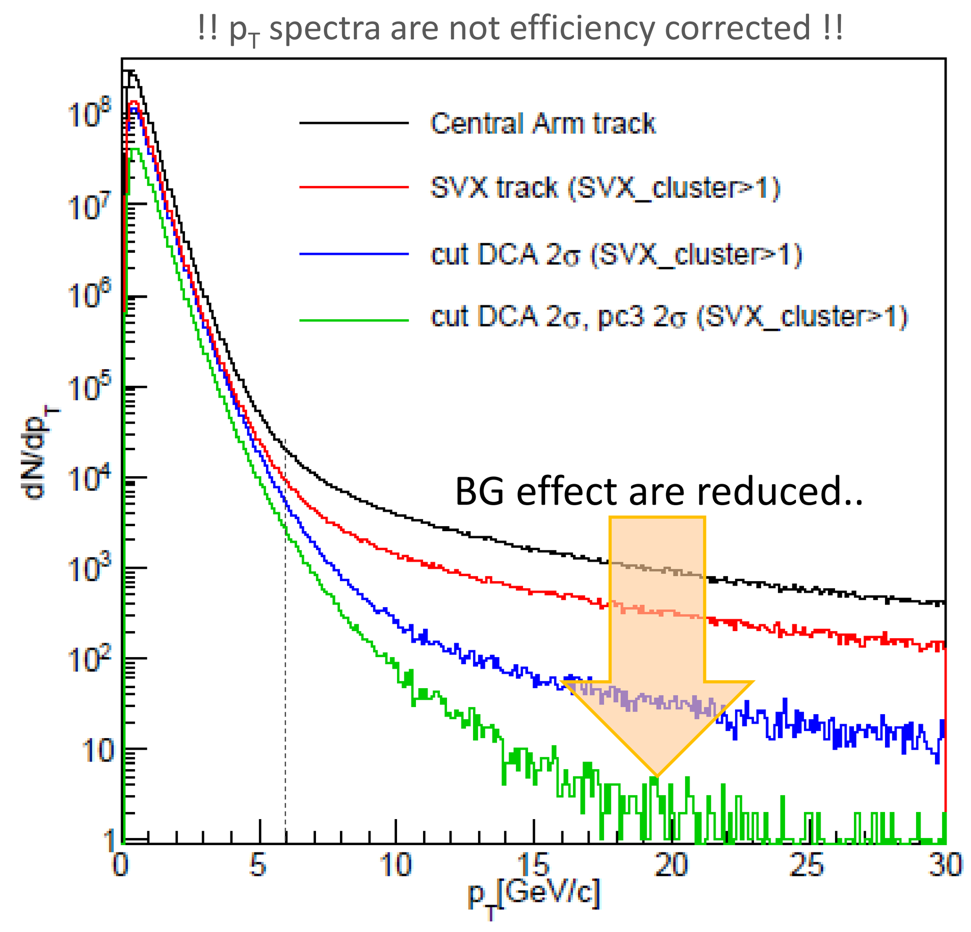
Sample of charged tracks reconstructed with DC-PC1 only is strongly contaminated at p_T > ~ 6 GeV/c by decay products of long lived particles and conversion. Contamination is an artifact of tracking algorithm which assumes that all tracks originate from the collision vertex. The background can be significantly reduced by requiring track confirmation in the SVX.

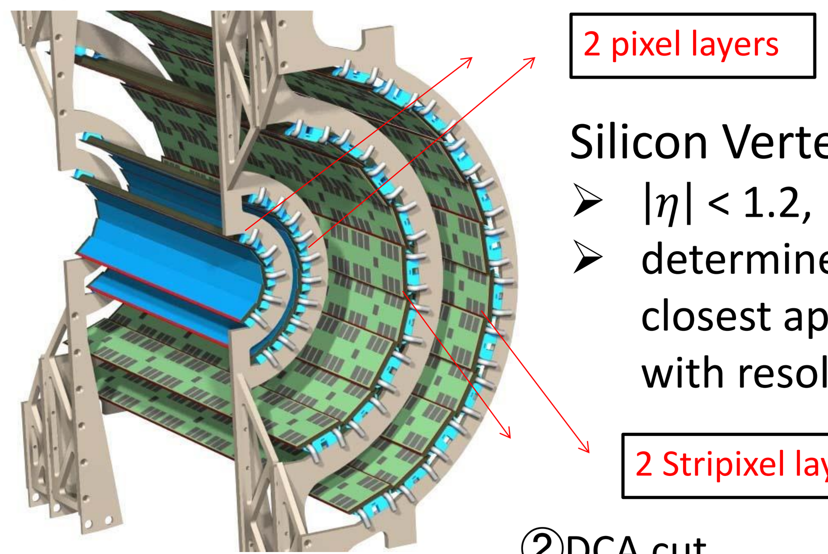
Track cut process

① SVX hit association cut

② DCA cut to select primary track

③ PC3 hit association cut





Silicon Vertex Detector (SVX)

- $|\eta| < 1.2$, $\Delta\phi$ ~ 360°
- determine DCA (Distance of closest approach) of tracks with resolution of ~ 100 μm

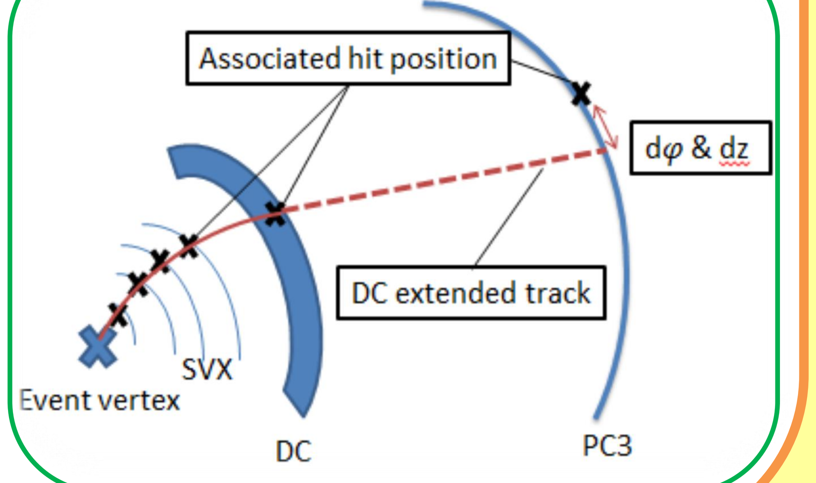
① SVX hit cut

- number of associated hits with CNT track
- max 4 SVX layers
- In this figure, require the most inner 2 layers hits

②DCA cut

Background contributions can be cut using DCA2DR (x,y), DCAZ measured by SVX.

③ PC3 (most outer pad chamber)



SVX cuts effectively remove background at high p_T. Estimation of sample purity and reconstruction efficiency are in progress.

Subtraction of BG tracks is very important for measuring right physics signals !!

Summary & Outlook

Summary

- Use of H.M. trigger allowed to enlarge data sample available for analysis by a factor of 10.
- We use CNT tracks to measure charged hadron spectra, but it has BG effects especially at high p_T because of decays and secondaries.
- Using 3 steps track cuts which are combination of Drift Chamber track with association to hits in SVX sublayers, DCA cut and PC3 track matching, high p_T BG is reduced for measured p_T spectra.

Outlook

- ☐ Nuclear modification factor R_{cp} and R_{AA} will be calculated with this BG reduction.
- ☐ To achieve this analysis goal, under relevant track cut conditions, it is necessary to verify different BG reduction cuts using full Geant Monte-Carlo detector simulations.

Nuclear modification factor "R_{cp}"

$$R_{cp} = \frac{\dfrac{1}{\langle N_{coll}^{cent}\rangle N_{eve}^{cent}} \dfrac{dN^{cent}}{dp_T}}{\dfrac{1}{\langle N_{coll}^{peri}\rangle N_{eve}^{peri}} \dfrac{dN^{peri}}{dp_T}}$$

"The ratio of spectra at Central event to Peripheral event"

- the yield in central ^{3}He + Au (N^{cent}) divided by the yield in peripheral ^{3}He + Au (N^{peri})
- normalized to the respective numbers of binary nucleon + nucleon collisions (N_{coll})
- normalized to the numbers of event (N_{eve})