Single Muon Measurement in PHENIX

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Single muon measurement for open charm

- **Measure charm production by D meson semi-leptonic decay, $D \rightarrow \mu \nu_\mu K$, in $\sqrt{s_{NN}} = 200\ \mathrm{GeV}$ d Au collisions.**

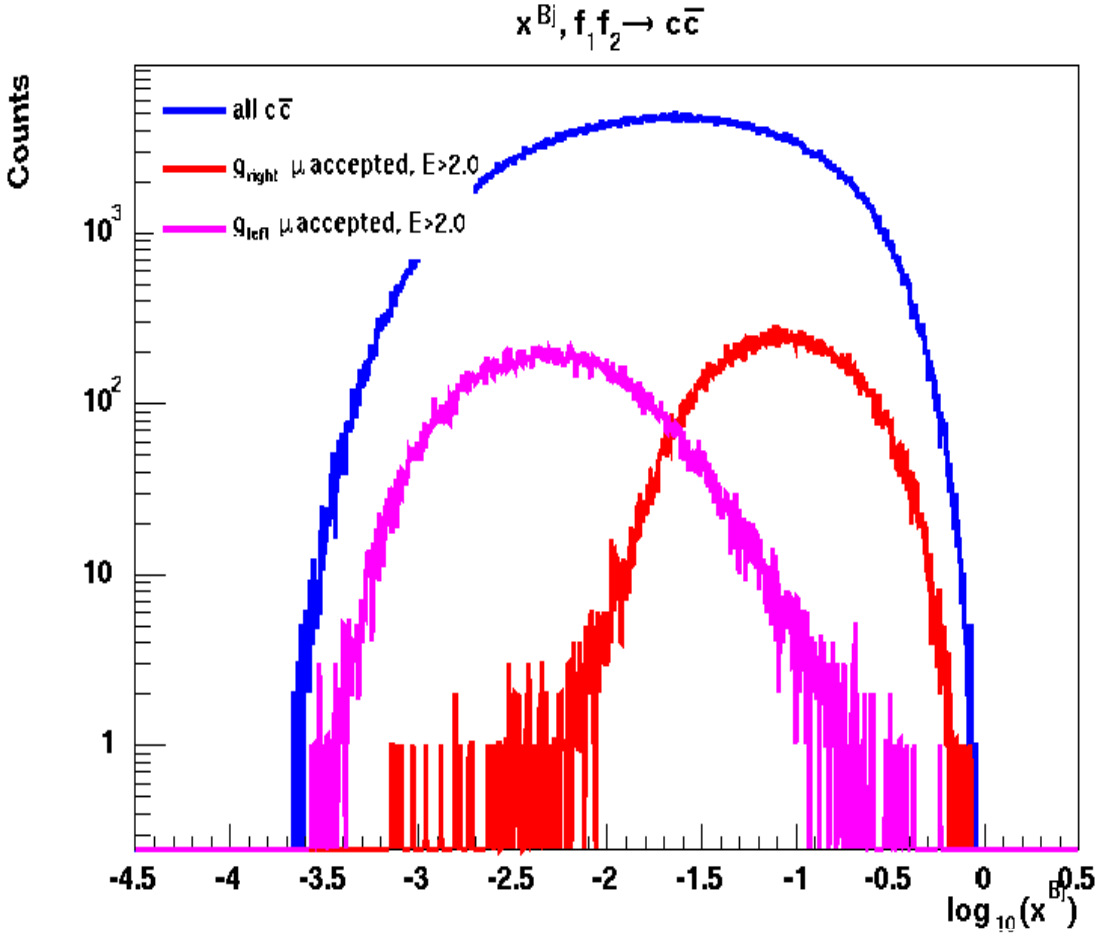
  *** Good normalization of J/ψ production.**
  *** An important probe of the early stage of heavy ion reactions.**
  *** Sensitive to the initial state gluon density in the nuclei, help us to invistigate varies interesting nuclear effects, such as shadowing, saturation.**

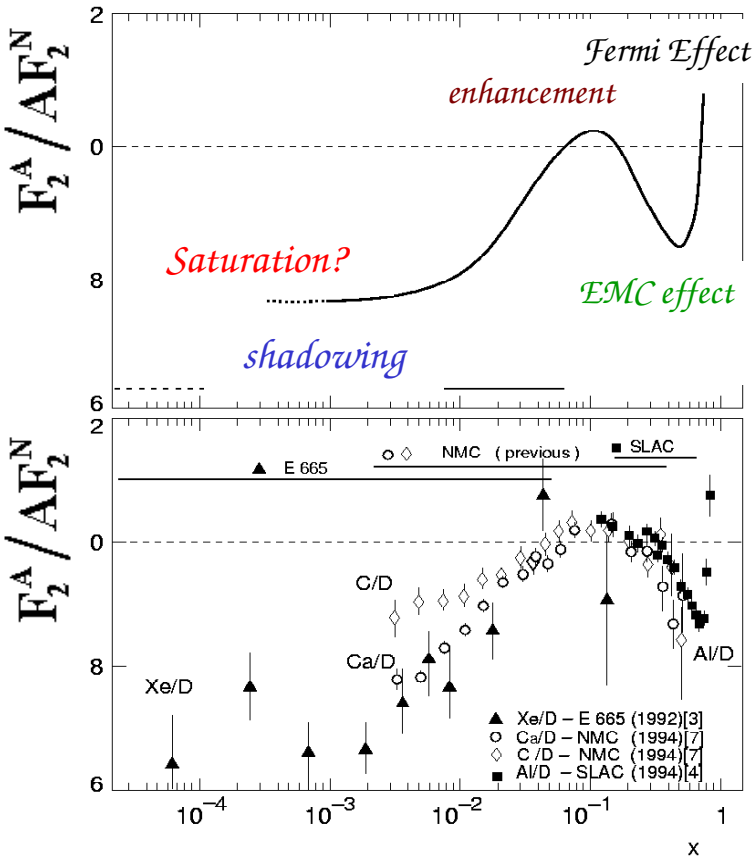
- **It is difficult to reconstruct D directly, instead we can measure inclusive single muon spectrum.**

- **Contributions to the single muon spectrum**
  a) Charm/Beauty decay.
  b) Pion and Kaon decays - most dominant contribution, especially in low p_T regime.
  c) Other light mesons, such as η, we believe their contributions are negligible.
  d) Drell-Yan di-muons and thermal muons.

We consider Pion/Kaon decay contribution as background

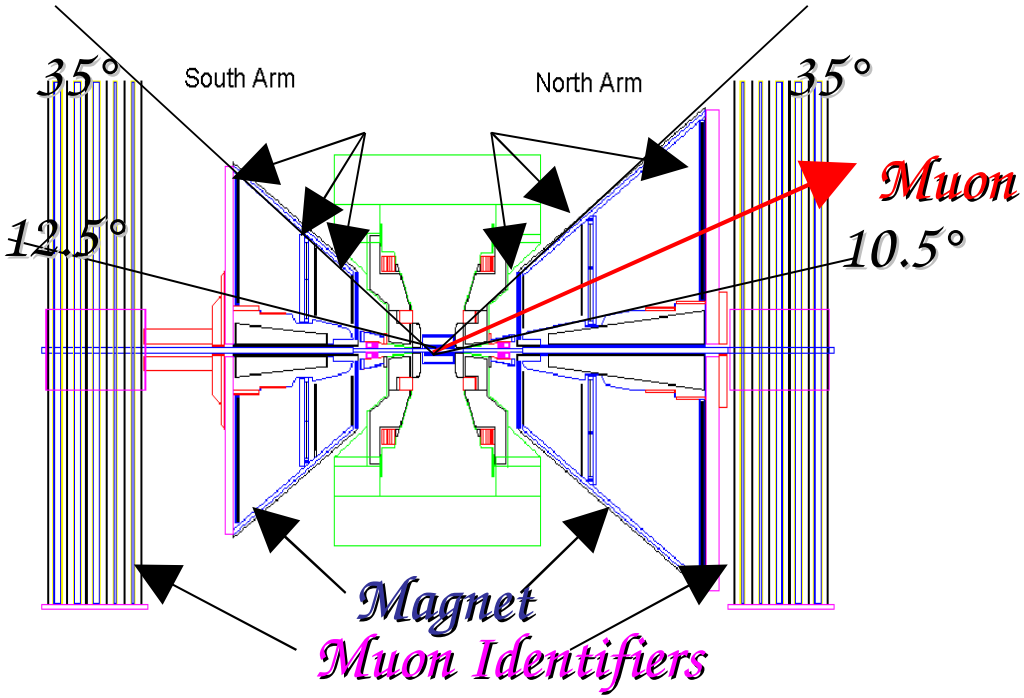
X_{bj} distribution





For open charm measurement, our muon arm covers a wide range of x_{bj}, especially in small x_{bj} range, where many interesting nuclear effects show up.

PHENIX Muon detectors

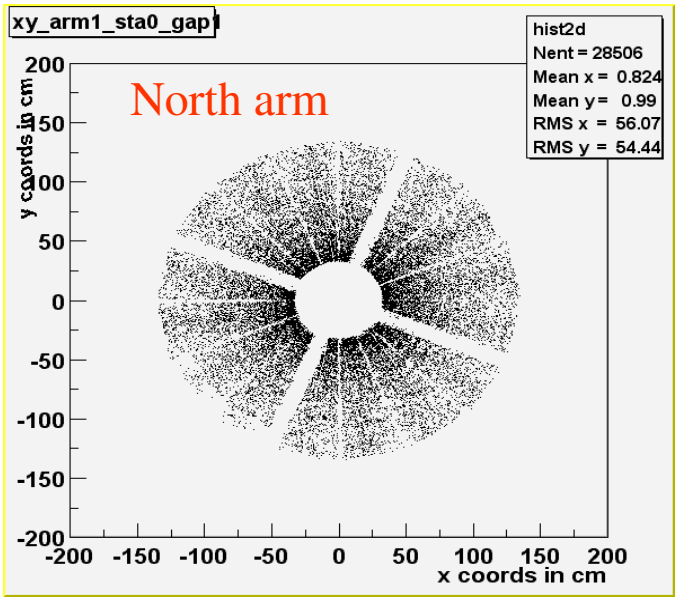


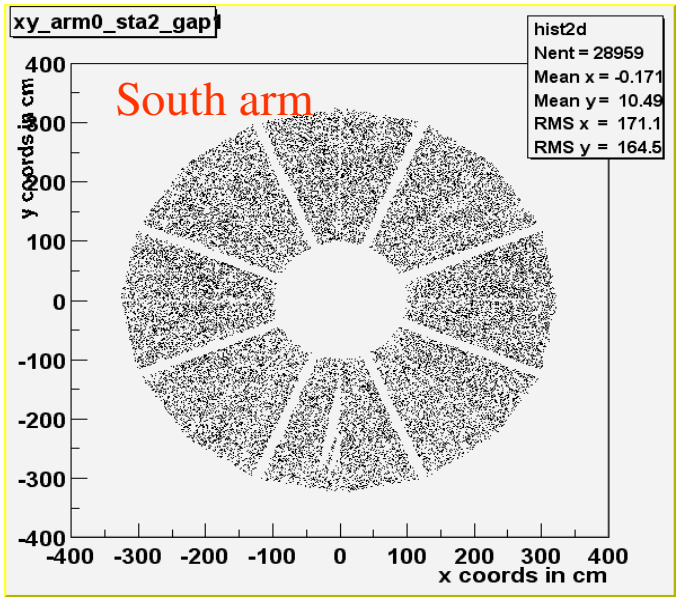
Two muon arms, each has a muon tracker detector and 5 muon identifier detectors.

Muon tracker measures the momentum of muon and muon identifier gives the identification of muon.

In order to reduce hadron hits in muon detector, PHENIX has put absorber before muon detector.

Detector performance





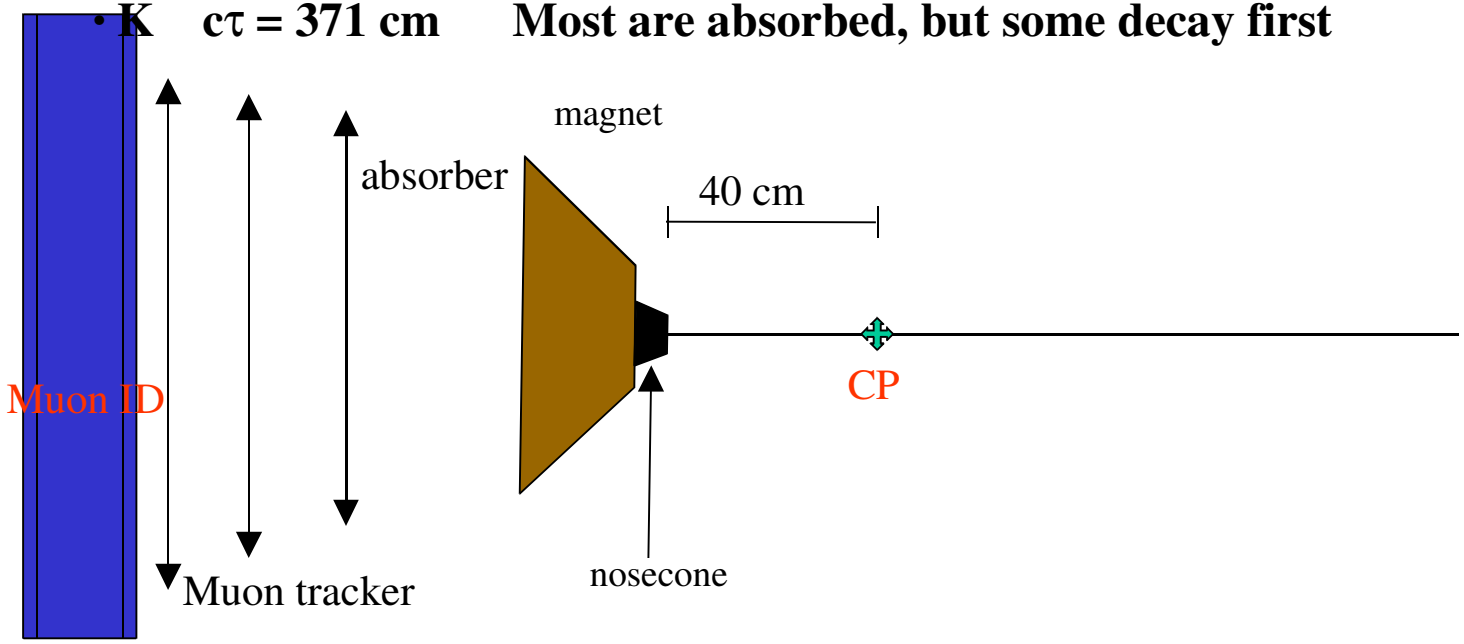
This year, both muon arms are in commissioning, the detectors has been running very stably.

We have a very good online monitoring system to monitor the performance, such as high voltage, dead strips.

Event vertex

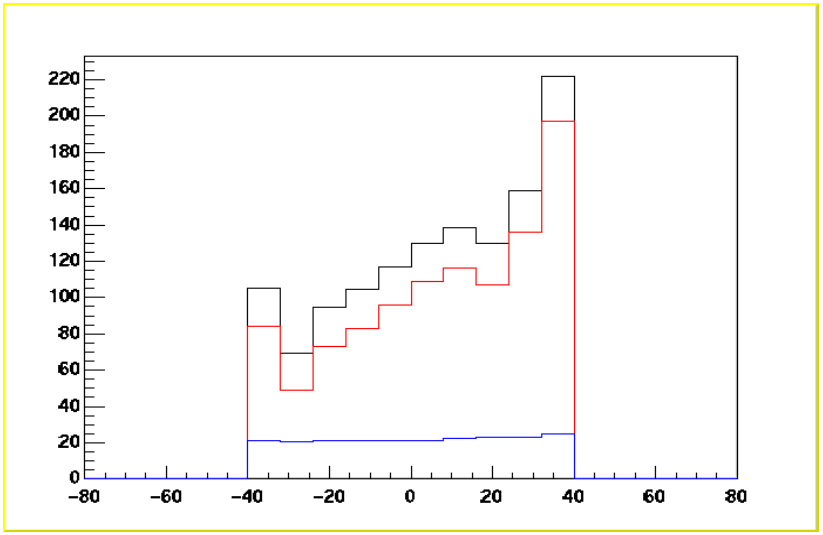
We want to separate the muon contribution from charm and π/K decays

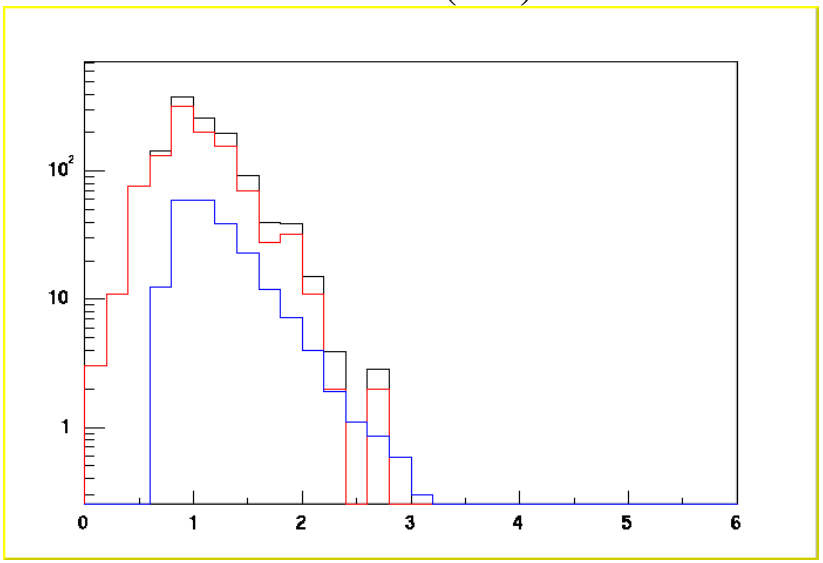
- **D $c\tau$ = 0.03 cm Decays before absorber**
- **π $c\tau$ = 780 cm Most are absorbed, but some decay first**
- **K $c\tau$ = 371 cm Most are absorbed, but some decay first**



Collisions occurring closer to the absorber will have fewer π/k contributions.

Simulation Study- summation of different contributions





• We can sum the two contributions together. In the summation, we weight each contribution by measured pion yield and measured charm production cross section.

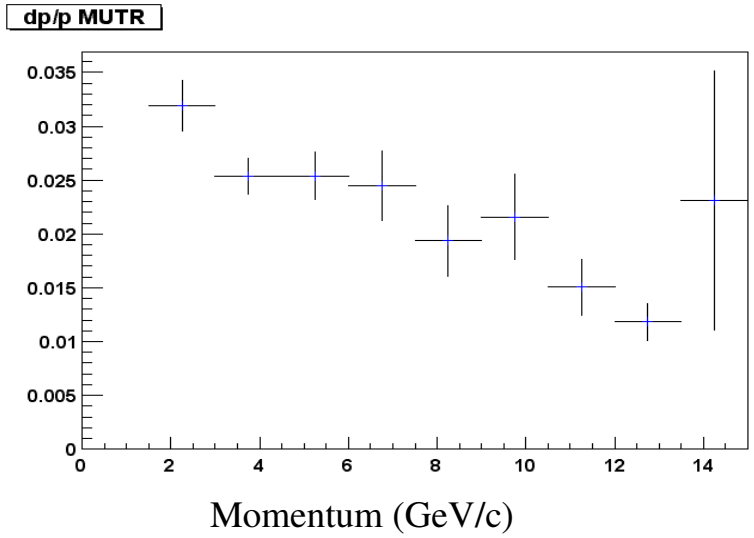
• Fit the combined event vertex distribution with a two-component function, a z dependent component and a z independent component, we can separate the two contributions.

Pions

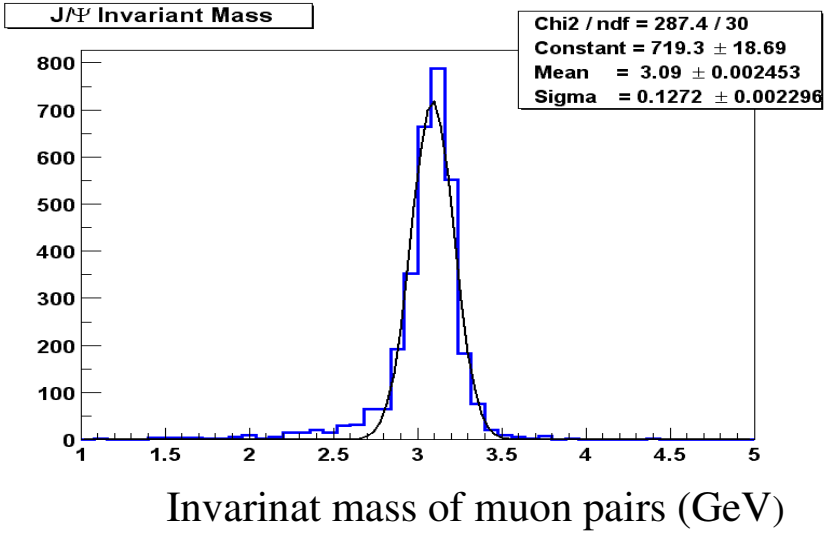
Sum

Charm

Tracking software simulation



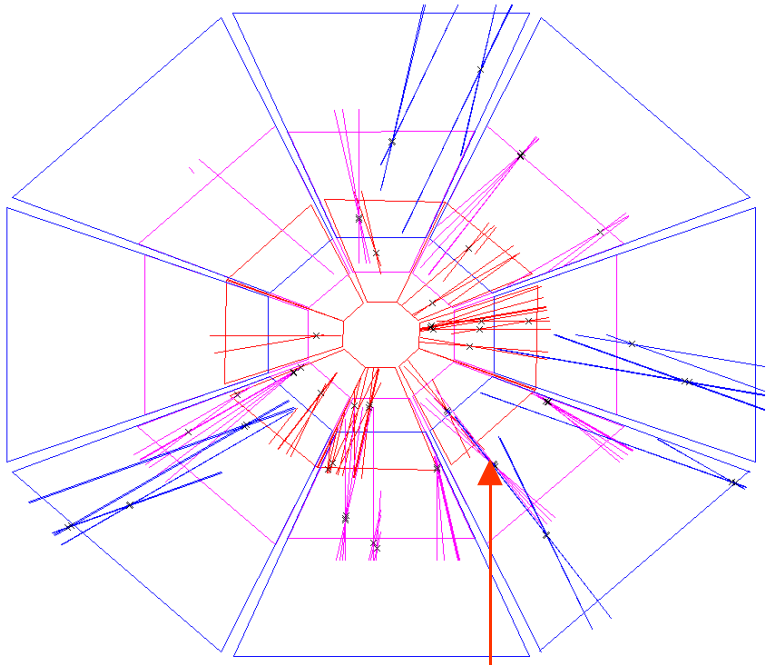
From simulation, our software achieved 3% momentum resolution and 130 MeV J/ψ mass resolution.



Single muon from PHENIX run3

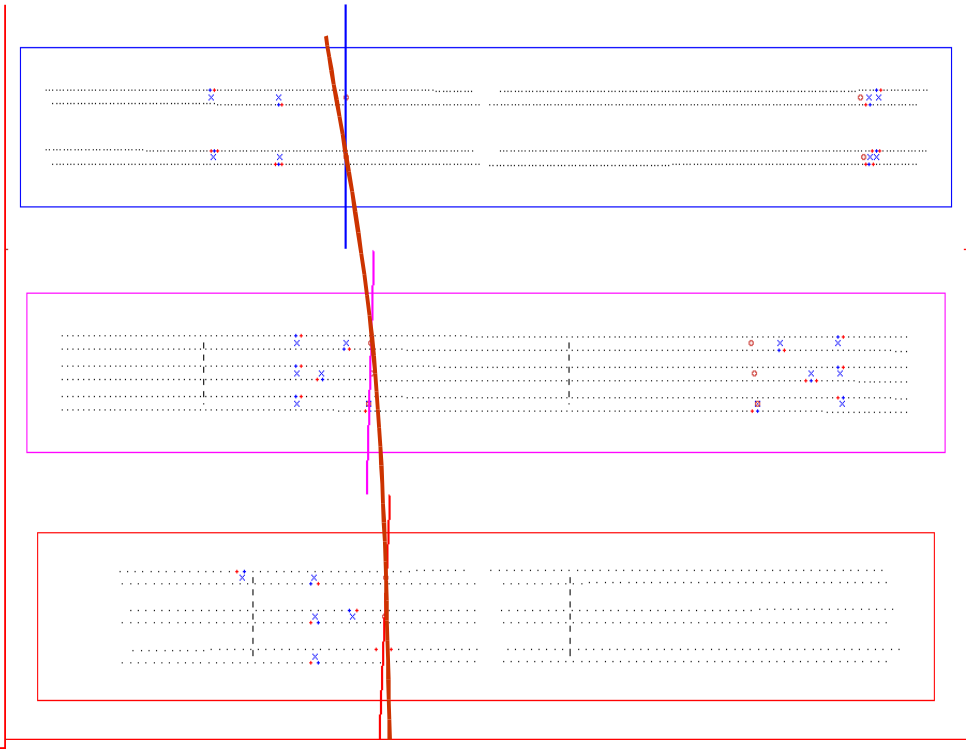
First look at data—event display

MUTR Octant View, Arm South, Event 61407



The track shows on right figure

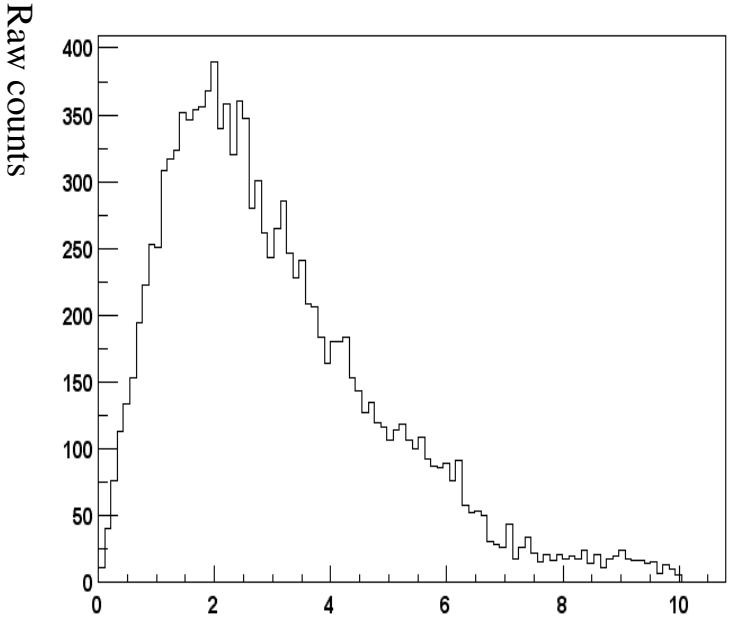
MUTR Plane View, Arm 0, Octant 7, Event 61407



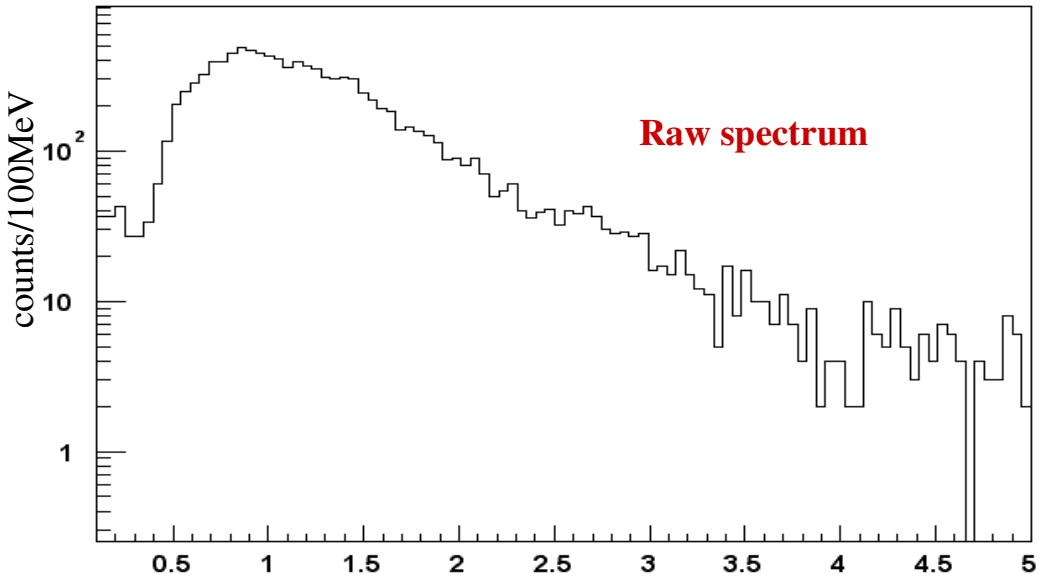
1. Look for track lets in each station.
2. Extrapolate station 3 track lets to station2, look for track lets in the search window. Associate them.
3. Extrapolate to station2.
4. Connected all associated track lets as whole tracks, fit them.

Single muon from PHENIX run3

First look at data—raw spectrum



chi square per freedom distribution of track fitting



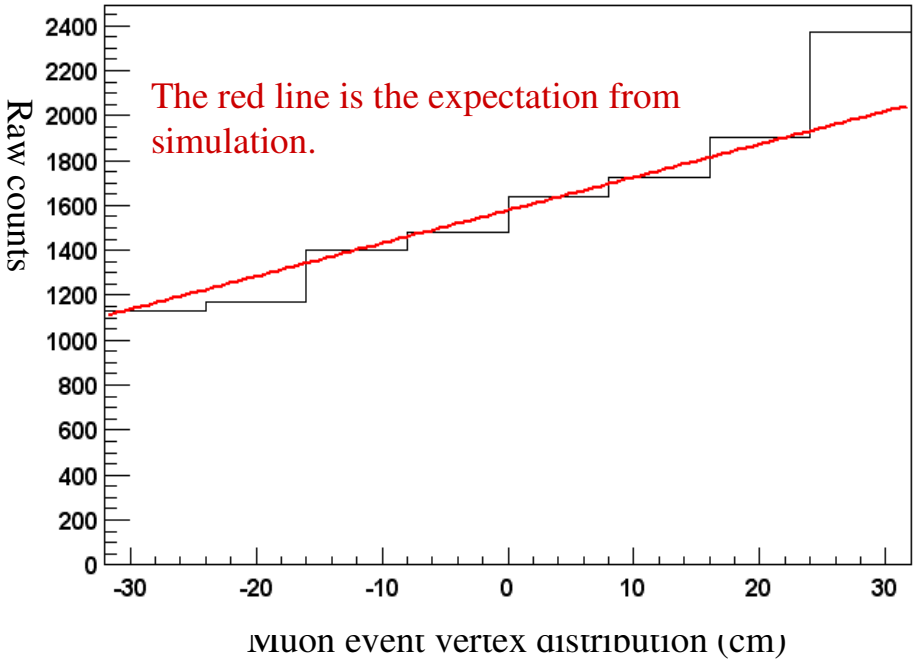
transverse momentum (GeV/c)

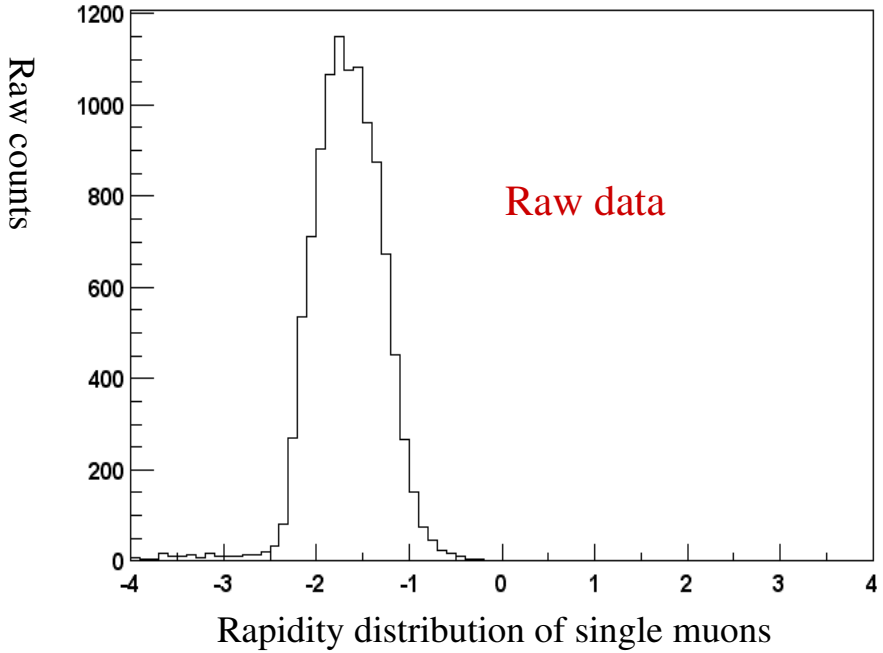
Tracks are selected by requiring

- **Associated with roads in Muon Identifier.**
- **Chi square is less than 6.**
- **Ghost rejected.**
- **At least 10 hits in Muon Tracker**.

Single muon from PHENIX run3

First look at data—vertex





Muon events are selected by requiring at least one fully reconstructed muon track in the events, and the distribution is normalized by minimal bias event vertex distribution.

Summary

- PHENIX muon detectors worked well during run3 data taking.
- Single Muon from charm decay contribution can be extracted from background by using event vertex method, as we saw from simulation and real data.
- Tracking software is in progress. Expect real physics result in near future.