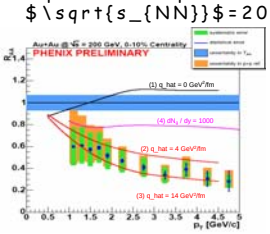
Measurement of single muons in Cu+Cu collisions with the PHENIX experiment at RHIC

ABSTRACT

DongJo Kim, Yonsei University for the PHENIX collaboration

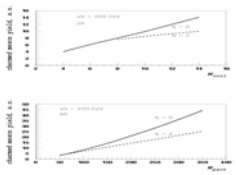
Quark Matter 2005, Aug4-9 Budapest Hungary

The measurement of open charm production in various collision species and energies is important to study the properties of matter formed in the early stage of relativistic heavy ion collisions, most interestingly to understand charm energy loss and recombination model systematically. The RHIC facility provided Cu-Cu collisions at both high and low energy in 2005. This lighter colliding system compared with Au-Au may give the much better precision on the centrality measurement in the lower Npart region and the comparison between two different colliding energies may give us more systematic understanding of the charm production. PHENIX detectors measure muons in the rapidity range $1.2 < | \eta | < 2.4$, thus enabling us to study open charm as well as light meson production at forward rapidity. The status of single muon measurement, regarding the centrality, transverse momentum and rapidity dependence of open charm and light meson production, in Cu+Cu collisions at $\sqrt{s_{NN}}$=200 GeV and 62.4GeV will be presented.



Theory curves (1-3) from N. Armesto, *et al.*, hep-ph/0501225
(4) from M. Djordjevic, M. Gyulassy, S.Wicks, Phys. Rev. Lett. 94, 112301

At Mid-Rapidity (**Non-photonic electron**) in AuAu central collisions;
see PHENIX Sergey Butsyk's Talk
➔What about forward rapidity ?
➔Smaller collision system ?
Stage is set, now Looking forward to seeing ?



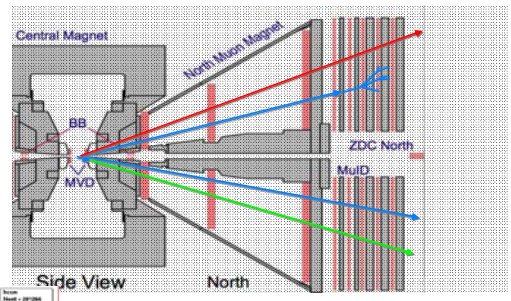
→ Ming X. Liu
Xiaorong Wang's poster

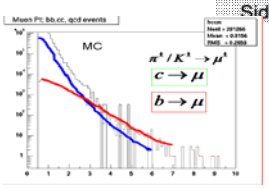
D. Kharzeev & K. Tuchin
hep-ph/0310358

THE PHENIX MUON SPECTROMETER

The muon arms covered rapidities 1.2 < |η| < 2.4

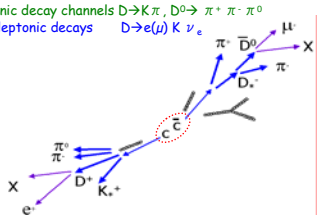
Candidate Tracks:
Prompt Muons
Punch-through hadrons
Stopped hadrons
Decay muons





• Experimentally observe the decay products of Heavy Flavor particles (e.g. D-mesons)

• Hadronic decay channels $D \to K\pi$, $D^0 \to \pi^+ \pi^- \pi^0$
• Semi-leptonic decays $D \to e(\mu) K \nu_e$



Origins of muons
PYTHIA p+p @ √s=200GeV
low PT:
light hadron decays
high PT:
Heavy quark decays

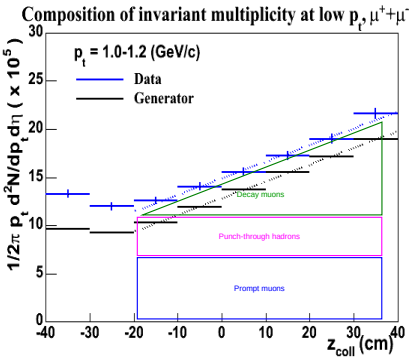
$BR(c \to \mu^+ + X) = 10\%$
$BR(b \to \mu^+ + X) = 10\%$
$BR(\pi^+ \to \mu^+ + \nu_\mu) = 99.99\%$
$BR(K^+ \to \mu^+ + \nu_\mu) = 63\%$

Signal and Background Extraction

Identification of muons from hadronic decay

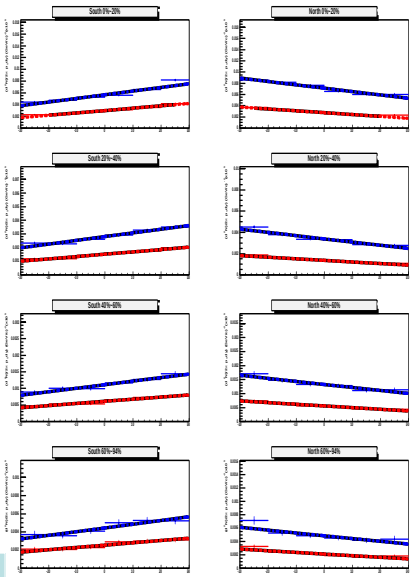
Since muons from hadronic decays exhibit a characteristic linear vertex dependence, this component can be separated from the "flat" vertex dependent component of prompt muons and punch-through hadrons. Estimation of the punch-through component then allows the determination of the prompt muon signal.

Decay muon vertex distributions

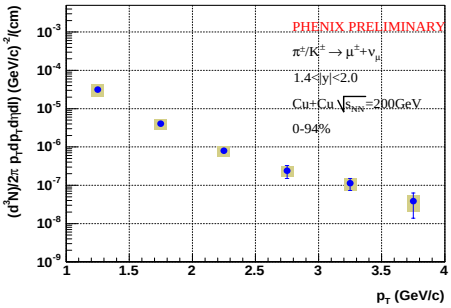


$$\frac{1}{N^{MB}_{measured}(Z)} \frac{d^3N(Z,\eta,P_T^{\mu^\pm})}{dZ dP_T^{\mu^\pm} d\eta} \approx \{\alpha(P_T,\overline{\eta})\cdot(Z - Z^0_{eff}) + \beta(P_T,\overline{\eta})\}$$

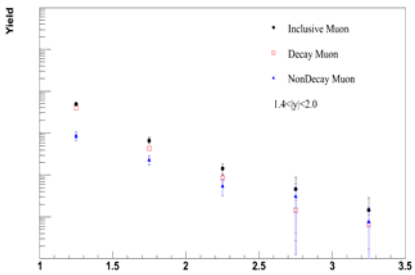
Signal Extraction : Centrality dependency



MinBias pT spectra



Prompt Muon signal extraction is underway

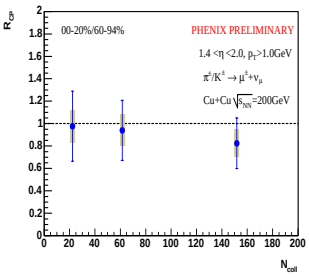


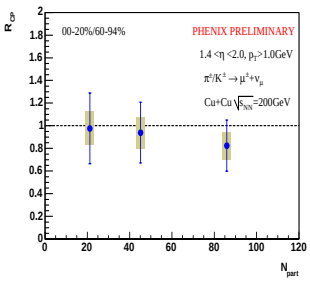
RESULTS

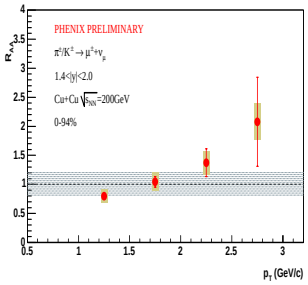
$$R_{CP}(P_T,\eta) = \frac{\dfrac{d^2\sigma_\mu^{central}(P_T,\eta)}{2\pi P_T dP_T d\eta}}{\dfrac{d^2\sigma_\mu^{peripheral}(P_T,\eta)}{2\pi P_T dP_T d\eta}}$$

$$R_{AA} = \frac{\left(\dfrac{d^3N}{dp^3}\right)_{AA}}{T_{AA}\cdot\left(\dfrac{d^3\sigma}{dp^3}\right)_{pp}}$$

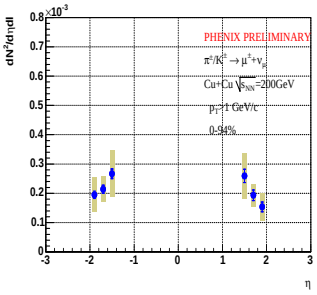
Centrality dependency







Rapidity dependency



Summary

- PHENIX measured Light mesons in forward rapidity 1.4<y<2.0 in Cu-Cu collisions at Sqrt(s)=200GeV and Nuclear modification factor has been studied in Minimum Bias collisions, shows similar trend shown in mid-rapidity (modest suppression in low pT, enhancement in higher pT).
- Rapidity dependency has been studied and the modest gaussian shape is observed.
- Prompt muon extraction and low energy run(62.4GeV) analysis are underway.

Please see other PHENIX single muon physics talks and posters by the following authors:

Youngil Kwon *(talk)*
Ming X. Liu
Xiaorong Wang
MinKyung Lee
Irakli Garishvili
WooJin Park