XXIV QUARK MATTER
DARMSTADT 2014

Heavy-flavor muon production at forward rapidity in d+Au collision at sqrt(s_{NN})=200 GeV

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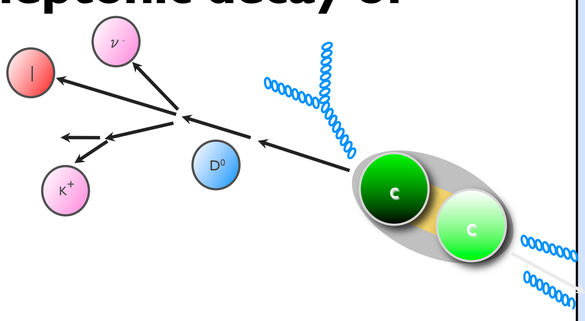
for the PHENIX collaboration

PHENIX

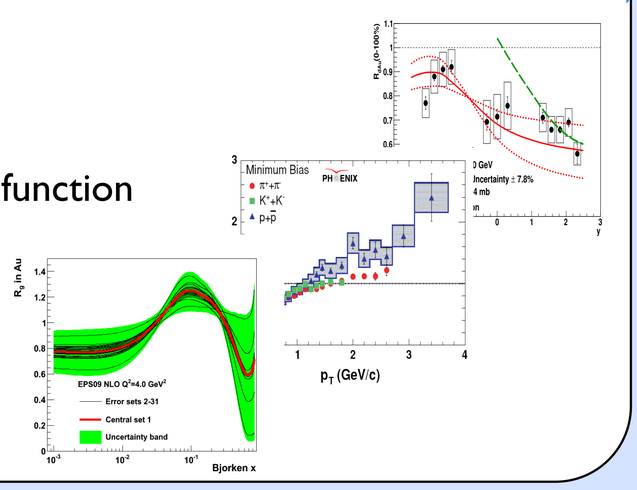
YONSEI UNIVERSITY

Motivation

Measuring muons from semi-leptonic decay of heavy-flavor mesons (D & B)



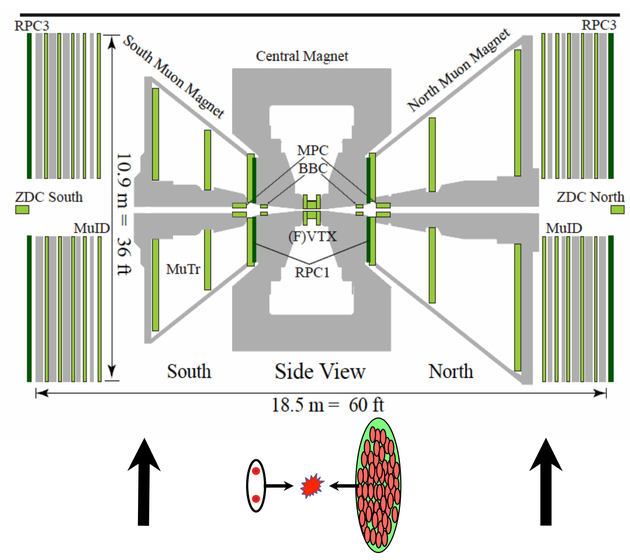
- **p+p collision**
  - reference for p+A and A+A collisions
  - test of pQCD calculation
- **d+Au collision**
  - study cold nuclear matter effects
  - comparison to heavy-ion results
- **CNM effects**
  - modification of parton distribution function
  - nuclear p_T broadening
  - initial-state energy loss
  - nuclear break-up of quarkonia



PHENIX muon spectroscopy

PHENIX muon arms are composed of the Muon Trackers and the Muon Identifiers to measure hadron/muon tracks at forward rapidity region

- **Muon Tracker**
  - 3 stations of cathode strip chambers
  - momentum measurement
- **Muon Identifier**
  - 5 interleaved layers of steel absorber and 2 larocci tube planes
  - hadron muon separation (~10^{-3} pion rejection rate)



South arm
Au-going side
$-2.2 < \eta < -1.2$

North arm
d-going side
$1.2 < \eta < 2.4$

Analysis overview

Source of tracks at muon arm

- **Prompt muon** - muons from semi-leptonic decay of heavy-flavor (D & B) mesons
- **Decay muon** - muons produced from the decay of light hadrons(π , K) before interaction with the absorber
  dominant background component at p_T below 3.0 GeV/c and shows clear linear z-vertex dependence of its production
- **Punch-through hadron** - hadrons surviving from nuclear interaction with the absorber and penetrating all MuID gaps
- **Stopped hadron** - hadrons stopped at the MuID Gap-2 or 3 due to interaction with absorber material
  important constraint for accurate background estimation by matching simulation to data

Background estimation

Estimation of light hadron spectra at muon arm rapidity range

↓

Generation of hadrons with realistic p_T and η distributions

↓

Full MC simulation using GEANT with modified nuclear cross sections & embedding into real data

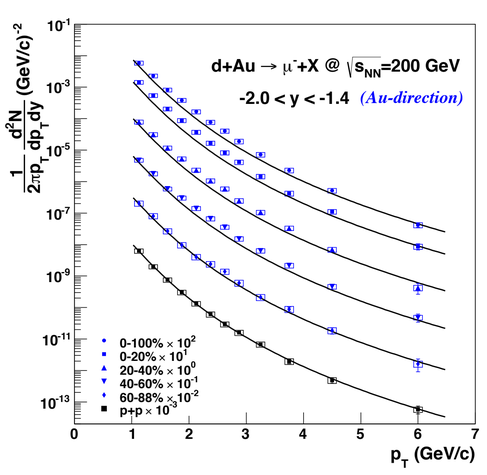
↓

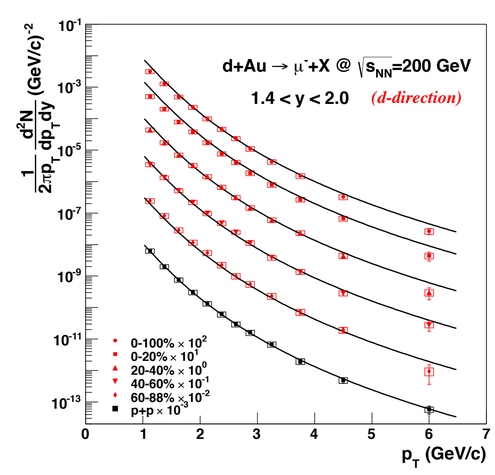
Matching MC to data at MuID Gap 2, 3 and 4 to adjust initial hadron production

↓

combining several versions of modified hadron cocktail simulation to determine the final background

Results



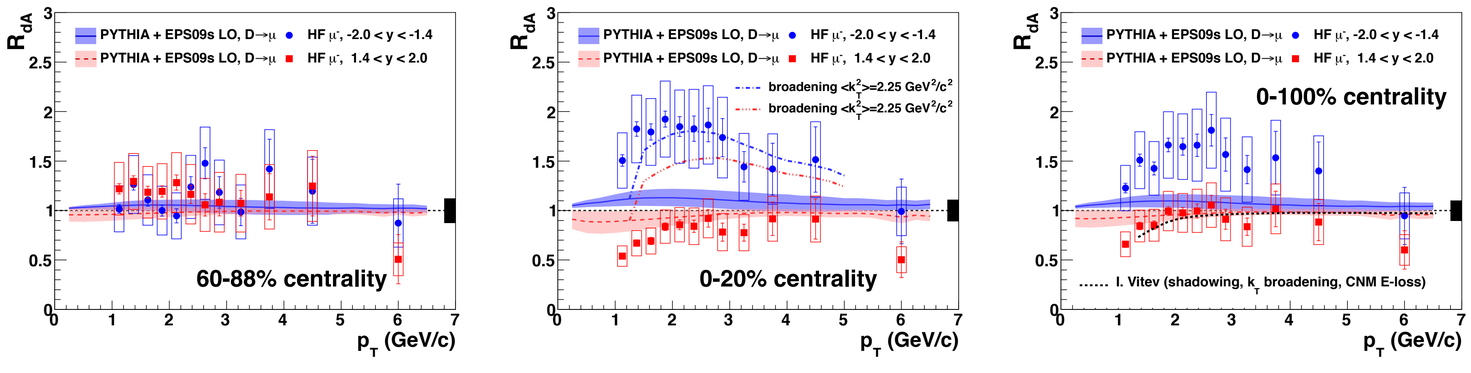


South arm (Au-going side)
$x_{Au} \sim 8 \times 10^{-2}$

North arm (d-going side)
$x_{Au} \sim 5 \times 10^{-3}$

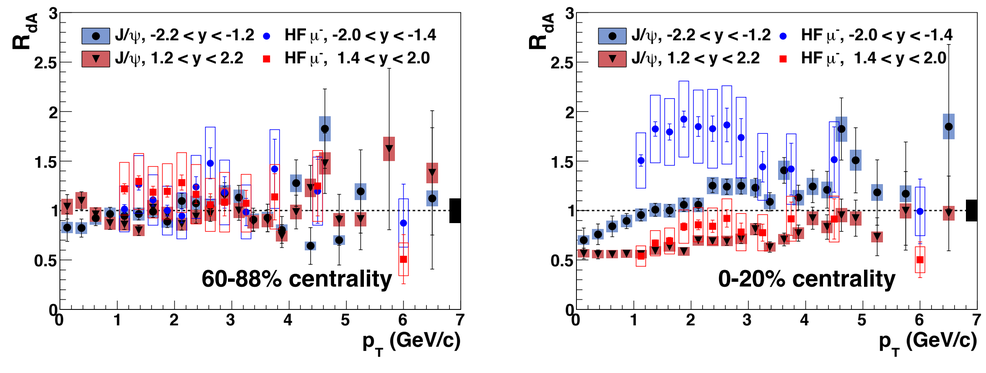
- **Invariant yield of heavy-flavor muons in p+p and different centrality ranges of d+Au collisions at forward and backward rapidity**
  - each line is a fit function to the p+p results scaled by <Ncoll>
  - the p+p results are consistent with previous PHENIX results (ref. : Phys. Rev. C 86, 024909)

Nuclear modification factor, $R_{dA}(p_T)$



- An **enhancement** (**suppression**) has been observed at **backward** (**forward**) rapidity region in most central d+Au collisions
- pQCD calculation considering shadowing, nuclear p_T broadening, and energy loss agrees well with the data at forward rapidity
- Theoretical approaches, PYTHIA + EPS09s nPDF parameterization and the same calculation including k_T broadening can not simultaneously describe the data at both rapidity regions from central d+Au collisions
  - possibility of the enhancement by final-state interaction at higher parton-density backward rapidity (ref. : Phys. Rev. Lett. 93, 082302)

Comparison to J/ψ



Comparison between J/ψ results (Phys. Rev. C 87, 034904) and heavy quark production provides an insight on role of nuclear break-up effect on quarkonia production

Difference is seen **only at backward rapidity region** in most central d+Au collisions
→ significant nuclear break-up by interacting with larger density of co-moving particles
(ref. for multiplicity in d+Au : Phys. Rev. Lett. 93, 082301)