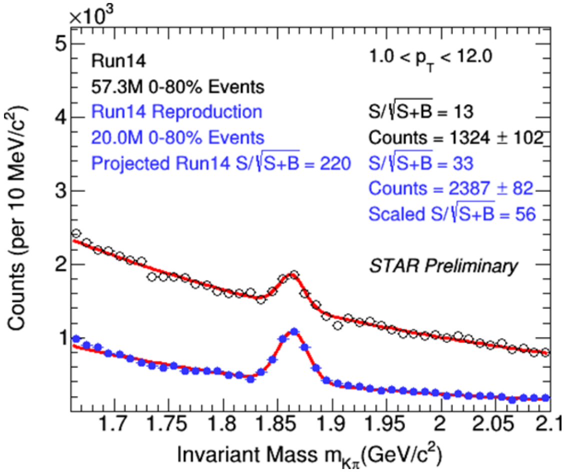
Open heavy flavor at RHIC



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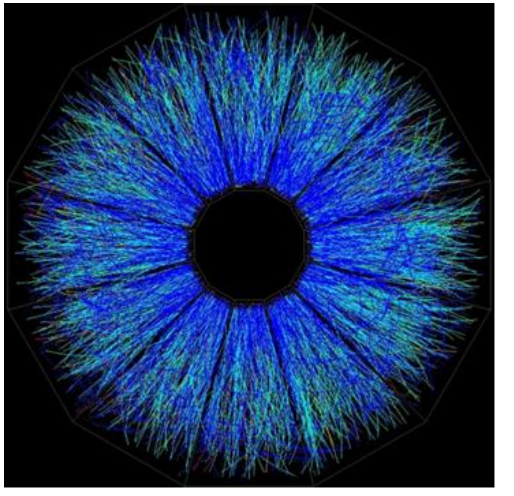

EMMI Rapid Reaction Task Force
Extraction of heavy-flavor transport coefficients in QCD matter

18 - 22 July 2016, GSI Darmstadt

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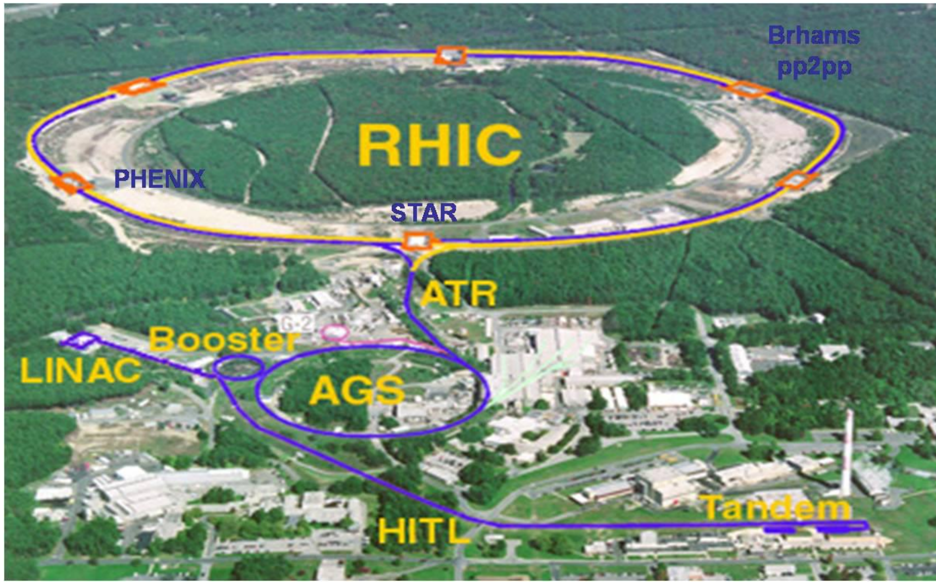
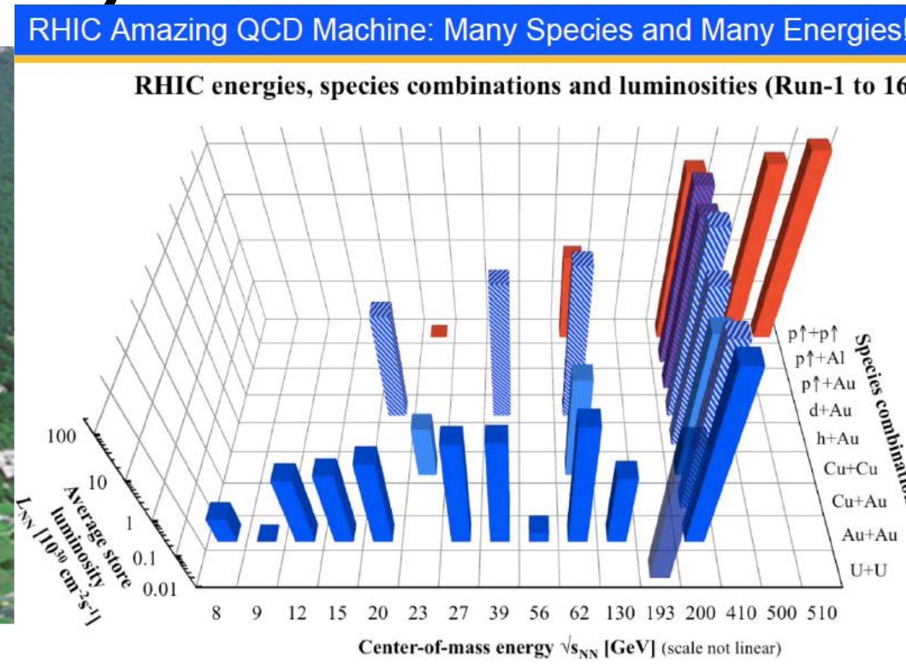
Relativistic Heavy-Ion Collider





- Extremely versatile: has collected data colliding a large array of different heavy ions
- Only polarized proton collider in the world

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Outline

- D mesons in p+p collisions
- d+Au NPE measurements
- D mesons with STAR HFT
- NPE in heavy ion at RHIC

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Heavy quarks – open questions

- **Colour charge** and quark mass **dependence of energy loss**

  Expectation $\mathbf{E_c < E_{u,d,s} < E_g}$ vs. observation $\mathbf{R_{AA}(D) \approx R_{AA}(\pi)}$

  Low p_T (<10 GeV/c): mass effect on energy loss + radial flow?

  At which p_T does R_{AA}(b) become compatible with R_{AA}(light)?

- **Energy loss** mechanism: **collisional** vs. **radiative**

  Path length dependence of energy loss (via v_2 at high p_T)

  Correlation measurements

- **Cold nuclear matter effects** in the initial and final state

  d+Au, system and energy scan

- **Collectivity and thermalization**

  charm v_2 and R_{AA} measurements at low p_T

- **Hadronization mechanism: coalescence vs. fragmentation**

  D_s, Λ_s measurements; v_2 and R_{AA} measurements at low pT

SaporeGravis network review Eur. Phys. J. C (2016) 76:107

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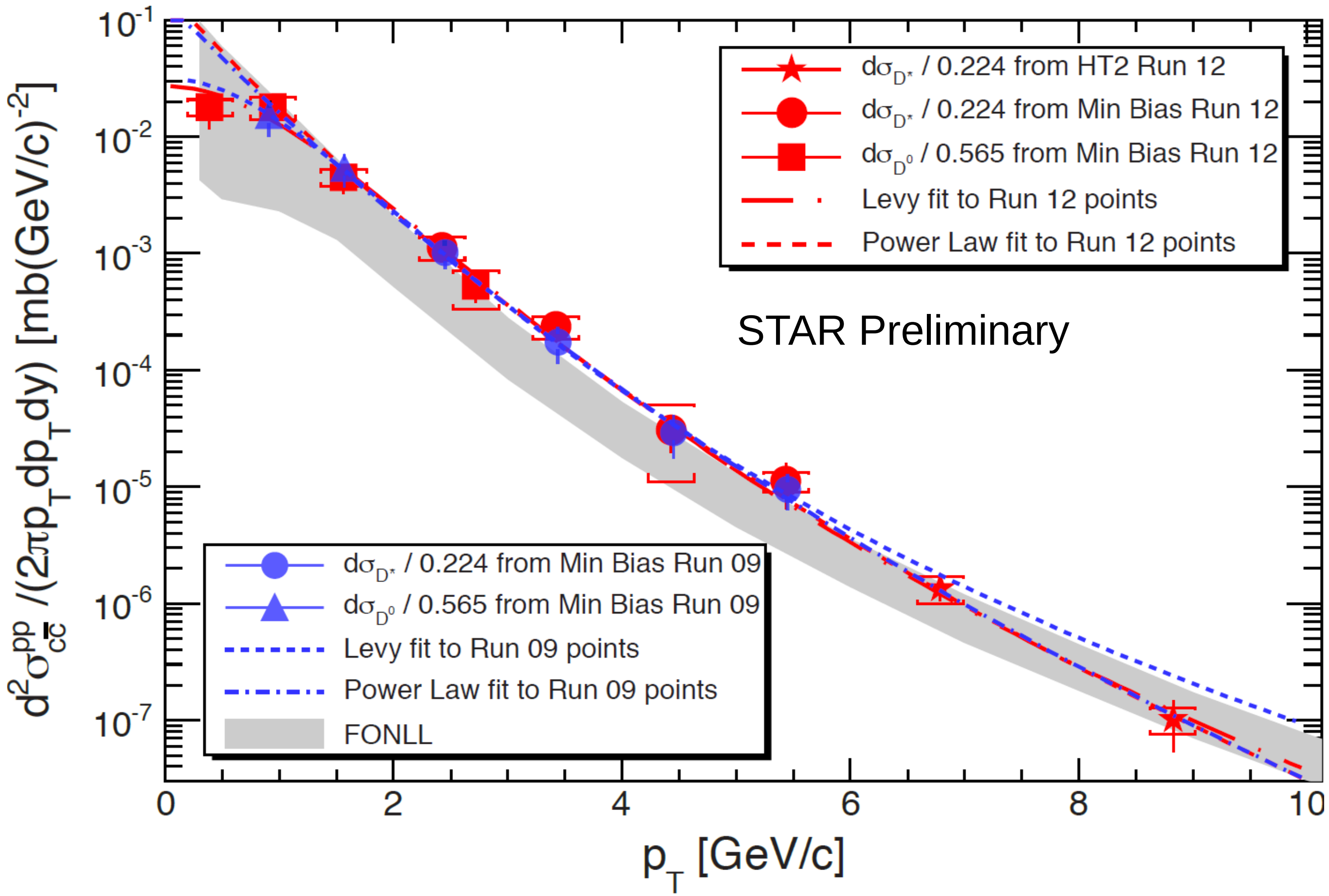
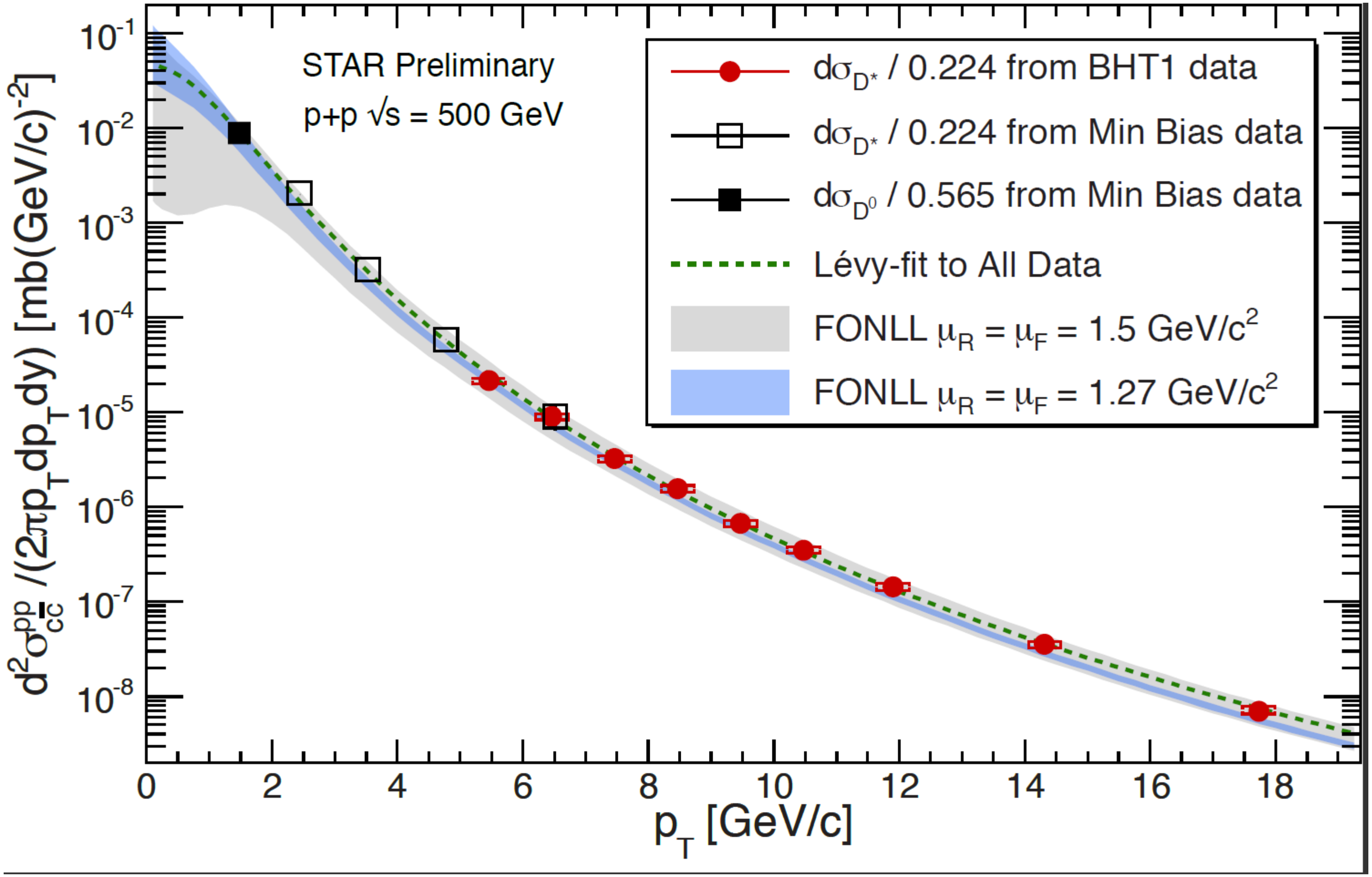
D^0 and D* p_T spectra in p+p 200 GeV collisions



- New measurement from Run 12 extents the range towards low-$p_{T.}$
- FONLL upper band is consistent with charm spectra.

FONLL: 200 GeV M. Cacciari, PRL 95 (2005) 122001
Run 09: Phys. Rev. D 86 (2012) 72013

D^0 and D* p_T spectra in p+p 500 GeV collisions



- D* measurement in p+p 500 GeV up to p_T ~ 18 GeV/c.
- FONLL is consistent with data.

FONLL: 500 GeV R.Vogt priv. comm., |y| < 1
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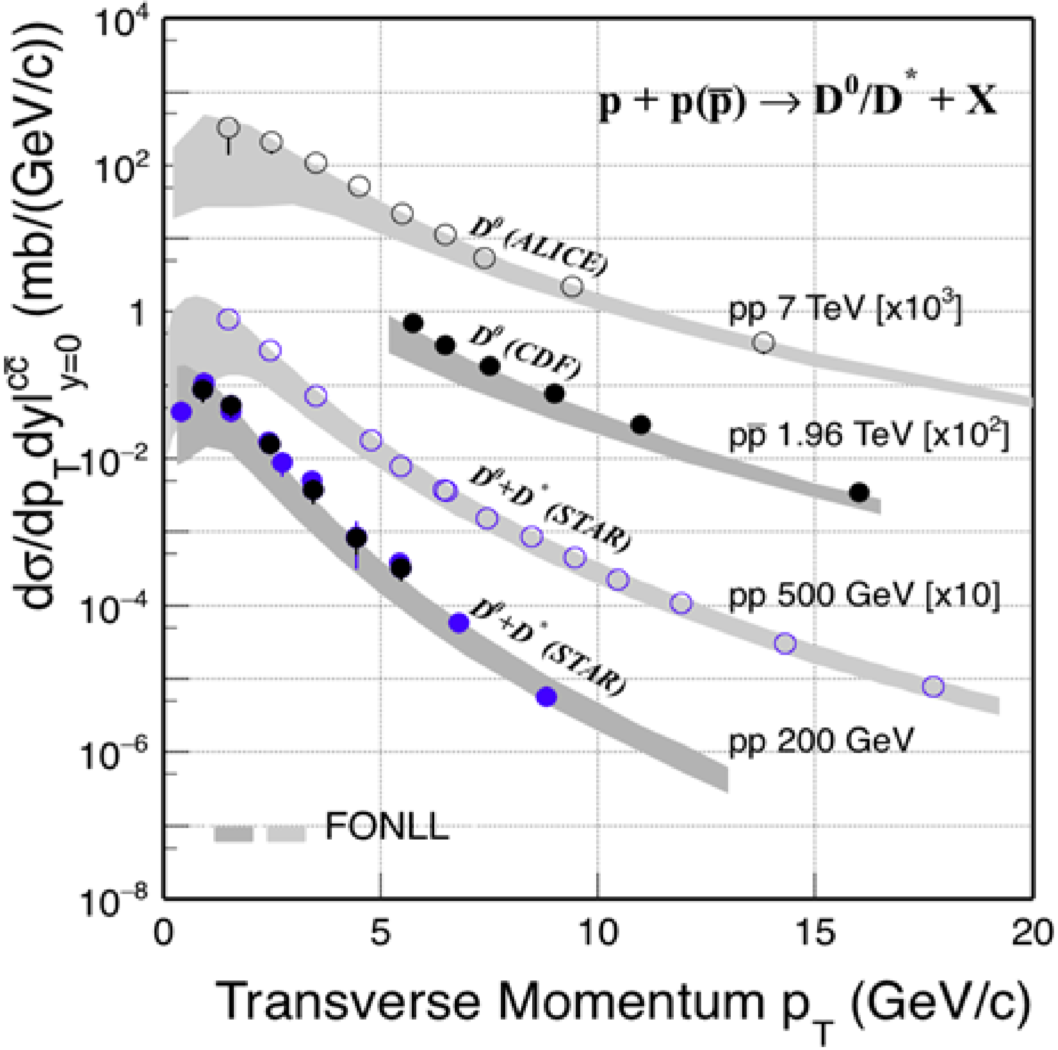
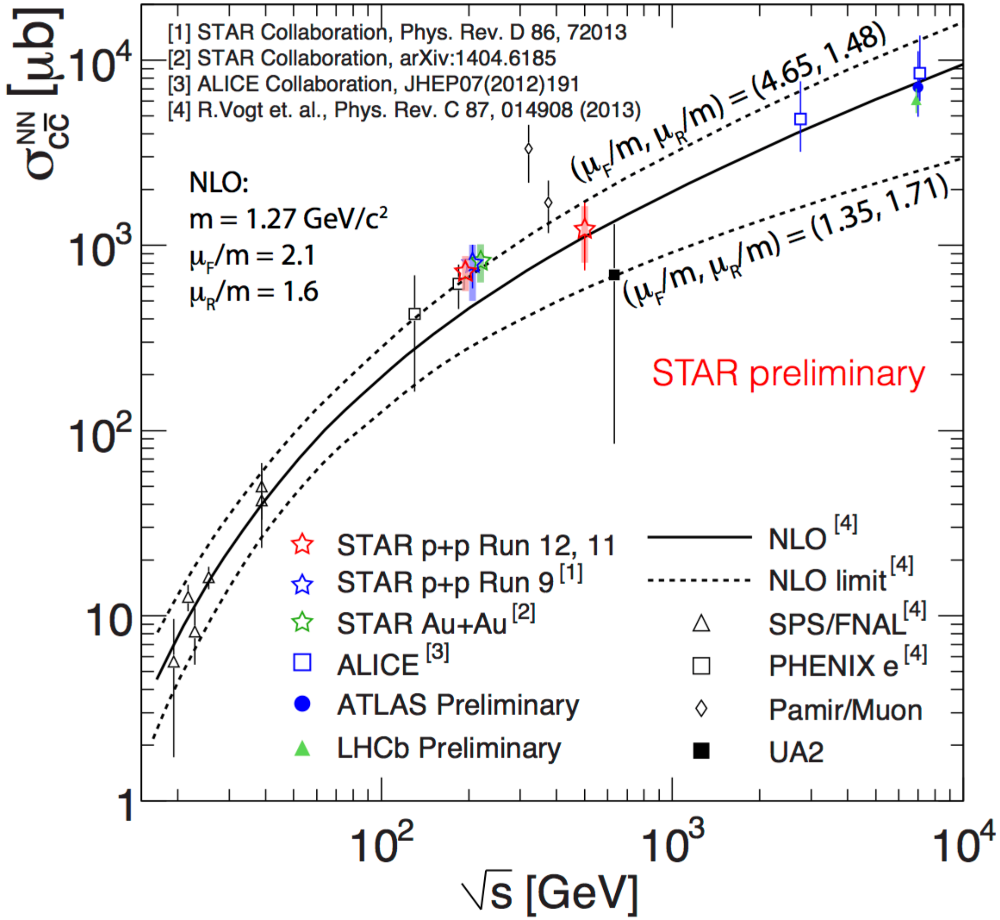


STAR: PRD 86 (2012) 072013, NPA 931 (2014) 520
CDF: PRL 91 (2003) 241804; ALICE: JHEP01 (2012) 128
FONLL: PRL 95 (2005) 122001

Total inclusive charm cross-section



- STAR 200GeV and 500 GeV data points are in world data trend.
- NLO pQCD calculations reproduce the data well.

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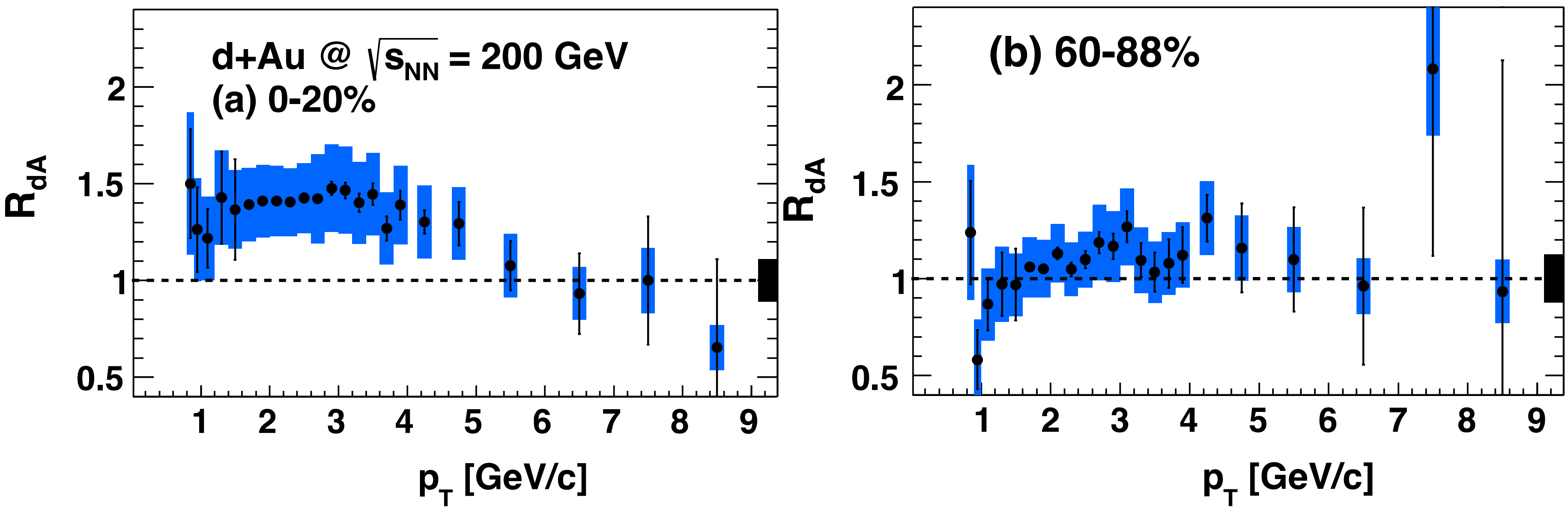
Cold nuclear matter@dAu 200GeV

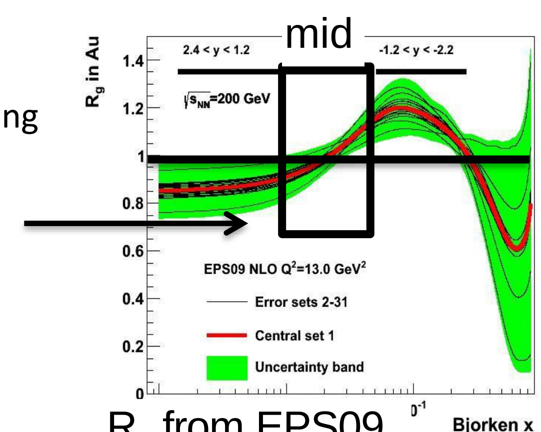
- Non-photonic electrons at midrapidity (PHENIX)



Central - Enhancement at intermediate p_T

Peripheral - Consistent with scaled p+p results

Shadowing/Anti-Shadowing Transition

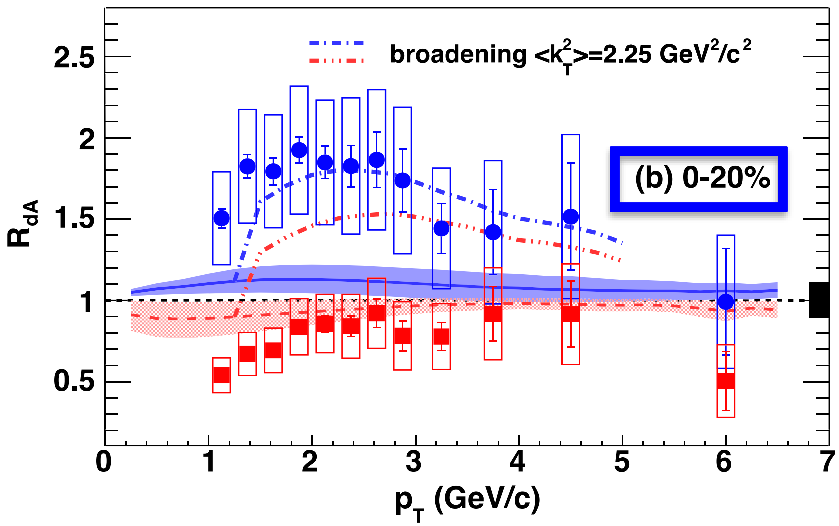


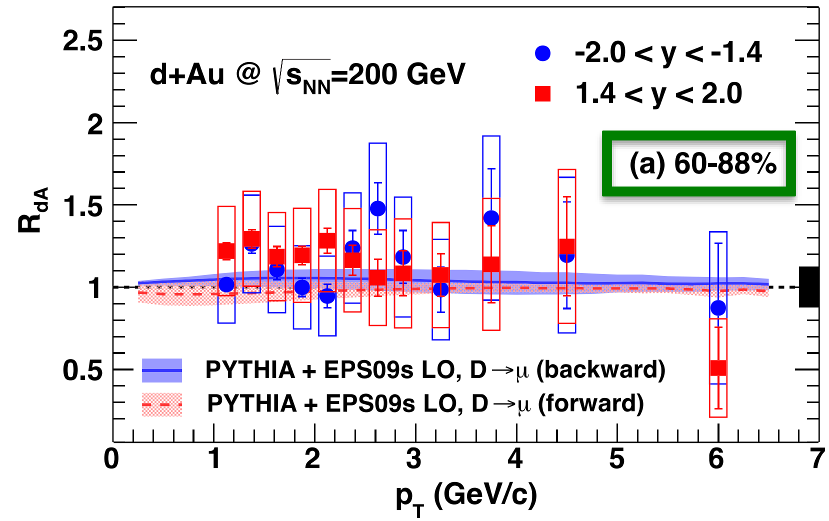
R_g from EPS09

PHENIX Phys. Rev. Lett. 109, 242301 (2012)

Muons at Forward/Backward Rapidity@PHENIX

PHENIX Phys. Rev. Lett. 112, 252301 (2014)





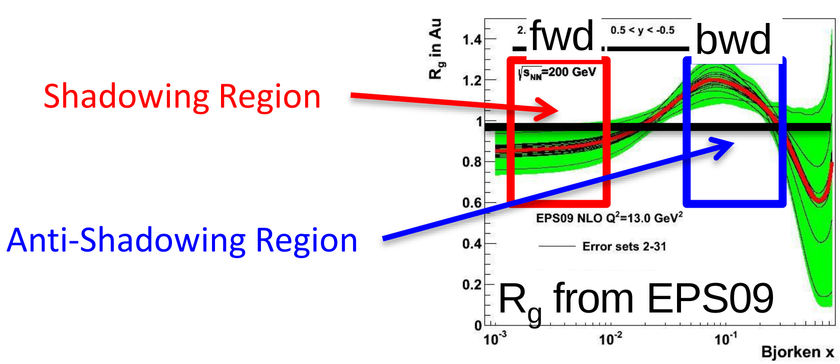
Central:

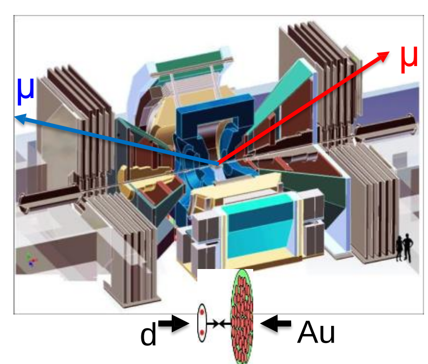
Suppression at forward rapidity

Enhancement at backward rapidity

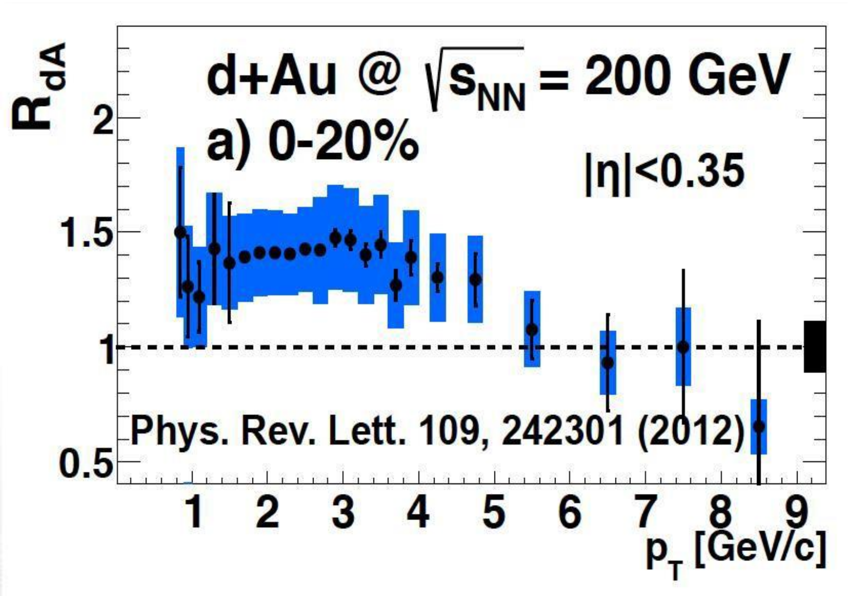
Peripheral:

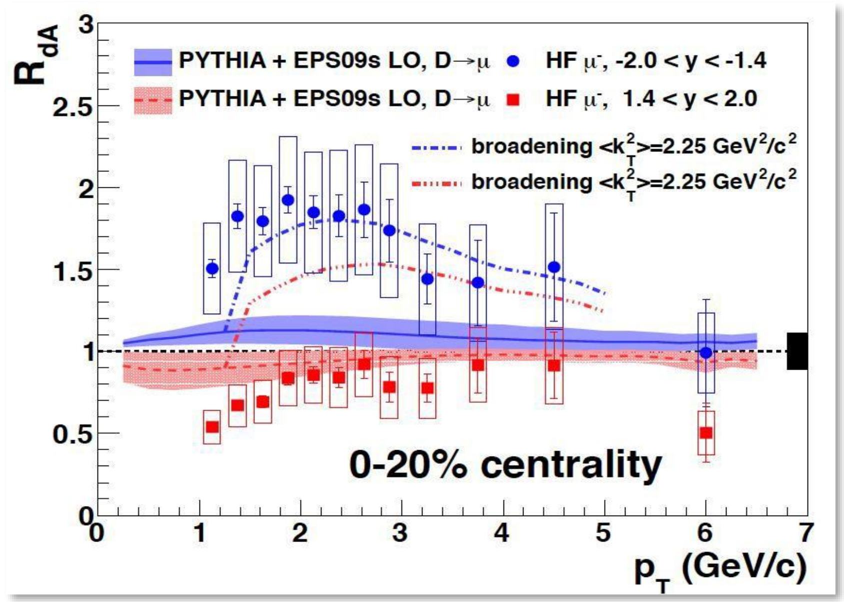
Consistent with scaled p+p results





R_{dAu}@PHENIX





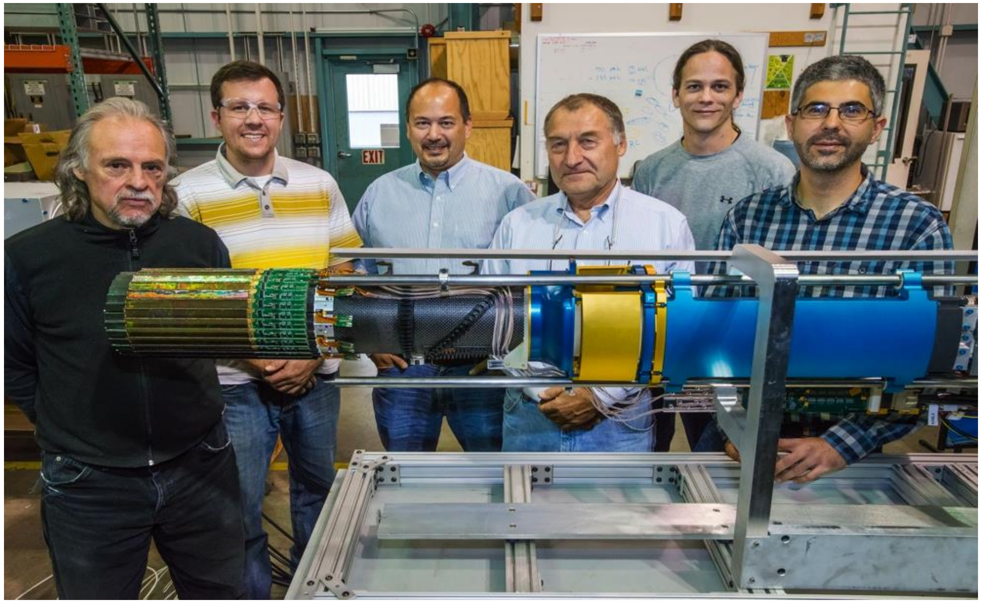
- Initial-state effects fail to reproduce the data at both rapidity simultaneously
  - Modification of nPDF
  - Initial k_T broadening

- Cronin enhancement?
  - Initial k_T component due to multiple scattering of incoming partons

Phys. Rev. C. 88, 024906 (2013)

STAR Heavy Flavor Tracker (HFT)

TPC – Time Projection Chamber
(main tracking detector in STAR)

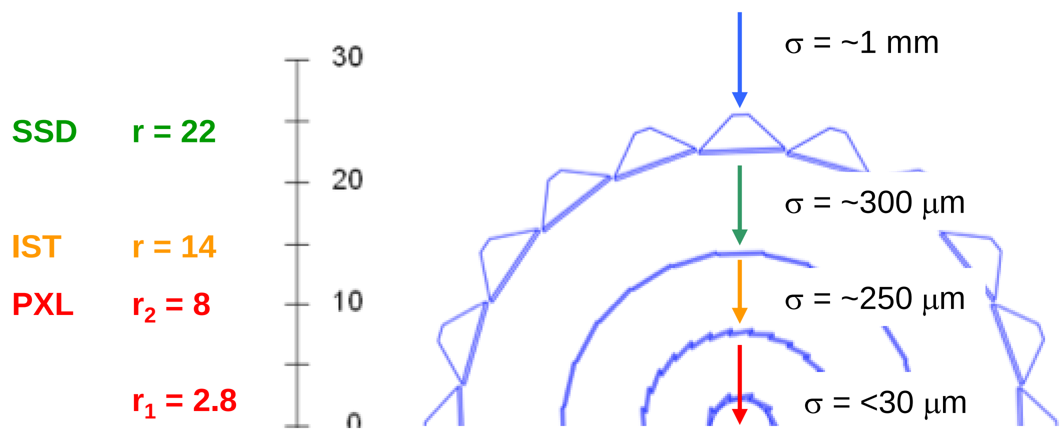


HFT – Heavy Flavor Tracker

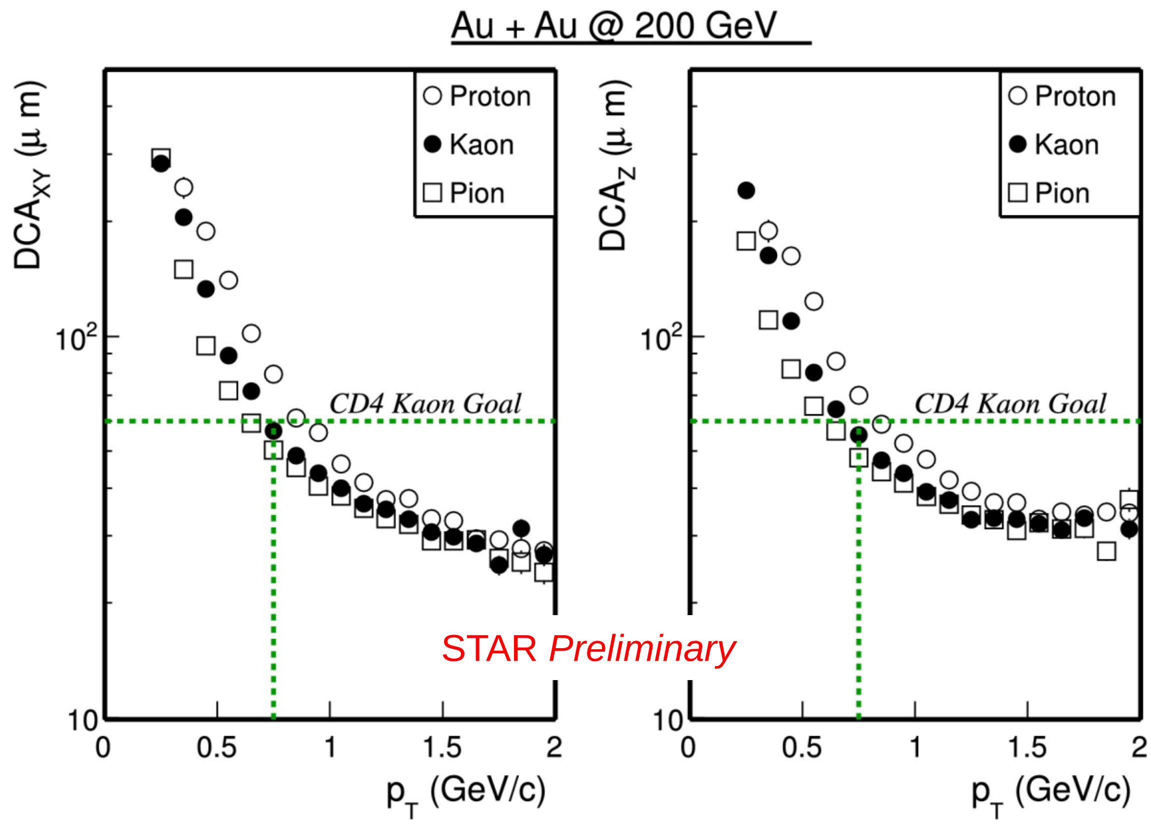
- SSD – Silicon Strip Detector
- IST – Intermediate Silicon Tracker
- PXL – Pixel Detector (356M pixels on ~0.16 m^2 of silicon)

Acceptance coverage:
$-1 < \eta < 1$
$0 < \phi < 2\pi$

STAR+HFT collected MB events		
Run14	Au+Au	1.2B
Run15	p+p	1B
	p+Au	0.6B
Run 16	Au+Au	2B



HFT Performance vs. design goals



- Kaon track pointing resolution exceeds the requirement < 55 μm at p_T=750 MeV/c
- Pointing resolution in the region with Al-cables ~ 45 μm

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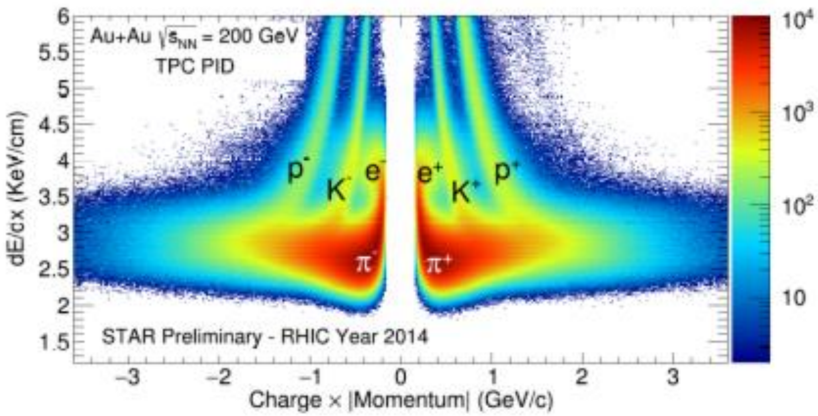
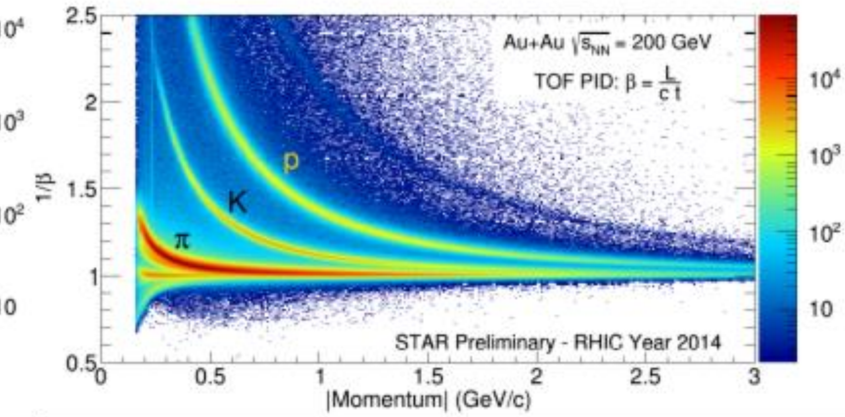
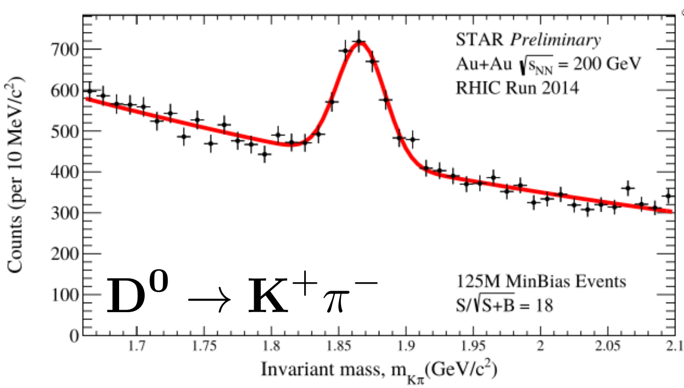
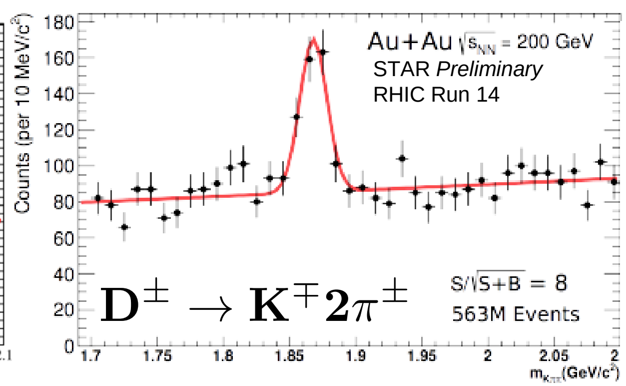
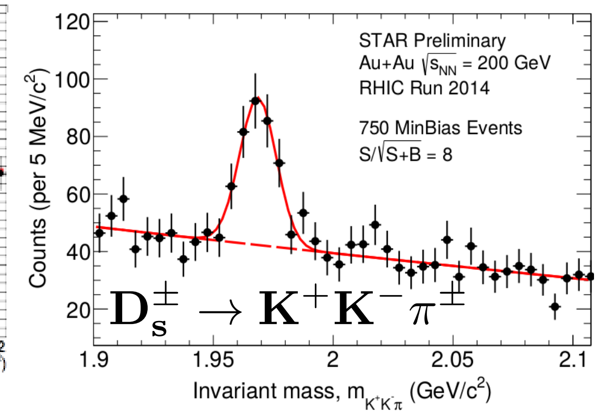
D mesons with HFT











- Excellent long-lived hadron and electron identification
- Secondary vertex reconstruction with HFT → full kinematic reconstruction of charmed hadron

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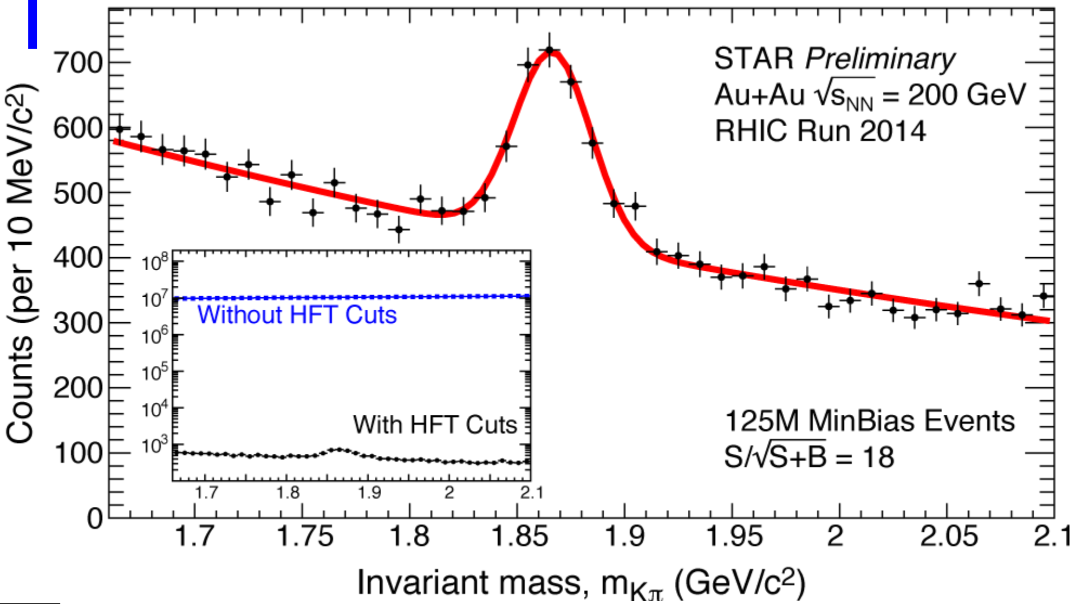
Topological reconstruction with HFT

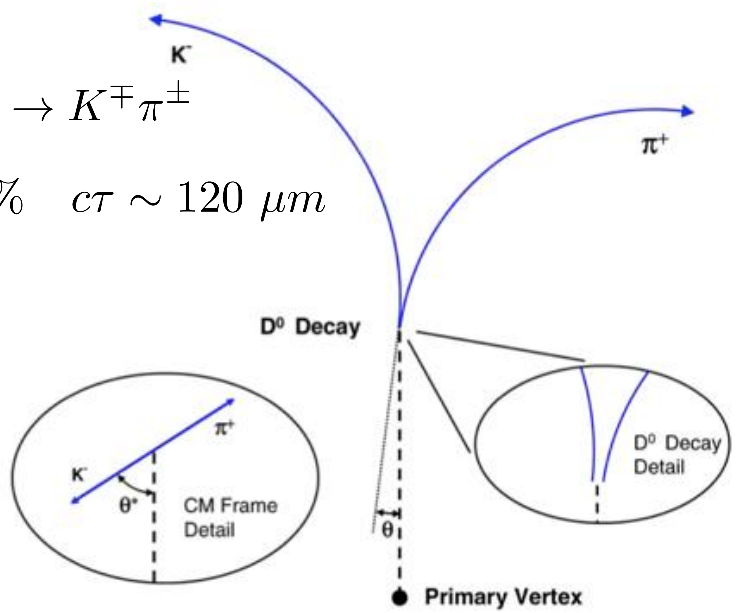
- Greatly reduced combinatorial background (4 orders of magnitude)
- Highly improved S/B



	w/o HFT	w HFT
	2010 + 2011	2014
# events(MB) analyzed	1.1 B	780 M
significance per billion events	13	51

$D^0(\overline{D^0}) \rightarrow K^{\mp}\pi^{\pm}$

B.R. 3.9% $c\tau \sim 120\ \mu m$



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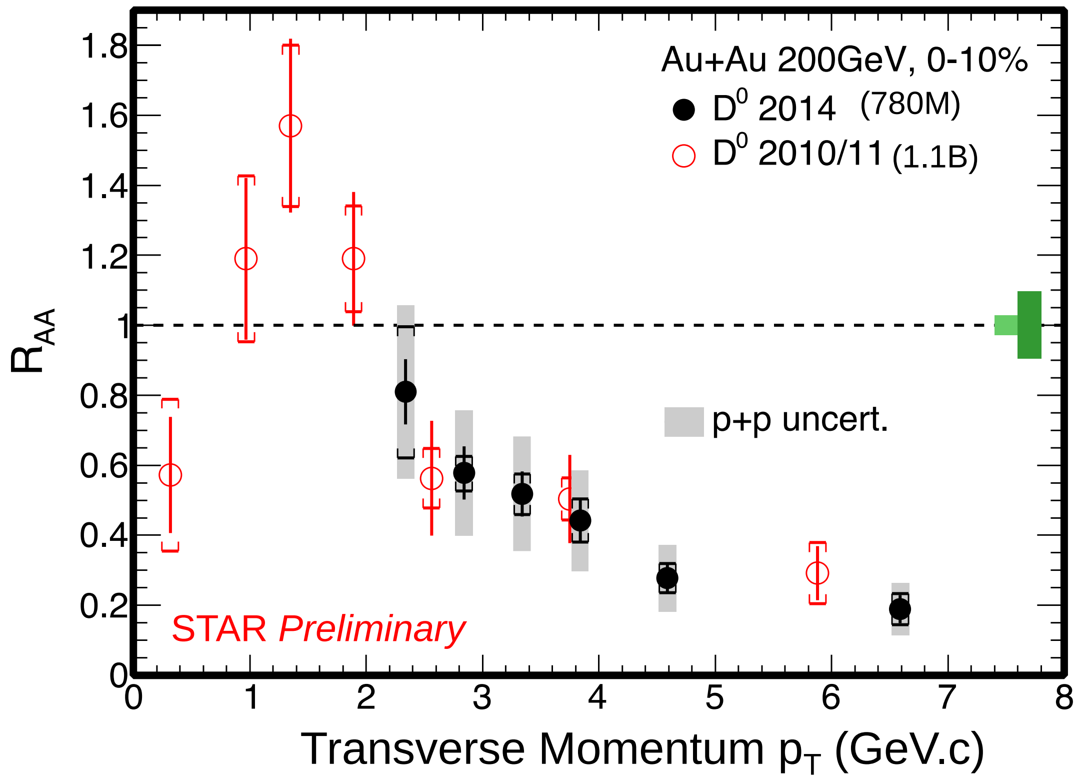
Nuclear modification factor

- High p_T: significant suppression in central Au+Au collisions.
  - New results have improved precision
  - Strong charm-medium interaction



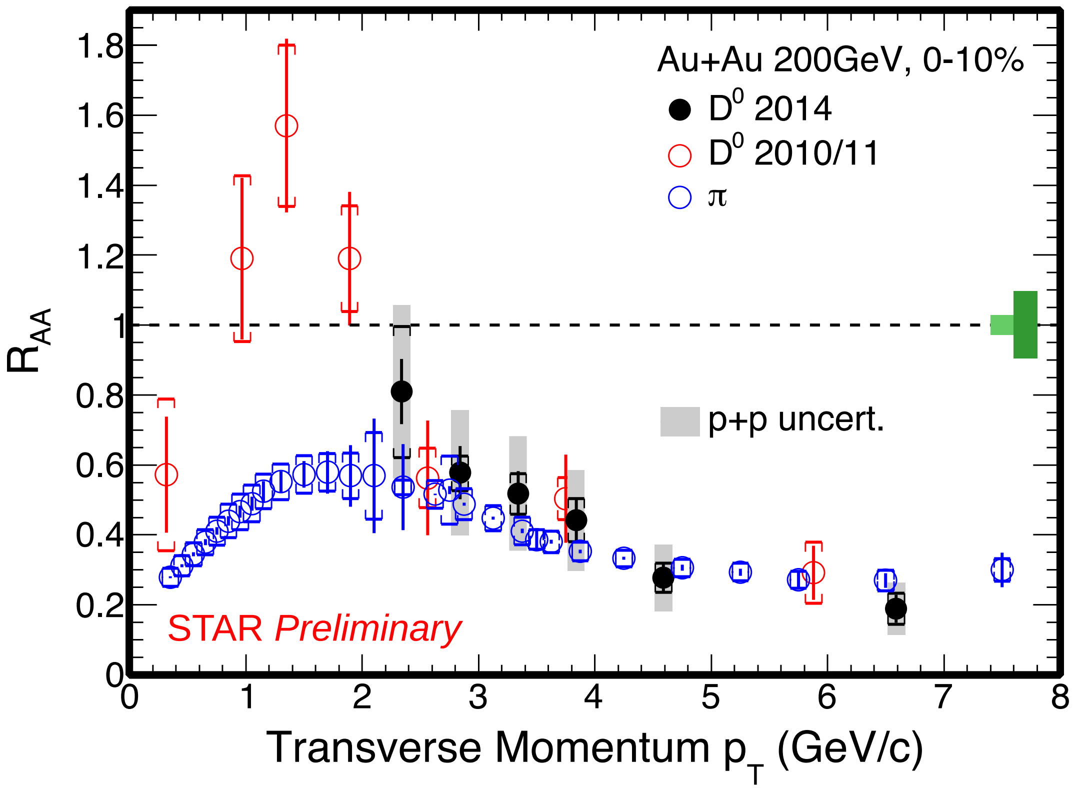
- $R_{AA}(D) > 1$ $p_T \sim 1.5$ GeV/c
  - Indication of charm coalescence with bulk

$$R_{AA} = \frac{dN_{AA}/dy}{N_{binary} \times dN_{pp}/dy}$$

STAR: PRL 113 (2014) 142301
PLB 655 (2007) 104

Nuclear modification factor

- High p_T: significant suppression in central Au+Au collisions.
  - New results have improved precision
  - Strong charm-medium interaction
- $R_{AA}(D) > 1$ $p_T \sim 1.5$ GeV/c
  - Indication of charm coalescence with bulk
- Similar suppression for light partons and charm quarks at high p_T (>4 GeV/c)

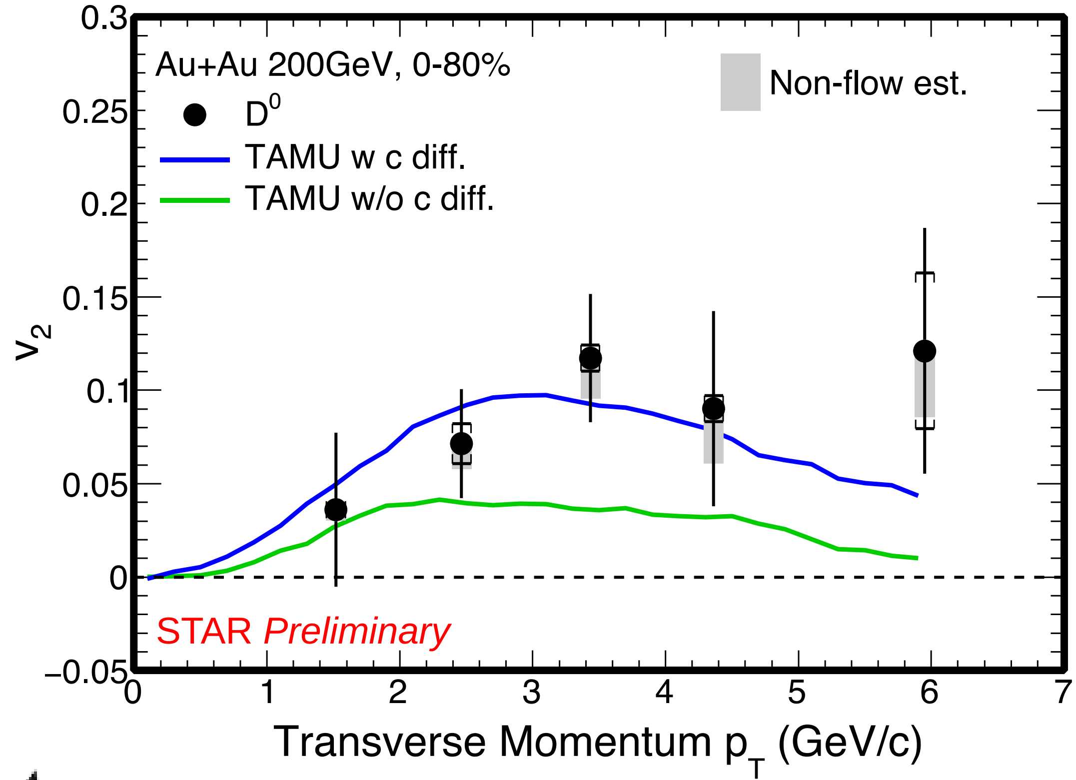


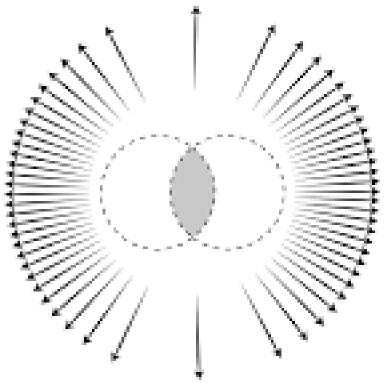
$$R_{AA} = \frac{dN_{AA}/dy}{N_{binary} \times dN_{pp}/dy}$$

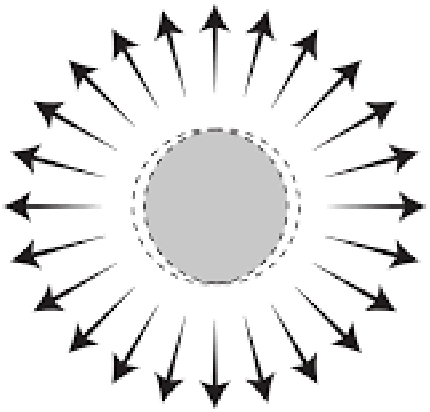
STAR: PRL 113 (2014) 142301
PLB 655 (2007) 104

D^0 azimuthal anisotropy

- D^0 azimuthal anisotropy significantly above zero for $p_T > 2$ GeV/c
- Data favor the model including charm quark diffusion in the medium





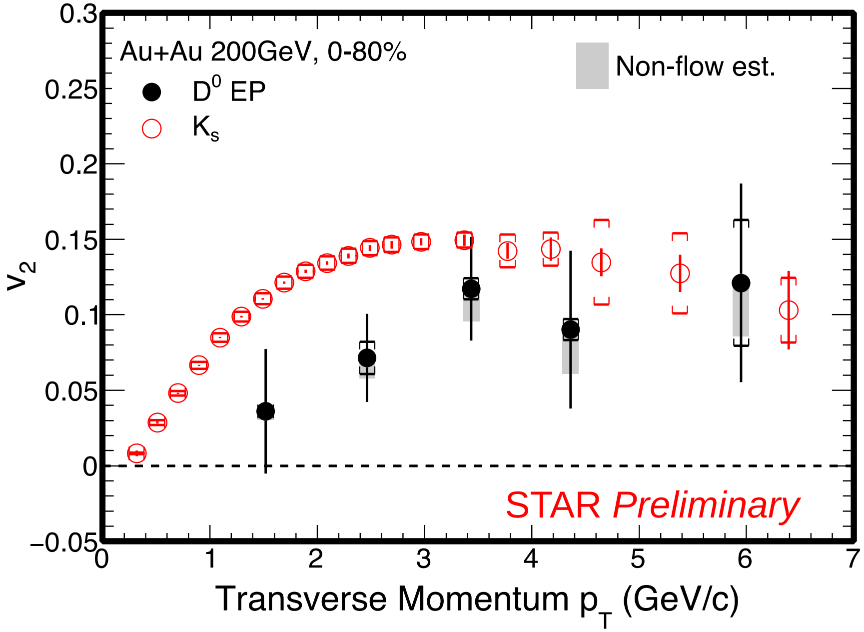


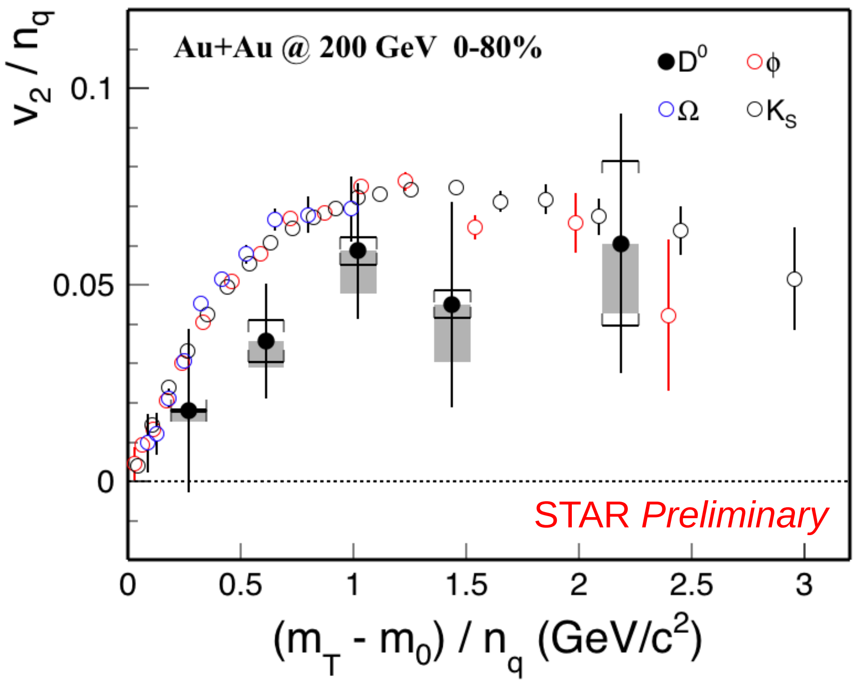
$$\frac{dN}{d\phi} = N_0 \left[1 + \sum_N 2 v_N cos(n\phi) \right]$$

Theory: arXiv:1506.03981 (2015) & private comm.

Mass effect

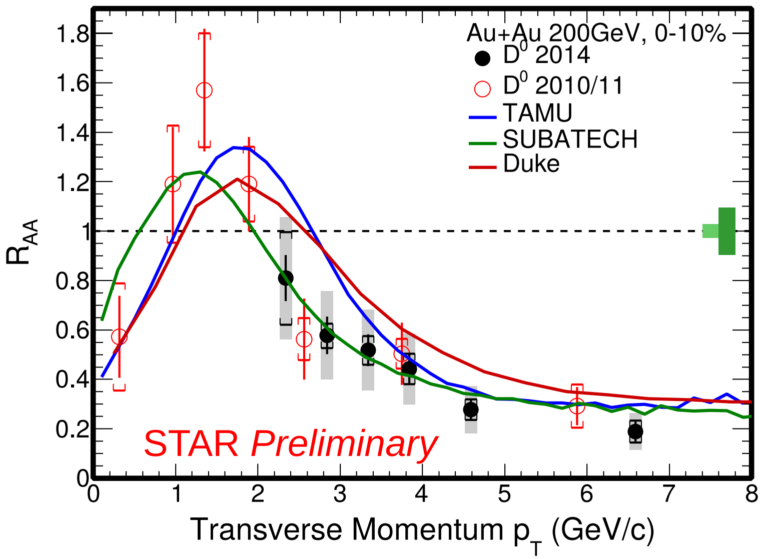
STAR:PRC 77 (2008) 54901
PRL 116 (2016) 62301

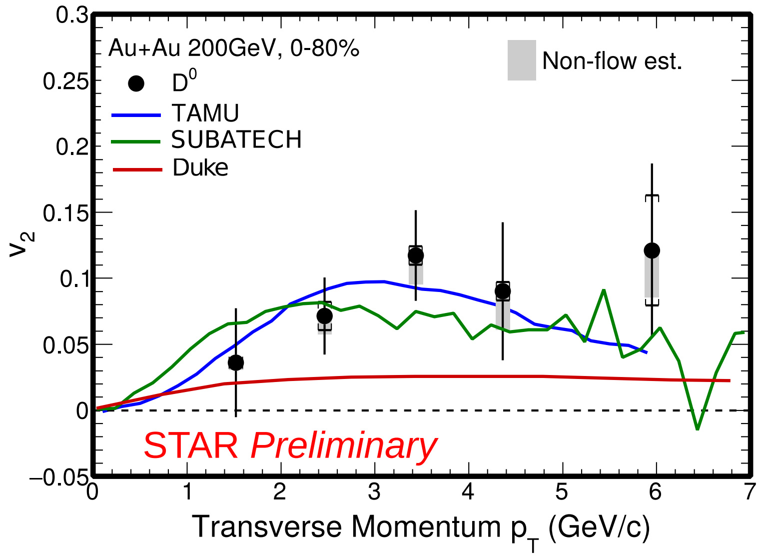




- Systematically below results obtained for light hadrons. Need better statistics for a firm conclusion
  - Suggests charm quarks may not be fully thermalized with the medium

Charm mesons vs models





- Models can successfully describe both R_{AA} and v_2

TAMU: non-perturbative T-Matrix approach:

$(2\pi T)D = 2$ - ~11

SUBATECH: pQCD + Hard Thermal Loops for resummation:

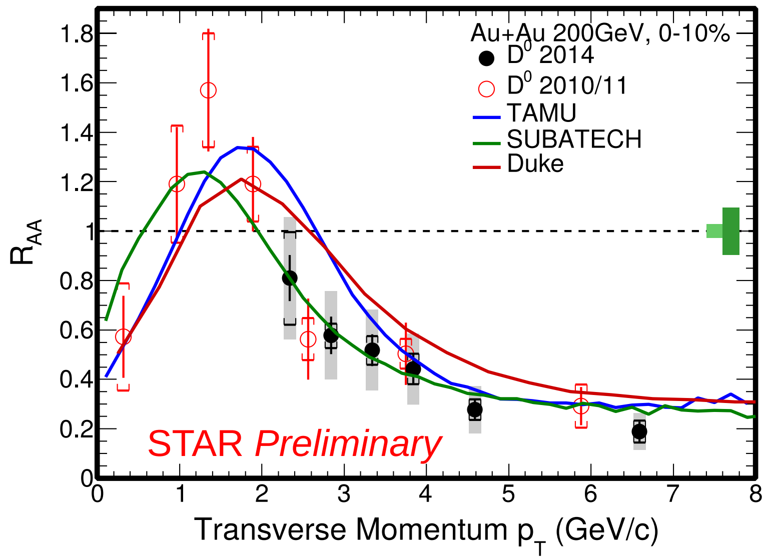
$(2\pi T)D = 2 - 4$

DUKE: Langevin simulation with transport properties tuned to LHC data:

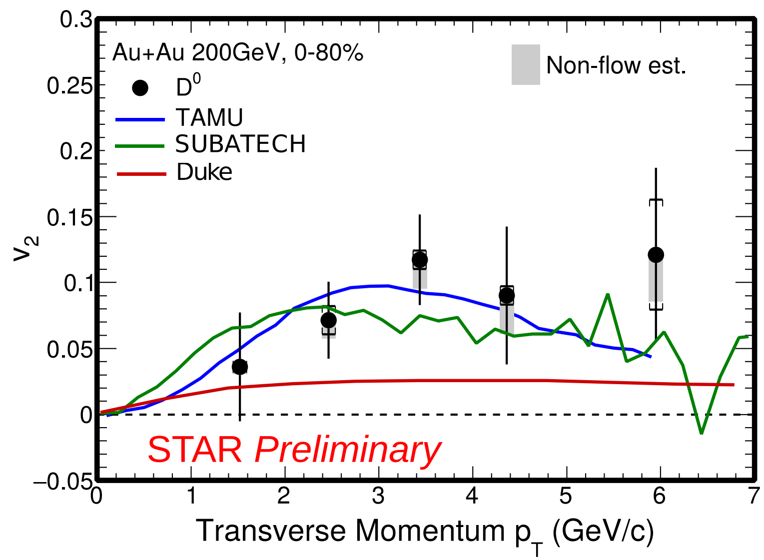
$(2\pi T)D = 7$

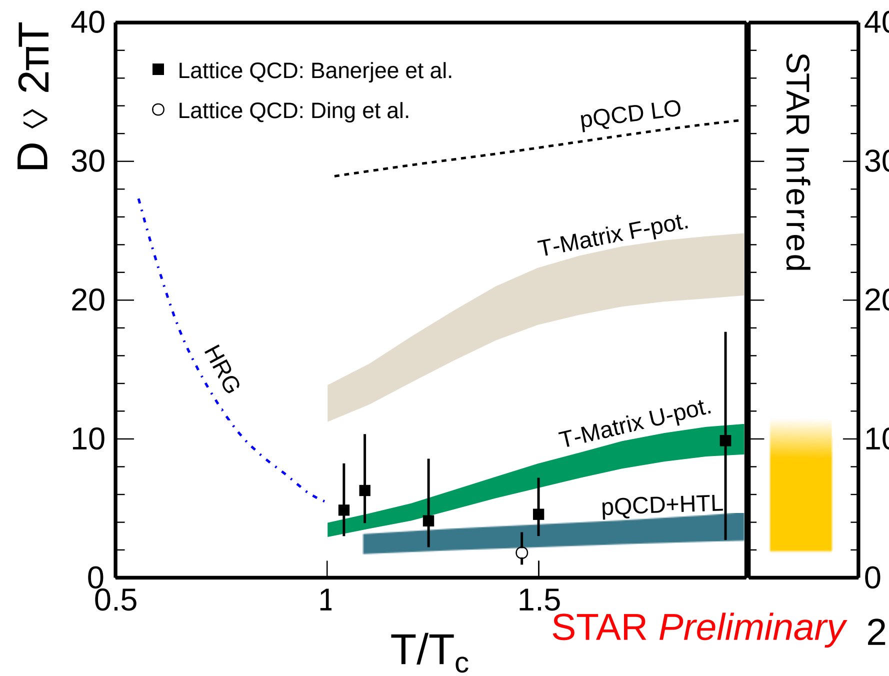
Theory: PRC 92(2015) 024907
arXiv:1506.03981 (2015)
& private comm.
STAR 2010/11: PRL 113 (2014) 142301

Extracting the diffusion coefficient (2πT)D



- Values for the diffusion coefficient extracted from models as a function of T/T_c and inferred range (2 to ~ 11) from STAR data.
- Lattice calculations, although with large uncertainties, are consistent with values inferred from data



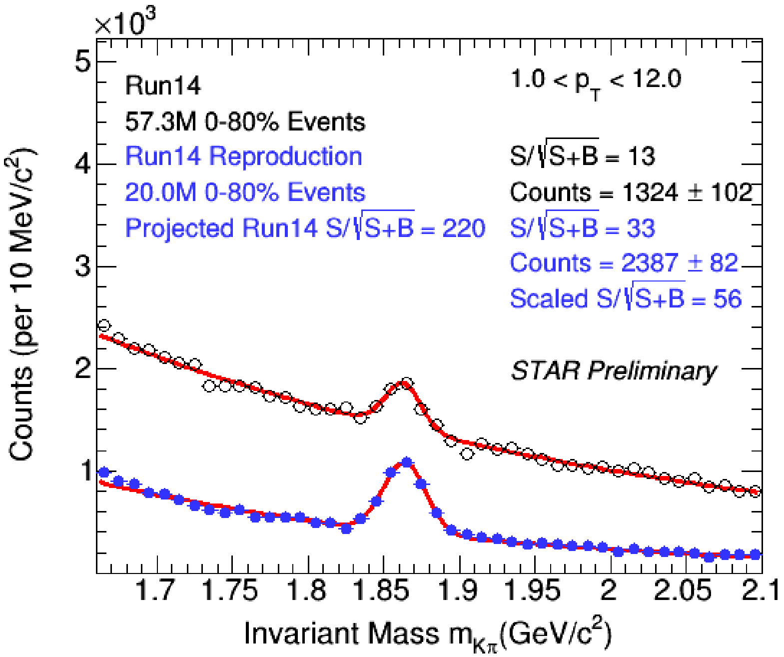


Run 14 data reprocessing

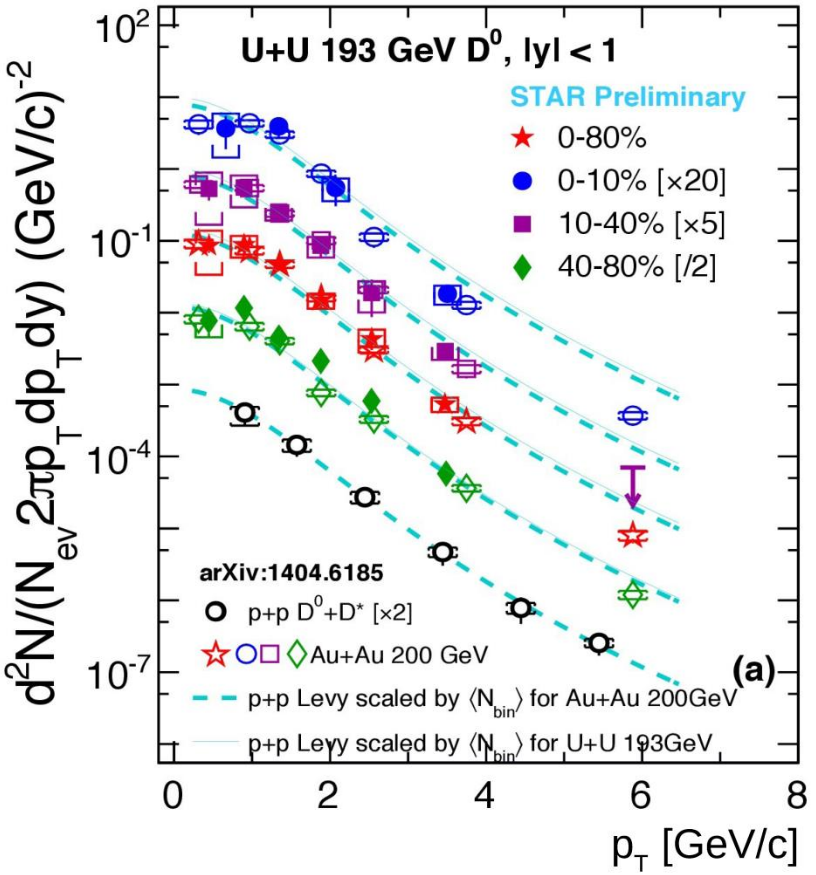
- Improved HFT tracking efficiency after PXL decoding issue has been discovered and resolved -> Factor 2-4 improvement in D^0 significance

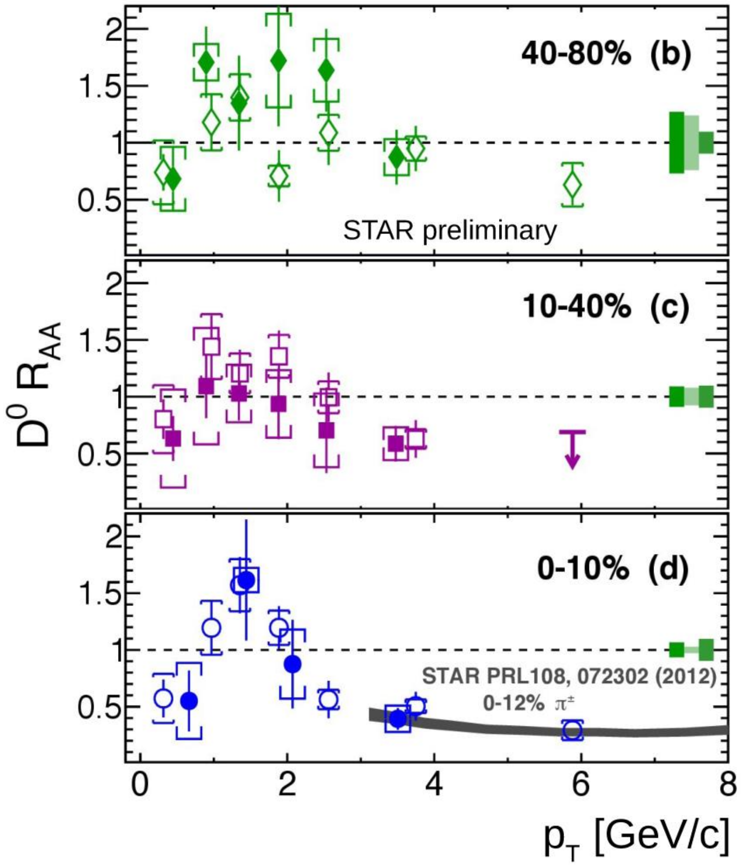
- Preliminary results are consistent with the results obtained with the available re-processed sample

- Run 16:
  - Full aluminum cables for inner layer of PXL: Factor 2 -3 further improvement for D^0 significance @ 1 GeV/c
  - Precision heavy flavor measurements

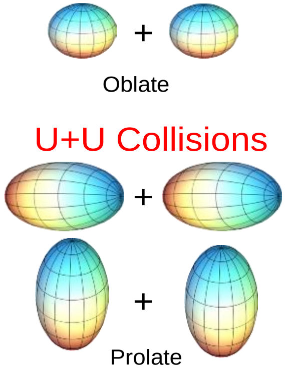


D^0 spectra in U+U 193 GeV



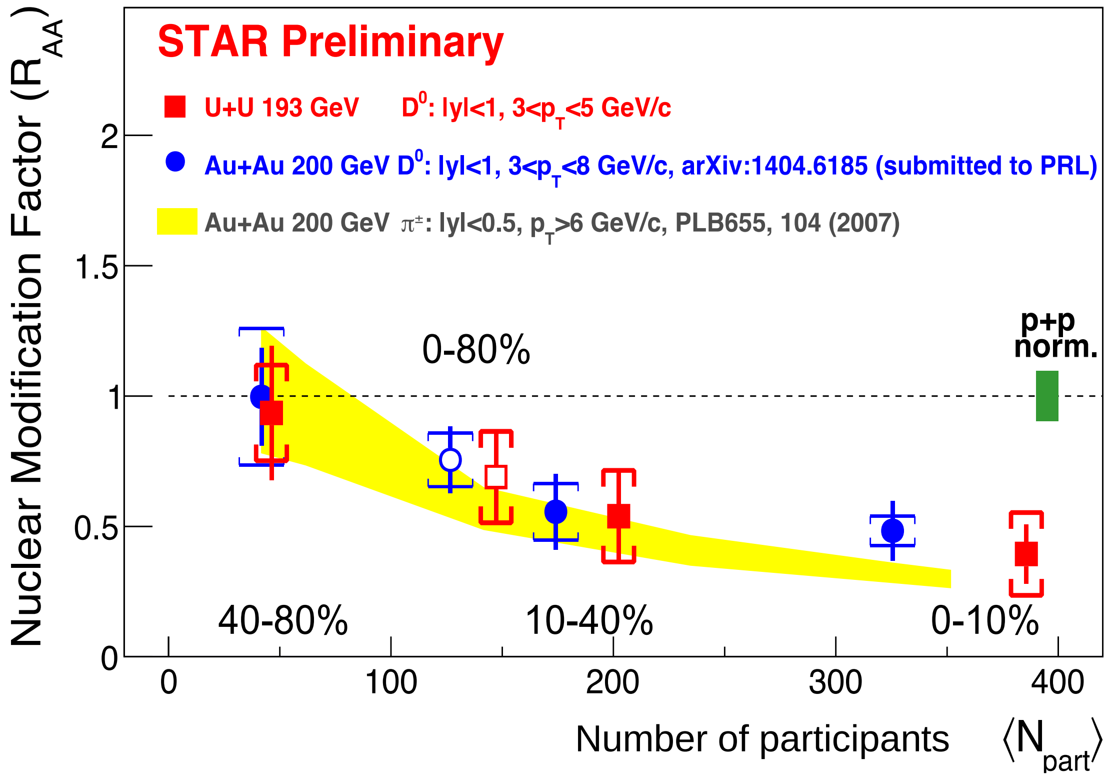


Phys. Rev. Lett. 113, 142301 (2014)



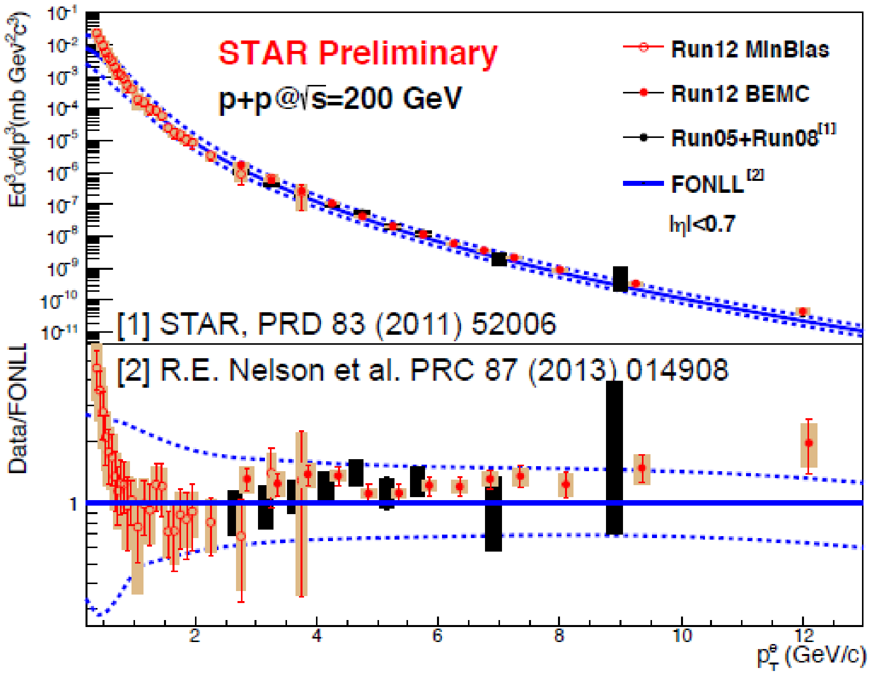
- U+U collisions can reach 20% more energy density.
- Similar suppression pattern in U+U collisions.

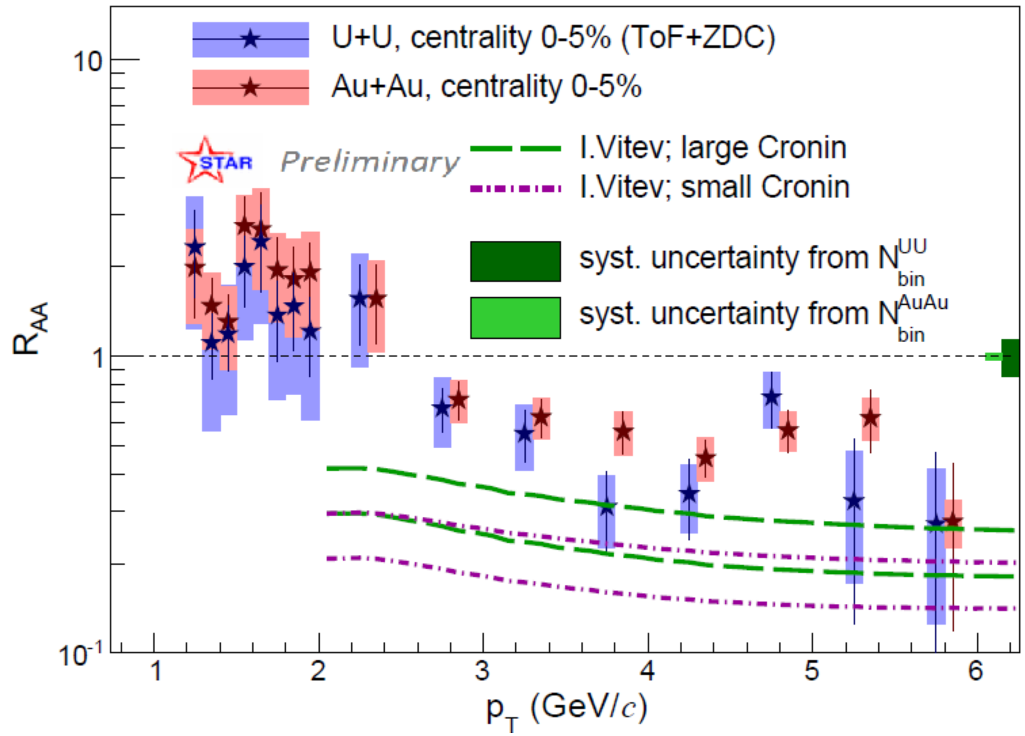
D^0 spectra in Au+Au vs. U+U collisions



- Similar suppression of charm mesons and pions.
- Increasing suppression with $N_{part.}$

NPE UU193GeV

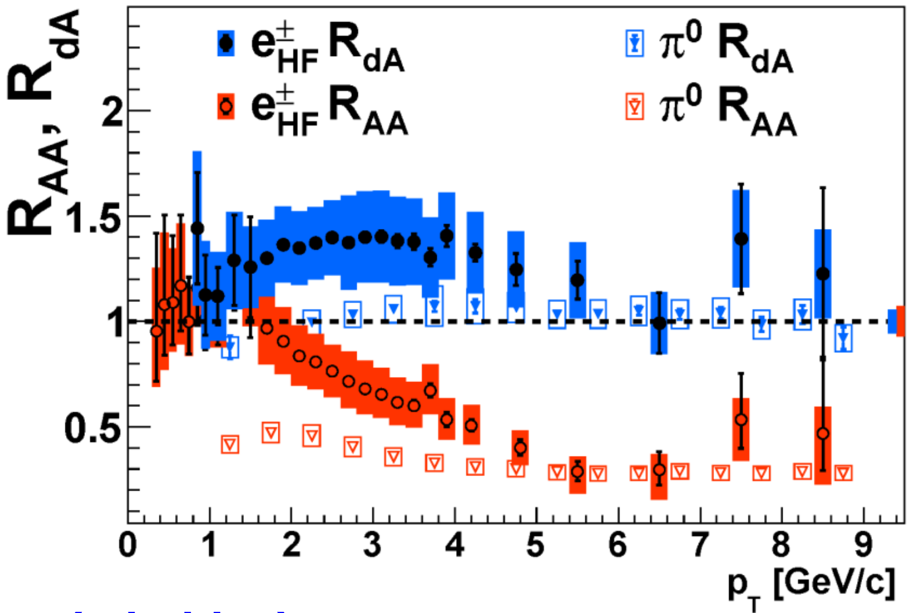




- Improved reference from Run12 data
- For 0-5% Au+Au 200 GeV and U+U 193 GeV no difference observed

Non-photonic electrons in 200 GeV Au+Au

PHENIX: PRL 109 242301



Au+Au 200 GeV (min.bias)

$1.0 < p_T < 5$ GeV/c : $R_{AA}(e_{HF}) > R_{AA}(\pi^0)$

$p_T > 5$ GeV/c : $R_{AA}(e_{HF}) \sim R_{AA}(\pi^0)$

At high-p_T:suppression similar to pions

d+Au 200 GeV

$1.0 < p_T < 5$ GeV/c : $R_{AA}(e_{HF}) > R_{AA}(\pi^0)$

$p_T > 5$ GeV/c : $R_{AA}(e_{HF}) \sim R_{AA}(\pi^0)$

At high-p_T: suppression similar to pions

Heavy flavor are suppressed due to final state effects in hot and dense nuclear medium in Au+Au 200 GeV.
No difference vs, pions observed.

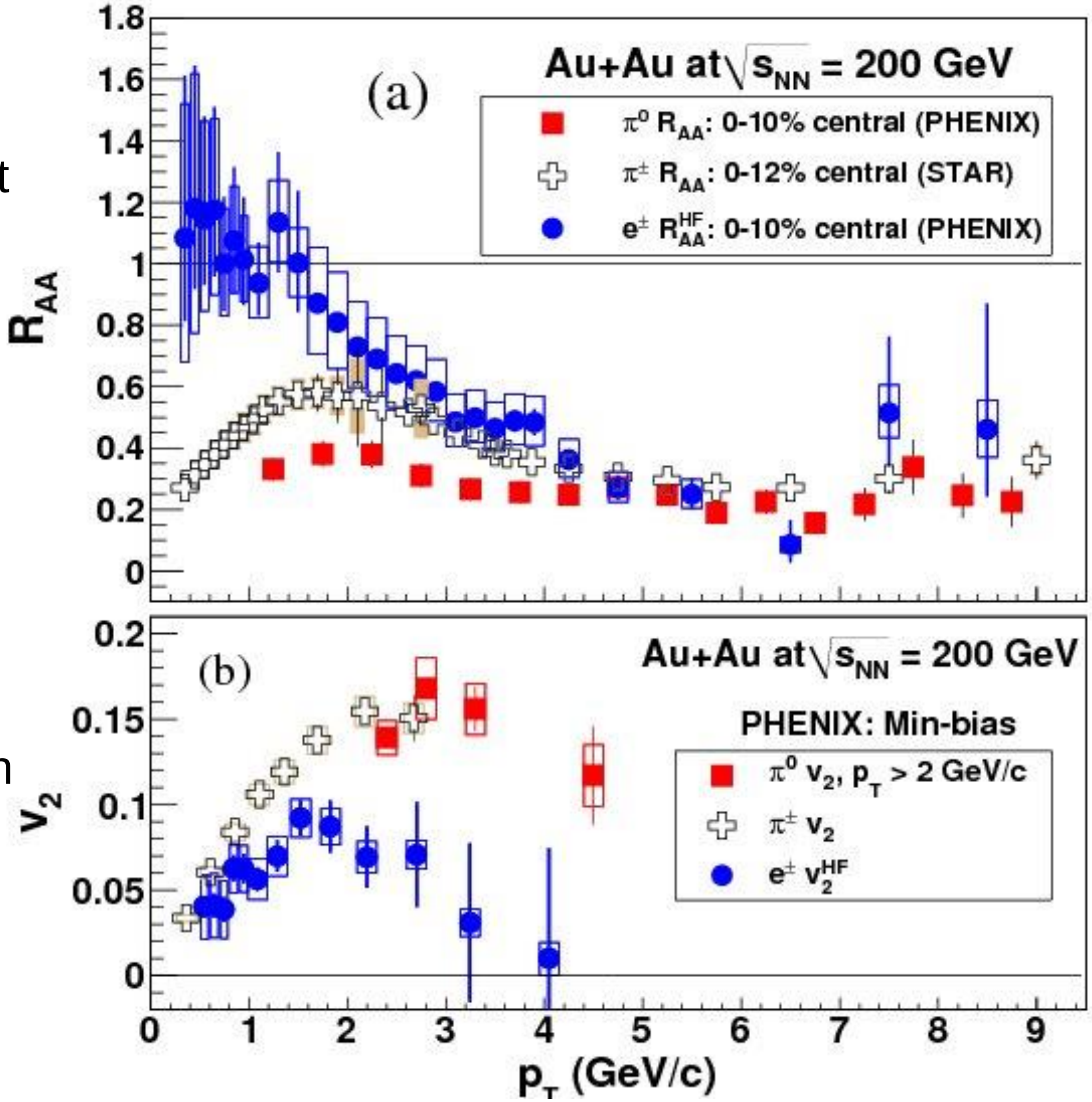
Heavy Flavor Electrons R_{AA} and v_2

High-p_T

- Significant suppression
- Similar suppression of light hadrons and EHF (c+b): what about c-e and b-e?

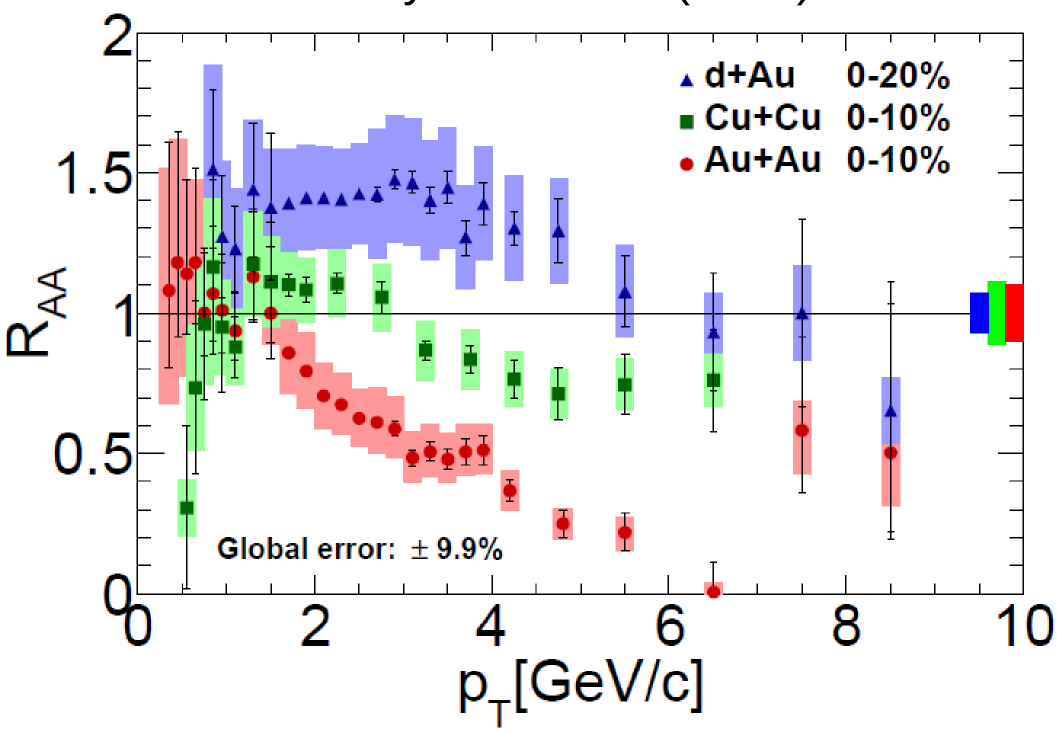
Low-p_T

- Little suppression
- EHF less suppressed than light hadrons.
- Significant v_2, but less than light hadrons.



Non-photonic electrons in Cu+Cu 200GeV

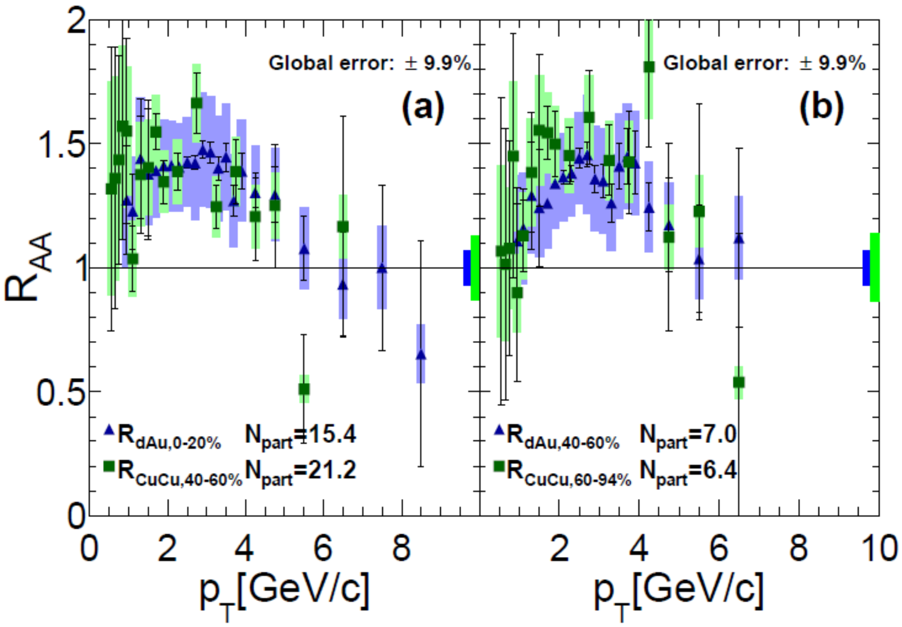
PHENIX: Phys.Rev. C90 (2014) 034903

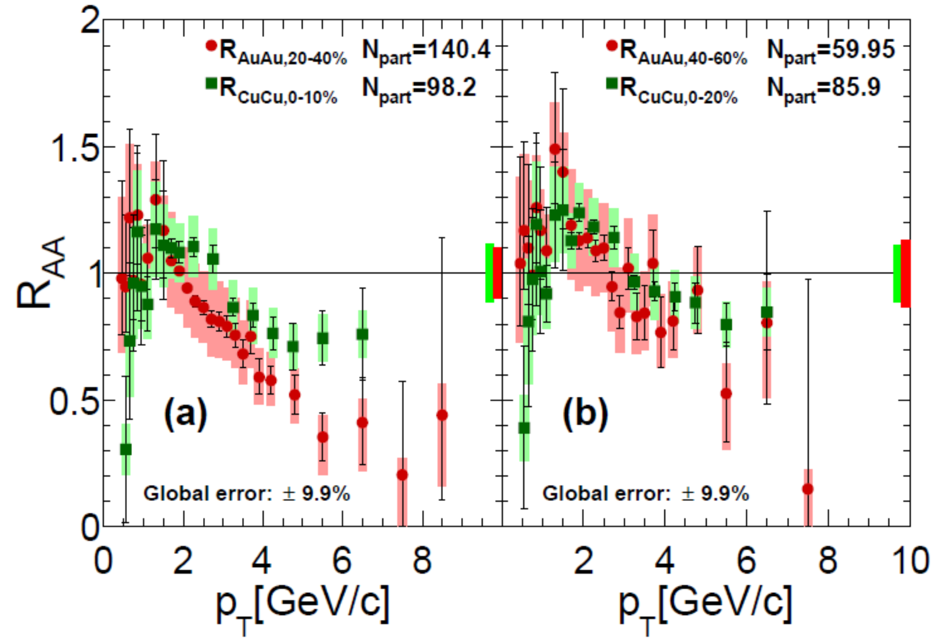


- Clear enhancement in d + Au
  Cold nuclear matter effects
- Large suppression in Au + Au
  Hot Medium effects
- Cu + Cu system intermediate
  R_{AA} between that in d + Au and Au + Au
  Interplay between CNM and Hot Medium effects.

Nuclear modification for similar $\langle N_{part} \rangle$

PHENIX: Phys.Rev. C90 (2014) 034903





$\langle N_{part} \rangle$ = 15 in d+Au
$\langle N_{part} \rangle$ = 20 in Cu+Cu

$\langle N_{part} \rangle$ = 7 in d+Au
$\langle N_{part} \rangle$ = 6 in Cu+Cu

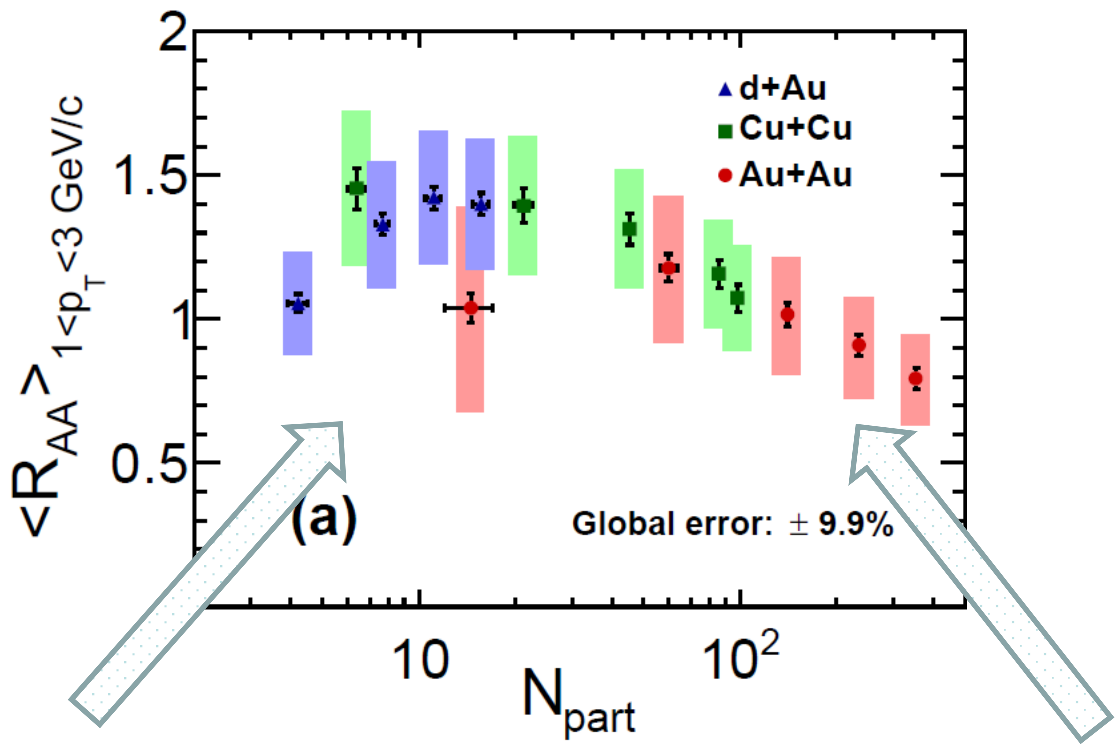
$\langle N_{part} \rangle$ = 100 in Cu+Cu
$\langle N_{part} \rangle$ = 140 in Au+Au

$\langle N_{part} \rangle$ = 86 in Cu+Cu
$\langle N_{part} \rangle$ = 60 in Au+AU

Similar enhancement and suppression are seen for the different system at similar $\langle N_{part} \rangle$

N_{part} dependence of R_{AA}

PHENIX: Phys.Rev. C90 (2014) 034903



Increase of enhancement
CNM effects

Onset of suppression
Hot matter effects take over

Enhancement and suppression effects depend on system size

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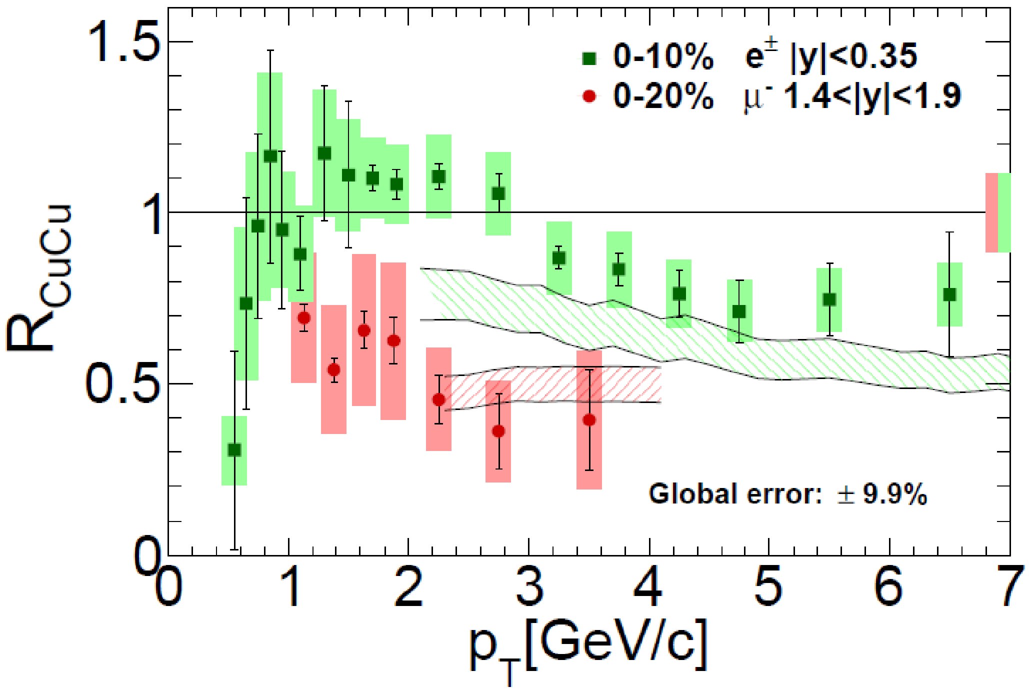
Cu+Cu 200 GeV
$e^{+/-}$ midrapidity vs. μ^- for forward rapidity

PHENIX: Phys.Rev. C90 (2014) 034903



More suppression in μ^- yield

- Additional CNM effects like shadowing and initial state energy loss

Theoretical calculation

R.Sharma et al. Phys.Rev. C 80 (2009) 054902

- partonic energy loss
- suppression due to fragmentation and dissociation of heavy-flavor hadrons
- shadowing effect
- Cronin effect

No theoretical calculation to explain both data

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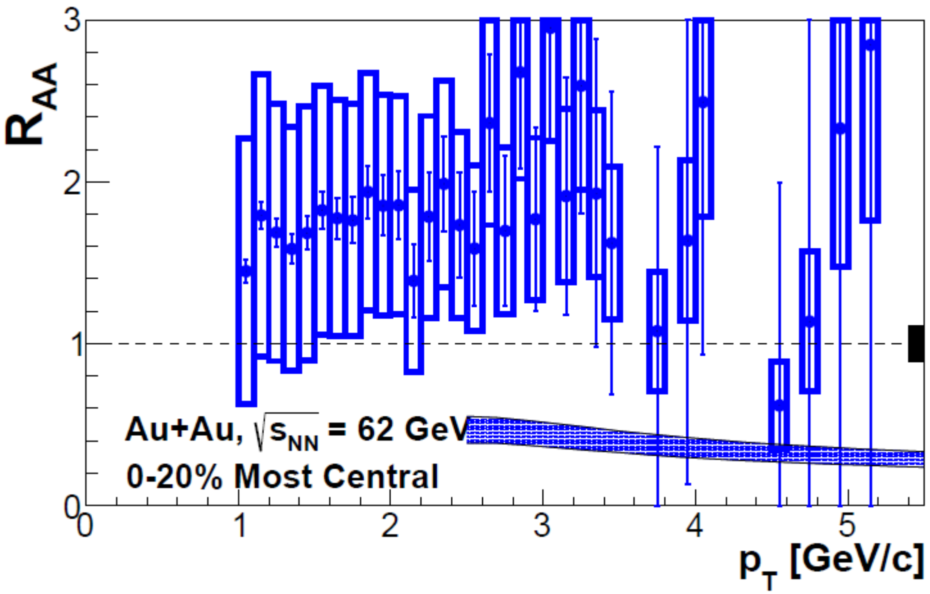
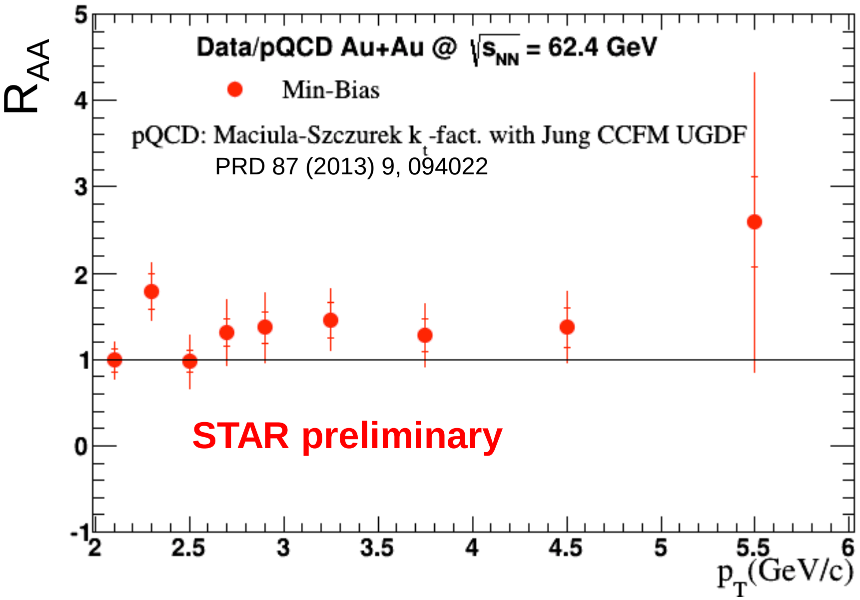
Non-photonic electrons Au+Au 62.4 GeV





Vitev model can describes 200 GeV suppression but it underpredicts 62.4 GeV data.

No suppression of NPE observed in 62.4 GeV Au+Au collisions.
Cold nuclear matter effects are not known.
Note: pQCD-scaled p+p reference

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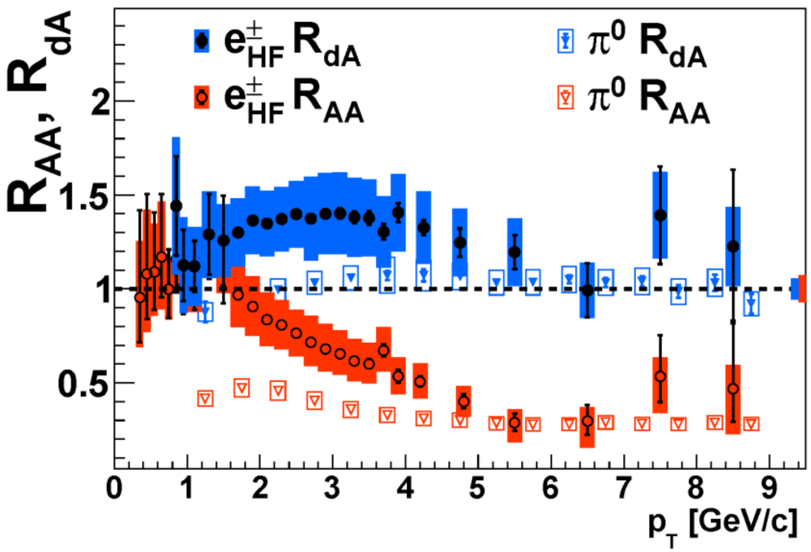
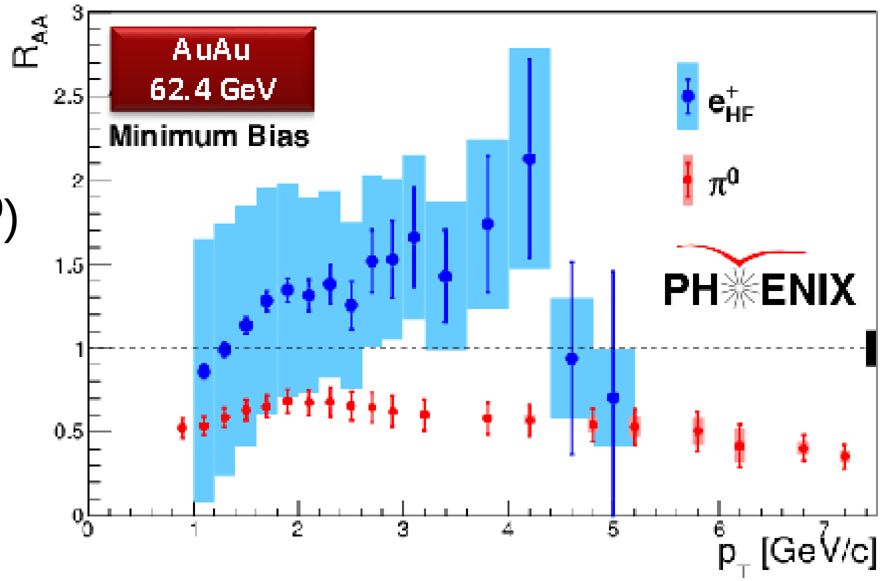
R_{AA} heavy flavor vs. pions

PHENIX: PRL 109 242301



PHENIX: PRC 91 044907

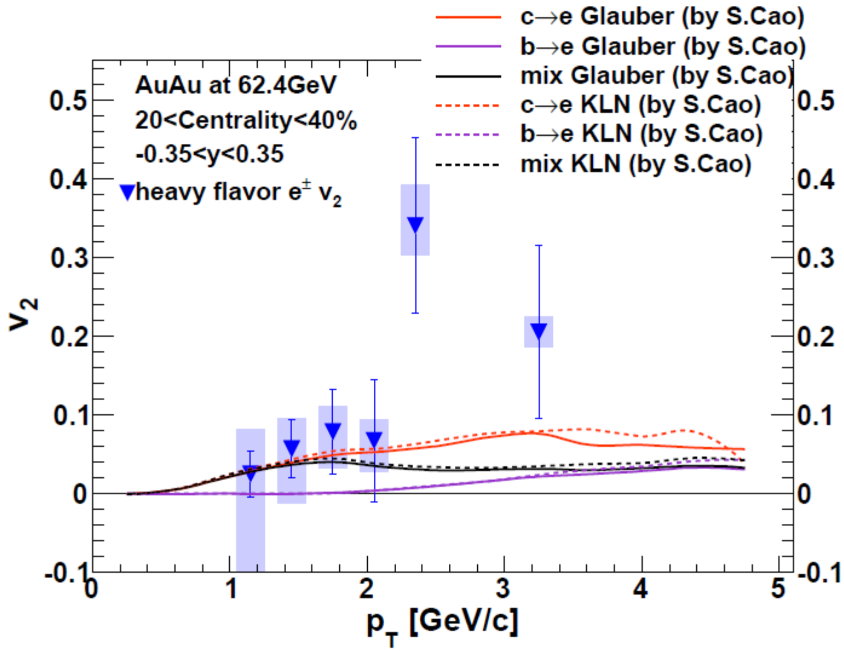


Au+Au 62 GeV

1.0 < p_T < 4-5 GeV/c : $R_{AA}(e_{HF}) > R_{AA}(\pi^0)$
There is enhancement at Au+Au 62 GeV

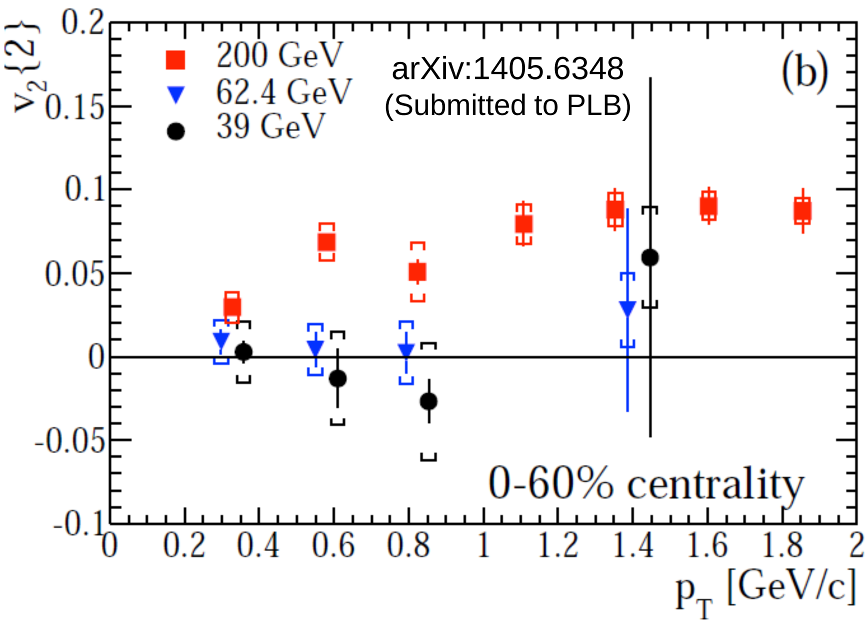
What is the source of this difference?
Due to less energy loss? larger Cronin effects?
Initial state effects might be different.

Non-photonic electrons Au+Au 39, 62.4 GeV



Anisotropy (v_2)

- Charm has a positive v_2 in 62 GeV Au + Au p_T> 1GeV.
- Collective motion of charm itself?
- Collective motion of charmed hadrons through recombination with flowing light partons?

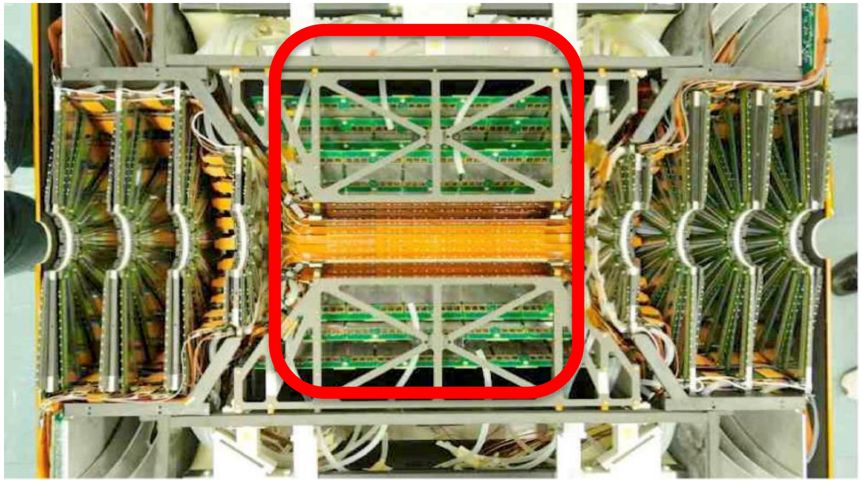


- NPE in 39 and 62.4 GeV Au+Au collisions **consistent with no flow.**
- Statistically different from 200 GeV for p_T < 1 GeV/c.

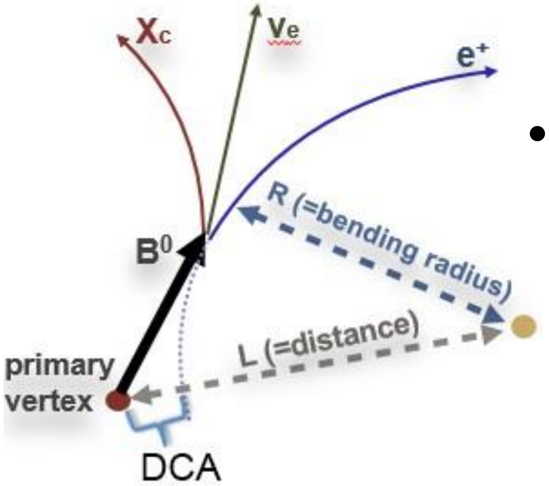
What NEW on Open Heavy Flavor?

NEW!

c/b separation by secondary vertex



VTX detector

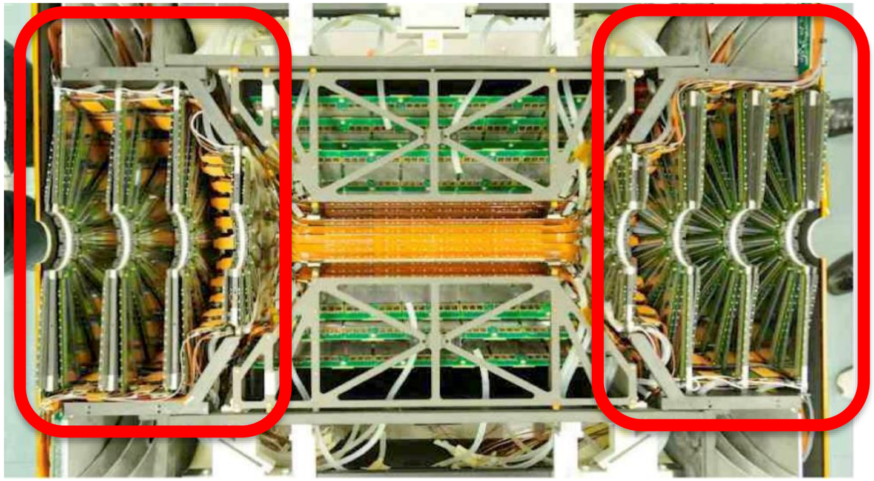


- VTX (2011):
  - Midrapidity: |η | <1.2
    - AuAu 200 GeV:
      ~ 60 μm DCA_T resolution

Life time (cτ)

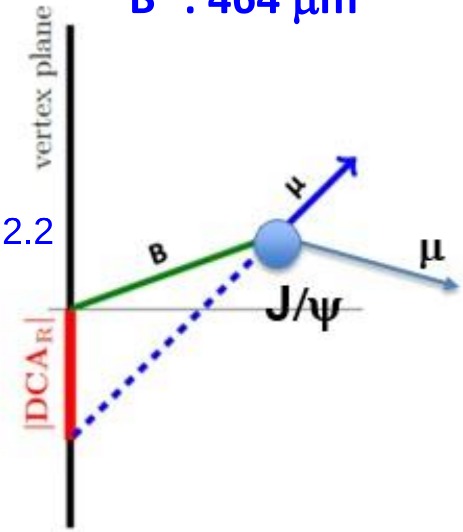
D^0 : 123 μm

B^0 : 464 μm



FVTX detector

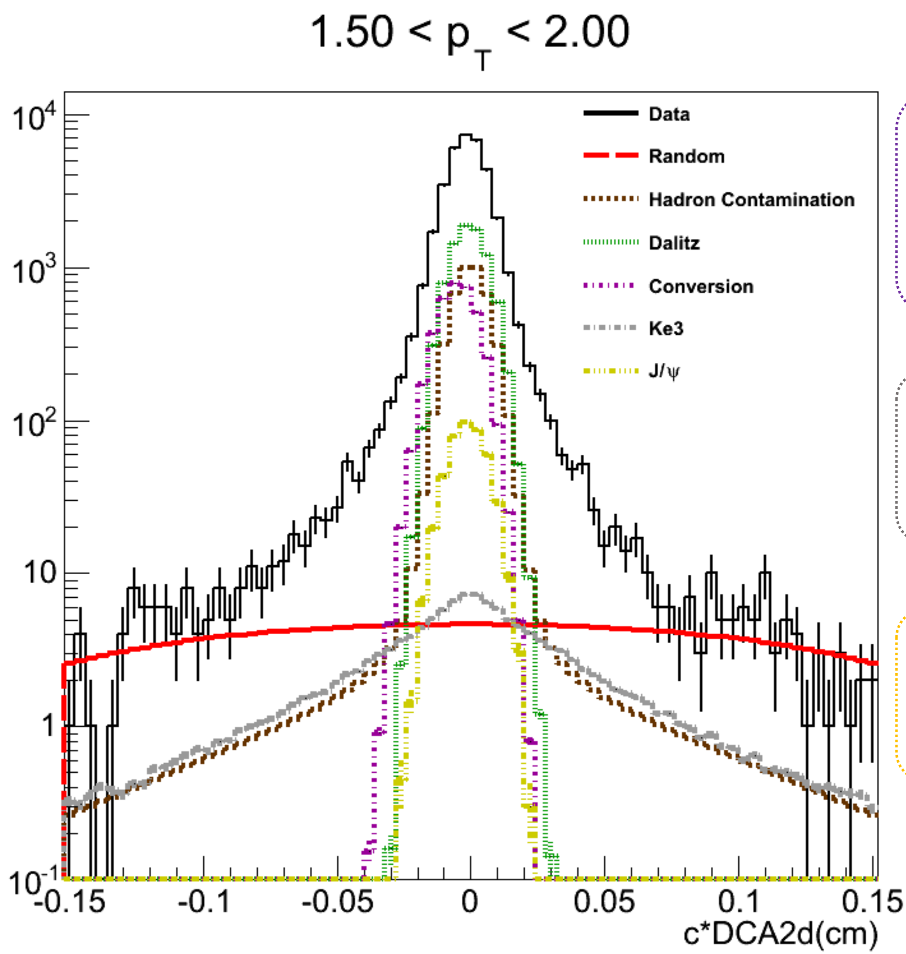
- FVTX (2012):
- Forward rapidity - 1.2 < |η| < 2.2
- Improved muon momentum resolution & precise tracking



What NEW on Open Heavy Flavor?

First Results from PHENIX VTX: b/c separation

DCA_T Distributions: Backgrounds



PHENIC: PRC **93**, 034904 (2016)

<u>High-Multiplicity Bkg.</u>
Data driven shape
Tracks with large DCA_L

<u>Mis-identified hadrons:</u>
Data driven shape
RICH Swap Method

<u>Dalitz:</u>
Monte Carlo shape
With measured yield

<u>Conversions:</u>
Monte Carlo shape
With Measured Pi0 yield
~75% rejected

<u>Ke3:</u>
Monte Carlo shape
With measured yield

<u>$J/\psi \to e^+e^-$:</u>
Monte Carlo shape
With measured yield

TAKEN FROM RACHID NOUICER SQM 2016 TALK

What NEW on Open Heavy Flavor?

NEW!

First Results from PHENIX VTX: b/c separation

DCA_T Distributions: b/c separation

b → e

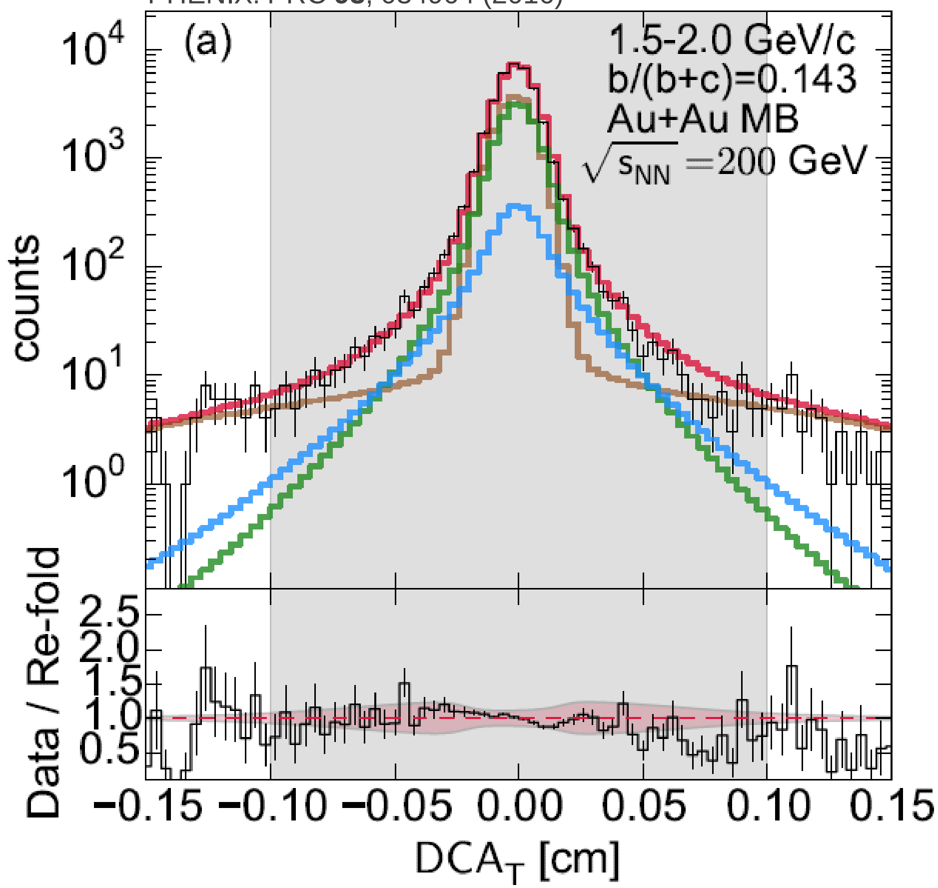
c → e

Total

Data

Backgrounds

PHENIX: PRC **93**, 034904 (2016)



c->e:
Monte Carlo shape
Normalization
from unfolding

b->e:
Monte Carlo shape
Normalization from
unfolding

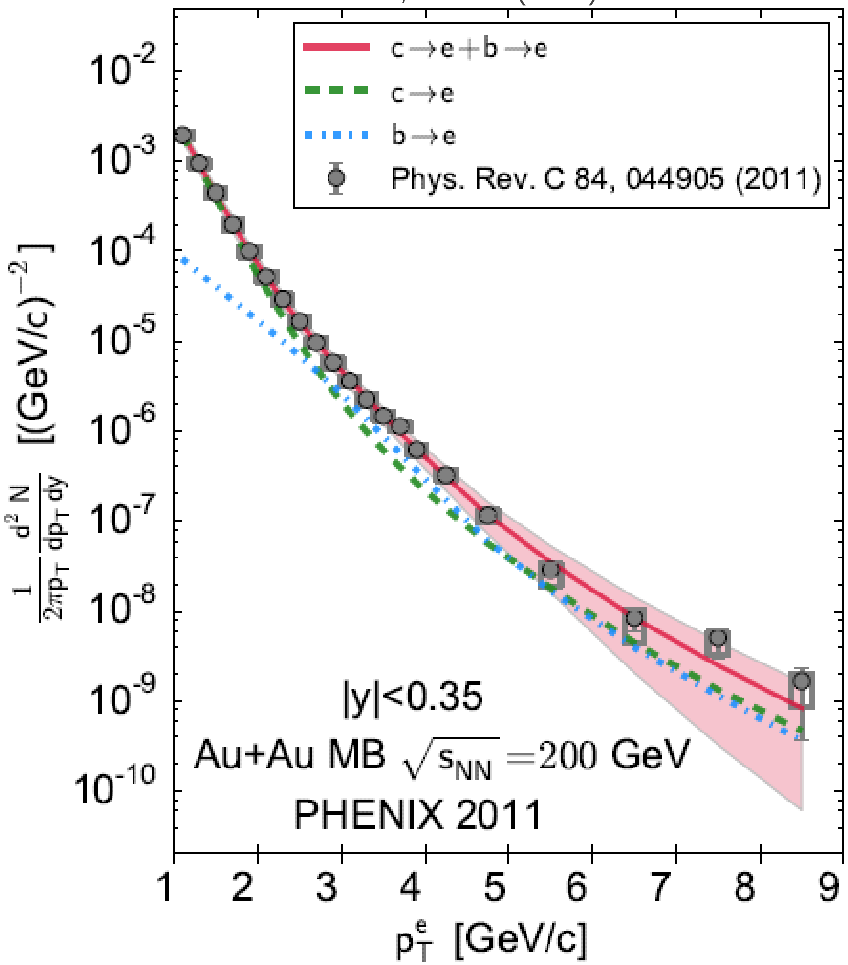
The charm and bottom yield predicted by the unfolding is consistent with electron measured DCA_T distributions.

What NEW on Open Heavy Flavor?

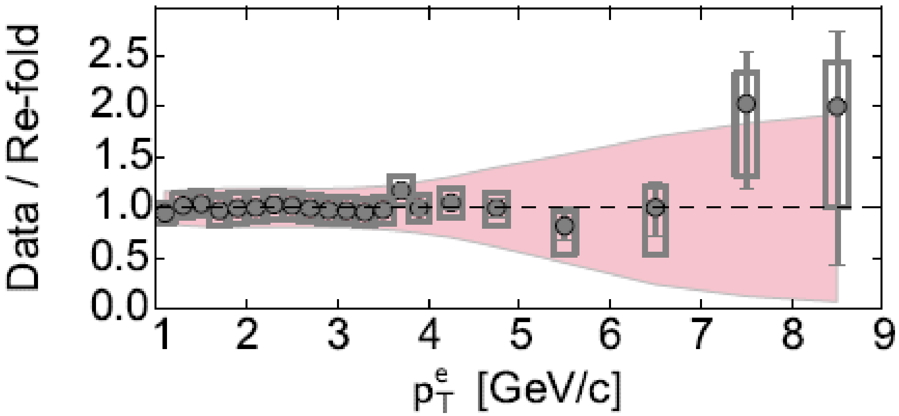
First Results from PHENIX VTX: b/c separation

Invariant yield compared to previous published results

PHENIX: PRC **93**, 034904 (2016)



The unfolding results are consistent with the previous published inclusive heavy flavor electron invariant yields.



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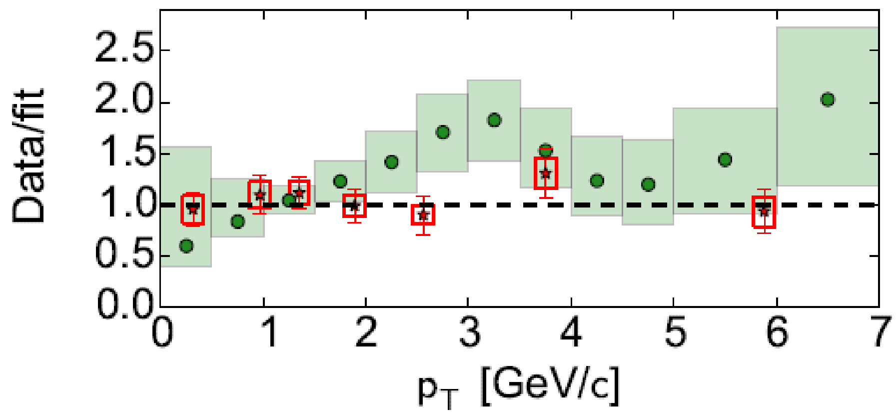
What NEW on Open Heavy Flavor?

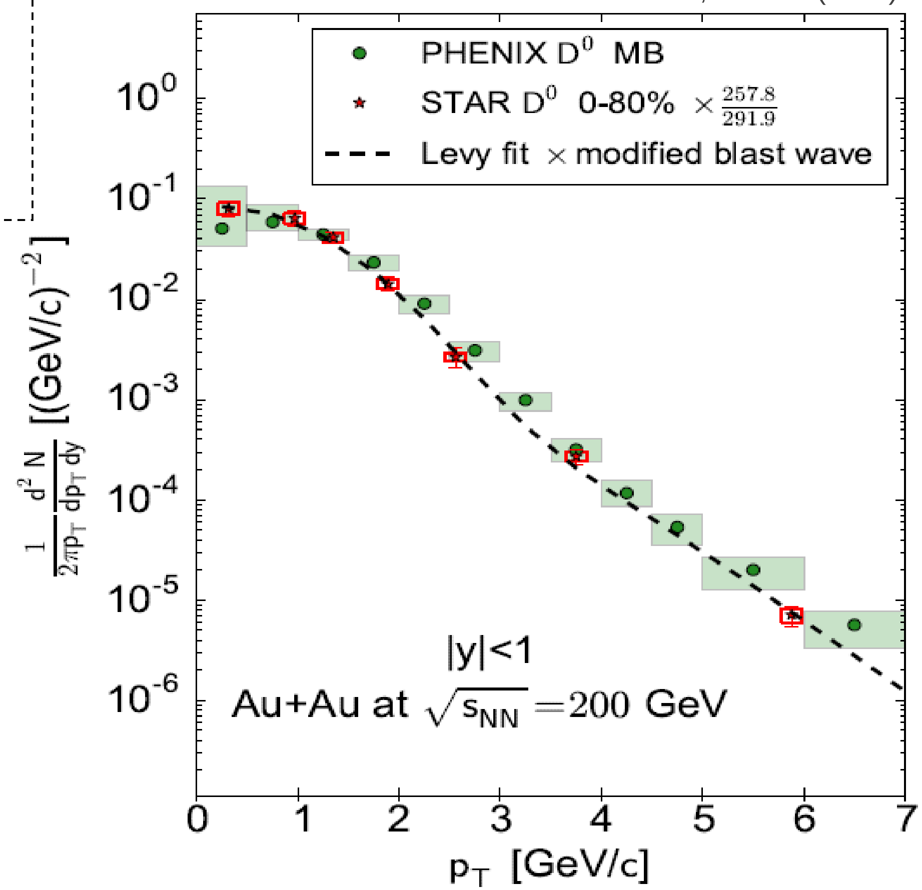
First Results from PHENIX VTX: b/c separation

Invariant yield:

PHENIX unfolded D^0 p_T spectra agrees within uncertainties with measurements from STAR.



PHENIX: PRC **93**, 034904 (2016)

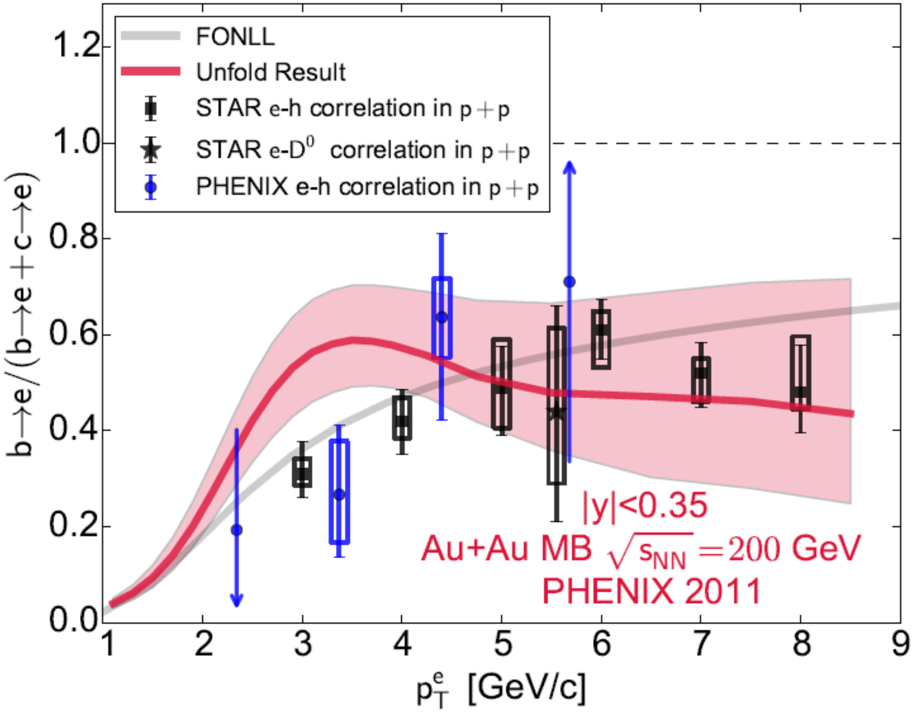


What NEW on Open Heavy Flavor?

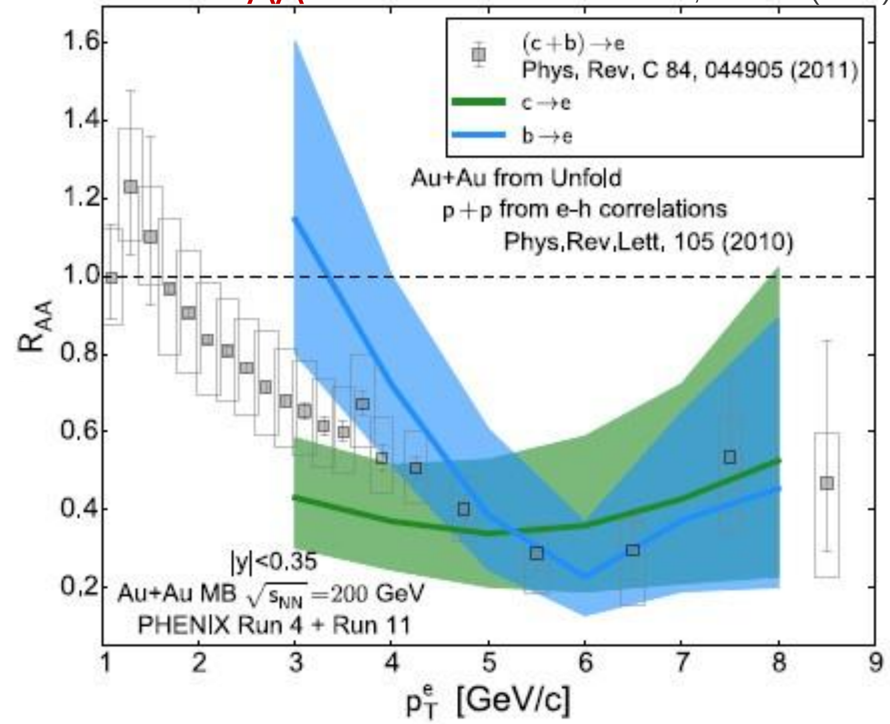
First Results from PHENIX VTX: b/c separation

Bottom and Charm R_{AA}

PHENIX: PRC **93**, 034904 (2016)



PHENIX: PRC **93**, 034904 (2016)



$$R_{AA}^{c\to e} = \frac{(1-F_{\rm AuAu})}{(1-F_{pp})} R_{AA}^{\rm HF}$$

$$R_{AA}^{b\to e} = \frac{F_{\rm AuAu}}{F_{pp}} R_{AA}^{\rm HF},$$

We see that around $p_T < 4$ GeV the electrons from bottom experience much less suppression than electrons from charm.

Stay Tuned:

- 2014 data set x10 better statistics than 2011
  - Decrease uncertainties
  - Increase p_T reach
  - Centrality separation
- Good 2015 p+p and p+Au data sets

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What NEW on Open Heavy Flavor?

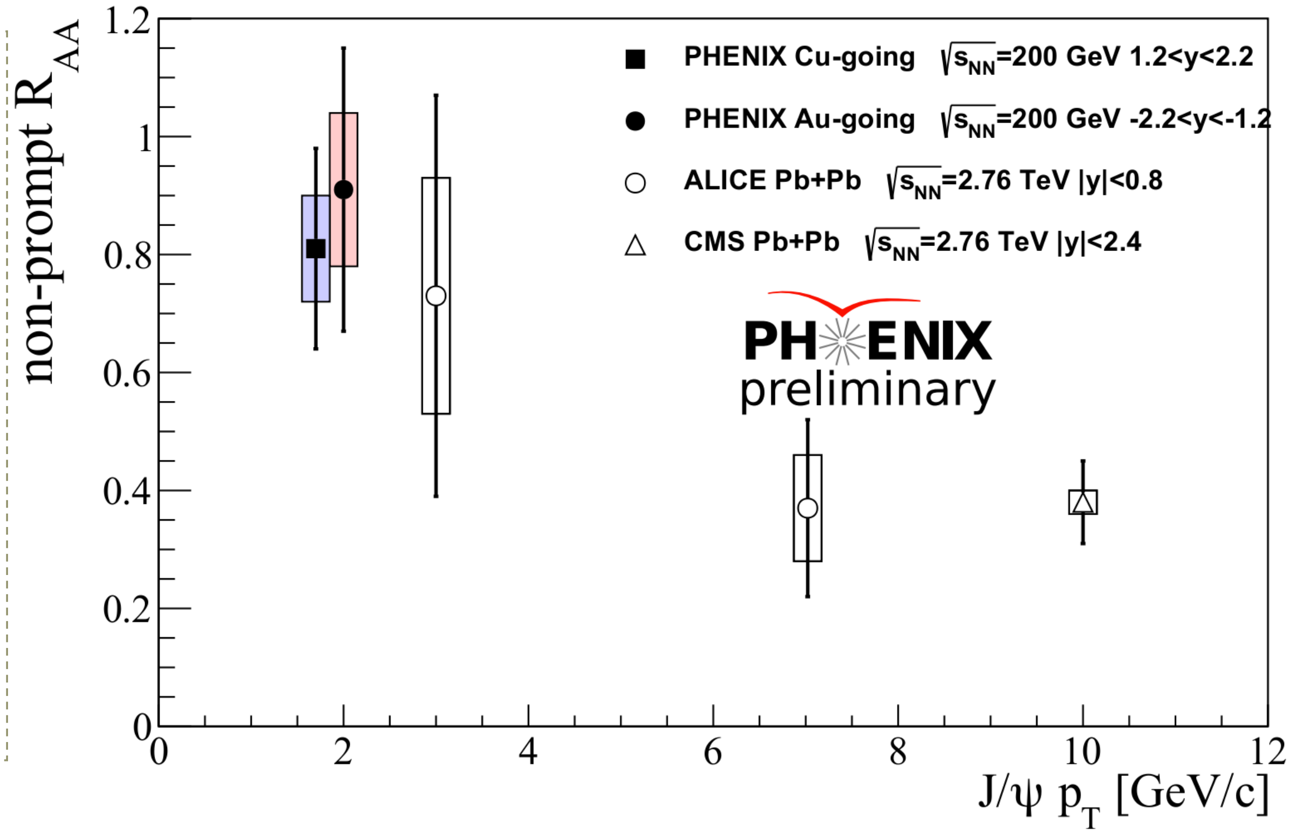
NEW!

First Results from the PHENIX FVTX: $B \rightarrow J/\psi$

Nuclear Modification factor Cu+Au at 200 GeV: R_{AA} (B->J/ψ)

$$R_{CuAu}^{B\rightarrow J/\psi} = \frac{F_{B\rightarrow J/\psi}^{CuAu}}{F_{B\rightarrow J/\psi}^{pp} = 0.1} R_{CuAu}^{inc.J/\psi}$$

- The B →J/ψ fraction measured in the Cu+Au collisions at PHENIX is much larger than the LHC results.
- Assuming the fraction is 0.1 in 200 GeV p+p collisions, the R_{CuAu} defined as is less suppressed
- PHENIX and LHC R_{AA} follow the same trend.



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Summary

- Recent charm production measurement in p+p at 200 and 500 GeV in extented p_T range. The pQCD calculations are consistent with data.

- Large suppression of heavy quark production at high-p_T in D^0 and non-photonic electrons measurements in 200 GeV central Au+Au and U+U collisions. Similar to light quarks. Dead cone effect?
  Comparison to models $(2\pi T)D = 2$ - ~11

- d+Au, Cu+Cu, Au+Au 200 GeV
  Similar enhancement and suppression for the different system at similar <Npart>

- Au+Au 62 GeV , need for better reference
  Importance of CNM effects at low energies.

- Finite v_2 of non-photonic electrons at 200 GeV
  Consistent with zero at lower energies p_T<1GeV/c, nonzero for p_T>1GeV/c.
  Charm flow?

- Significant improvement of heavy flavor measurements with STAR HFT
- and PHENIX VTX.

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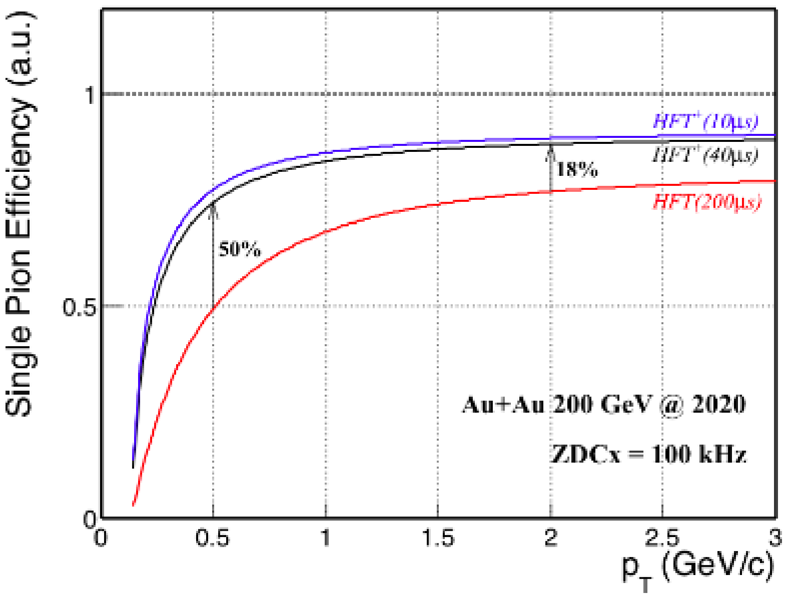
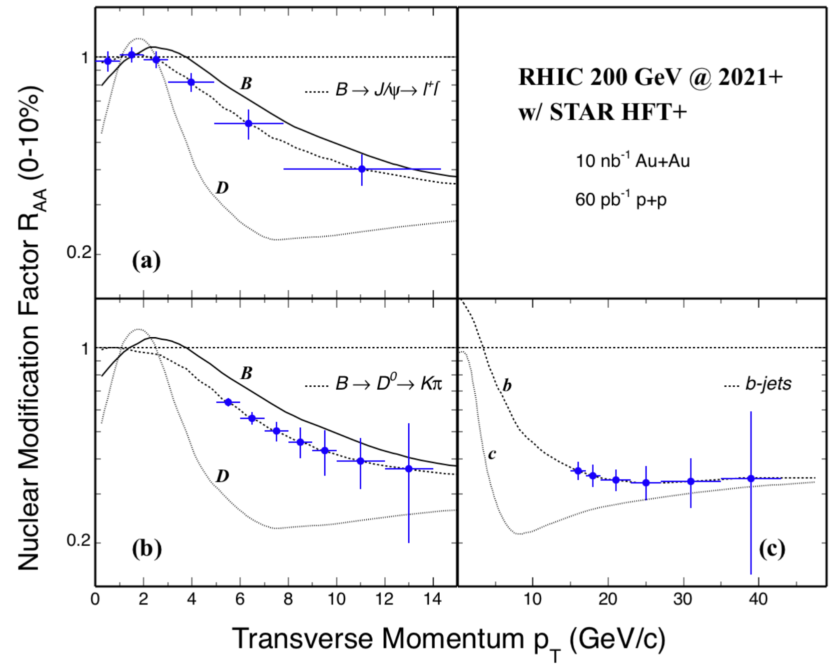
HFT+ simulation

Efficiency: fast vs. slow HFT



- HFT (~200 μs) → HFT+ (≤40 μs)

HFT+ flagship measurements



- R_{AA} for *J/ψ* and *D^0* from *B*, and *b-jets*

- The planned HFT+ program (2021-2022) is complementary to sPHENIX at RHIC and ALICE HF program at LHC

Future HFT+ Upgrade plan (2021-2022)

HFT+ upgrade motivation:

- Measure **bottom quark hadrons** at the RHIC energy
- Take data in **higher luminosity** with high efficiency

HFT+ detector requirements:

- **Faster** frame readout of 40 μs or less
- **Similar or better**: pointing resolution
  S/N ratio
  Total power consumption
  Radiation length

→ **ALICE ITS Upgrade** MAPS sensor

- **Compatible** with the existing insertion mechanism, support structure, air cooling system

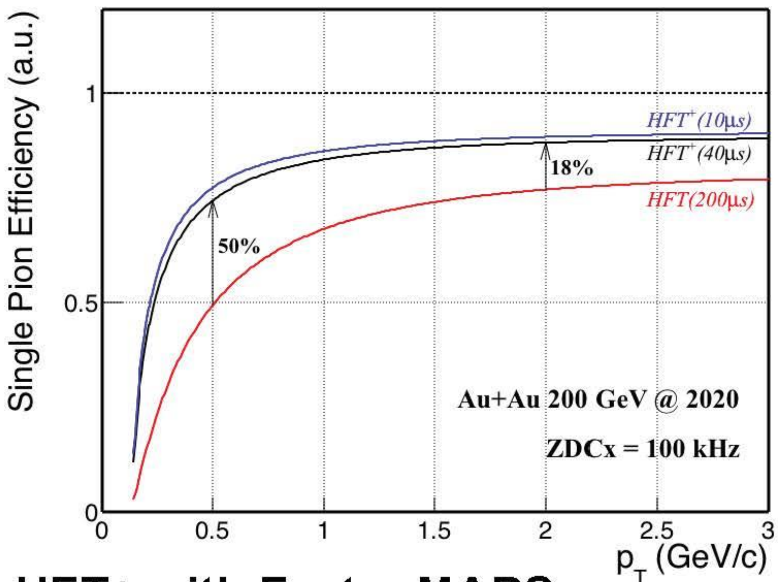
→ **STAR HFT** mechanics and services

HFT+ read-out electronics requirements:

- **Compatible** with STAR DAQ system and trigger

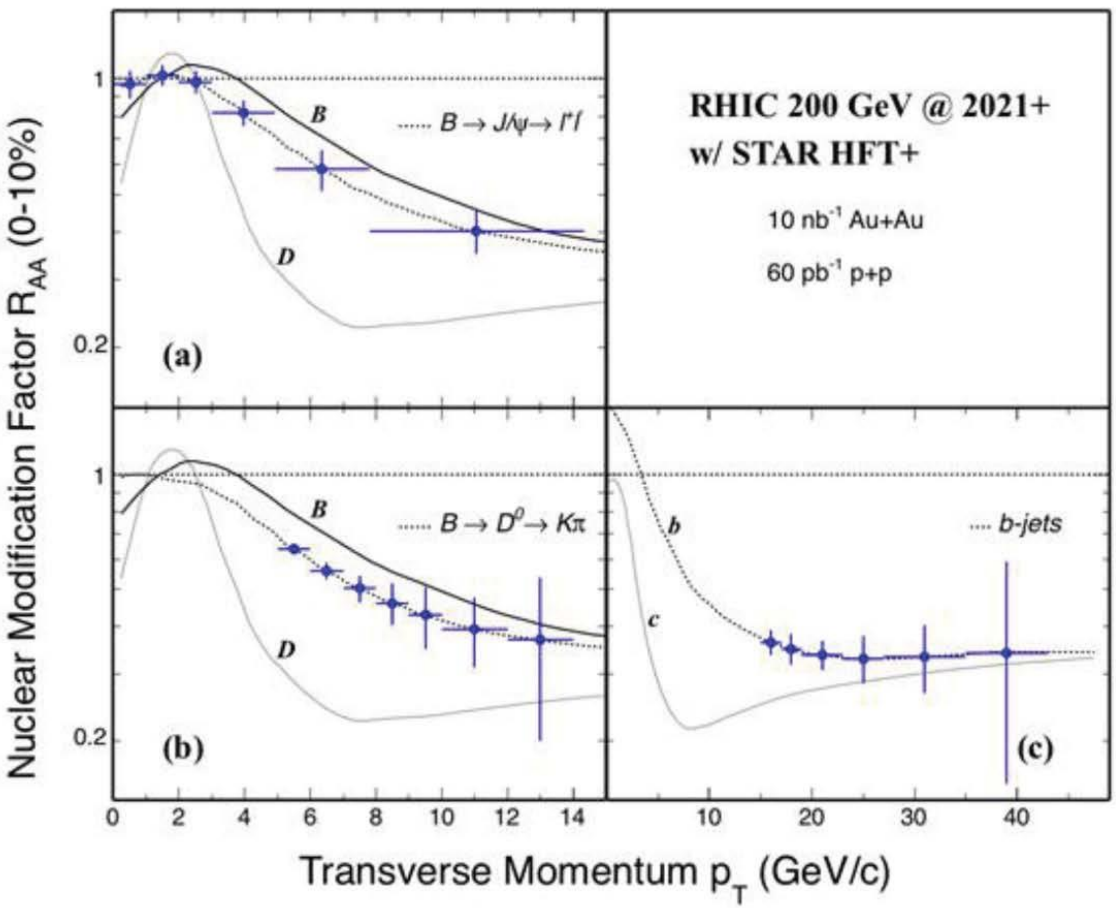
→ **STAR + ALICE** new development

STAR Heavy Flavor II (2021-2022)



HFT+ with Faster MAPS sensors

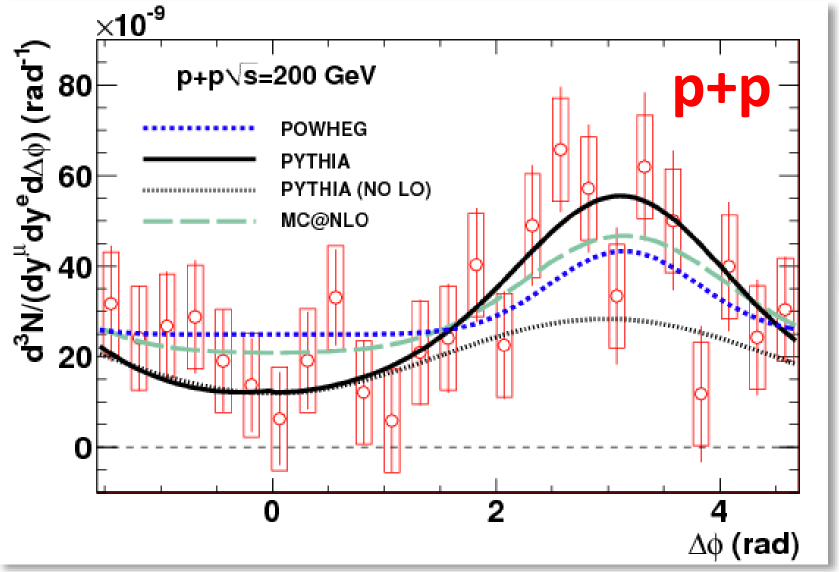
- integration time from ~185 μs to below 40 μs – less pile-up hits and thus better tracking efficiency
- use chips developed for ALICE ITS upgrade and existing HFT infrastructure – cost effective
- experienced team worked on HFT

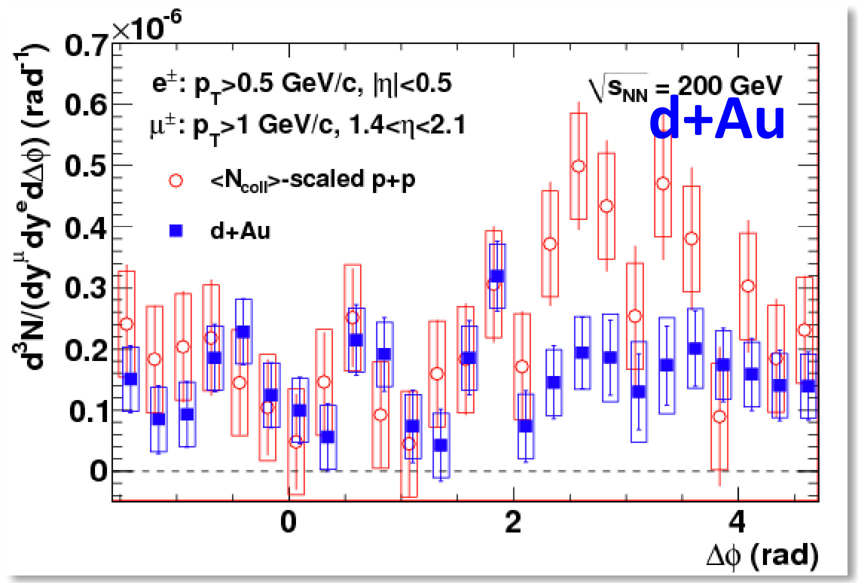


Projected R_{AA}(0-10%) stat. uncertainty for RHIC pp and AuAu running in 2021-22

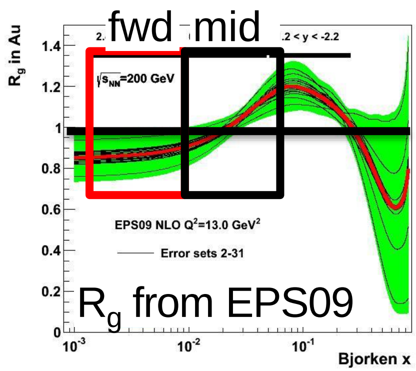
Precise bottom measurements with the HFT+ to complete the heavy flavor physics at RHIC. Complementary to ALICE HF and sPHENIX Jet and Upsilon programs.

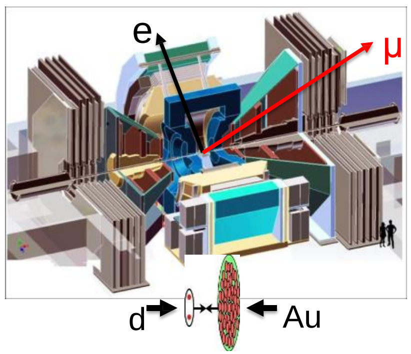
Electron-Muon Correlation@dAu200GeV





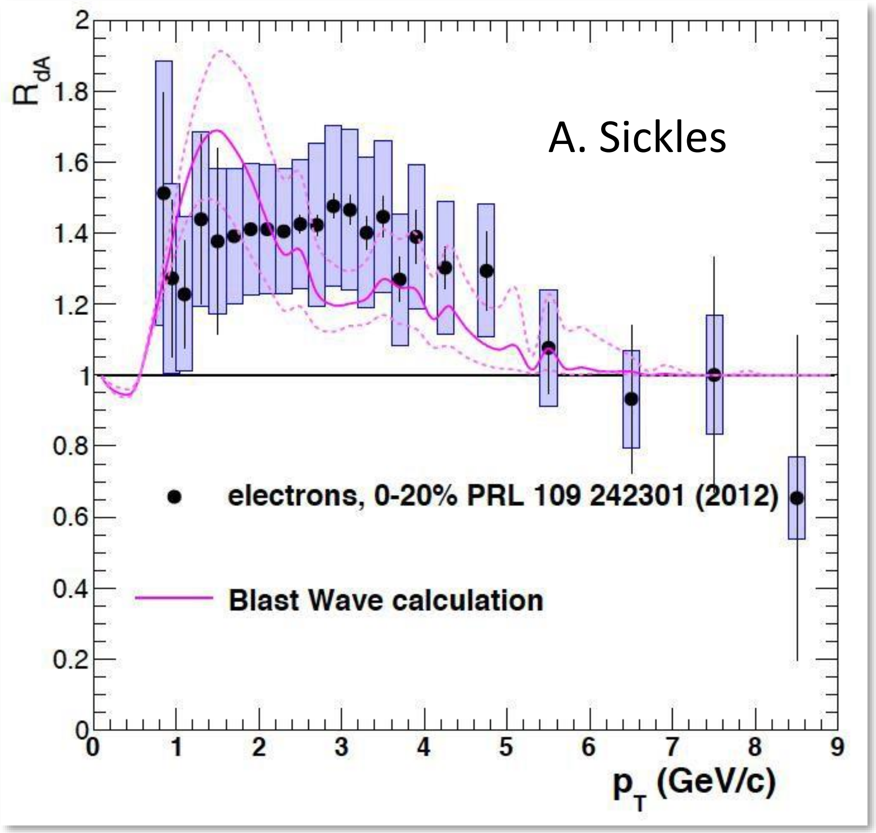
- pQCD-based models agree with the data in p+p collisions
- ***Clear suppression*** of e-mu correlation in d+Au collisions
  - CNM effects from heavy nuclei





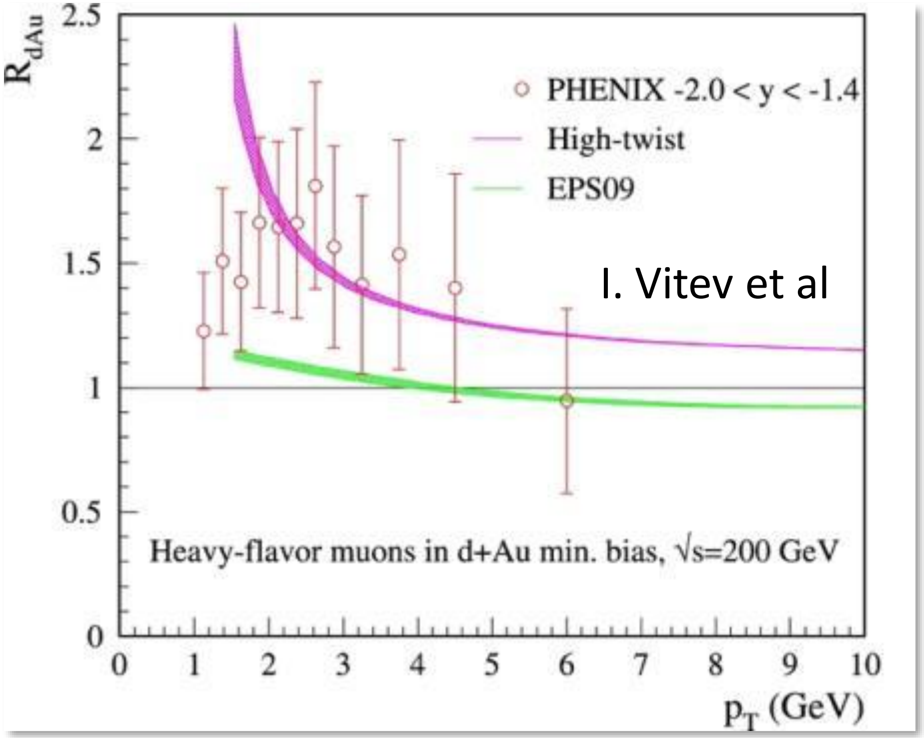
Phys. Rev. C. 89, 034915 (2014)

Models backward@dAu



Phys. Lett. B731 (2014) 51

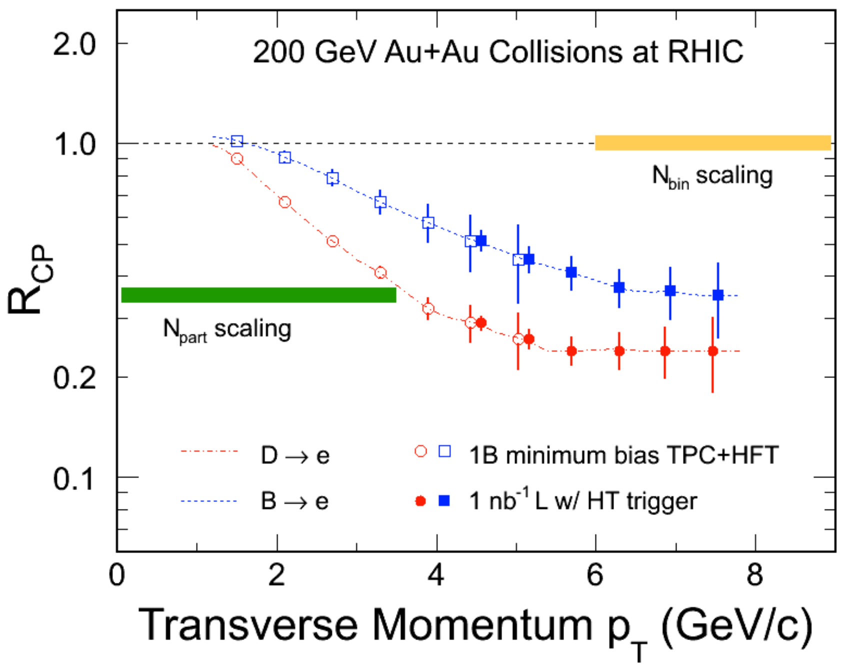
- Radial flow also qualitatively reproduce the enhancement

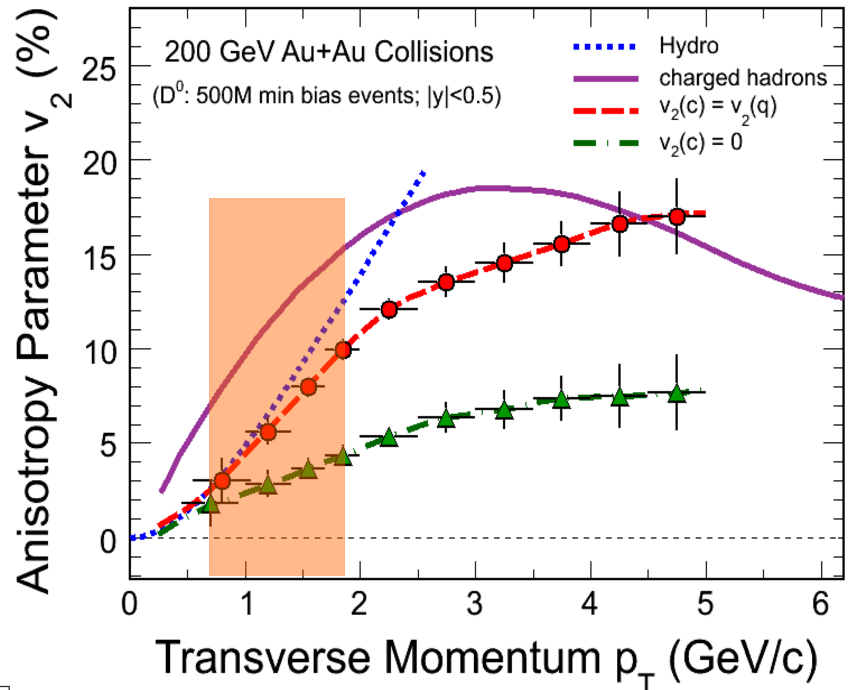


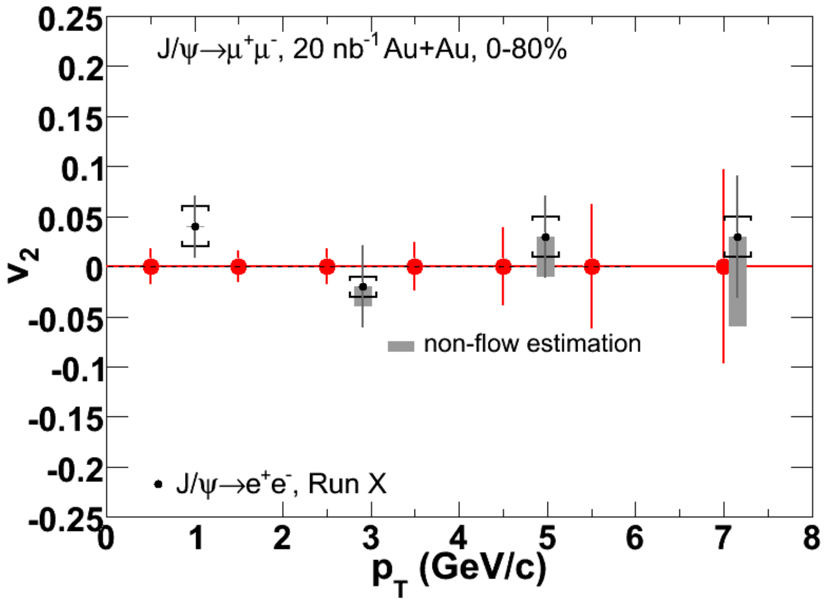
Phys. Lett. B740 (2015) 25

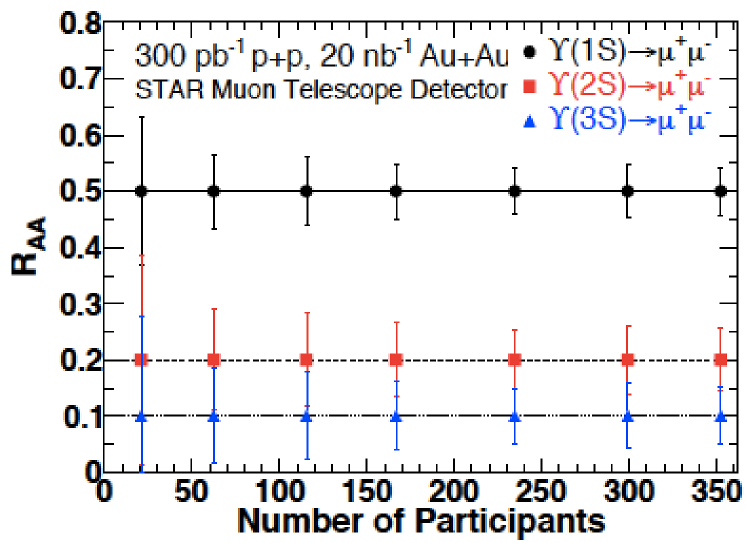
- pQCD calculation considering incoherent multiple scattering reproduce the enhancement at backward rapidity

Heavy flavor with HFT 2014-2016

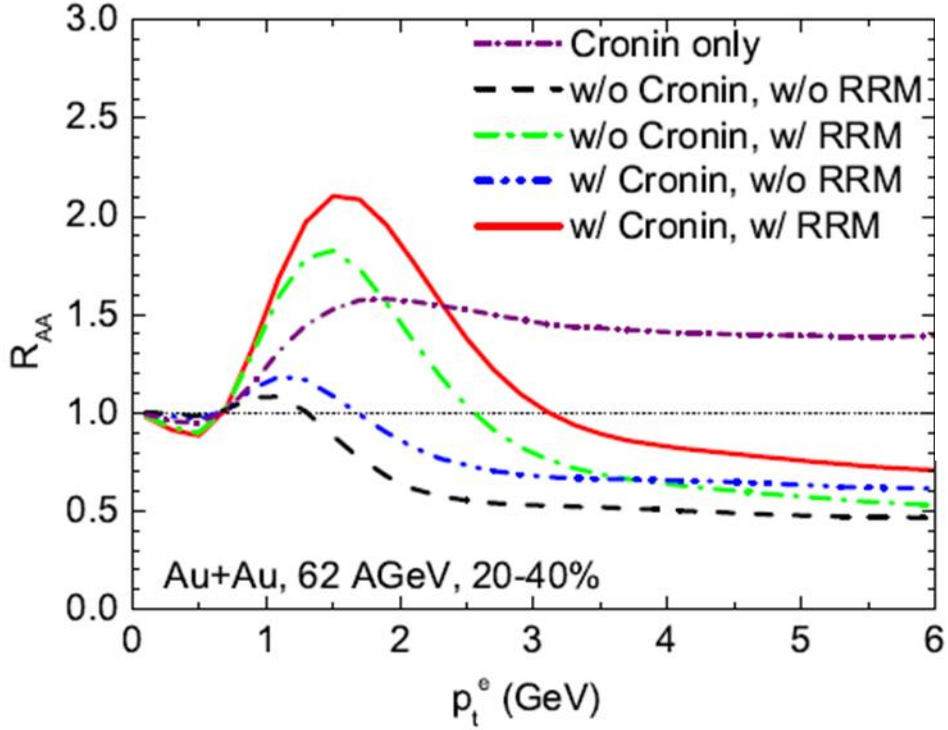


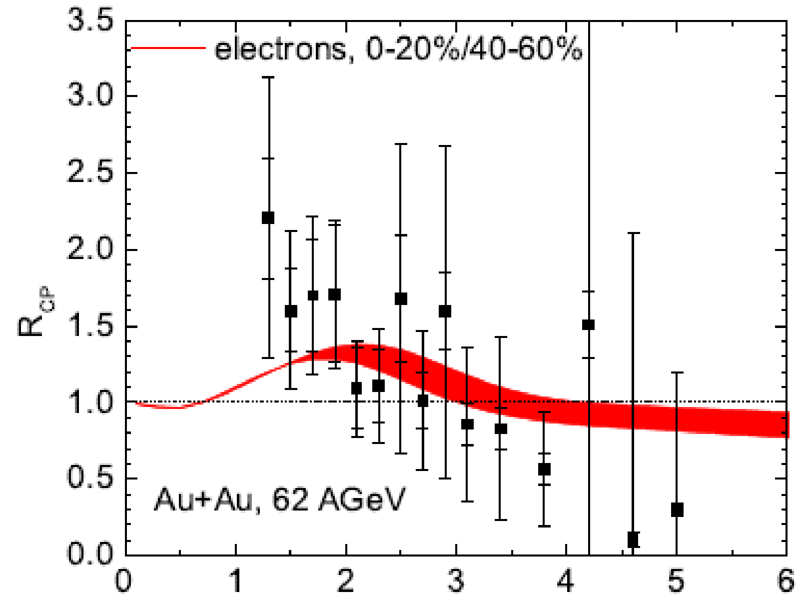


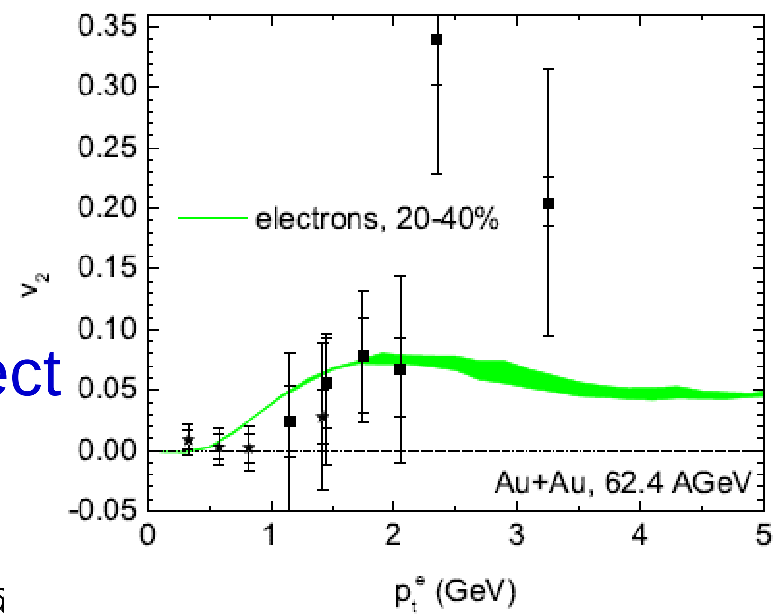




Ralf Rapp @ SaporeGravis workshop 2014



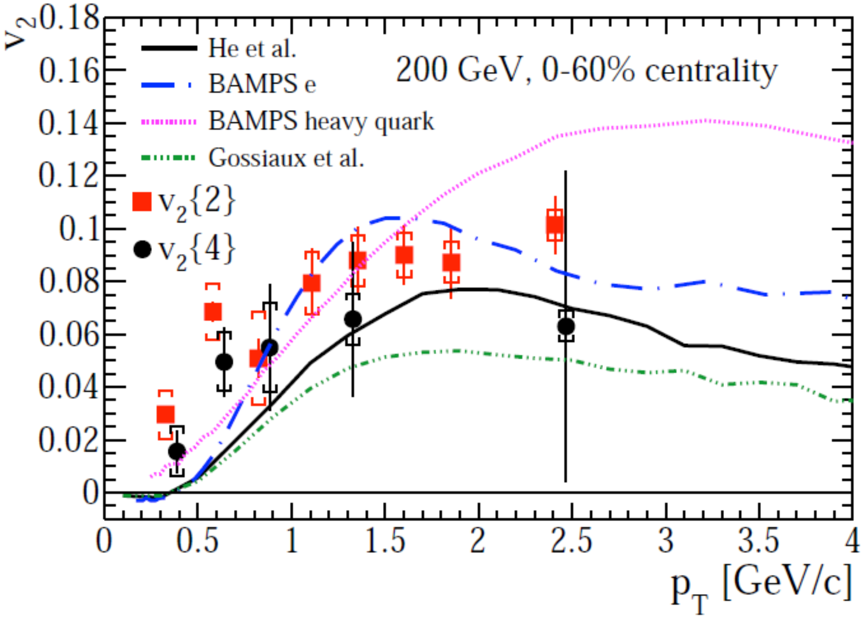


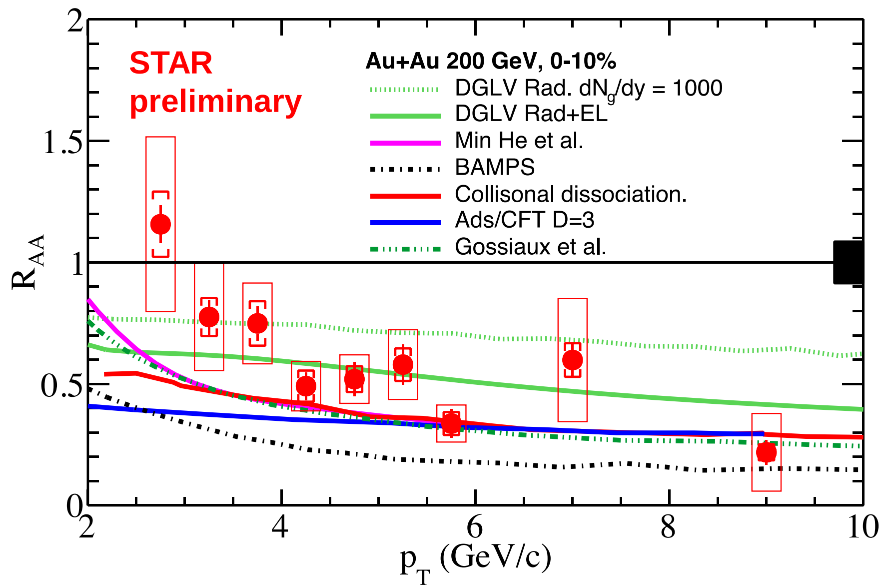


- importance of flow + Cronin effect at lower energies

Non-photonic electrons azimuthal anisotropy

STAR arXiv:1405.6348

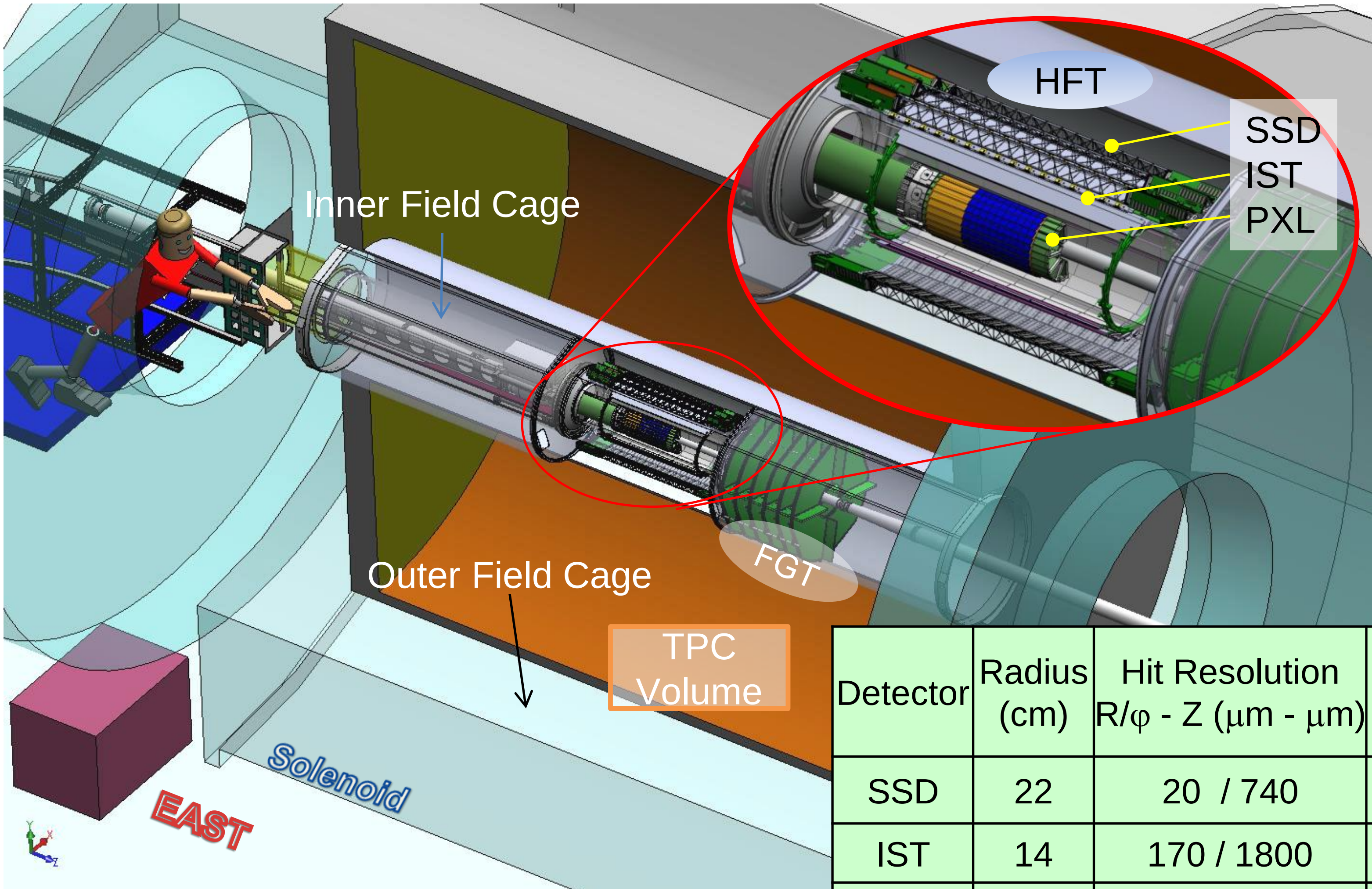




Anisotropy (v_2)

- Substantial elliptic flow of NPE is seen in 200 GeV Au+Au collisions.
- Models with strong charm medium coupling are consistent with the data within the current uncertainties.
- it’s challenging for models to describe suppression and flow at the same time.

Heavy Flavor Tracker



Detector	Radius (cm)	Hit Resolution R/φ - Z (μm - μm)	Radiation length
SSD	22	20 / 740	1% X_0
IST	14	170 / 1800	<1.5% X_0
PIXEL	8	12 / 12	~0.4% X_0
	2.5	12 / 12	~0.4% X_0

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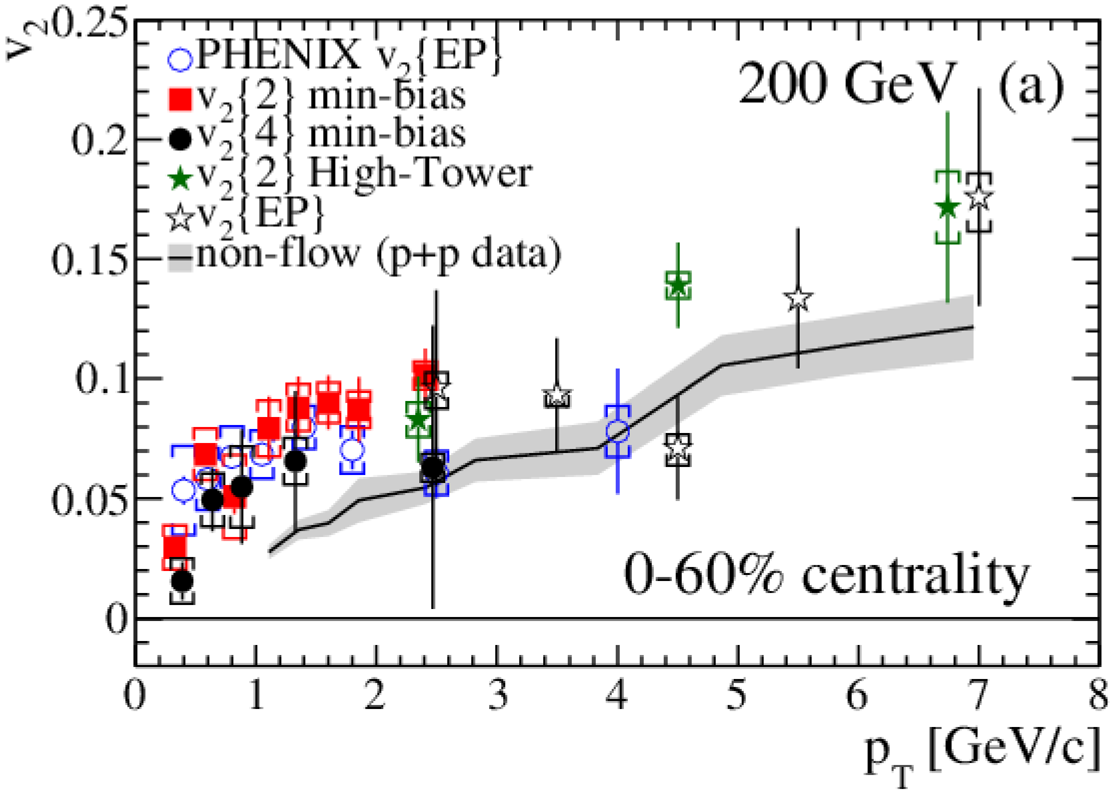
NPE flow in Au+Au 200 GeV

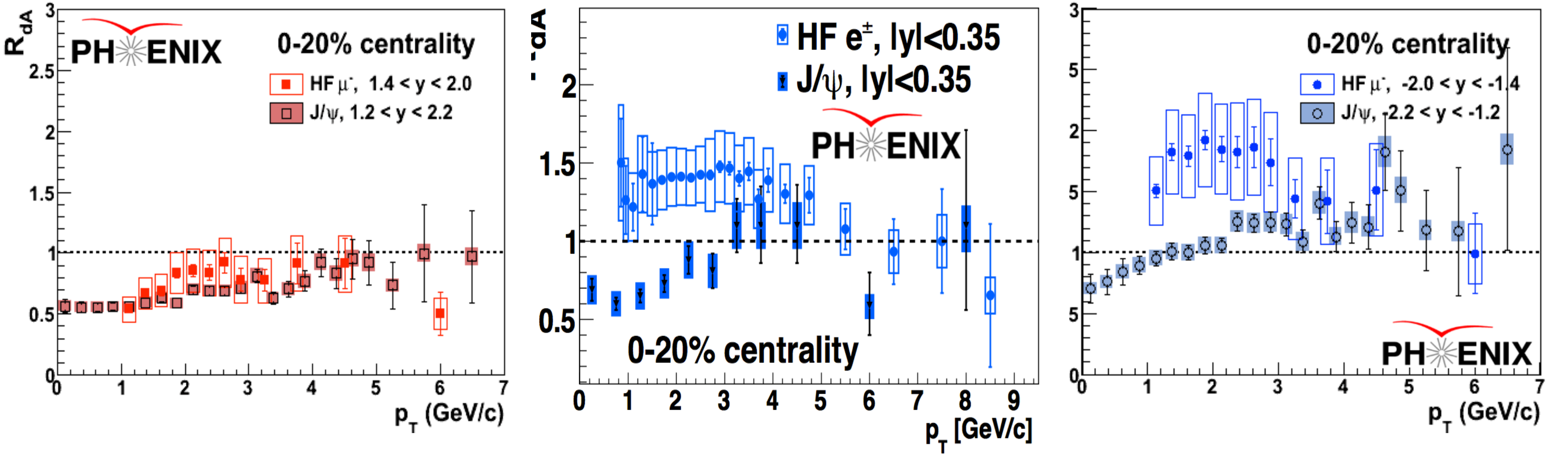


arXiv:1405.6348

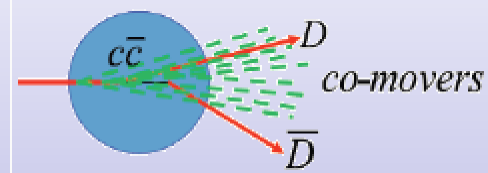
- Finite v2 at low and intermediate pT
- Increase of v2 at high pT likely due to jet-like correlation

Heavy Flavor Comparison with *J/ψ*

d-Going **Mid-Rapidity** **Au-Going**

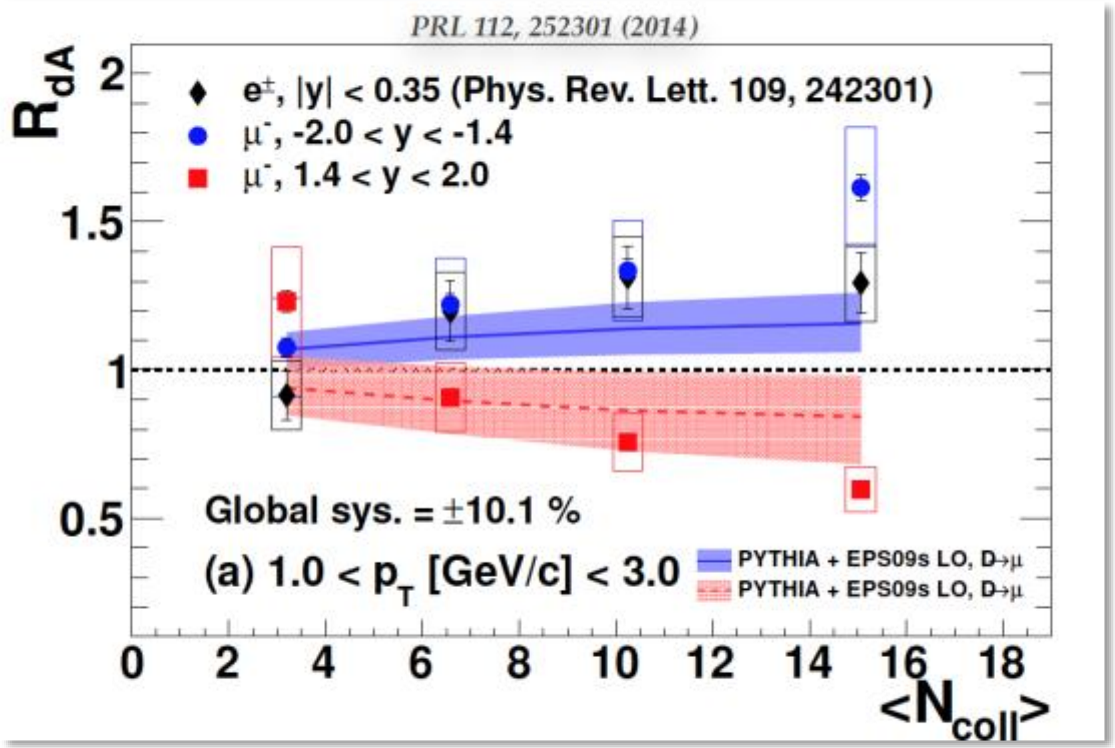


- Similar suppression at forward rapidity
  - Low co-mover density
  - Same suppression mechanism
- Different behavior at mid and backward rapidity
  - Different suppression mechanism
- Larger nuclear break-up effects at higher-density region



J/ψ: Phys. Rev. C. 87, 034904 (2013)

R_{dAu} v.s. N_{coll}

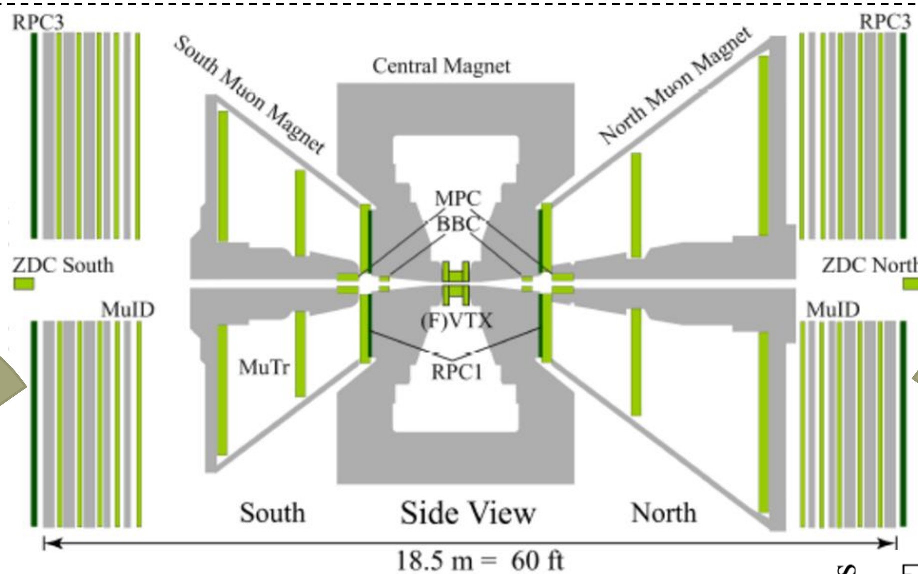


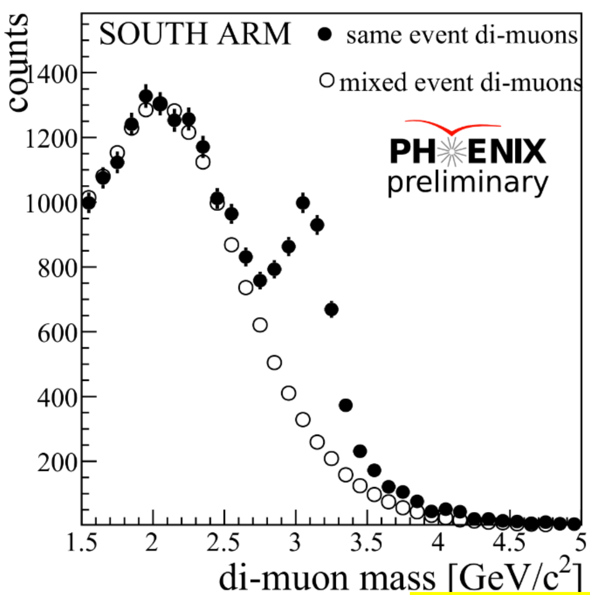
- **Peripheral** $R_{dA} \approx 1$
- **Central** Mid/Backward- $R_{dA} > 1$

  Forward-y $R_{dA} < 1$
- Difference Back/Forward beyond EPS09s nPDF

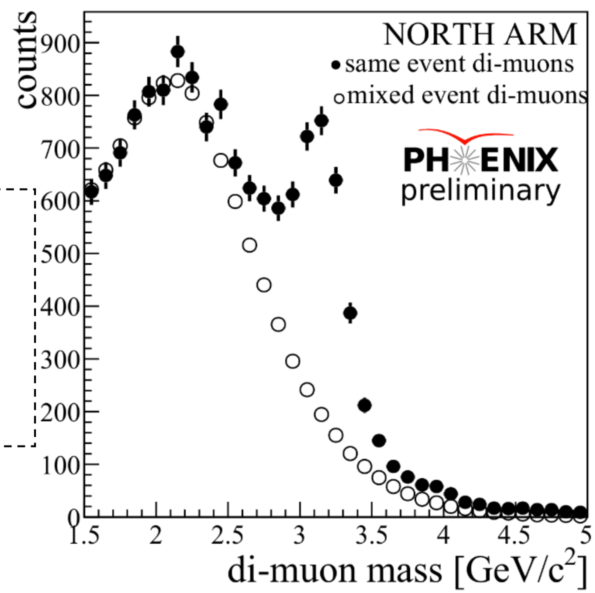
What NEW on Open Heavy Flavor?

First Results from the PHENIX FVTX: B-meson → J/ψ in Cu+Au 200 GeV





Using muon pairs in the J/ψ mass region an analysis was performed to determine the fraction from B → J/ψ decays



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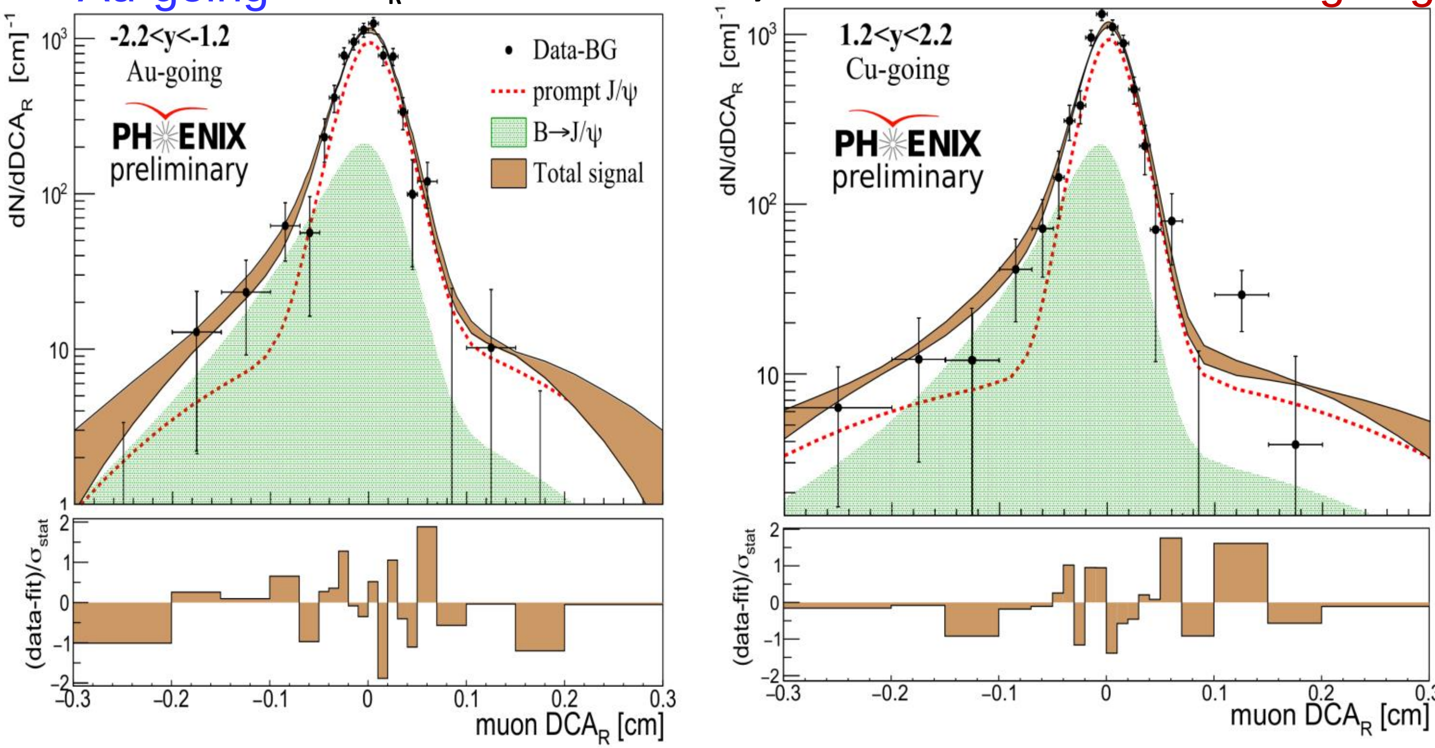
TAKEN FROM RACHID NOUICER SQM 2016 TALK

What NEW on Open Heavy Flavor?

First Results from the PHENIX FVTX: B-meson → J/ψ in Cu+Au 200 GeV

B→ J/ψ prompt J/ψ separation through DCA_R

Au-going **DCA_R Distributions for clarity are shown BG subtracted** Cu-going



- Prompt J/ψ and B-> J/ψ DCA_R template shapes, determined using MC simulations, were used in the fit.

- The sum of the DCA_R contributions agrees well with the data as shown in the bottom panel.

BROOKHAVEN NATIONAL LABORATORY

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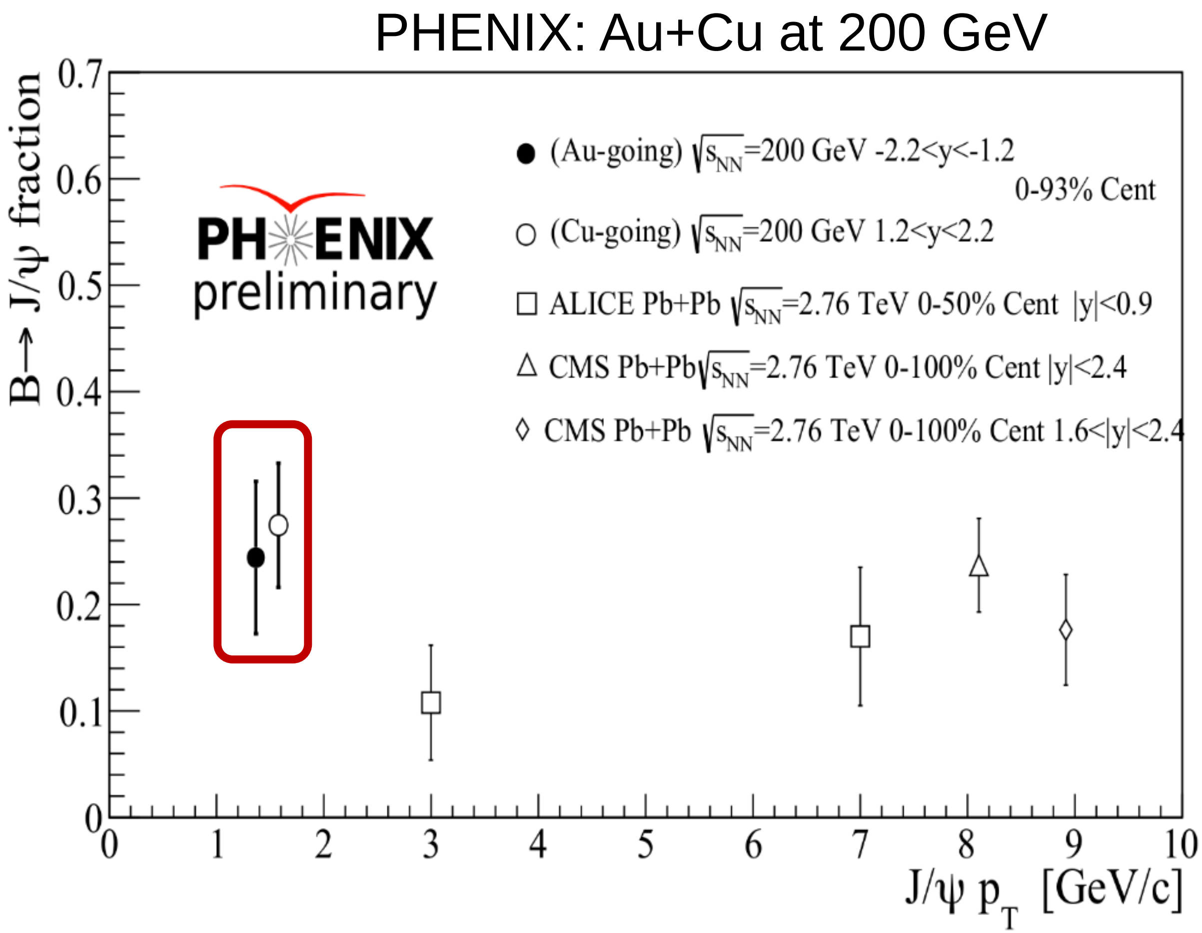
B->J/ψ fraction

- $F_{B\rightarrow J/\psi}$ was determined for both the gold and copper going directions.

- The B−meson fraction is larger in Cu+Au collisions because integrated pT and centrality B−mesons are less suppressed than prompt J/ψ



What NEW on Open Heavy Flavor?

NEW!

First Results from the PHENIX FVTX: B-meson → J/ψ in p+p 510 GeV

B->J/ψ fraction

The fraction of B-mesons in J/psi yields is of around 10%, in accordance with world data.

The B →J/ψ fraction does not have the energy dependence for J/ψ $p_T < 5$ GeV/c region.

PHENIX: p+p at 510 GeV compared to word data