Collectivity in d+Au? Recent results from PHENIX

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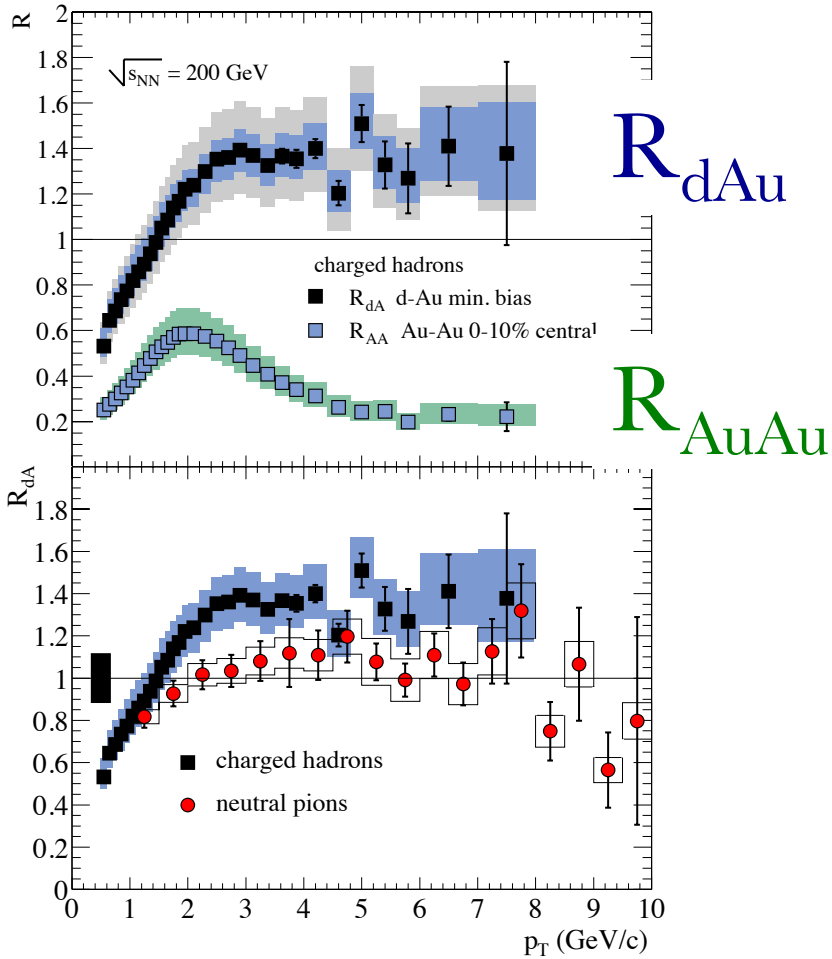
Oak Ridge National Lab

RHIC/AGS Users' Meeting June 18, 2014

A funny thing happened…

…on the way to the control example.



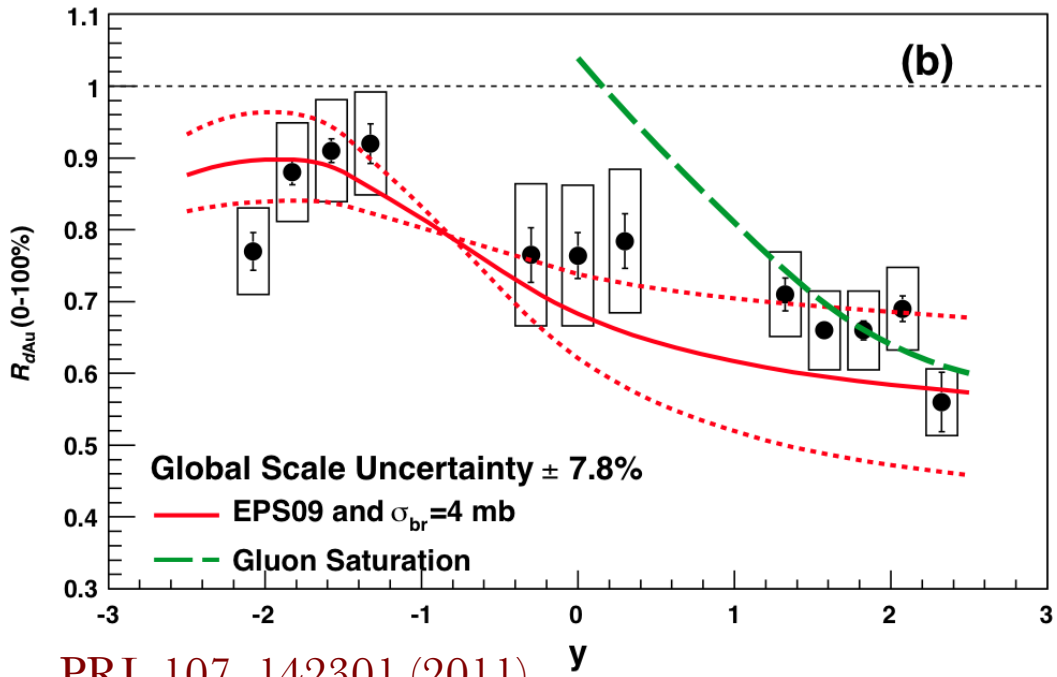
PRL 91, 072303 (2003)

Idea: d+Au is just like N+N except for initial-state/ CNM effects on partons.

2003: d+Au does not show jet quenching! There was much rejoicing!

But: That simple picture is breaking down…

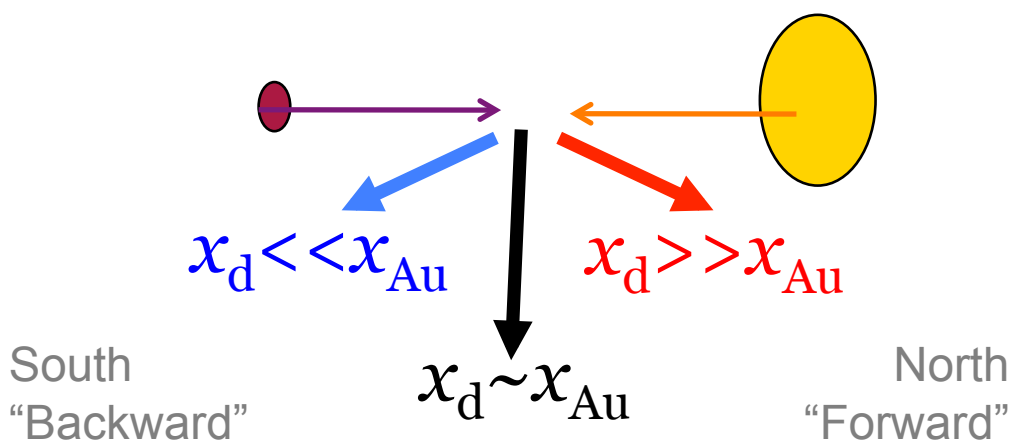
d+Au to forward/backward J/Psi



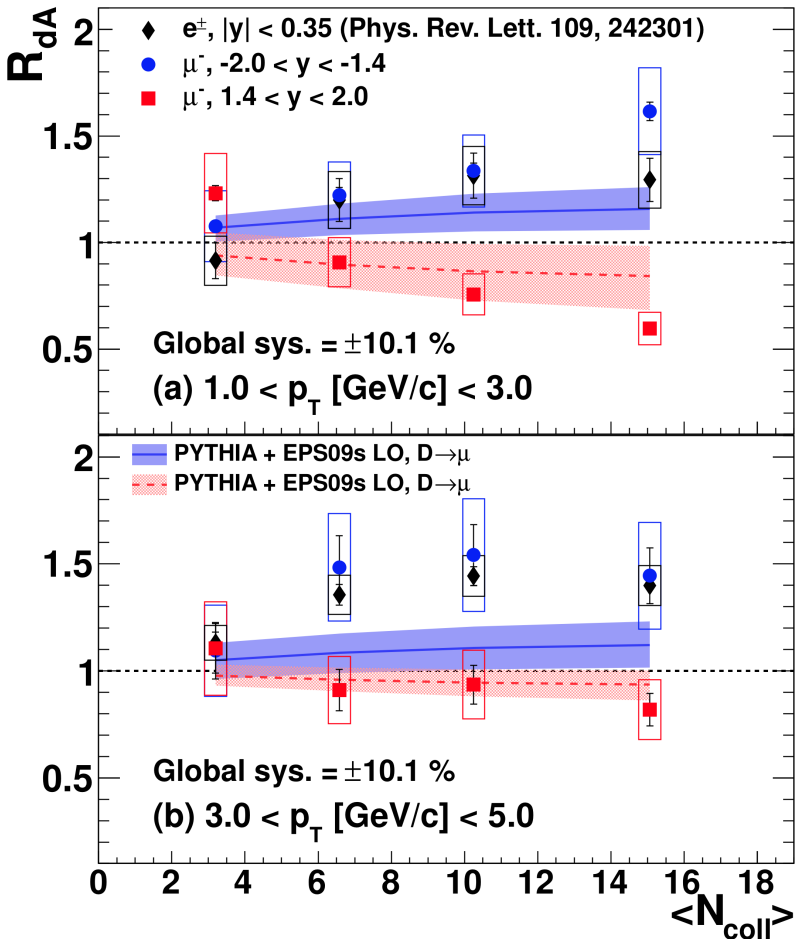
PRL 107, 142301 (2011)

R_{dAu} for J/Psi in min-bias d+Au

For inclusive d+Au, CNM modifications capture forward/ backward difference (but geometry dependence is harder).



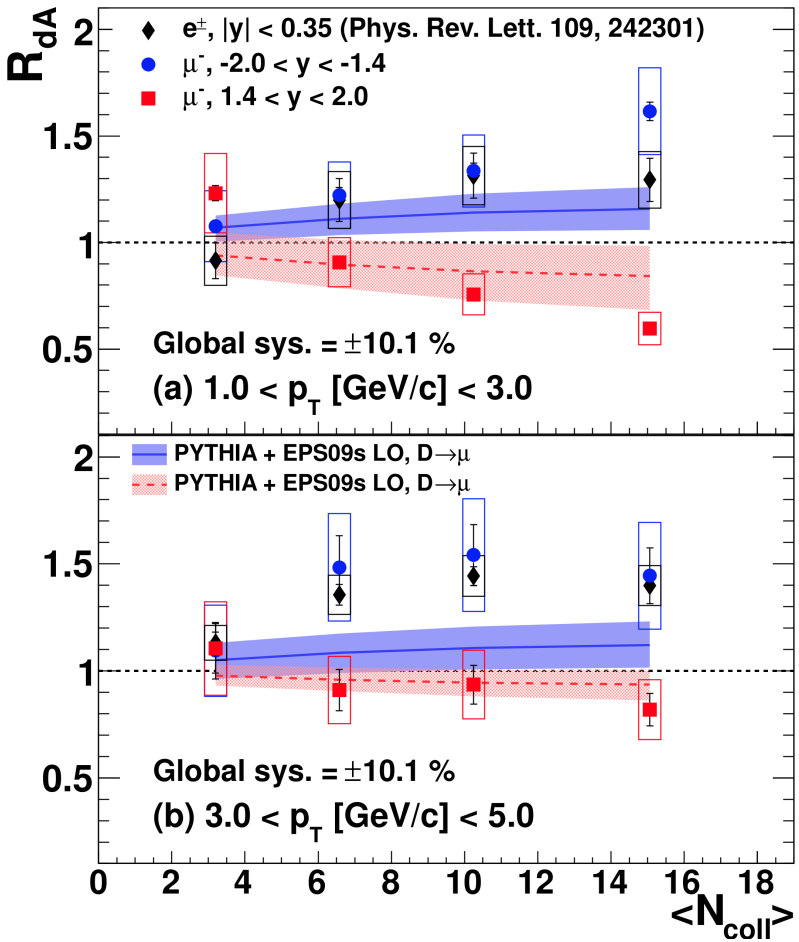
Heavy flavor leptons, forward/back

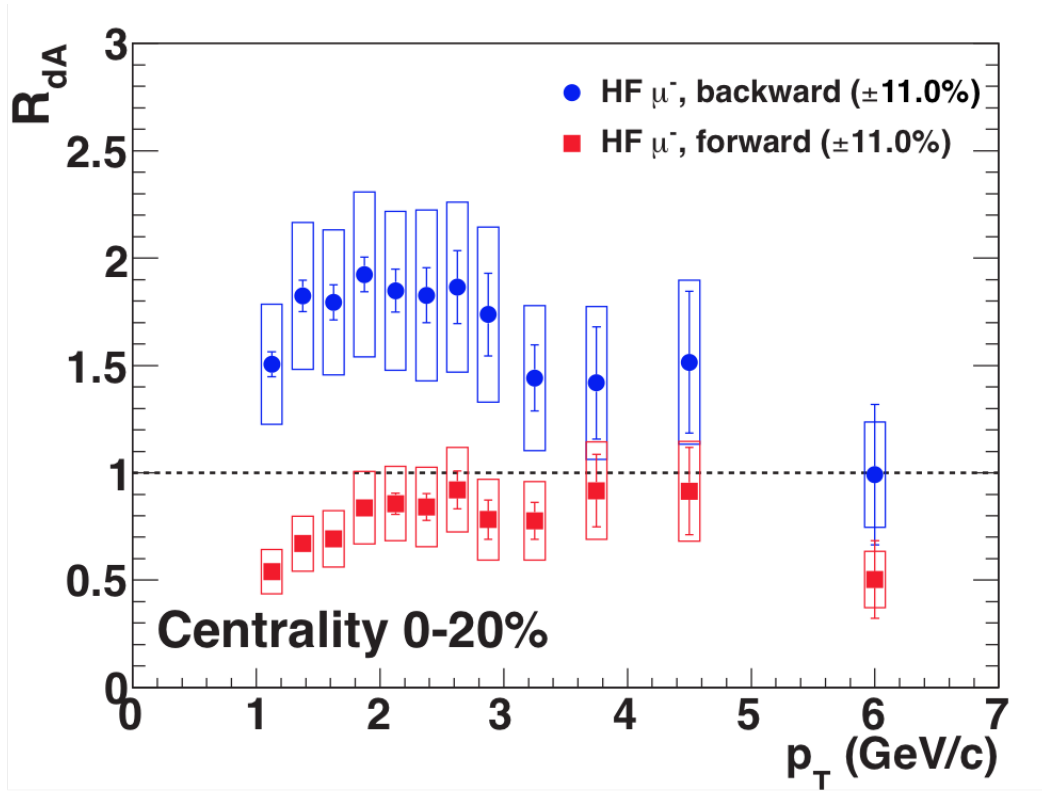


Forward-backward difference seen, but larger than from EPS09

arXiv:1310.1005

Heavy flavor leptons, forward/back





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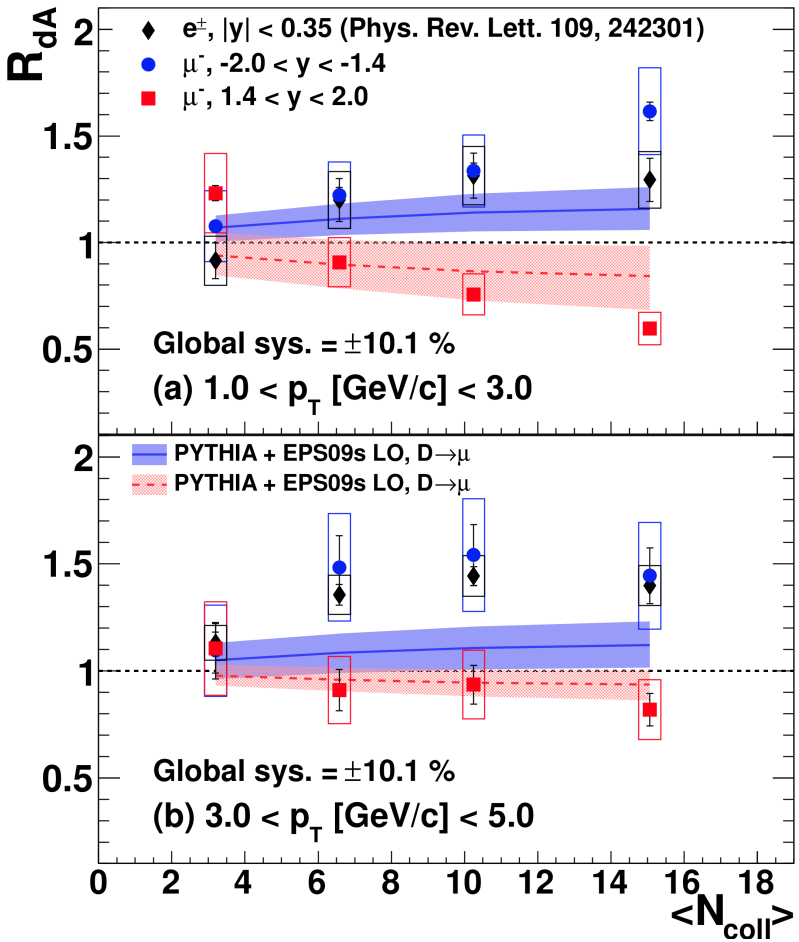
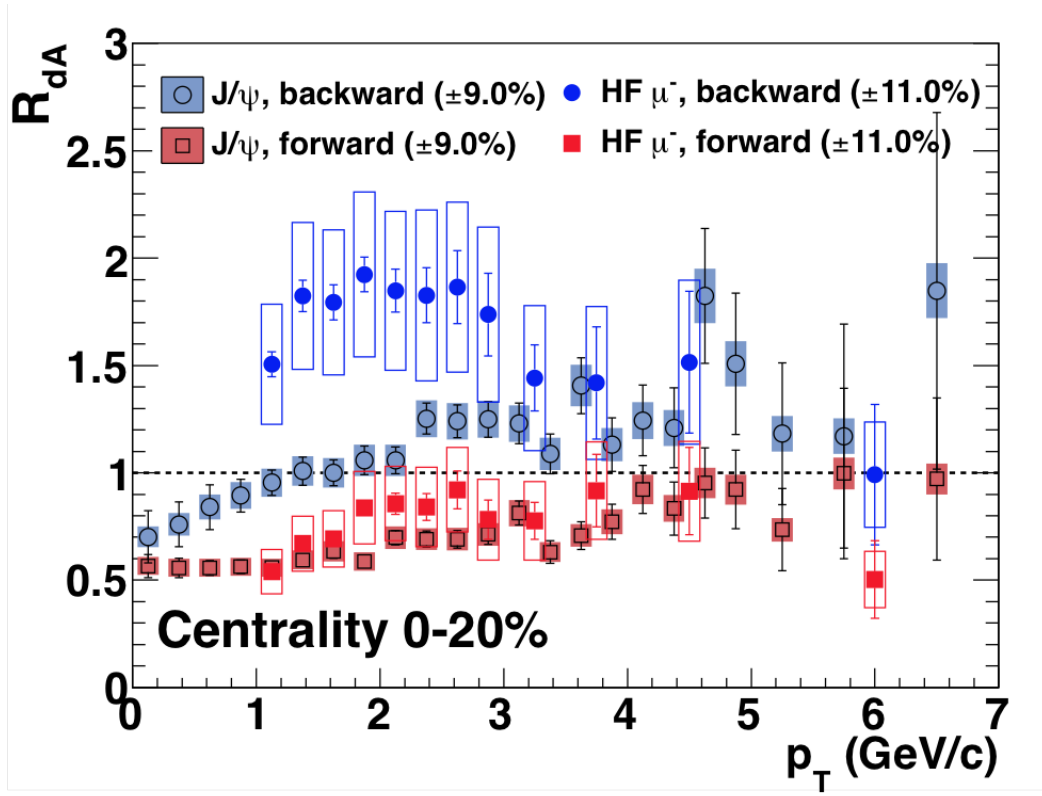




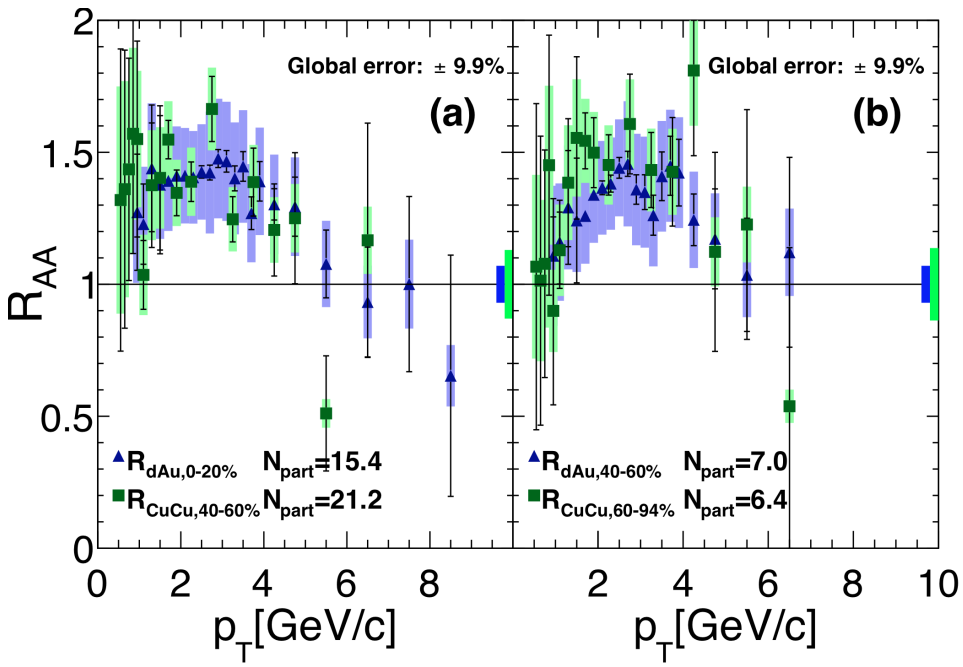
Backward, Au-going effect larger for HF than for J/Psi

arXiv:1310.1005

Charm boost follows N_{Part}

Heavy-flavor electrons in three systems

d+Au meets Cu+Cu



arXiv:1310.8286

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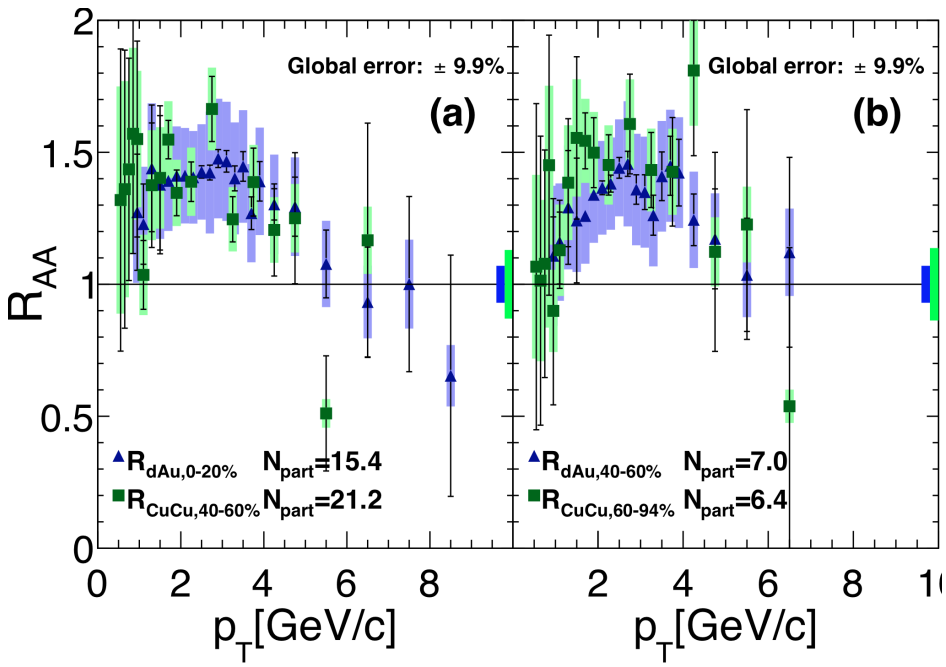
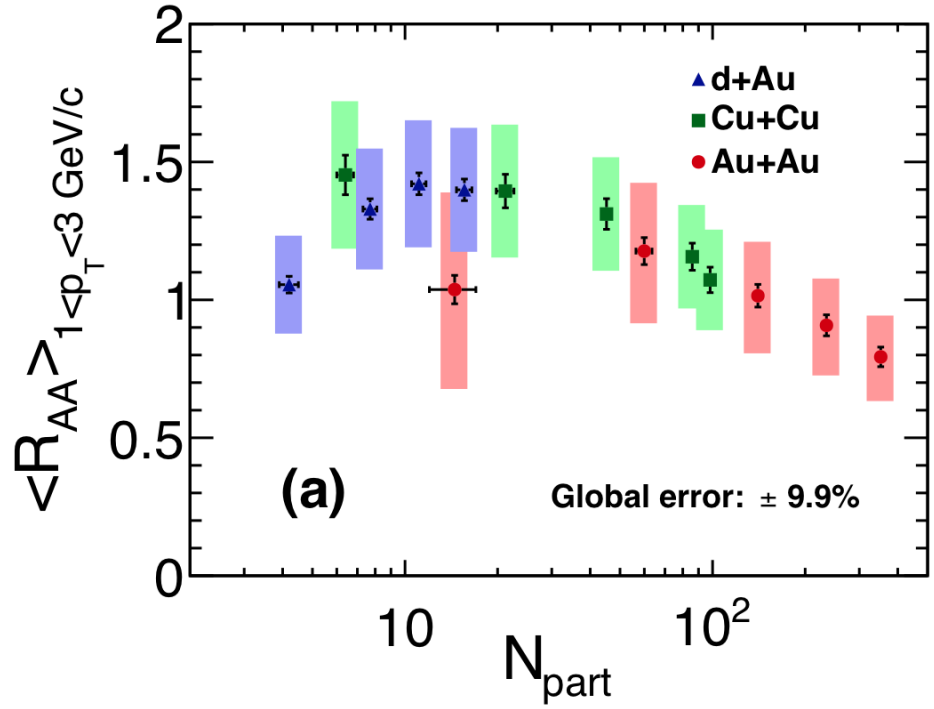
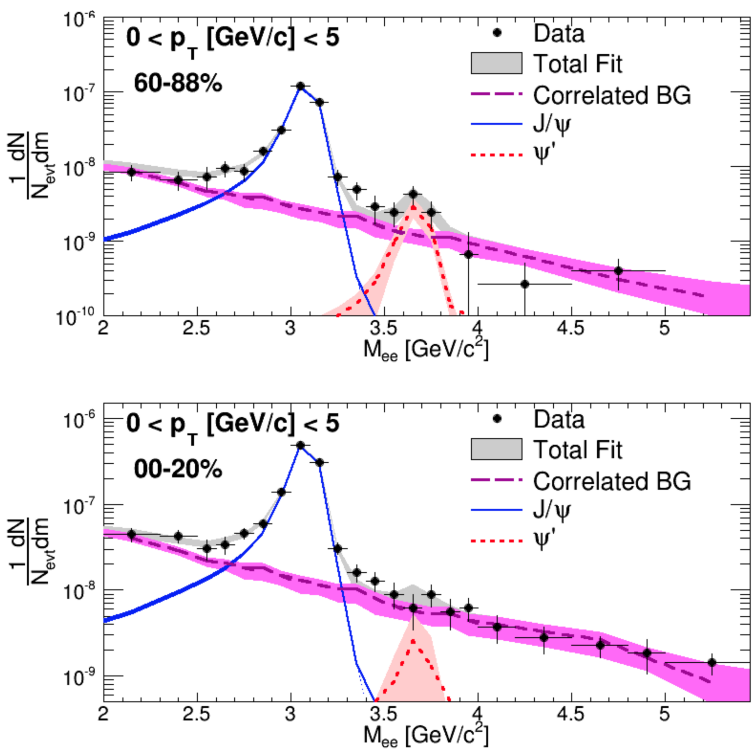




arXiv:1310.8286

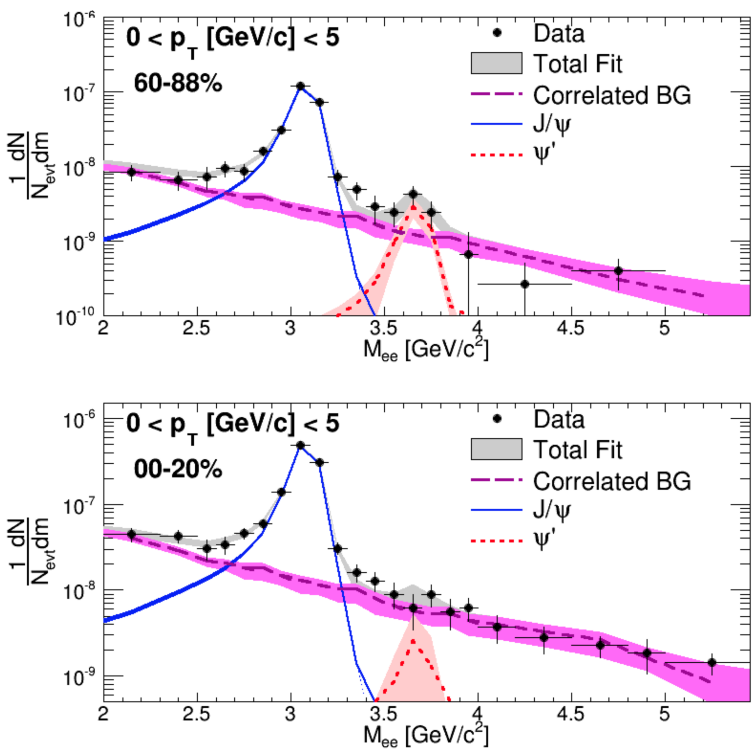
Single charm is pushed but never destroyed; is trend with N_{Part} indicative of medium effect?

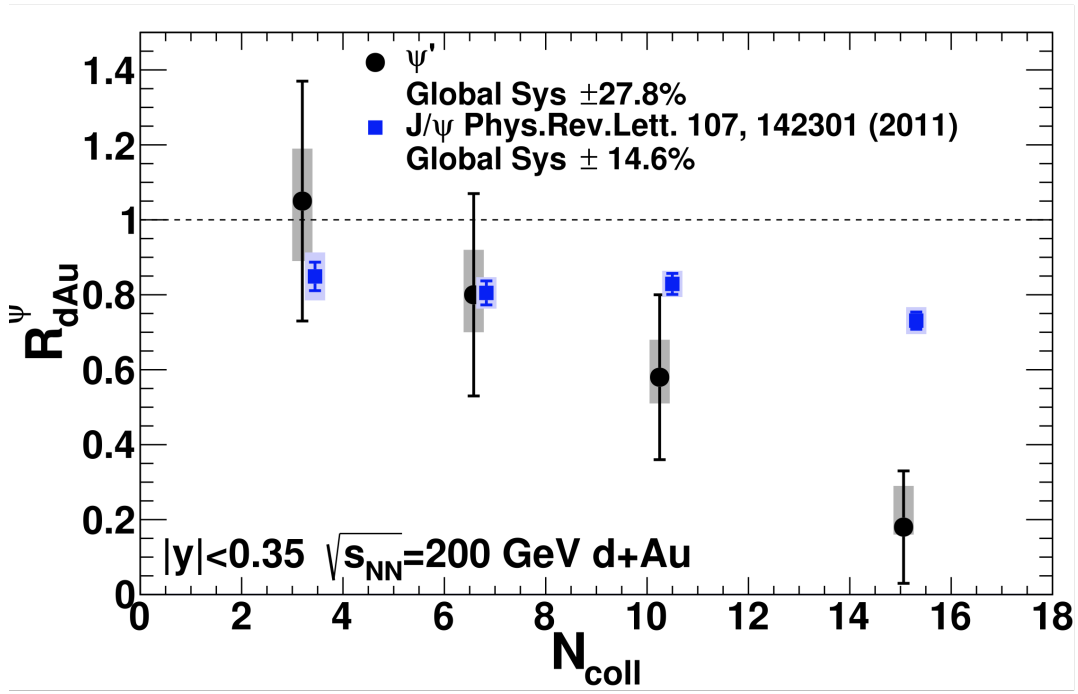
Psi' (over?) suppression in d+Au



PRL 111, 202301 (2013)

Psi' (over?) suppression in d+Au

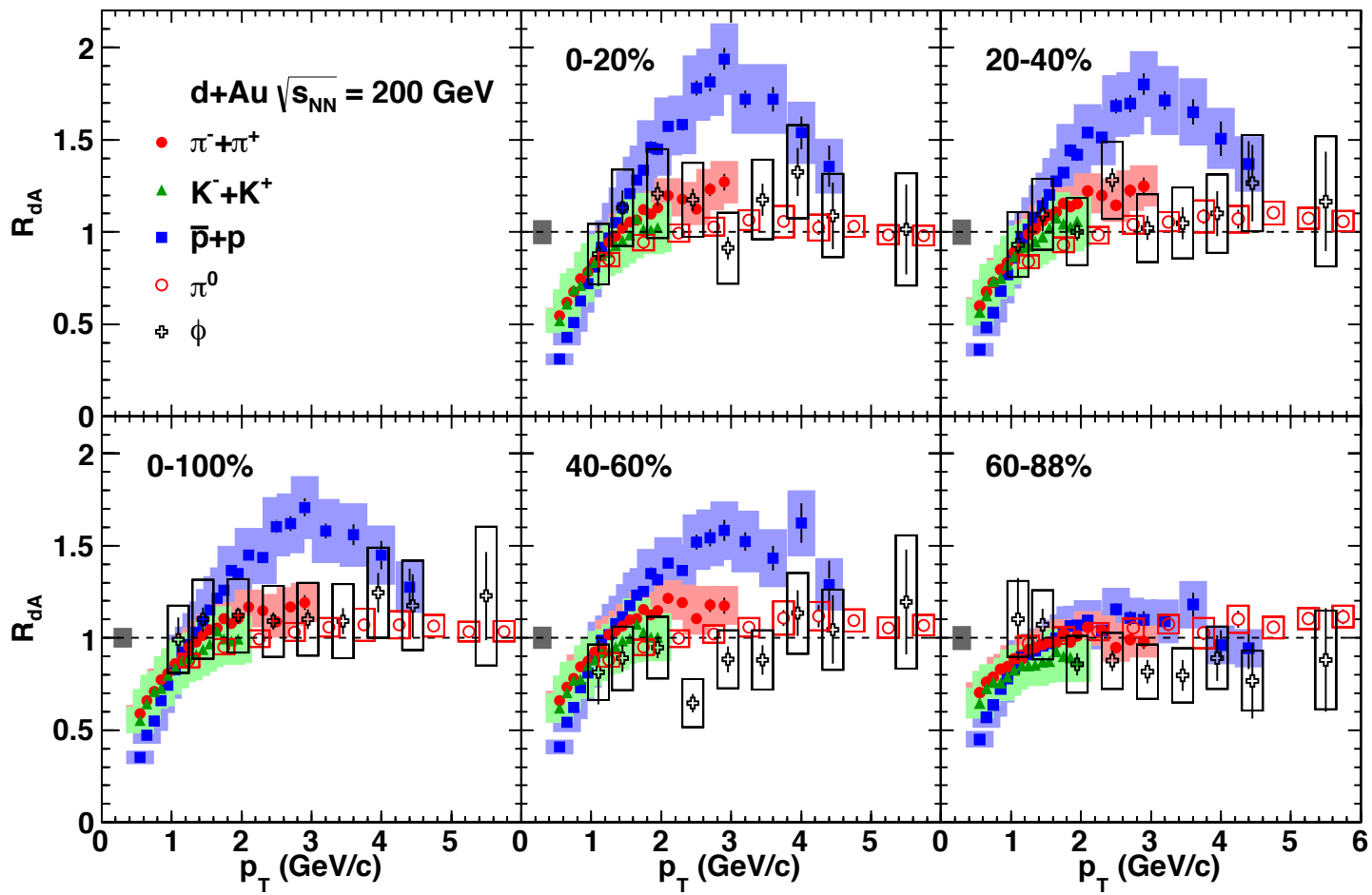




Relative suppression of Psi' compared to J/Psi – is it a created medium effect?

PRL 111, 202301 (2013)

Light hadrons Cronin rides again?



Phys. Rev. C 88, 024906 (2013)

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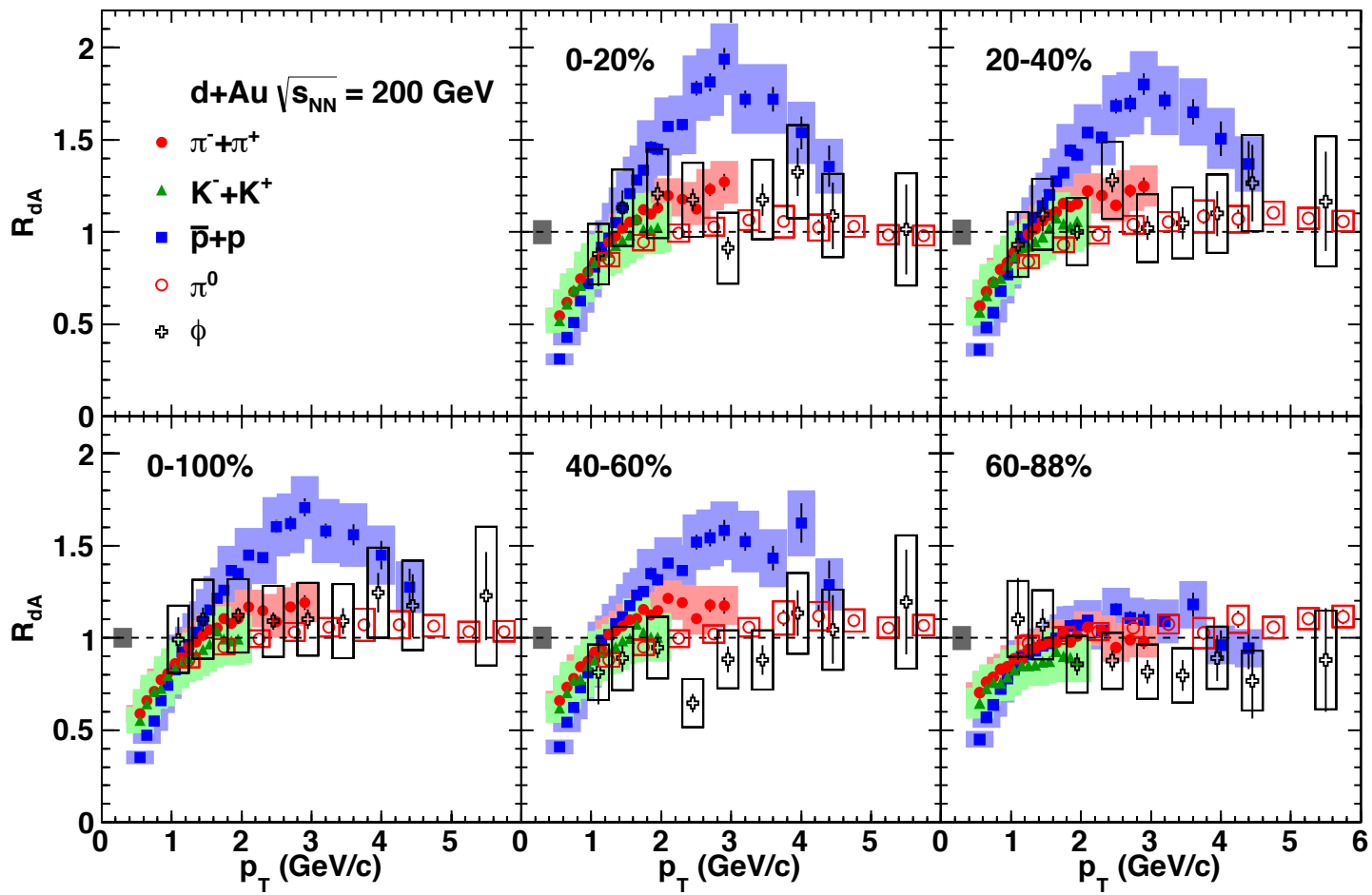


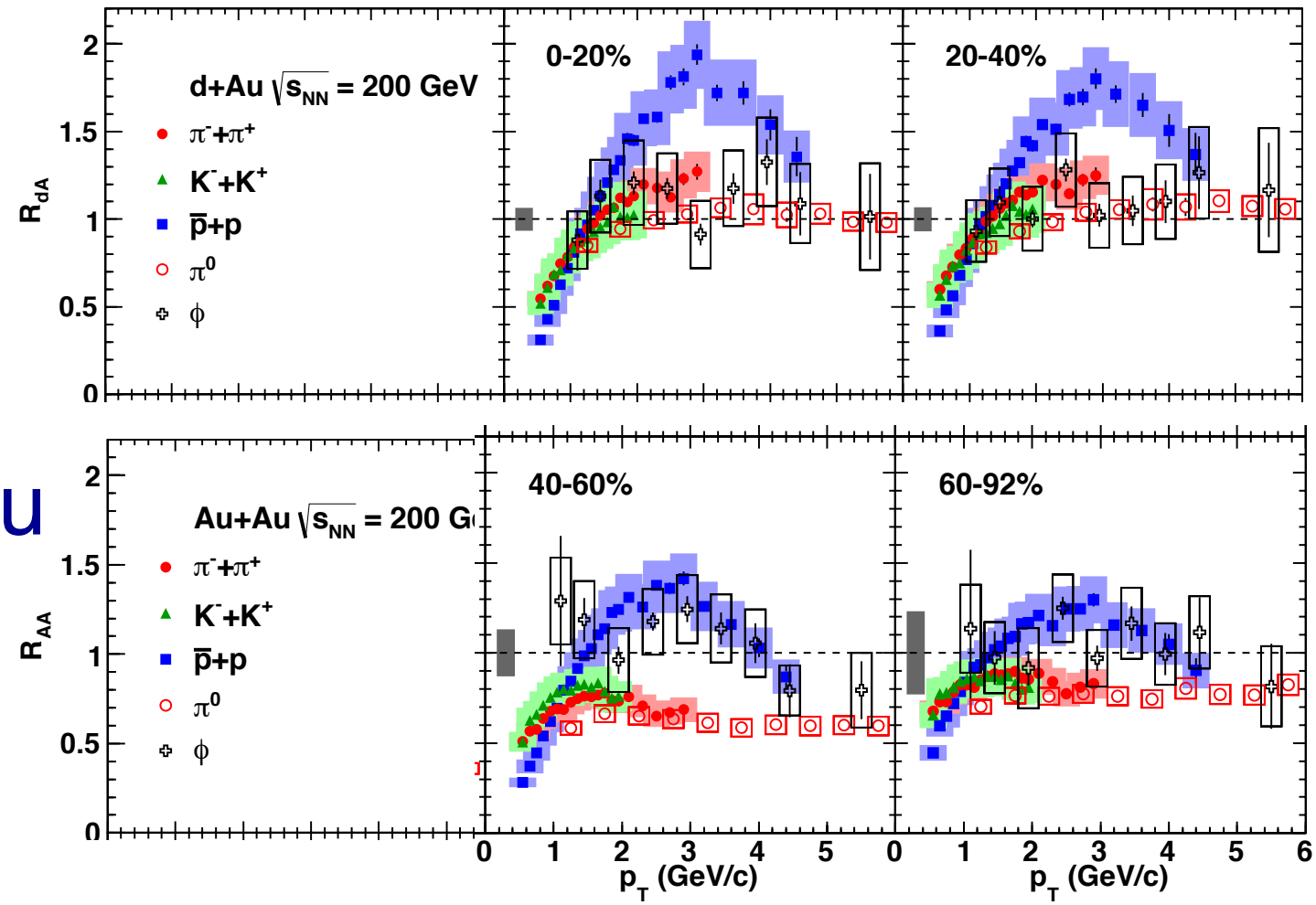
Dramatic baryon enhancement: recombination from a medium?

Phys. Rev. C 88, 024906 (2013)

Central d+Au *vs* Periph Au+Au

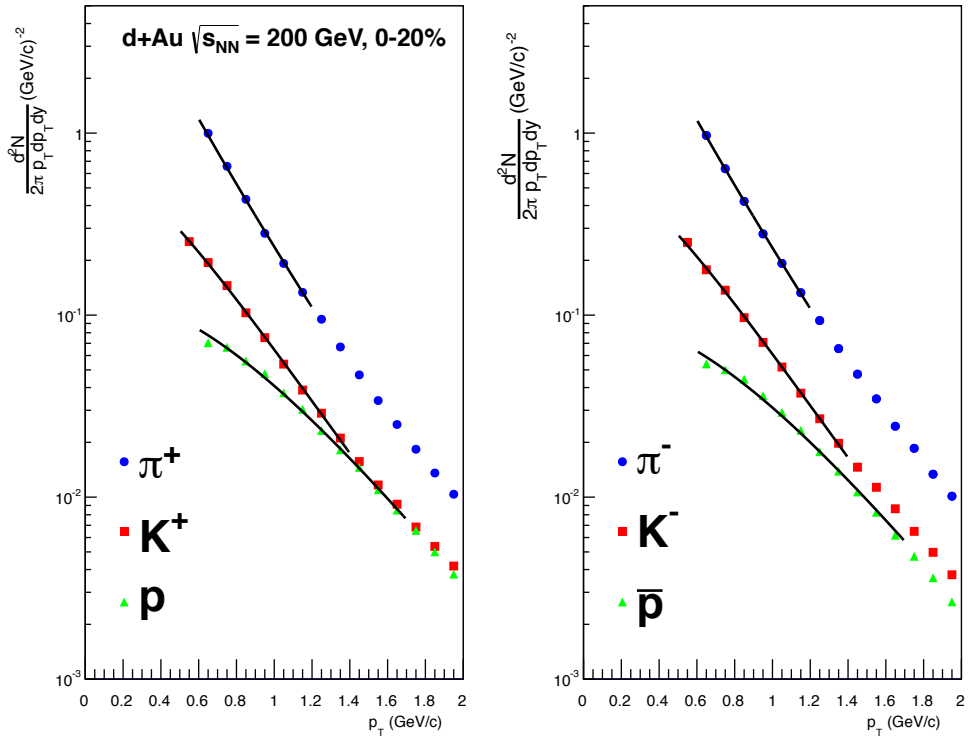
d+Au

Au+Au



Phys. Rev. C 88, 024906 (2013)

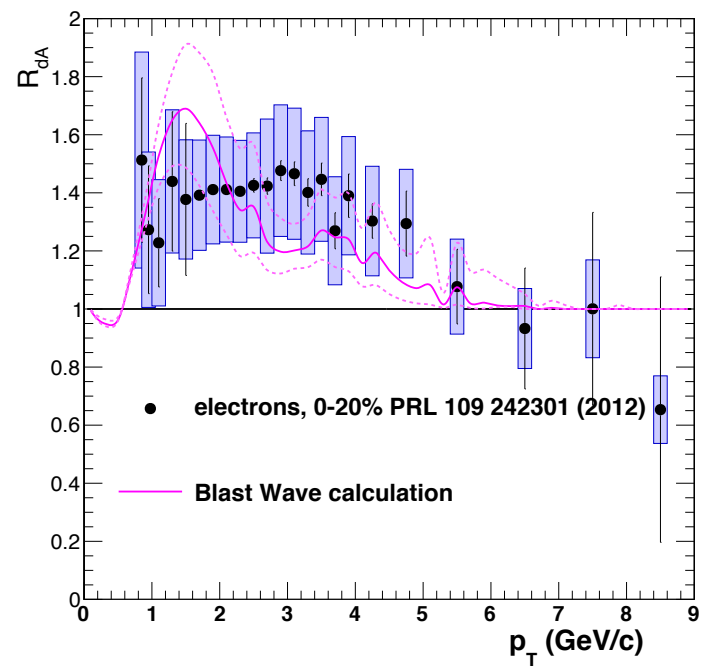
Radial flow in d+Au?



Blast-wave fits to identified light hadron spectra

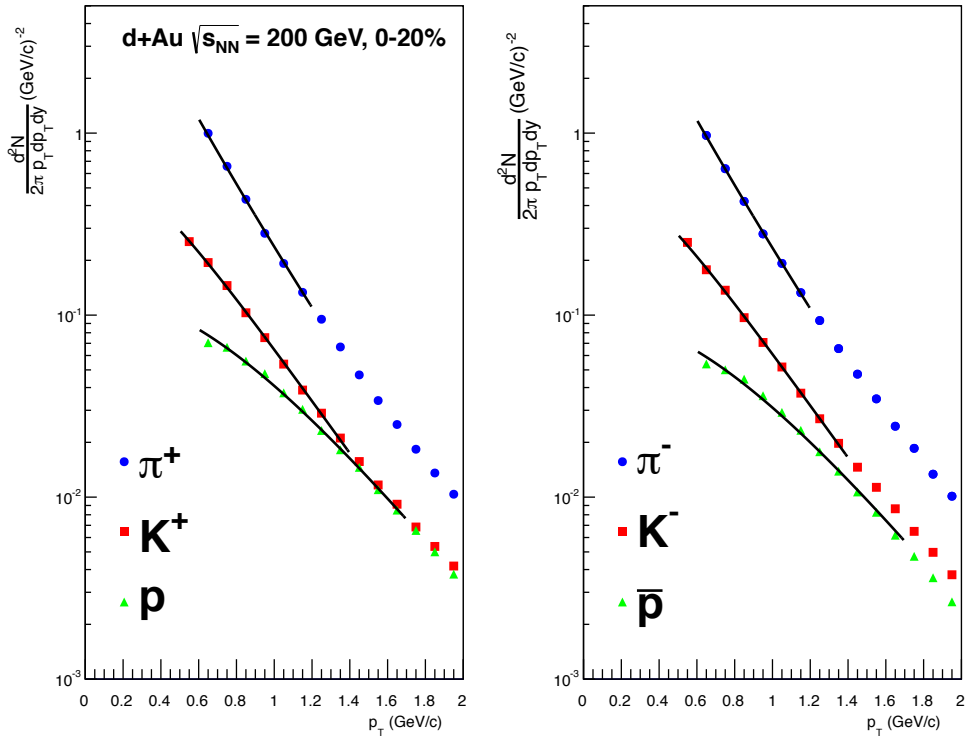
A. Sickles, Phys. Lett. B731 51-56 (2014), "Possible Evidence for Radial Flow of Heavy Mesons in d+Au Collisions"

Was it the source of the Cronin effect?



Heavy-flavor (charm) electron R_{dAu}

Radial flow in d+Au?



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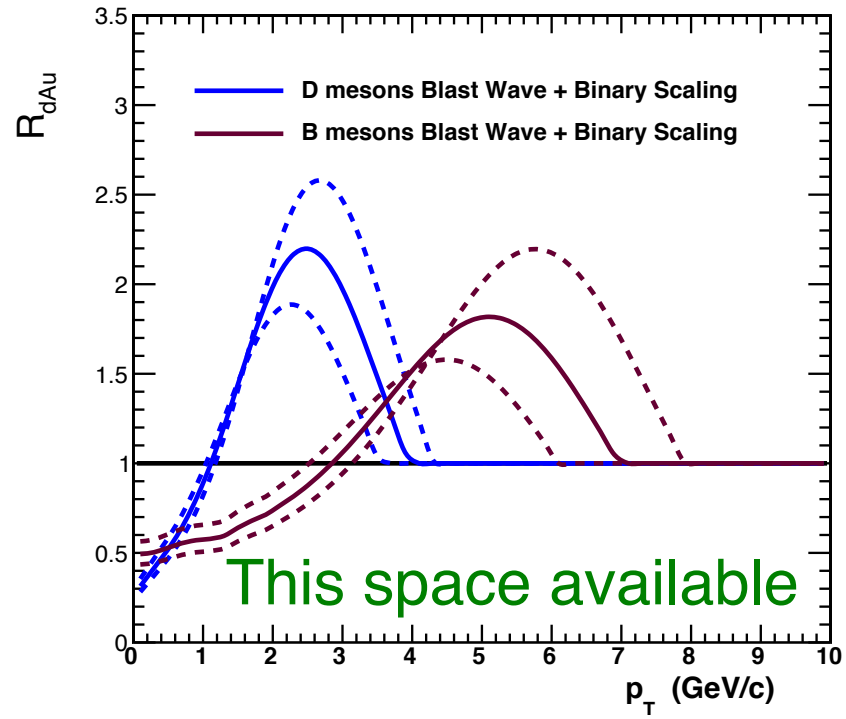
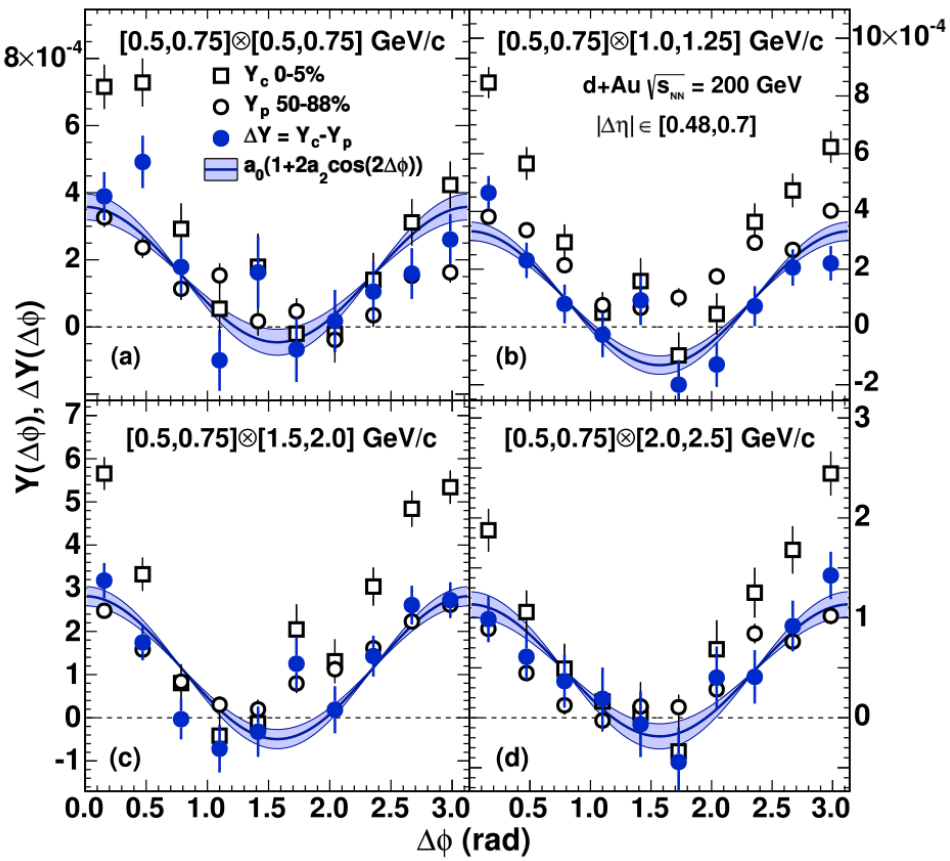


Heavy-flavor meson predicted R_{dAu}

A. Sickles, Phys. Lett. B731 51-56 (2014), "Possible Evidence for Radial Flow of Heavy Mesons in d+Au Collisions"

Elliptic flow in d+Au?

Charged pairs at mid-rapidity over $\Delta\phi$; central, peripheral and difference



PRL 11, 212301 (2013)

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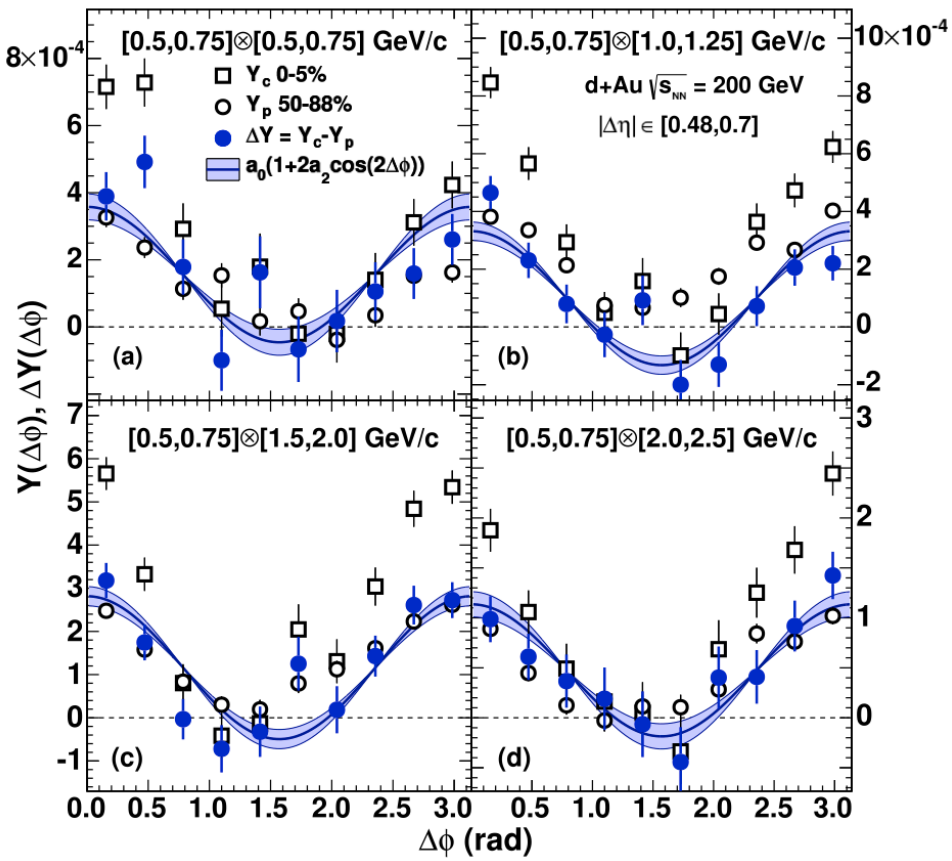
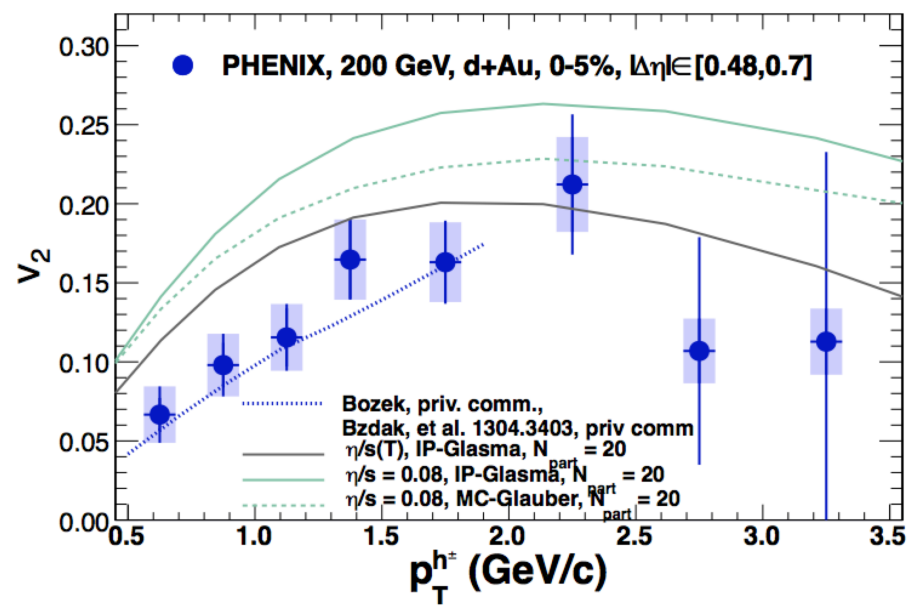


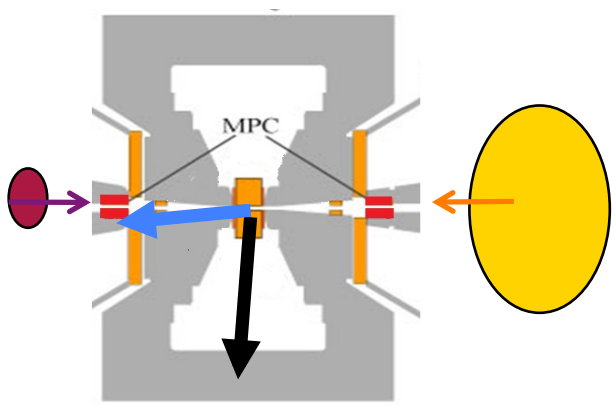
PRL 11, 212301 (2013)



Quadrupole anisotropy allows extraction of singles v_2

Near-side "ridge" in d+Au?

Pair central arm tracks with MPC-S, $\Delta\eta \sim 3.4$



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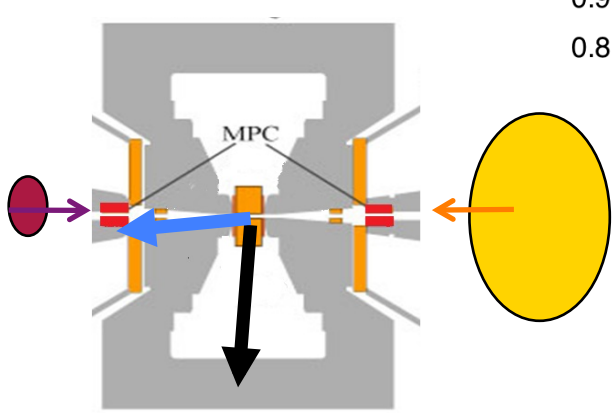
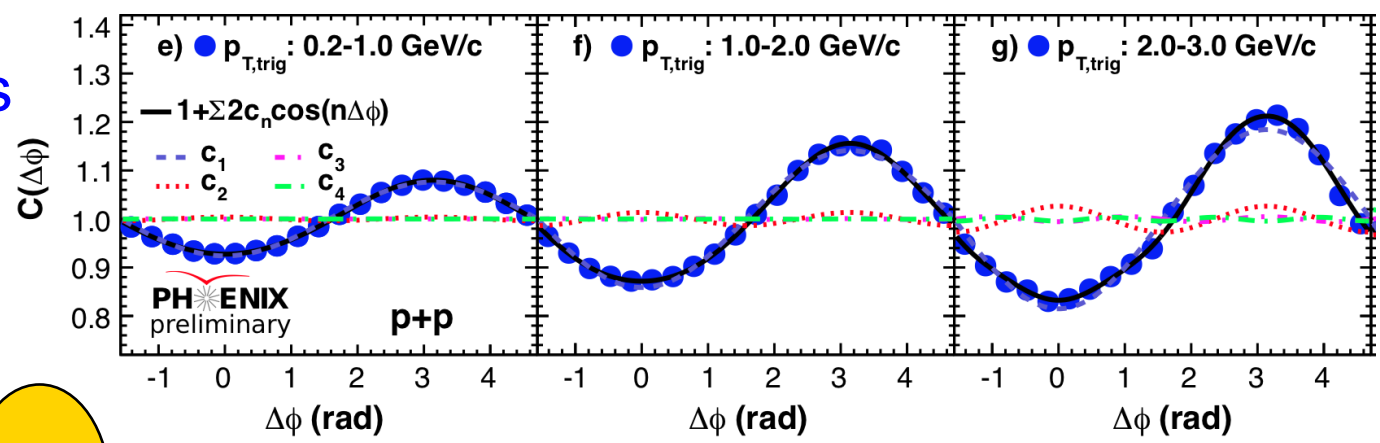
p+p min-bias



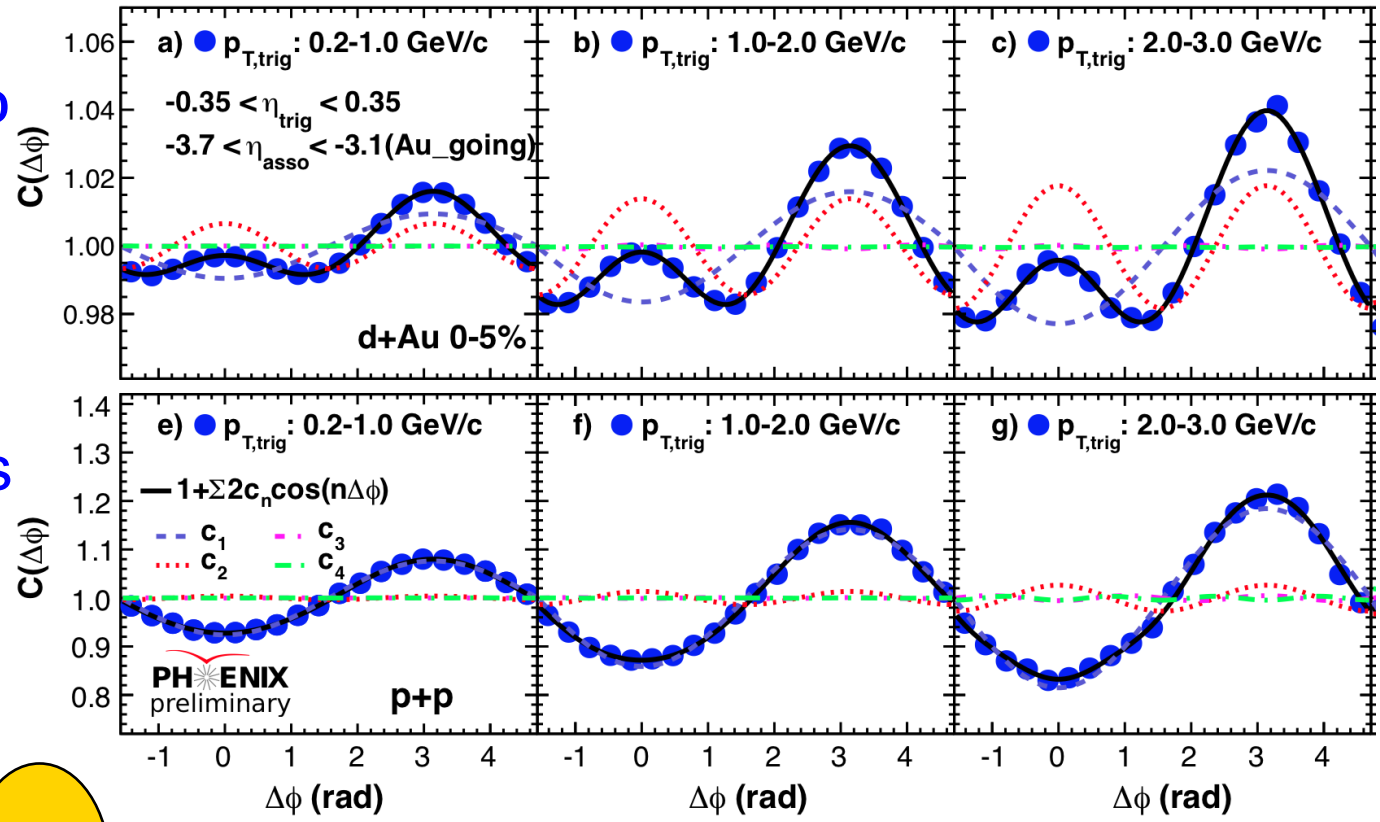


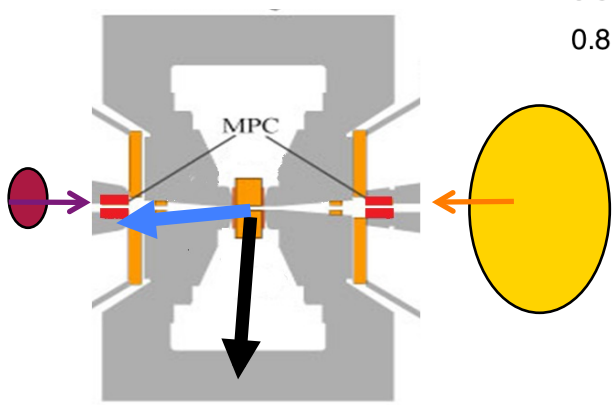
Near-side "ridge" in d+Au?

Pair central arm tracks with MPC-S, $\Delta\eta \sim 3.4$

d+Au 0-5%

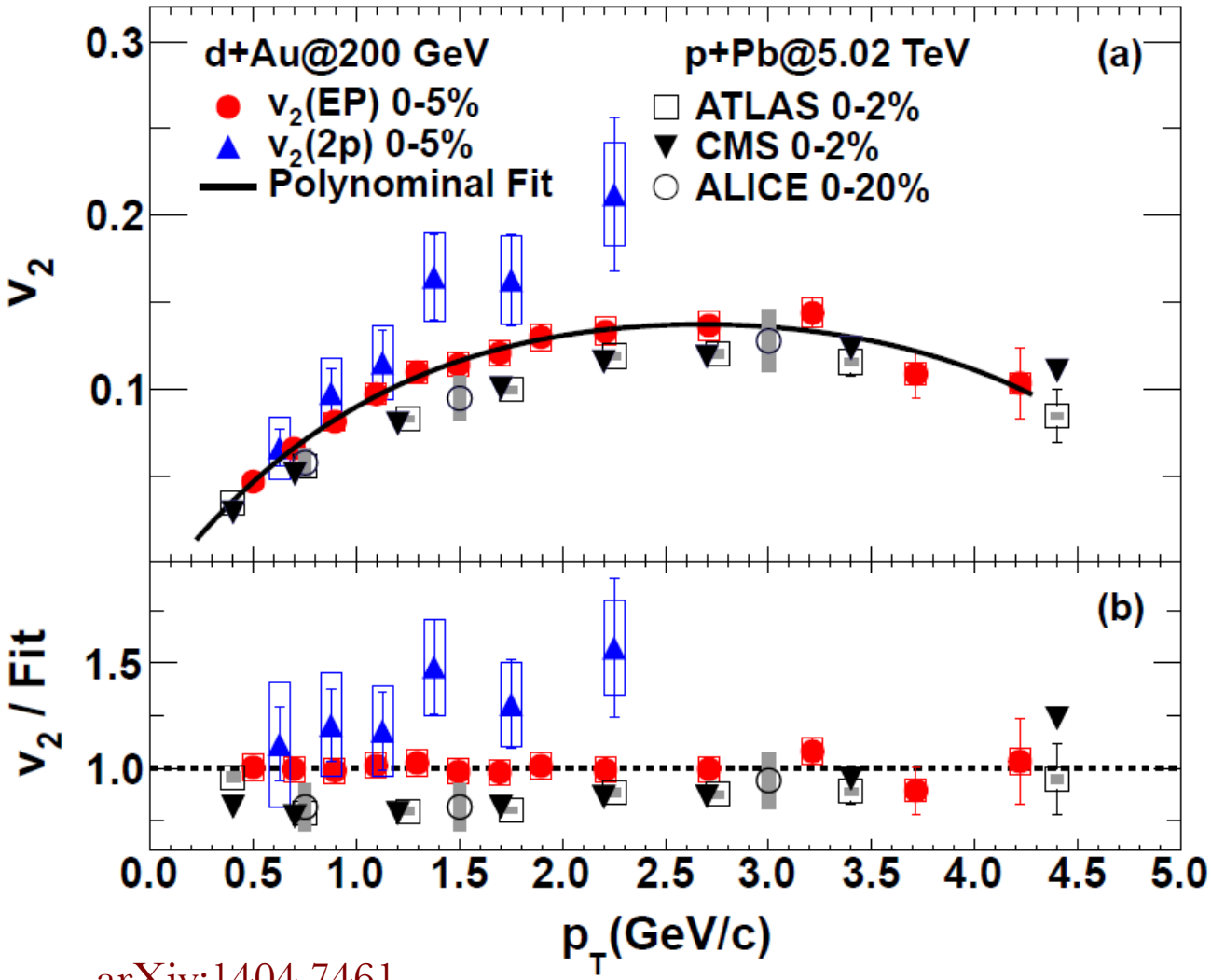
p+p min-bias





arXiv:1404.7461

V_2(EP) of charged hadron in 0-5% d+Au

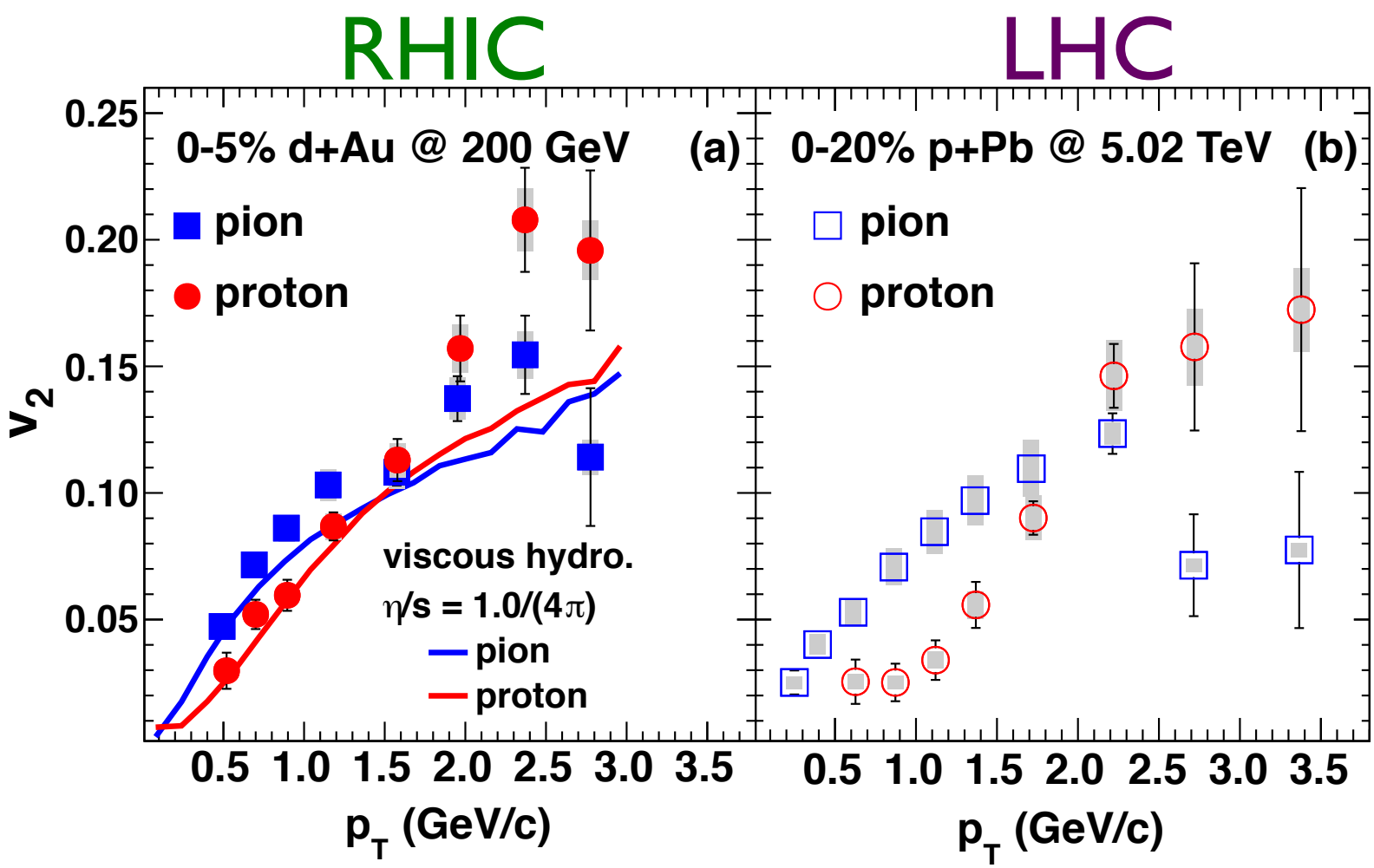


arXiv:1404.7461

Hydro-like shape in $v_2(p_T)$?

No visible v_3 over long range, unlike LHC p+Pb.

Mass splitting of v_2(EP)



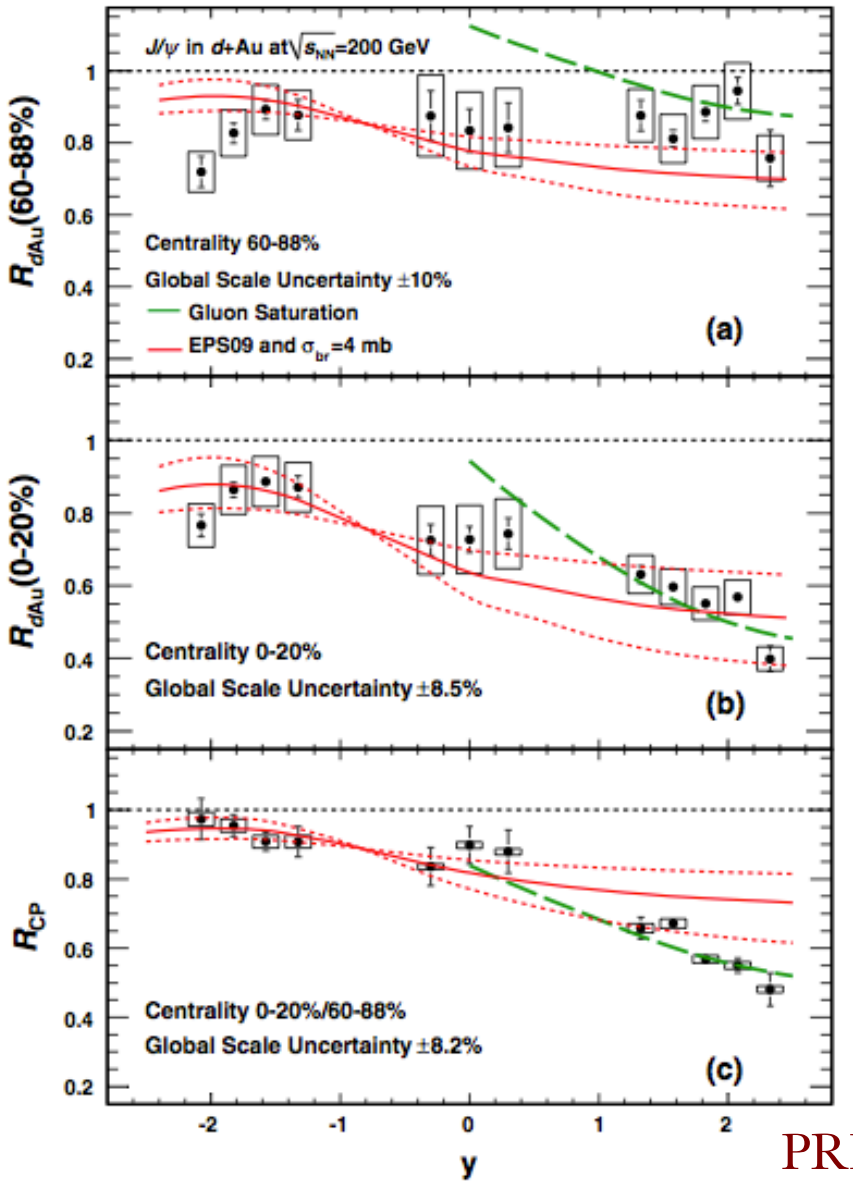
arXiv:1404.7461

Summary

- d+Au is not just a control system anymore
  - **Wealth** of new results in d+Au
  - Geometry of CNM effects?
  - Many indications of collectivity in d+Au:
    - Charm radial boost
    - Psi' relative suppression
    - Radial flow/boost in light hadrons
    - Near-side ridge and elliptic anisotropy
    - Geometry control is next natural step

Backup material

Geometry of CNM effects?



Peripheral

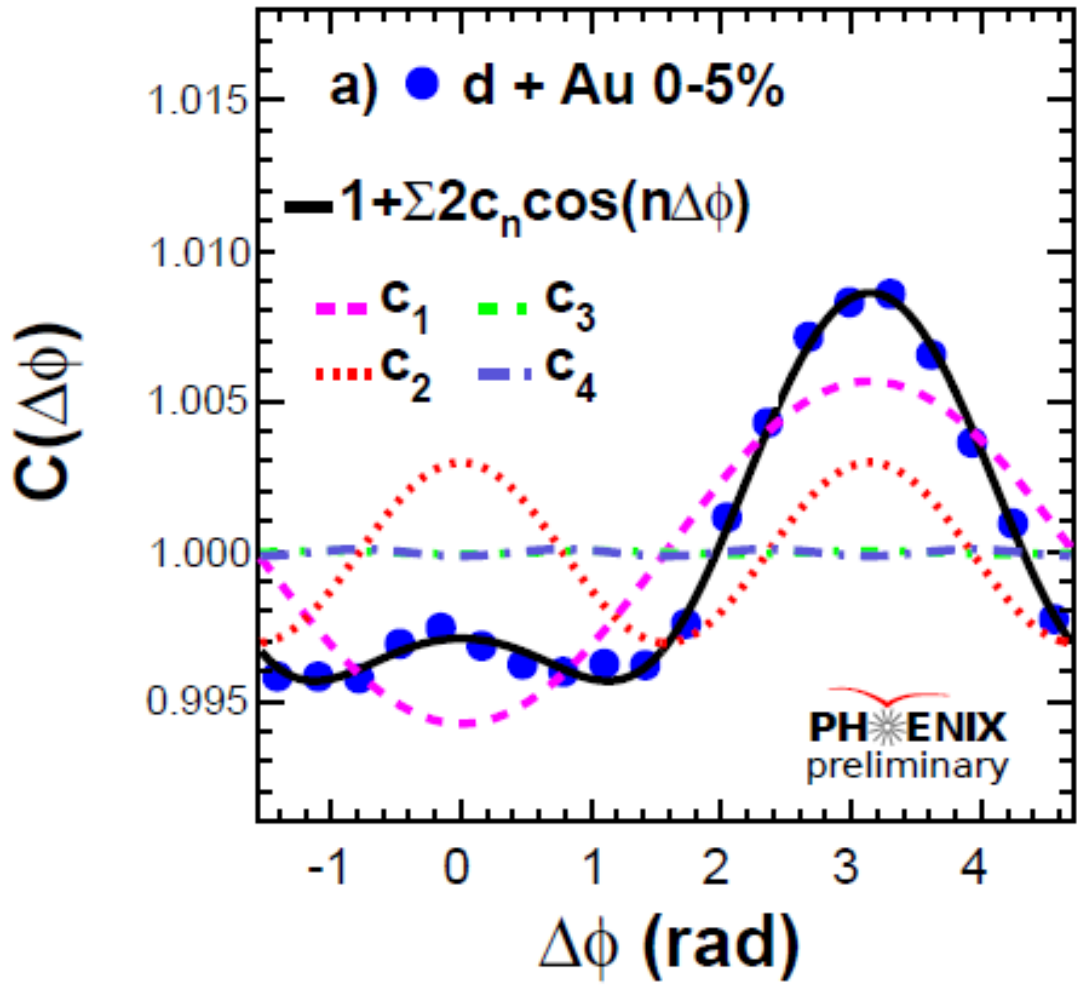
Central

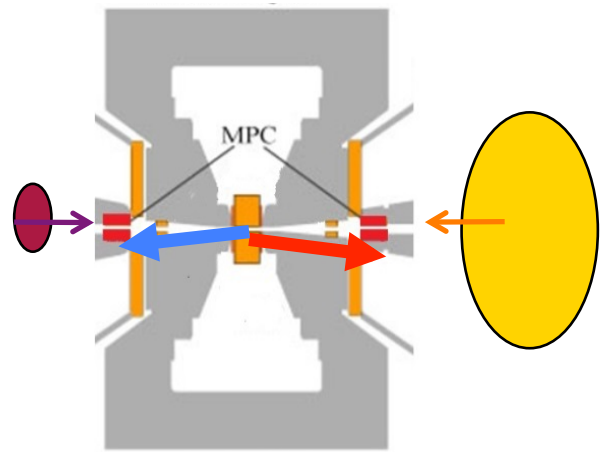
R_{CP}

CNM modification does *not* reproduce centrality/geometry dependence.

PRL 107, 142301 (2011)

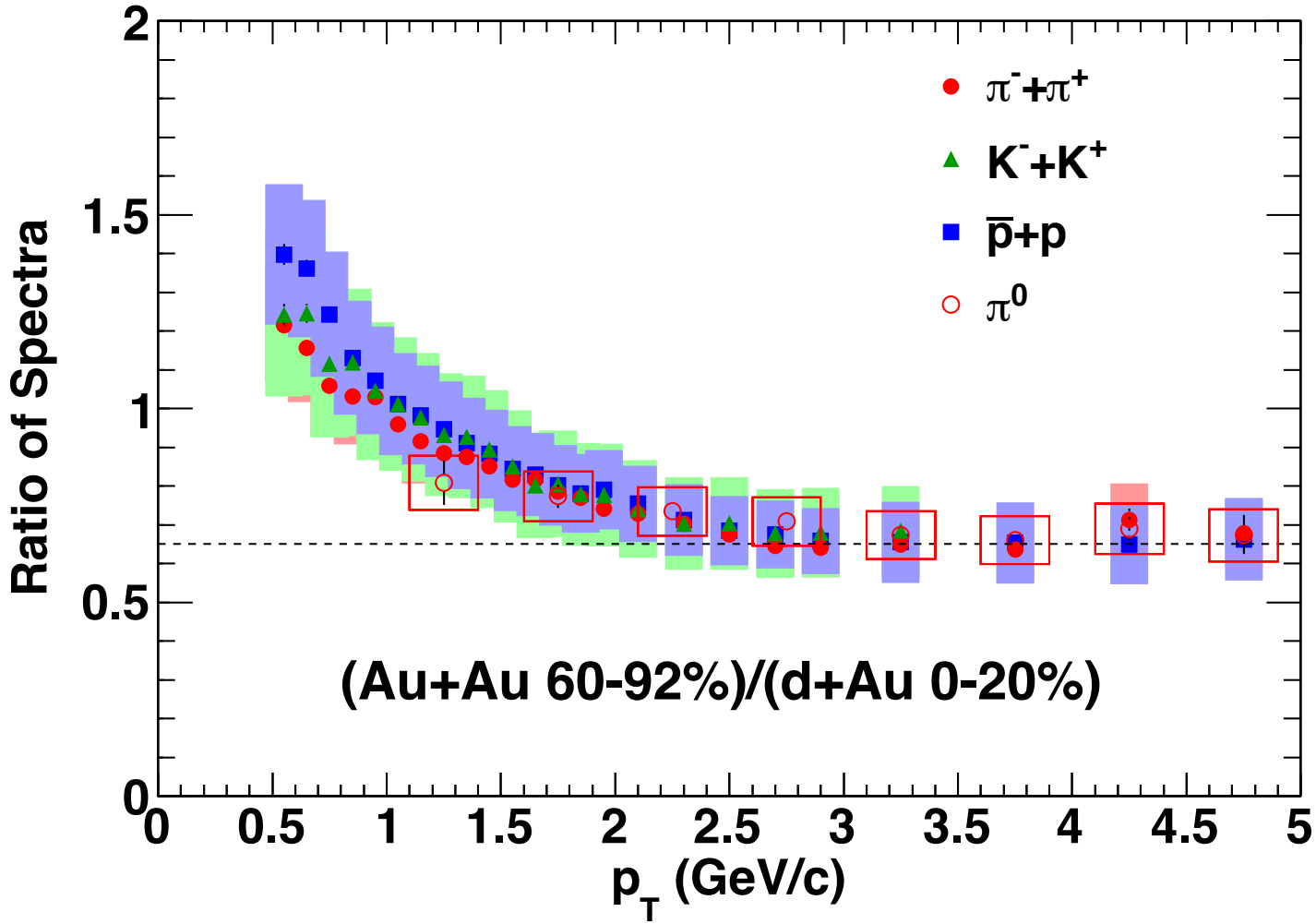
Near-side "ridge" over $\Delta\eta \sim 7$





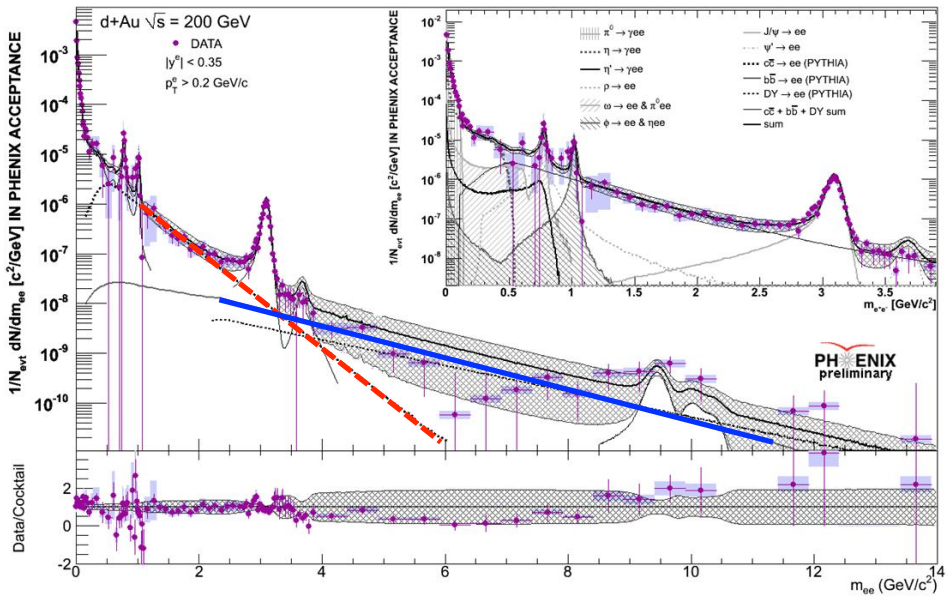
Correlation between Au-going and d-going MPC towers

Periph Au+Au/Central d+Au



Phys. Rev. C 88, 024906 (2013)

More news…



cc vs bb separation via dielectrons in d+Au across mass and p_T