d+Au collisions at 200 GeV by PHENIX experiment at RHIC

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for the PHENIX collaboration

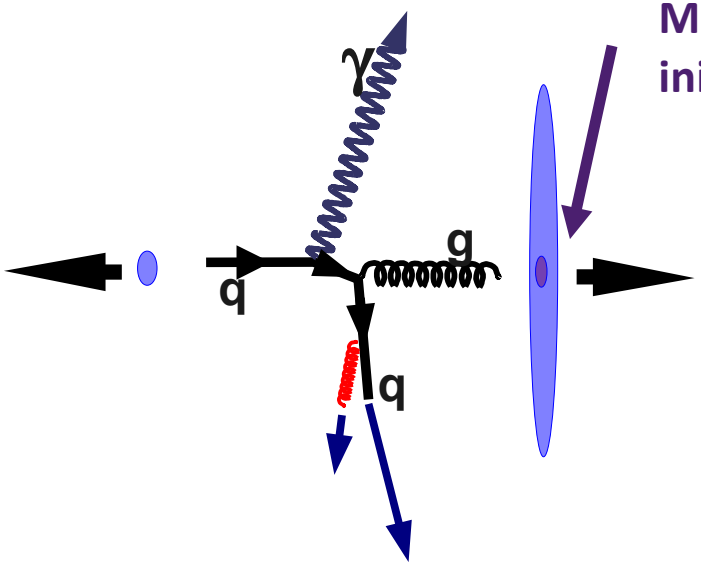
Why do we study d+Au collisions?

I. d+Au – control experiment to Au+Au to quantify the medium

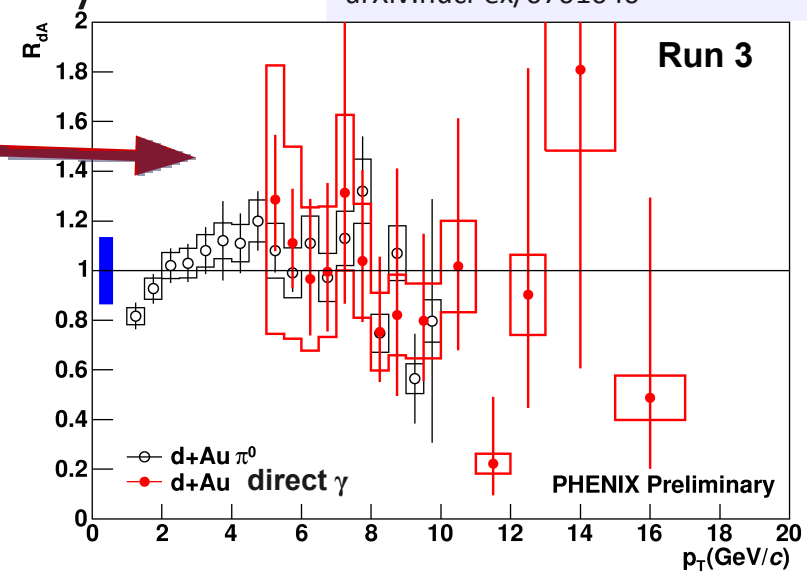
→ Is the initial state modified?

→ $\mathbf{R_{AA}}$ and $\mathbf{R_{dA}}$ of particle production at midrapidity

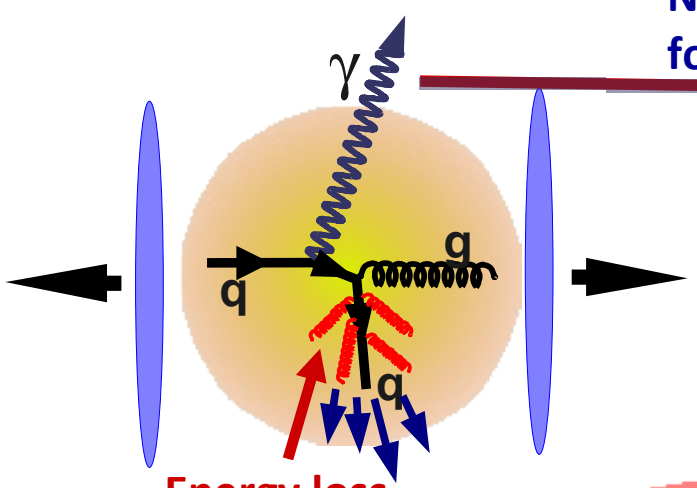
Phys. Rev. Lett. 98, 172302 (2007)
arXiv:nucl-ex/0701040



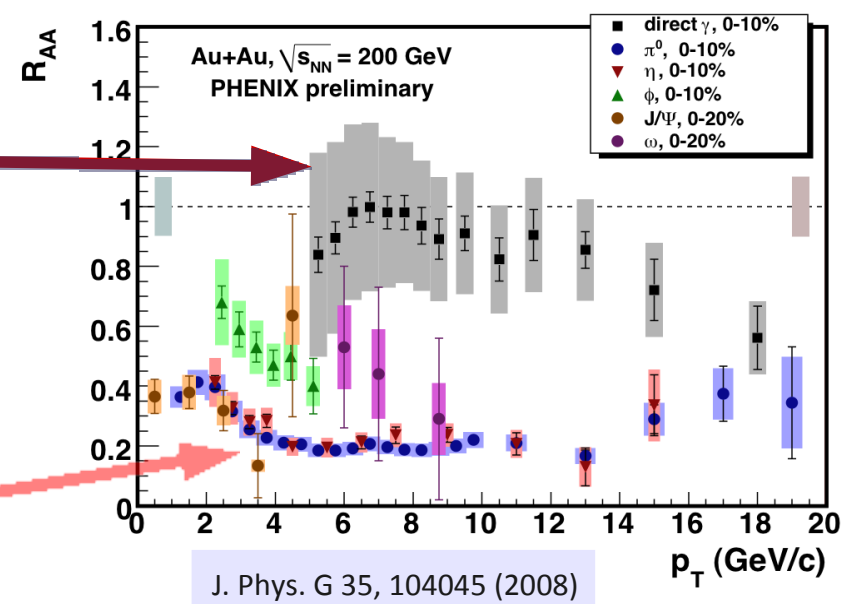
Modified initial state?



No energy loss for photons

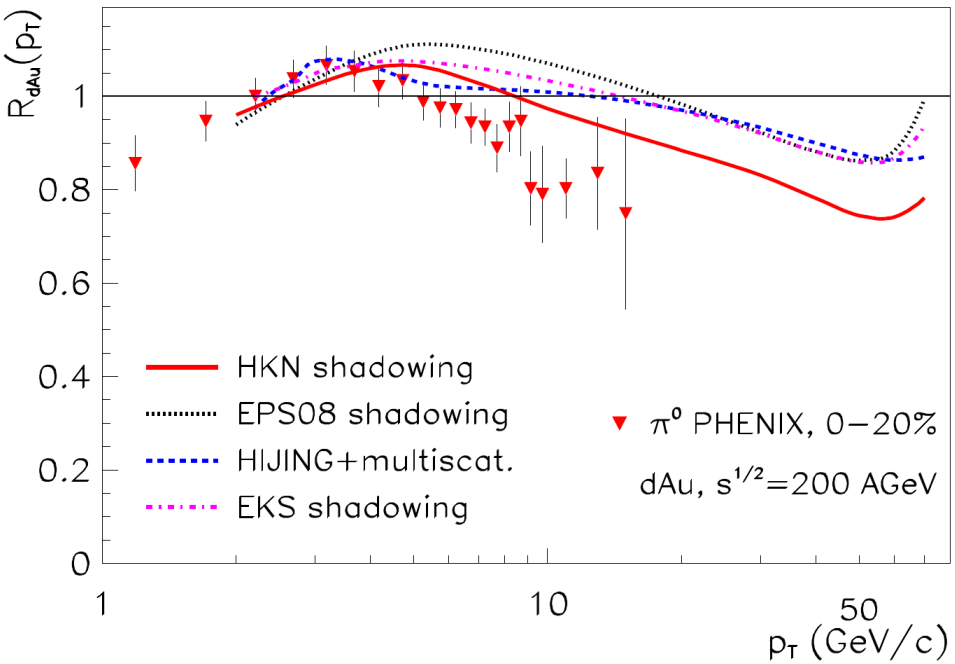


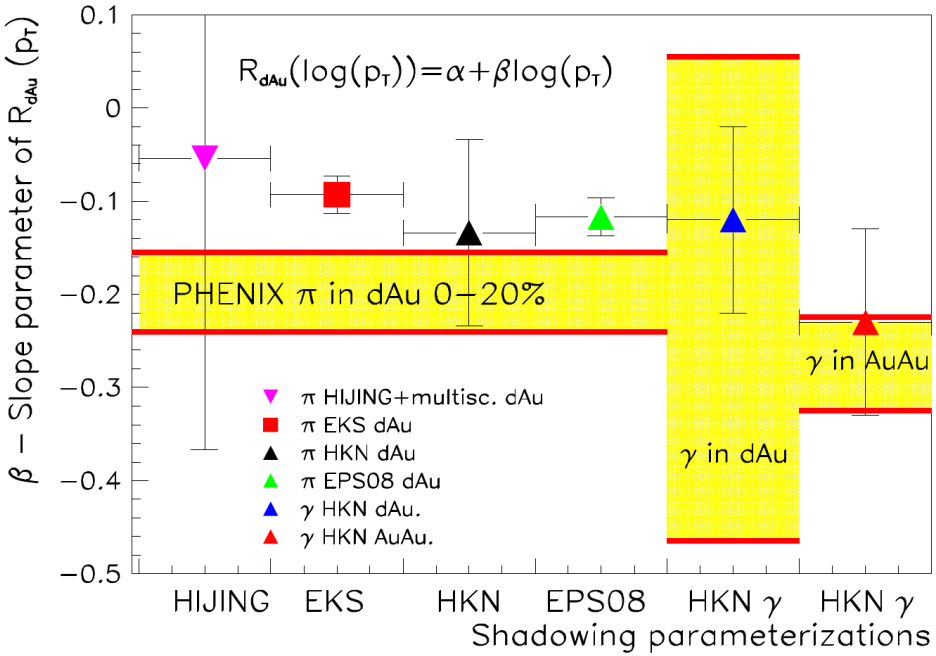
Energy loss for q and g



J. Phys. G 35, 104045 (2008)
[arXiv:0804.4562 [nucl-ex`]]

Control experiment for Au+Au





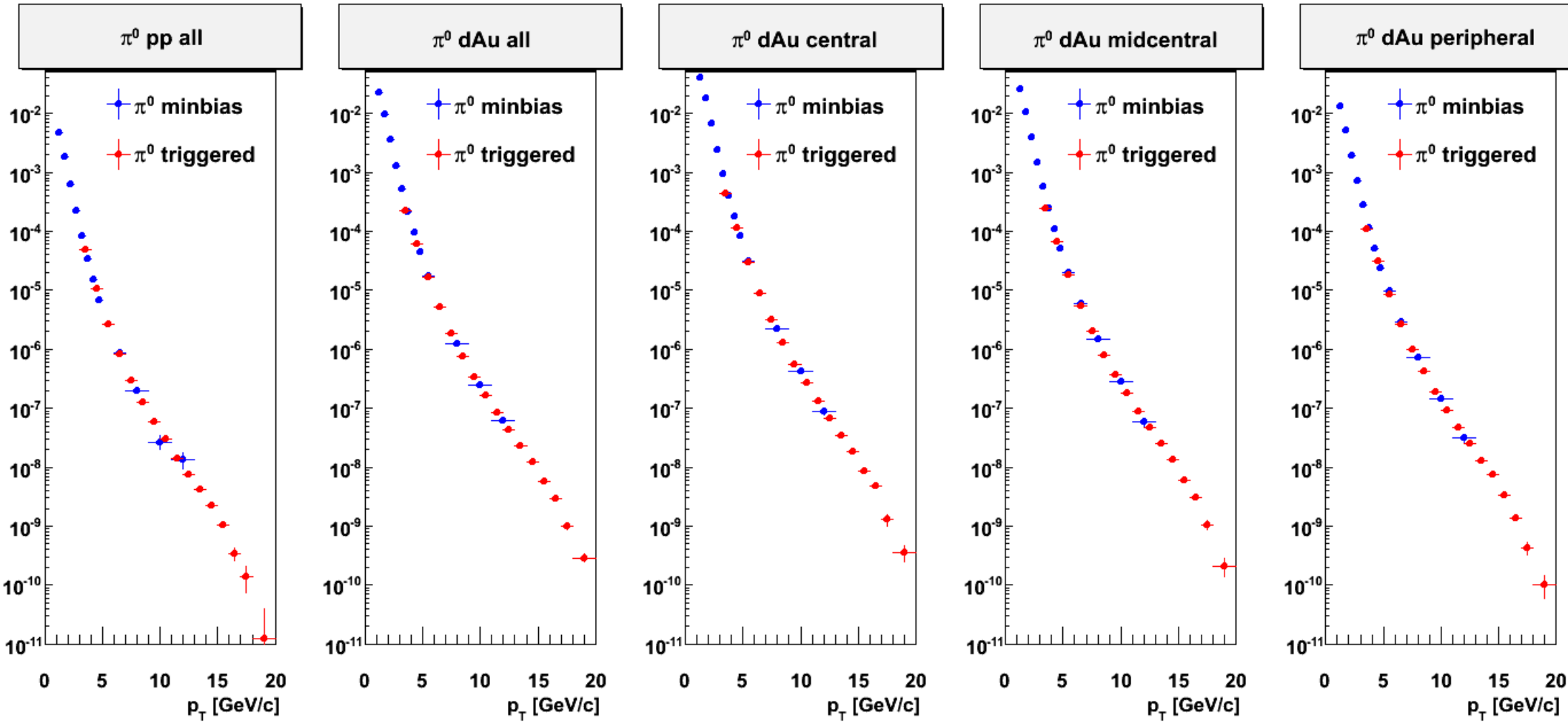
From: G. G. Barnafoldi, G. Fai, P. Levai, B. A. Cole and G. Papp, arXiv:0805.3360 [hep-ph]

2003 data - insufficient precision to quantify and attribute cold nuclear matter (CNM) effects

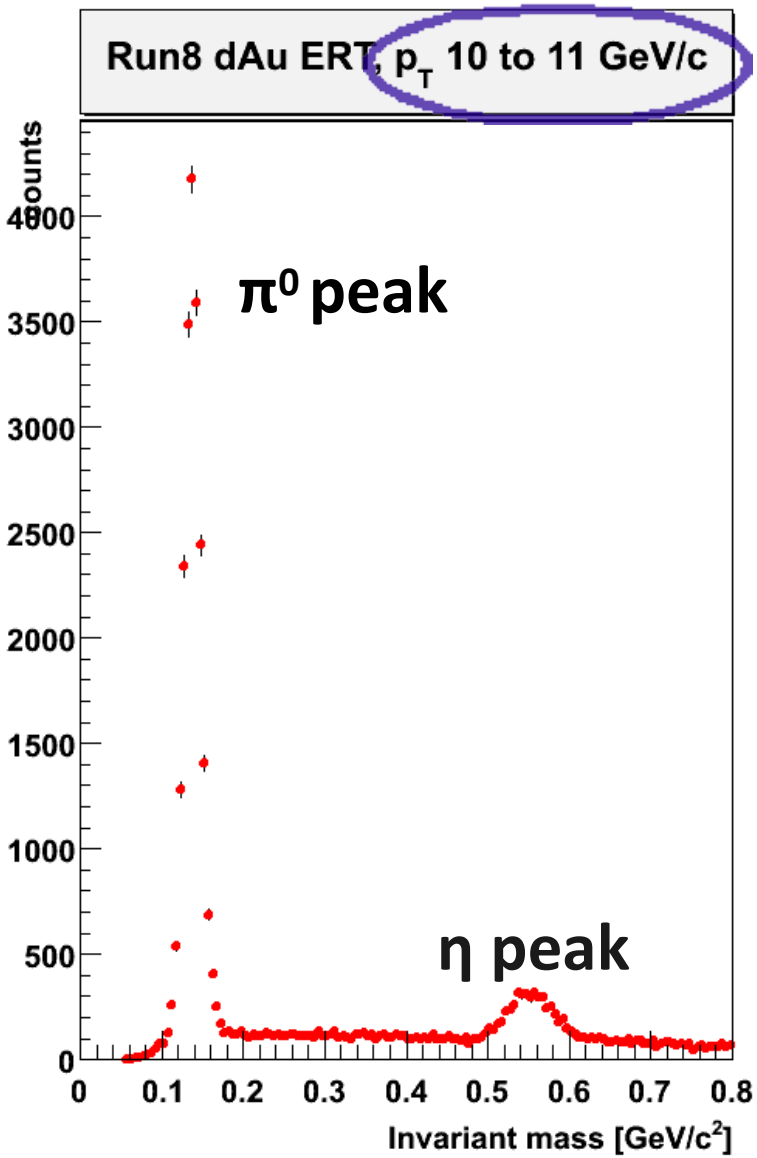
Year 2008 data: ~30x more statistics, p_T reach extended by ~5 GeV/c with respect to 2003 data

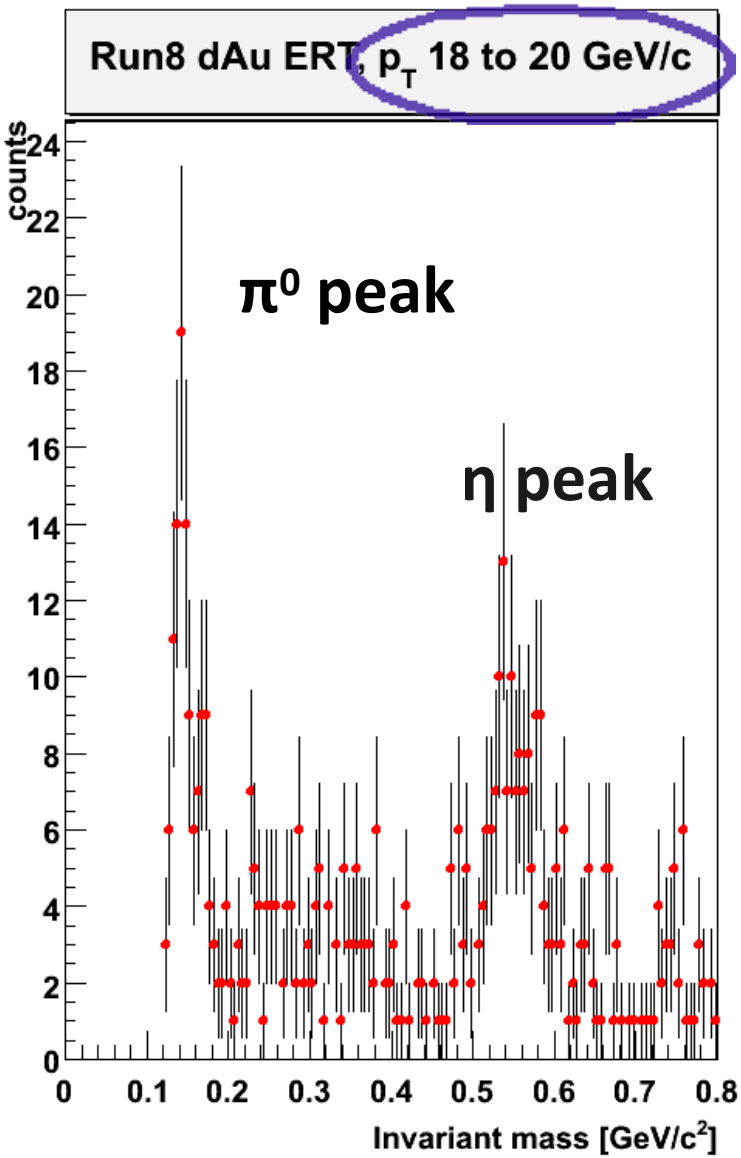
	min bias	triggered
p + p	529 M	1170 M
d + Au	1649 M	3680 M

Raw inclusive π^0 yields per event at y=0. (Note the stat. error bars)



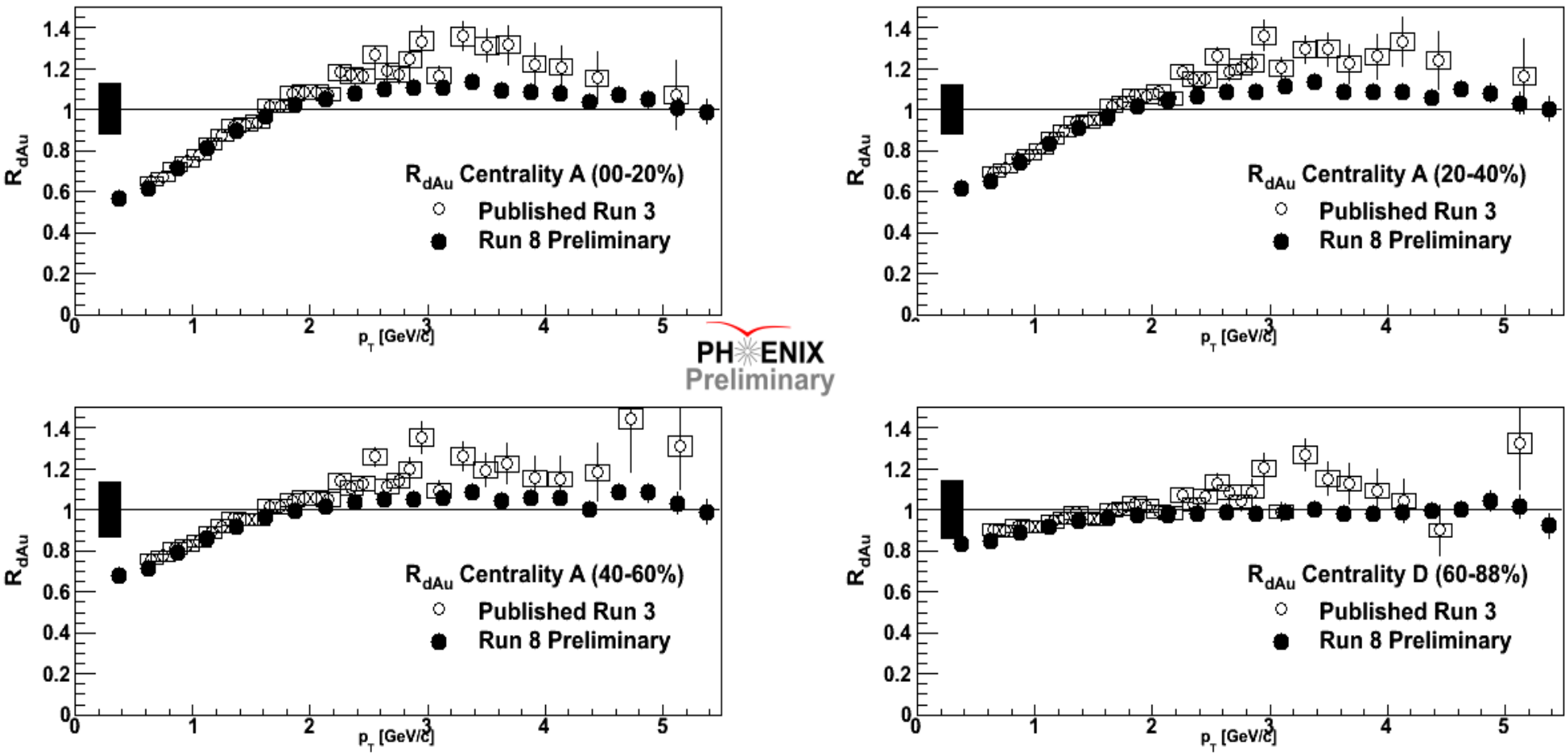
Invariant mass spectrum of gamma+gamma pairs





R_{dAu} precision of 10-20 % at p_T ~20 GeV/c feasible with 2008 data for π^0, η, and direct photons

Inclusive charged R_{dAu} at midrapidity



Zvi Citron (for PHENIX), arXiv:0907.4796v3 [nucl-ex]

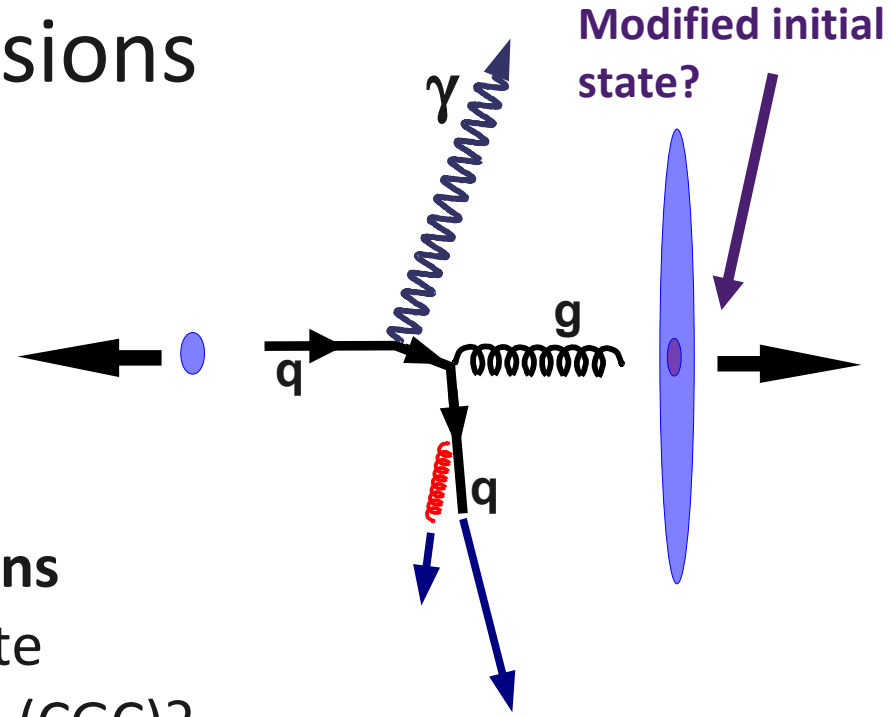
- New preliminary data overlap with year 2003 π^0 measurement
- Little if any Cronin effect observed

CNM effects in d+Au collisions

I. d+Au – control experiment to Au+Au

→ Is the initial state modified?

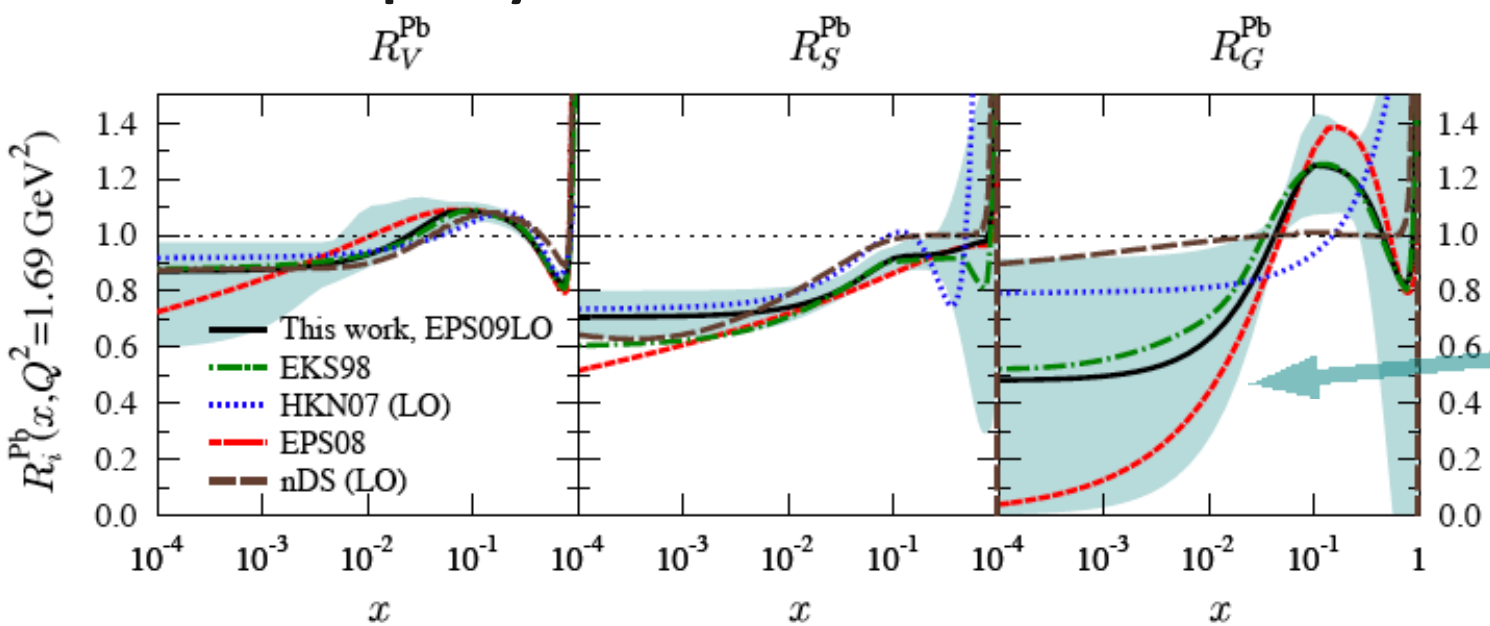
→ $\mathbf{R_{dA}}(p_T)$ and $\mathbf{R_{AA}}(p_T)$ at midrapidity



II. d+Au – probe structure of bound nucleons

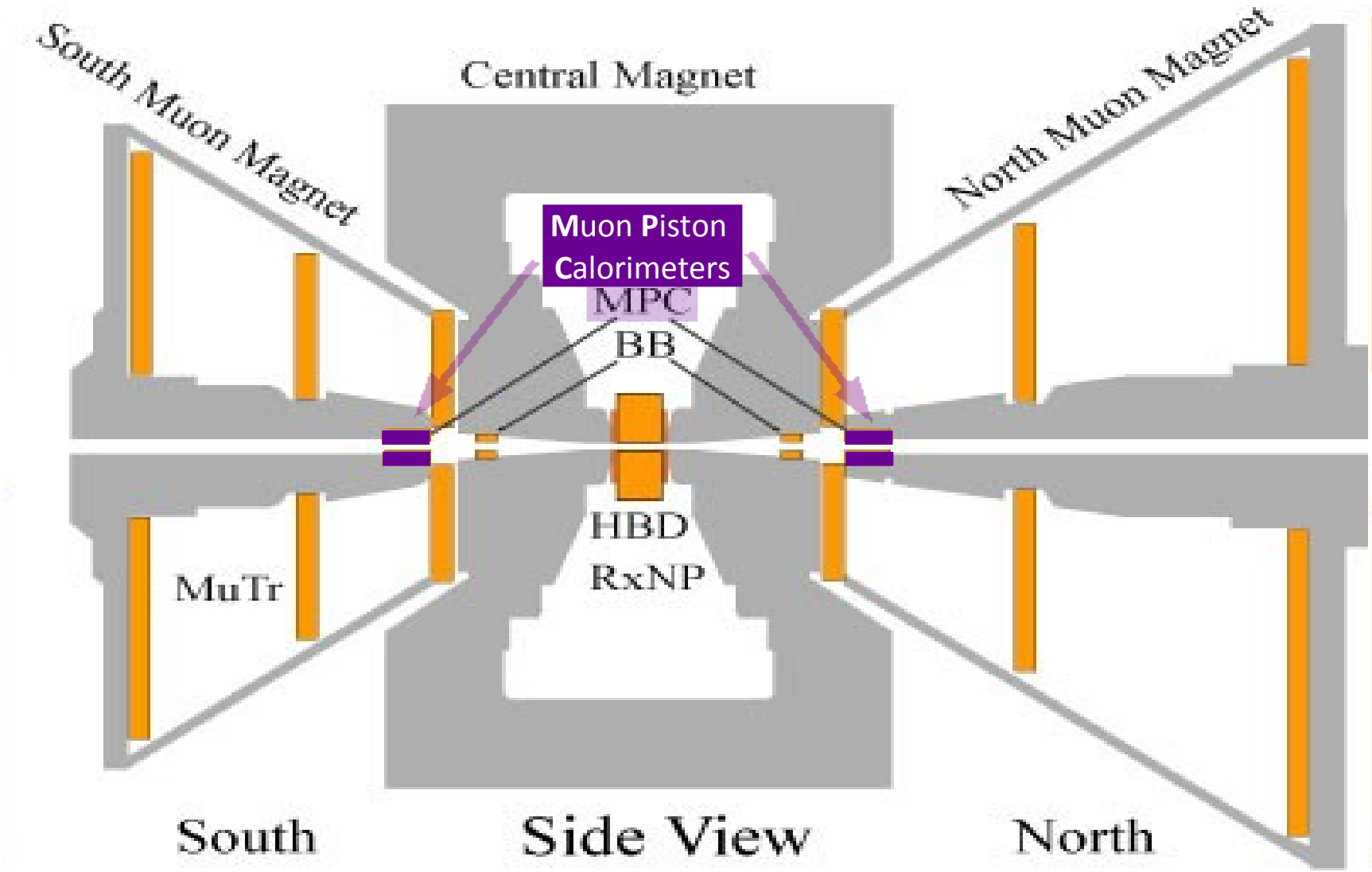
→ Does gluon density in a nuclei saturate with decreasing Bjorken x and increasing √s (CGC)?

→ Signatures of saturation: suppressions of $R_{dA}(p_T)$, $R_{CP}(p_T)$, and $I_{dA}(p_T)$ at **forward rapidity: MPC detector**



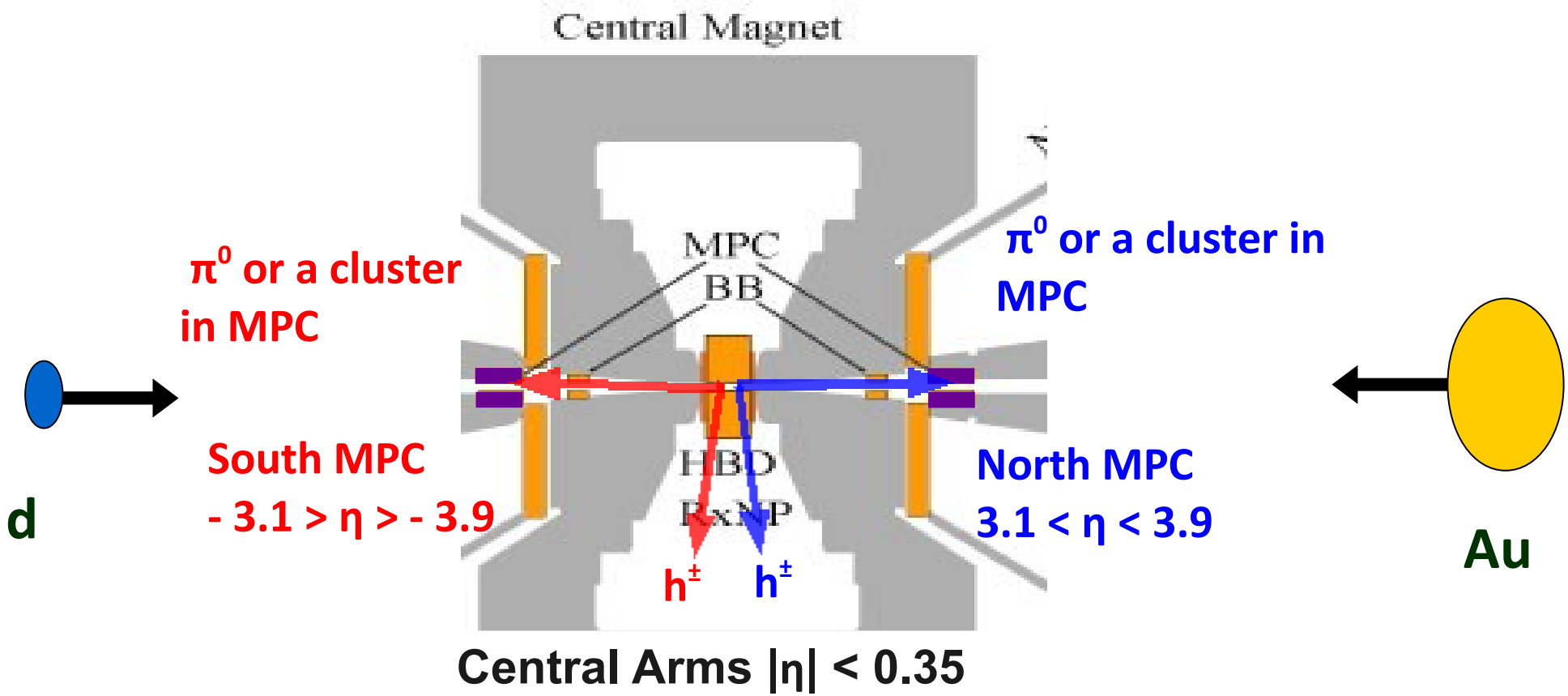
Gluon nuclear PDF – unknown at low x

Side view of the PHENIX detector



Muon Piston Calorimeters (**MPC**) are electromagnetic calorimeters covering pseudorapidity ranges **3.1 < |η| < 3.9**

d+Au collision in the PHENIX detector

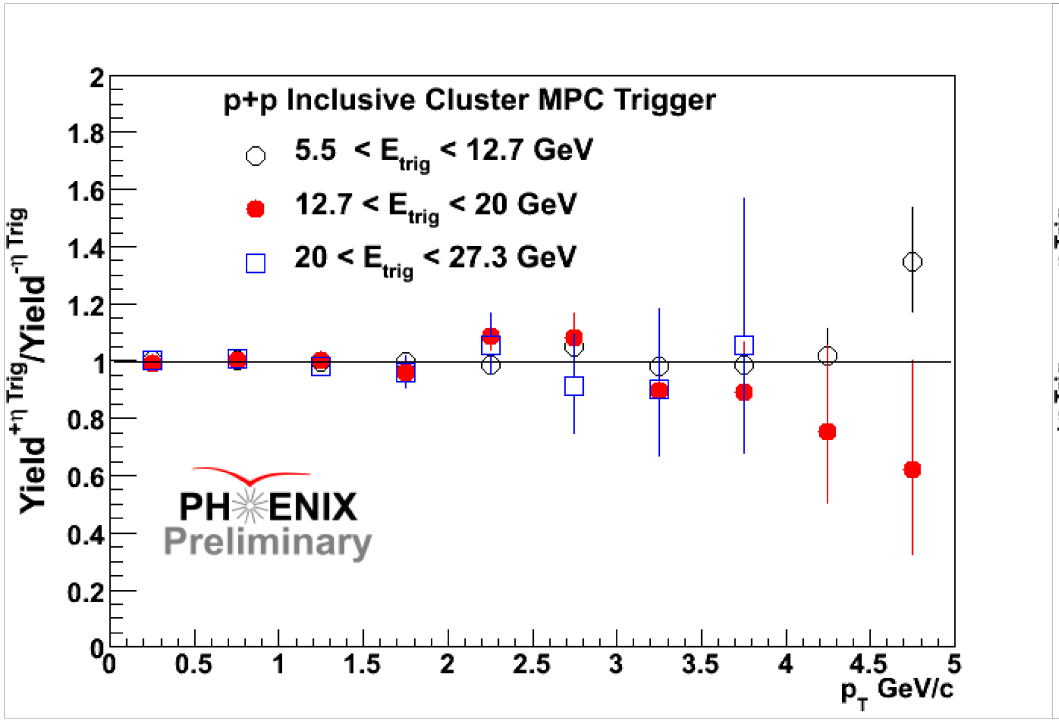


- Trigger on **forward** or **backward** (relative to **d**) going identified π^0 or unidentified clusters in MPCs
- Measure conditional charged multiplicity in the central arms

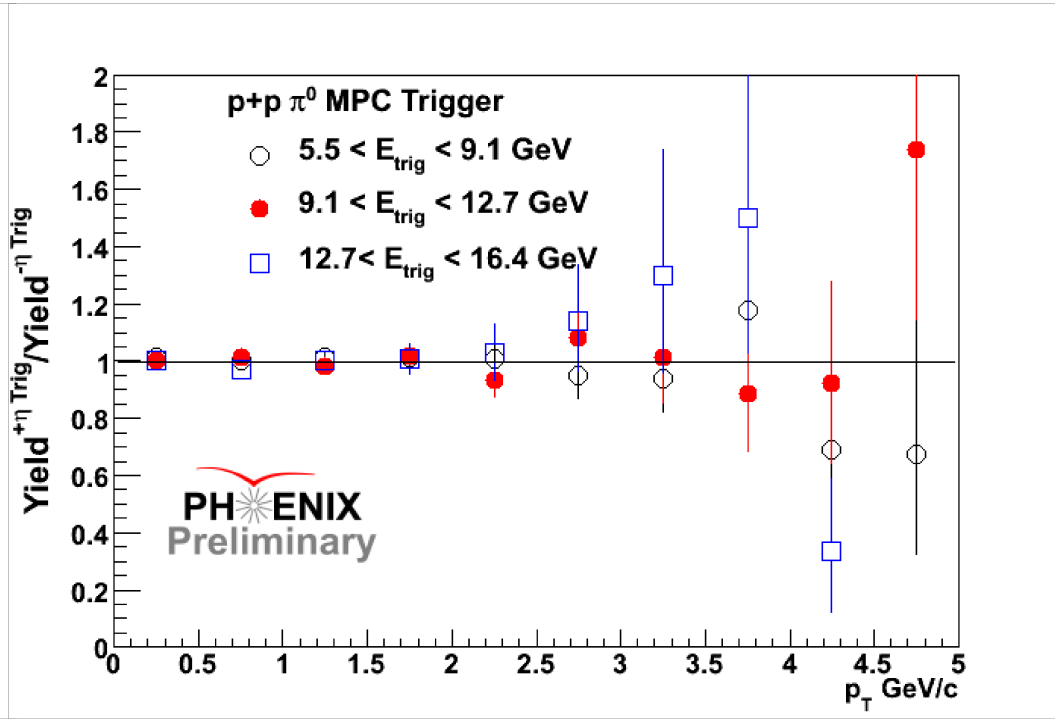
- NB: for the inverse case of central triggers and MPC yields see the next talk by Beau Meredith

MPC + central arms correlated yields: p+p

Ratio of forward/backward triggered mid-rapidity charged hadron **yields** from 2008 **p+p** data to **confirm symmetry**



MPC inclusive **cluster trigger**

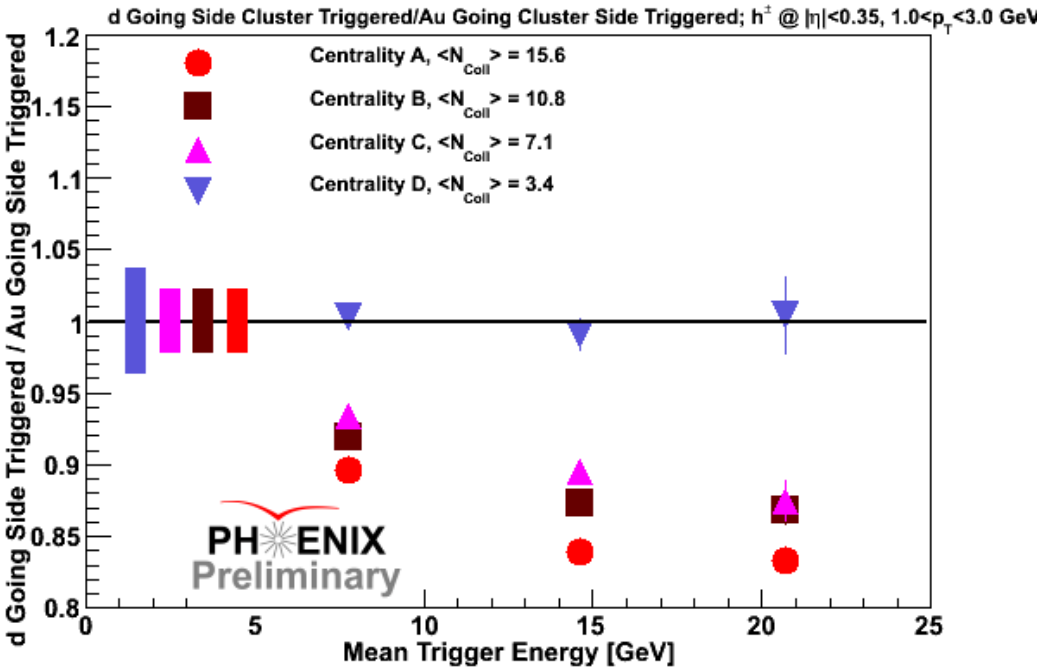


MPC reconstructed **π^0 trigger**

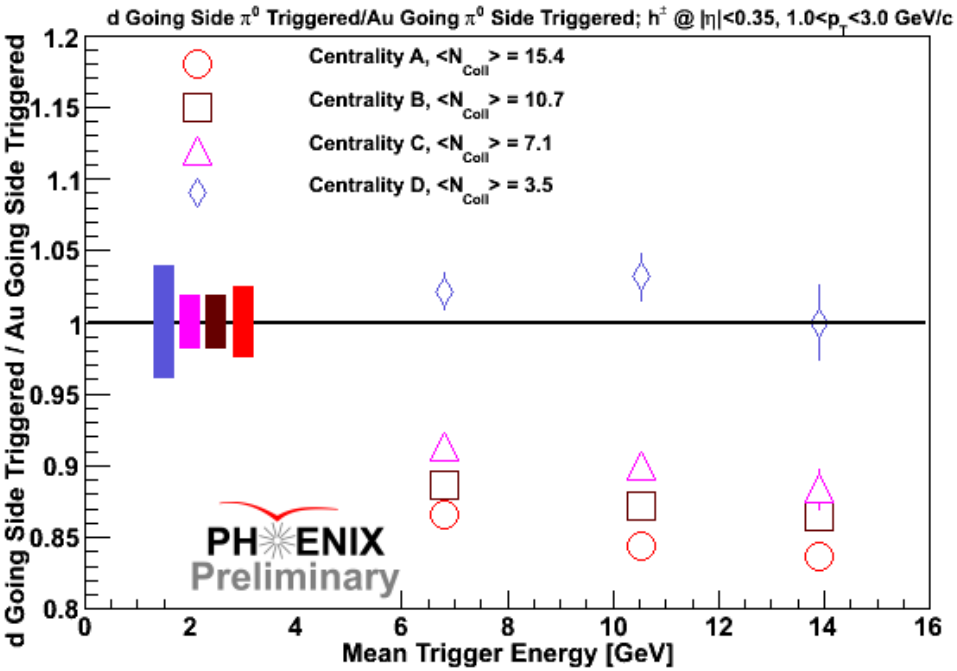
Zvi Citron (for PHENIX), arXiv:0907.4796v3 [nucl-ex]

MPC + central arms correlated yields: d+Au

Ratio of forward/backward triggered mid-rapidity charged hadron **yields** using 2008 **d+Au** data



MPC inclusive **cluster trigger**



MPC reconstructed **π^0 trigger**

→ Suppression increases with centrality and trigger energy

Zvi Citron (for PHENIX), arXiv:0907.4796v3 [nucl-ex]

Conclusions

- 2008 run: ~30x the integrated luminosity of previous 200 GeV d+Au measurement in 2003
- Further analysis will increase our understanding of d+Au collisions and their implications for initial state effects in nuclei
- π^0 and direct gamma measurement in progress
- d-side triggered central yields are suppressed compared to Au-going side triggered ones
- See the following talks for other interesting results