R_{dA} of π^0 and γ in d+Au collisions at 200 GeV

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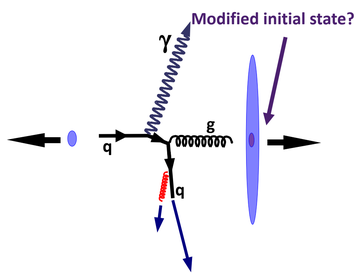
Physics Motivation

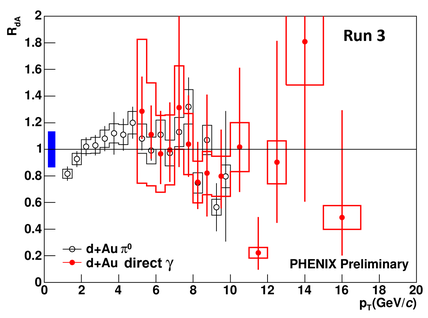
Nuclear modification factors R_{AB} compare particle production in A+B collisions to elementary p+p interactions (NB: all data plots at midrapidity, |y|<0.35):

$$R_{AB}(p_T) = \frac{d^2N^{\pi^0}_{AB}/dydp_T}{\langle T_{AB}\rangle \times d^2\sigma^{\pi^0}_{pp}/dydp_T}$$

T_{AB} is a relative nuclear thickness of A+B/p+p collision

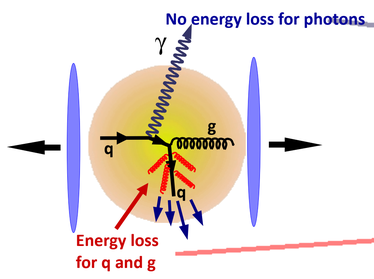
Deviations from unity indicate nuclear effects.
"Cold nuclear matter effects" result from the differences in the properties of nucleons that are bound in the nuclei and those that are not.
Preliminary 2003 run results indicate R_{dAu} ~1, with large errors:

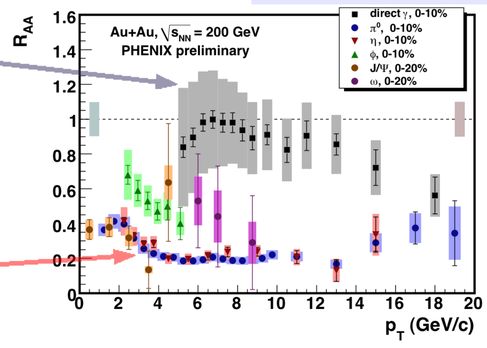




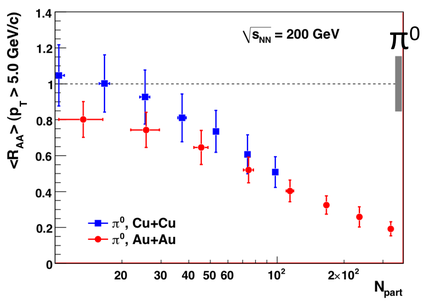
"Hot nuclear matter effects" result from a hot, strongly interacting medium created in A+A collisions.

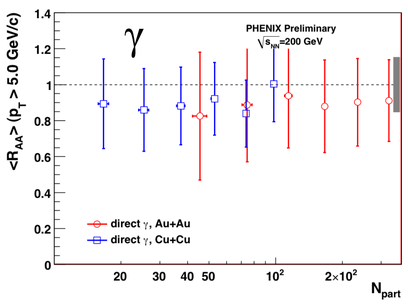
K. Reygers [PHENIX Collaboration], J. Phys. G 35, 104045 (2008) [arXiv:0804.4562 [nucl-ex]]





Large suppression of high p_T hadrons and no suppresion for direct photons, observed at central A+A collisions at RHIC indicates the creation of a hot dense strongy interacting medium (sQGP).

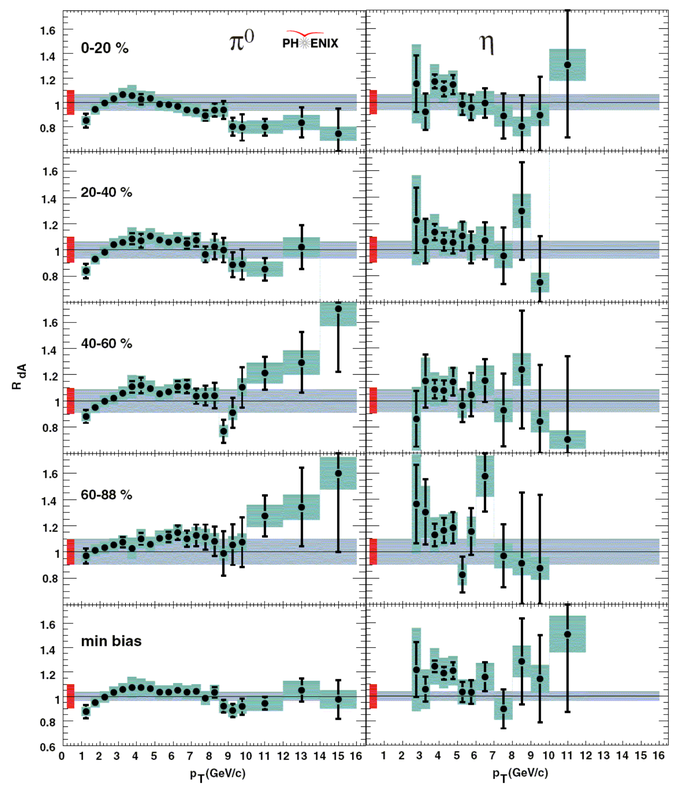




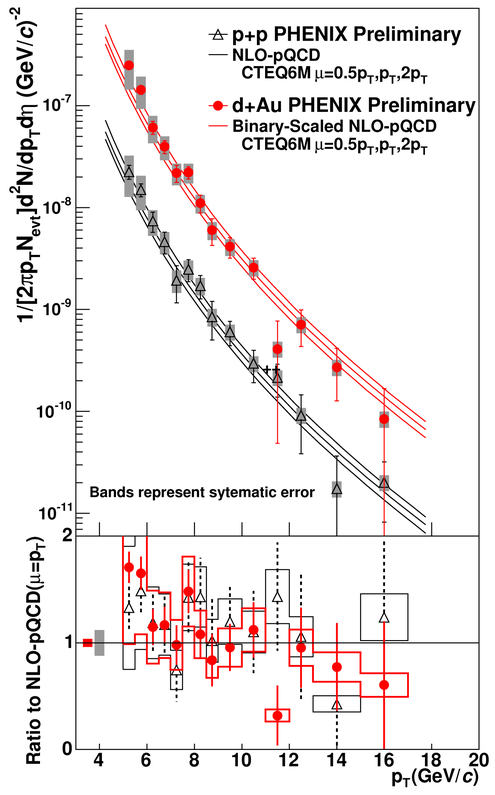
The centrality dependence of R_{AA} shows an increasing suppression of π^0 mesons with an increasing number of participants. No such suppression is observed for direct photons. Little dependence on collision system is measured.

Existing PHENIX d+Au measurements

Mesons



Direct photons

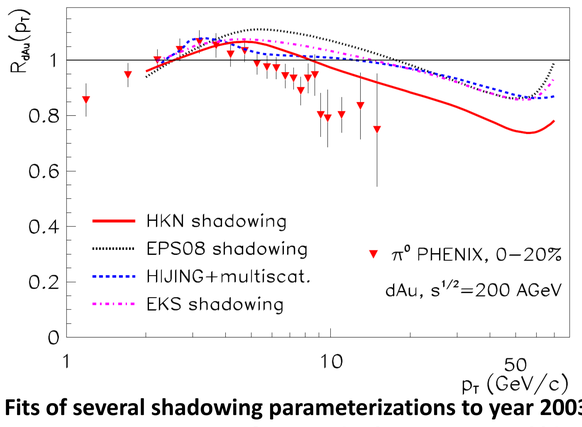


References: S. S. Adler et al. [PHENIX Collaboration], Phys. Rev. Lett. 91, 072303 (2003) [arXiv:nucl-ex/0306021]
S. S. Adler et al. [PHENIX Collaboration], Phys. Rev. Lett. 98, 172302 (2007) [arXiv:nucl-ex/0610036]
T. Isobe [PHENIX Collaboration], J. Phys. G 34, S1015 (2007) [arXiv:nucl-ex/0701040]

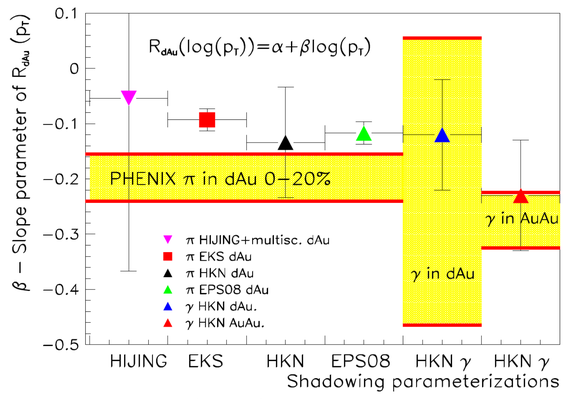
There may be cold matter effects though ...

R_{dAu} slopes β were found lower than expected from shadowing in pQCD improved parton model (*)
Contributions of isospin effects or final state interactions are not excluded. A better measurement needed to address the issue quantitively.

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



Fits of several shadowing parameterizations to year 2003 PHENIX measurement of π^0 R_{dAu} in the most central bin.



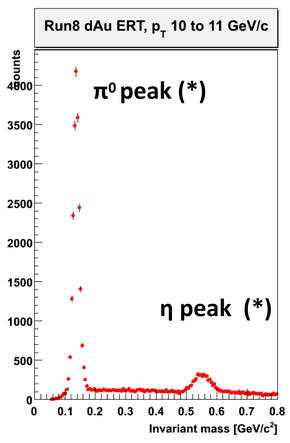
Extracted slopes for π^0 and γ are compared with several shadowing model parameterizations

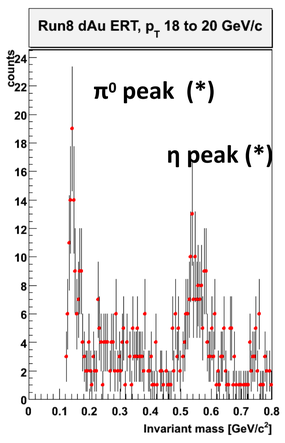
2008 run: ~30x larger integrated luminosity

2008 run recorded events

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

Invariant mass spectrum of gamma+gamma pairs in PbSc part of PHENIX EMCal, in two bins of transverse momentum:





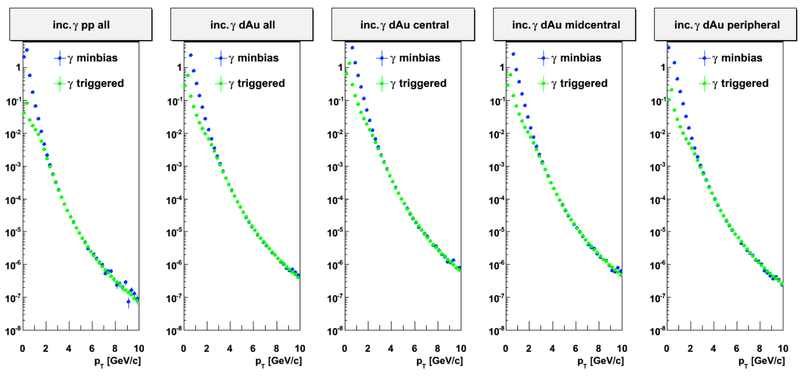
R_{dAu} measurement precision of 10 - 20 % at p_T ~ 20 GeV seems feasible using 2008 data

(*) Decrease of relative height of the π0 vs. the η peak with increasing p_T is caused by merging of decay photon clusters. With increasing meson mass, the decay opening angle increases, lowering the merged fraction.

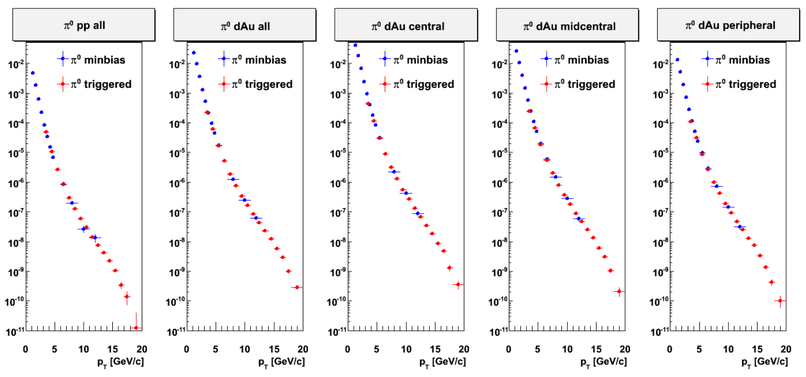
Raw yields per minbias event measured in 2008 run

Triggered data are scaled to minbias using high p_T region where triggered/minbias ratios become stable.

Uncorrected inclusive photon yields

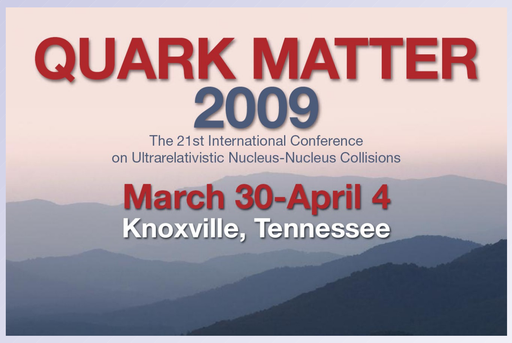


Uncorrected inclusive π^0 yields



pp all | dAu all | dAu central | dAu midcentral | dAu peripheral

Conclusions & Outlook

Previous results from data taken in year 2003 indicated that high p_T particle suppression in Au+Au interactions is a final state effect, since R_{dA} ratios were compatible with unity, albeit within large experimental errors.
It is important to test this conclusion to higher precision since the modification of structure functions themselves may be involved.

Recent d+Au data taken in 2008 improve integrated luminosity of the 2003 data sample by about a factor of thirty. This 2008 PHENIX measurement will shed more light on the origin of cold matter effect (PDF shadowing, isospin, final state effects).