

Energy dependence of π^0 suppression in Au+Au collisions

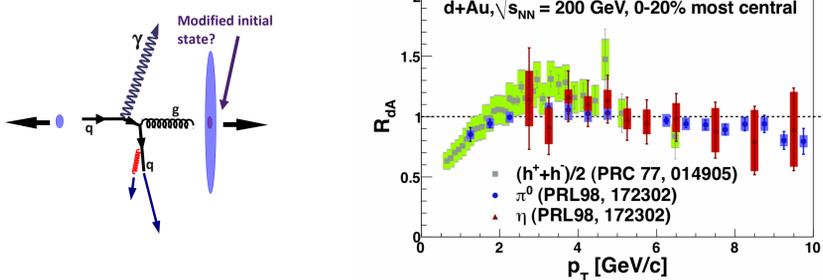
Physics Motivation

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

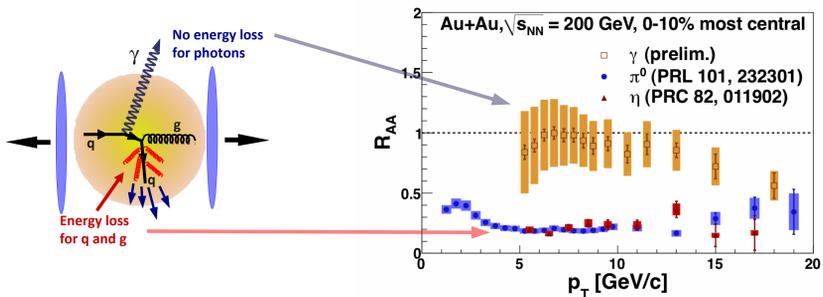
$$R_{AB}(p_T) = \frac{d^2 N_{AB}^0 / dy dp_T}{\langle T_{AB} \rangle \times d^2 \sigma_{pp}^0 / dy dp_T}$$

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

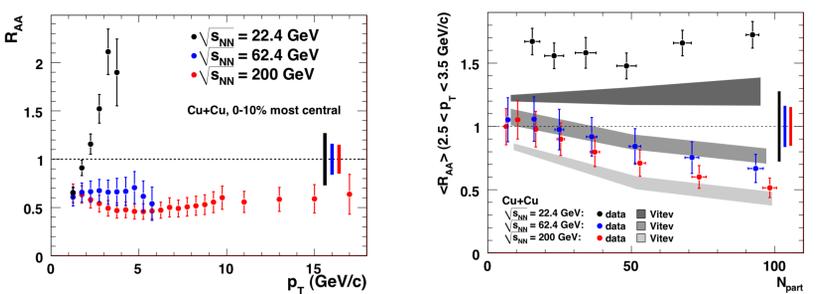
Deviations from unity indicate nuclear effects. "Cold nuclear matter effects" result from the differences in the properties of nucleons that are bound in the nuclei and those that are not. Preliminary 2003 run results indicate $R_{dAu} \sim 1$, in the region dominated by hard scattering ($p_T > 5$ GeV/c):



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



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



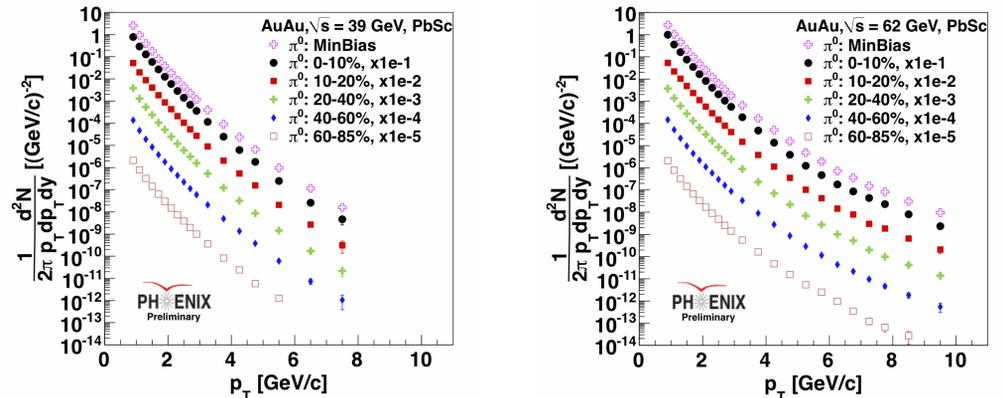
When does the suppression transition occur? In the Cu+Cu system, above, it appears between $\sqrt{s} = 22 - 62$ GeV

Systematic study of suppression

We study suppression by colliding systems of different size at different colliding energies. The PHENIX low energy scan program included medium sized ions (copper), heavy ions (gold), and several interaction energies from 19.6 to 62.4 GeV complementing the main program focused on $\sqrt{s} = 200$ GeV collisions.

Year	System	E [AGeV]
2005	Cu + Cu	200
	Cu + Cu	62.4
	Cu + Cu	22.4
2010	Au + Au	62.4
	Au + Au	39.0
2011	Au + Au	19.6

Recent preliminary results of π^0 production at mid-rapidity from Au+Au collisions at 39 and 62 GeV are shown below.

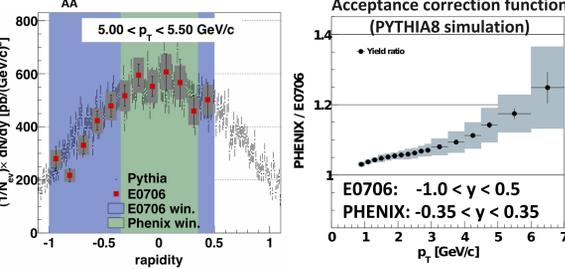


Establishing reliable p+p references

In order to calculate R_{AA} , a p+p reference is needed. PHENIX own measurements exist at 200 GeV over the full p_T range available in A+A.

PHENIX has no p+p data at 39 GeV. A fixed-target Tevatron experiment E0706 at 38.7 GeV had a different rapidity coverage. It was corrected by PYTHIA8.

Having a PHENIX p+p reference would reduce systematic error by 13% on our R_{AA} measurement.



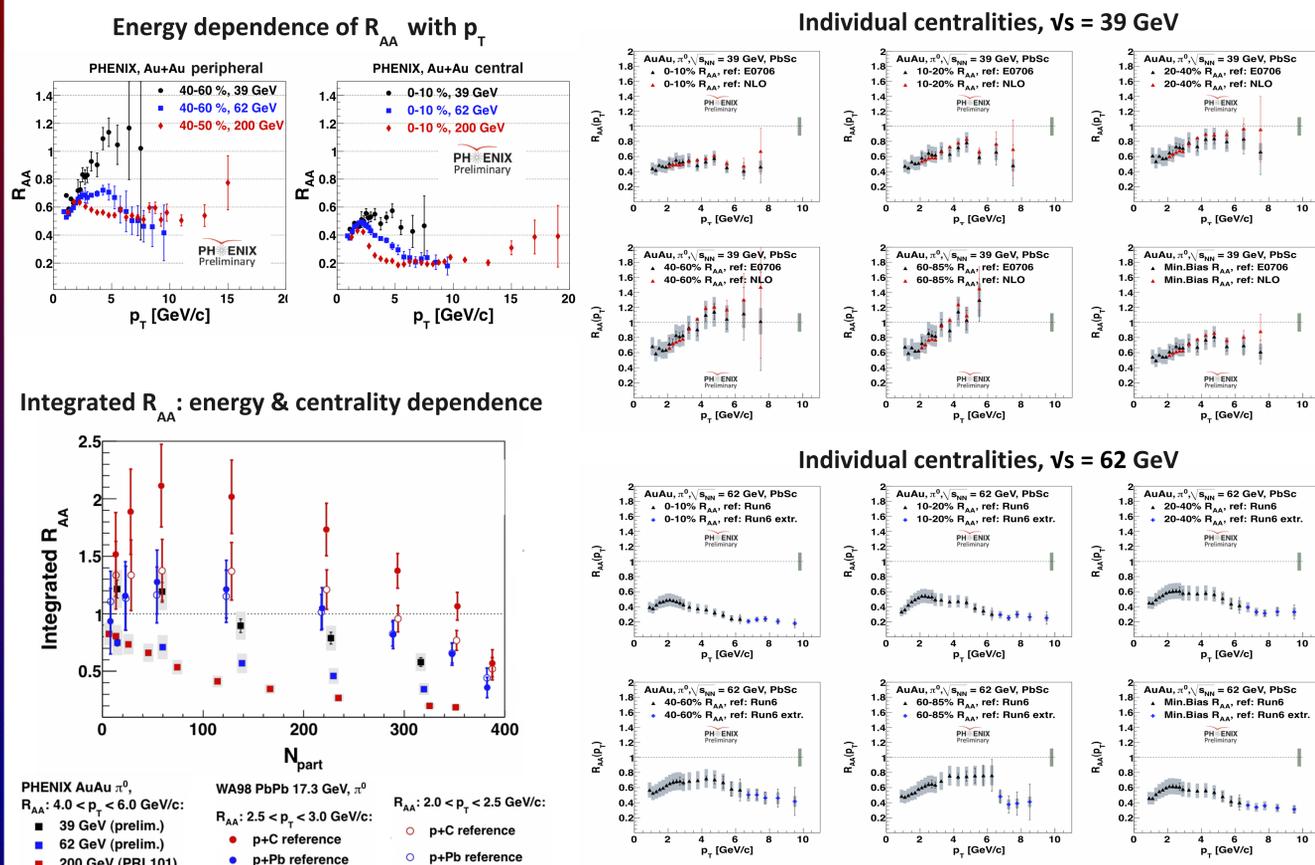
PHENIX 62.4 GeV data is available up to $p_T = 7$ GeV/c.

Extrapolation to 10 GeV/c using a power-law fit.

Within the systematic errors of the fit, there is agreement with CERN-ISR CCOR data in the region of extrapolation.

In-house p+p ref. would reduce the 18% systematics on the 10 GeV point.

Results: π^0 suppression in heavy ion collisions



Conclusions

Neutral pion suppression in heavy ion collisions presents a consistent picture: it increases with centrality, energy, and system size.

We observe π^0 suppression in the 62 GeV data close to the one observed at 200 GeV, and a strong suppression in the 39 GeV central data, which crosses over to enhancement at $N_{part} \sim 100$.

This year PHENIX recorded 700M Au+Au events at 19.6 GeV, the analysis is in progress.

Using a reference p+p measurement taken by the same apparatus significantly reduces systematic errors and should be considered in future running.

Please go see related PHENIX talks by Norbert Novitzky (Friday 18:50 – 19:10) and Martin L. Porschke (Wednesday 9:20 – 9:35)