Charmonia production in high energy collision experiments

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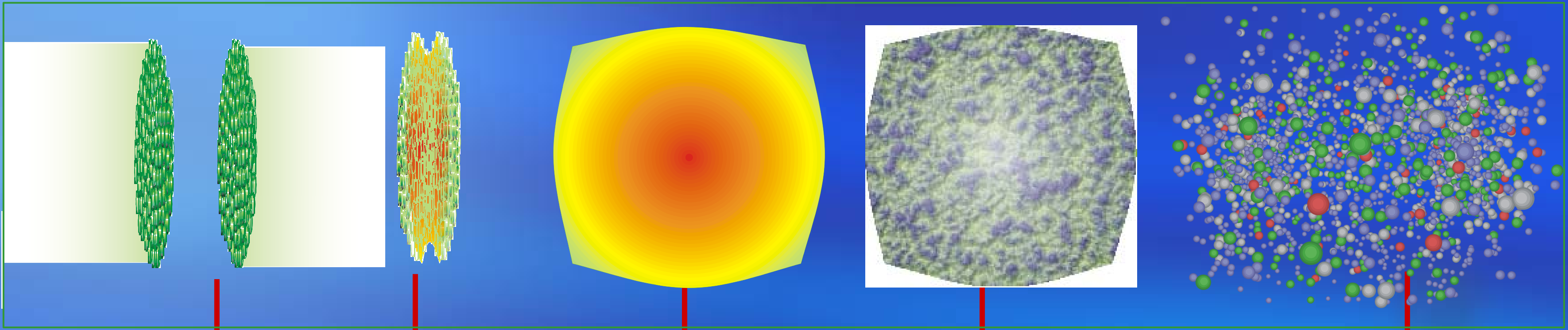
--Journal Club

Outline

- Introduction
- Results form RHIC and CERN SPS
- Cold nuclear matter effect

Introduction



S. Bass

Initial conditions

Initial high Q^2 interactions

Partonic matter - QGP - The hot-QCD

Hadronization and Freeze-out

(1) Hard scattering production - QCD prediction
(2) Interactions with medium - deconfinement/thermalization
(3) Initial parton density

(1) Initial condition in high-energy nuclear collisions - Color Glass Condensation
(2) Cold-QCD-matter, small-x, high-parton density
- parton structures in nucleon / nucleus

Introduction

- J/Psi was thought to be a perfect probe for the created hot medium in Heavy-Ion Collision:

  color screening ⟶ J/Psi suppression

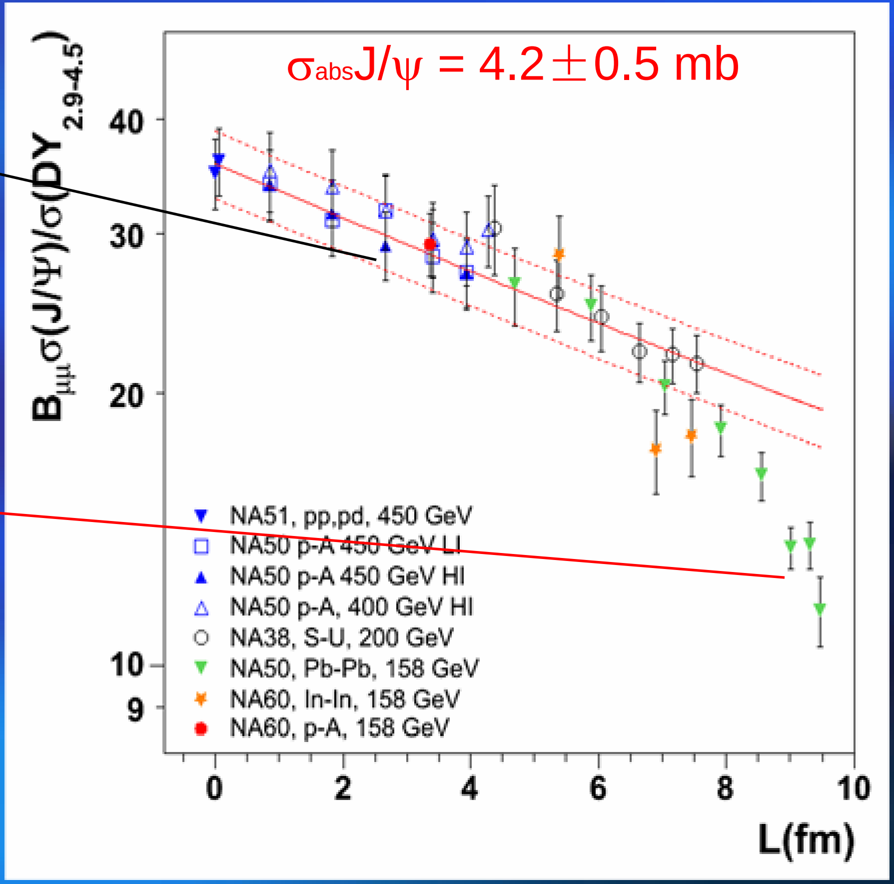
- But cold nuclear matter can also absorb them: initial state energy loss and shadowing, charm quark energy loss, recombination of initially uncorrelated c c-bar pairs …

CERN SPS Experiment

- Take into account the cold nuclear effect by invoking a nuclear absorption

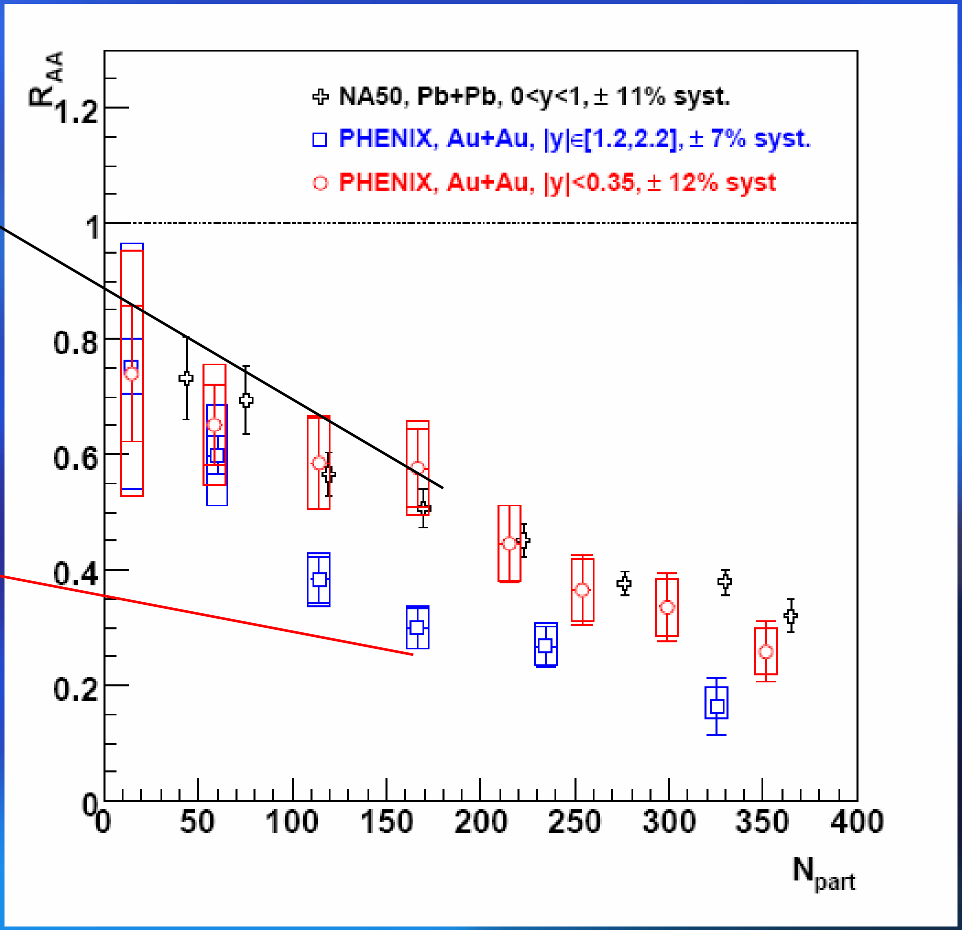
Under a certain centrality, explained very well by a simple nuclear absorption

An anomalous suppression at more central collisions: signature of QGP ?



The RHIC anomalies

- Similar suppression though different collision energies
- More suppression at forward rapidity



nuclear modification factors of the hottest SPS(Pb+Pb) and RHIC(Au+Au) collisions

The RHIC anomalies

- Two possible explanations:

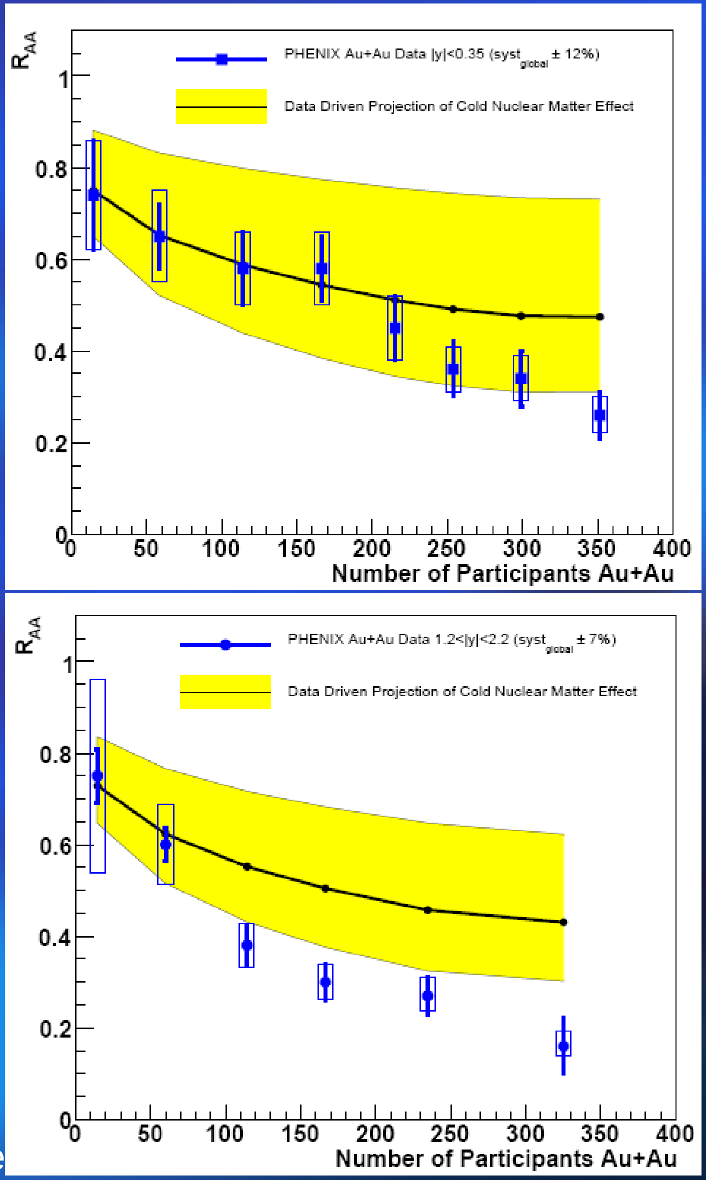
(1) More recombination from initially uncorrelated c c-bar pairs during the hot partonic phase, and more c c-bar quarks to combine at mid-rapidity

(2) J/Psi could be more suppressed at forward rapidity because of cold nuclear effect(Color Glass Condensate)

Explore cold nuclear matter effect

Anomaly may be the same
at mid and forward rapidity
due to large uncertainty

Crucial need for a more precise
estimation of cold nuclear
matter effect



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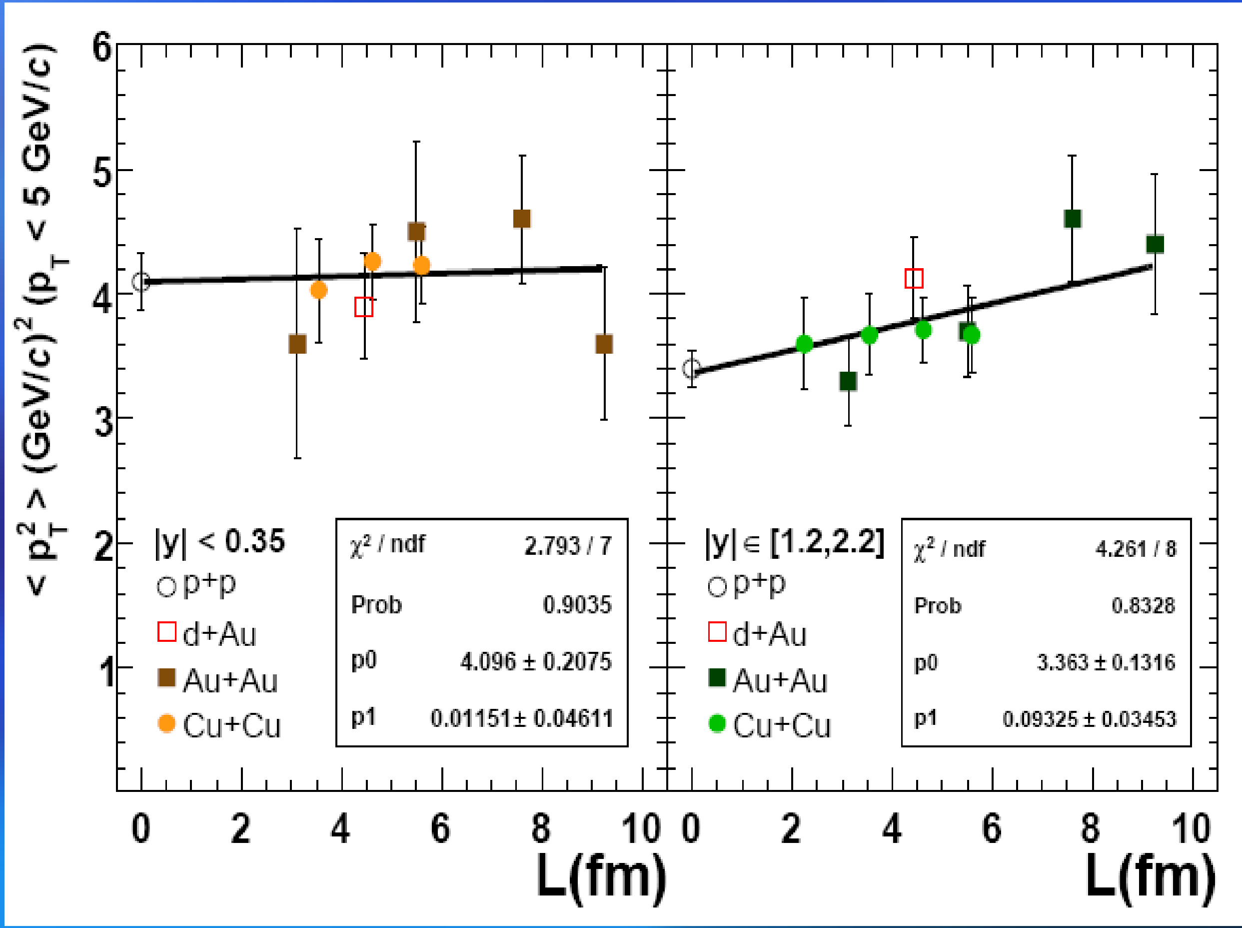
Transverse momentum

- In case of pure Cronin effect,

$$\left\langle p_T^2 \right\rangle(L) = \left\langle p_T^2 \right\rangle_{pp} + \alpha_{gN} L$$

- No evidence for a deviation from Cronin effect



J/Psi $< p_T^2 >$ versus L form PHENIX

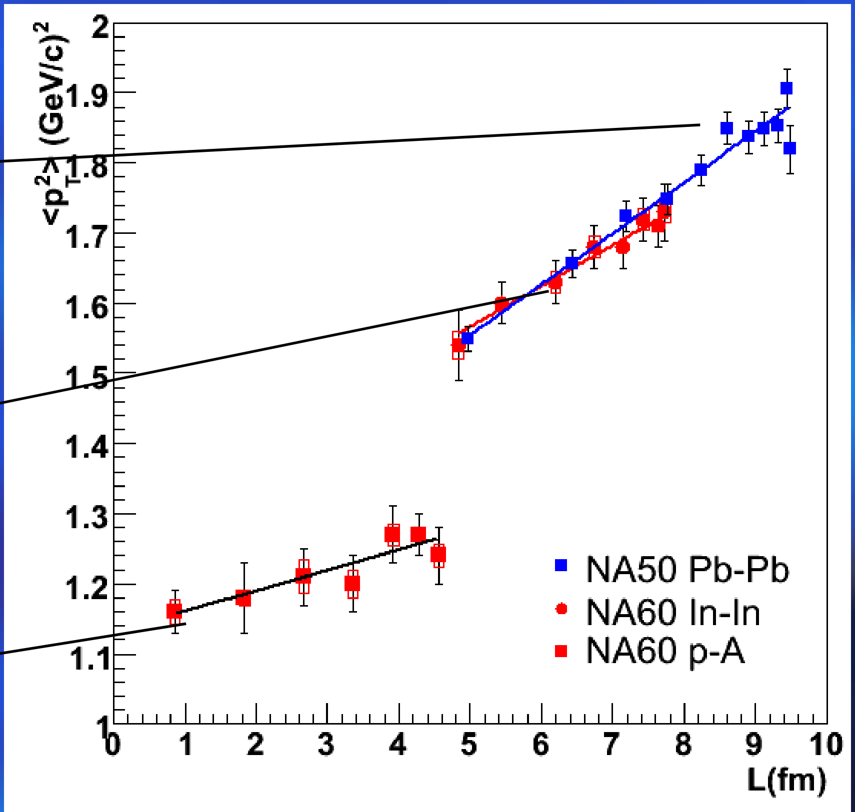
Transverse Momentum

- A slope change??

$\langle p_T^2 \rangle_{pp}$=1.19 $\pm$ 0.04 (GeV/c)^2
α_{gN}=0.072 $\pm$ 0.005(GeV/c)^2/fm

$\langle p_T^2 \rangle_{pp}$=1.27 $\pm$ 0.09 (GeV/c)^2
α_{gN}=0.058 $\pm$ 0.014 (GeV/c)^2 / fm

$\langle p_T^2 \rangle_{pp}$=1.13 $\pm$ 0.04 (GeV/c)^2
α_{gN}=0.029 $\pm$ 0.011 (GeV/c)^2 / fm



Conclusion

- Need more study to confirm the experiment data and test the theory explanations