A couple of models for J/ψ suppression:

Comover interaction & DPM, and Dissociation models

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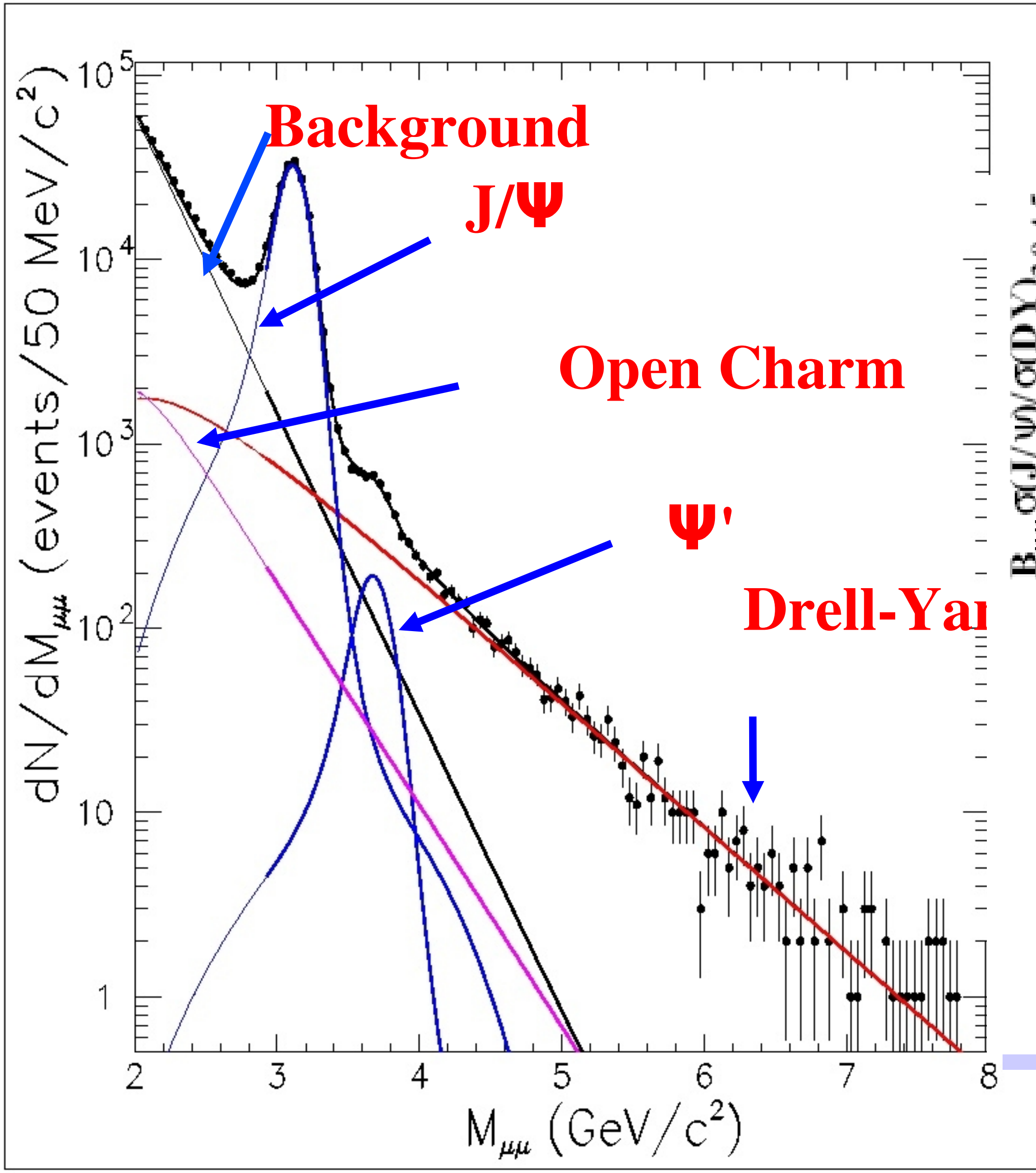
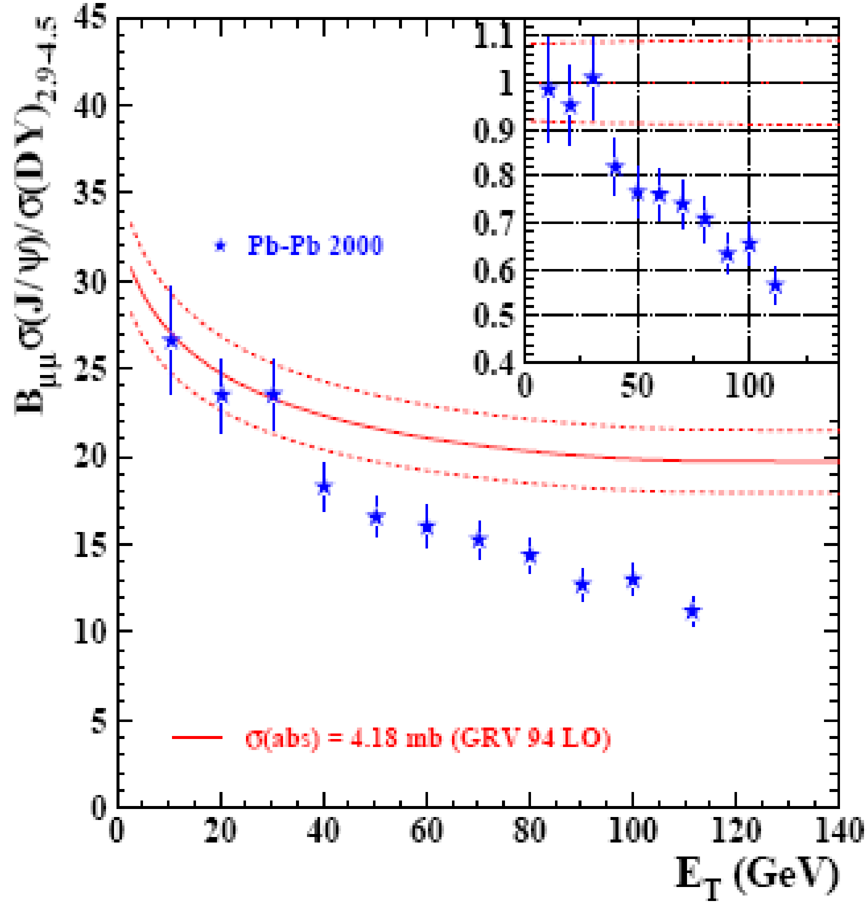
February 26, 2009

Looking J/Ψ in Pb-Pb collisions



J/ψ suppression



Competing J/ψ Production Effects

- Normal nuclear absorption:
  - J/ψ breakup by nucleons in the final state resulting in charm hadrons
- Shadowing:
  - Accounts for parton distribution modifications relative to free protons
  - Affects parton distribution function before collision occurs
- Color Screening:
  - In deconfined medium resonance interactions needed to convert $c\bar{c}$ pairs to J/ψ's are prohibited
- **Comover Interactions:**
  - J/ψ interactions with secondary hadrons results in dissociation
  - Suppression mechanism that does not require deconfined medium
- **Parton Induced Dissociation:**
  - Breakup of J/ψ due to in medium parton interactions

1. And many others....

Comover interactions model

(A.Capella and D. Sousa: Nucl-th/0303055
A. Capella and E. G. Ferreiro EPJC42,419(2005))

J/ψ suppression predicted (T. Matsui, H. Satz PLB178(1986)416) was interpreted as signal of deconfinement. It can also be described as a result of a final state interaction of the c-cbar with the dense medium produced in the collision (comovers' interaction)

The survived J/ψ 's interact with secondary hadrons: J/ψ +h->DD.

Crucial parameter : J/ψ -hadron inelastic cross-section,

($\sigma_{\psi h}^{inel}$) a very uncertain parameter !

Theoretical estimates : $\sigma_{\psi h}^{inel}$ ~0.1-1 mb

Common assumptions: isoentropicmedium , longitudinal expansion of the hadron gas (Monte Carlo calculations include transverse expansion); the density decreases as $1/\tau$ (τ proper time)the interactions stop at the freeze-out.

Dual Parton Model

[A.Capella et al.,Z.Phys.C3,329,(1980); Phys.Rep.236,225(1994)
A.Capella et al.,nucl-th/0303055; hep-ph/0505032]

The number of secondary hadrons(comovers) at the initial (formation) time is given by the sum of two contributions, proportional respectively to the number of participants and to the number of binary N-N collisions (s=coordinate in the transverse plane) :

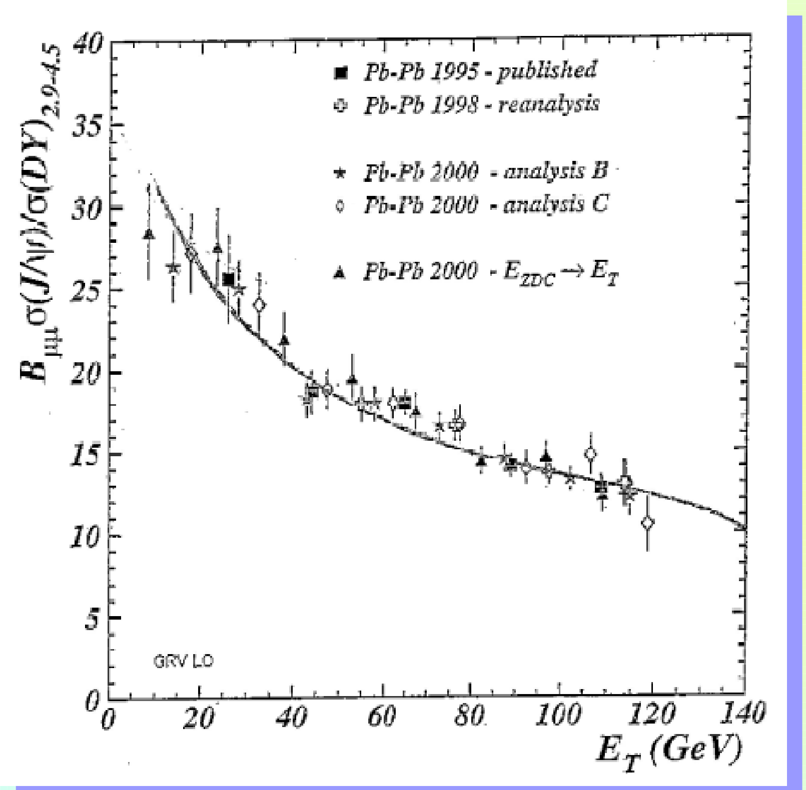
$$N^{com}(b,s,y,\sqrt{s}) = C_1(b,y,\sqrt{s})N^{part}(b,s) + C_2(b,y,\sqrt{s})N^{coll}(b,s)$$

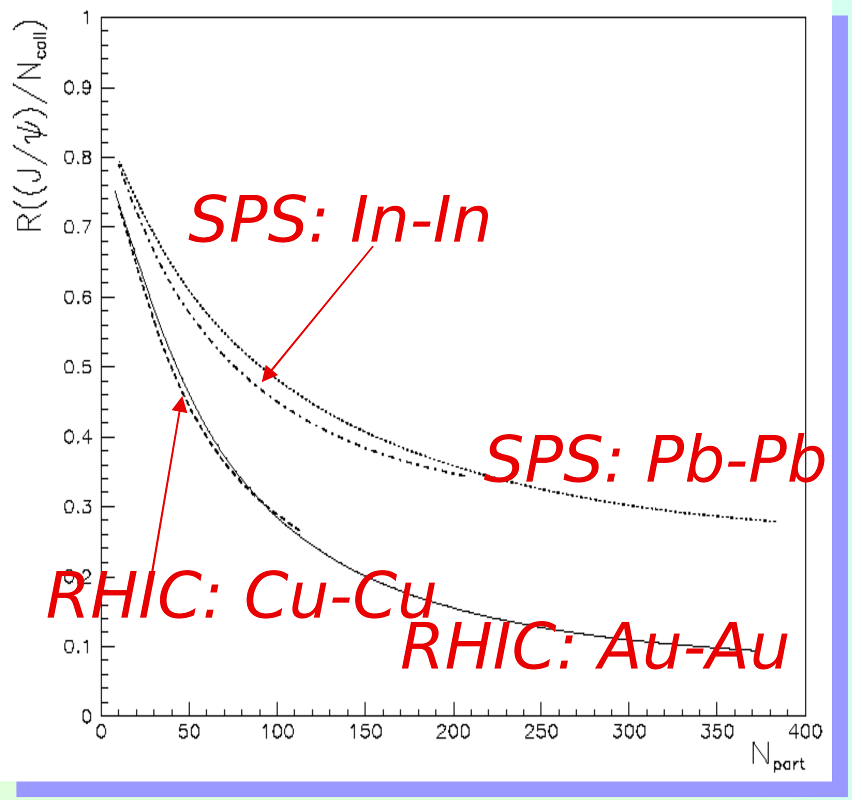
The coefficients C_1 and C_2 are predicted in the DPM.

RHIC : shadowing corrections (to moderate the increase of the produced secondaries)

Comover interactions and DPM: results

A.Capella,D.Sousa,nucl-th/0303055
A.Capella,E.Ferreiro,EPJC42,419(2005)(hep-ph/0505032)





σ_{abs}=4.5 mb
$\sigma_{\psi h}^{inel}$=0.65 mb (fitted to Pb-Pb)

Comover absorption: problems

- To reproduce the observed suppression in Pb-Pb, the density of comovers must by <u>very</u> high : can a hadron gas exist in these extreme conditions ?

Dissociation: J/ψ Absorption

(Maiani et al. NPA748,209(2005): hep-ph/0408150); NPA741,273 (2004): hep-ph/0402275)

1).- Interaction with of J/ψ a nuclear medium. We assume the J/ψ to be produced inside a thermalised pion gas as discussed by Bjorken.

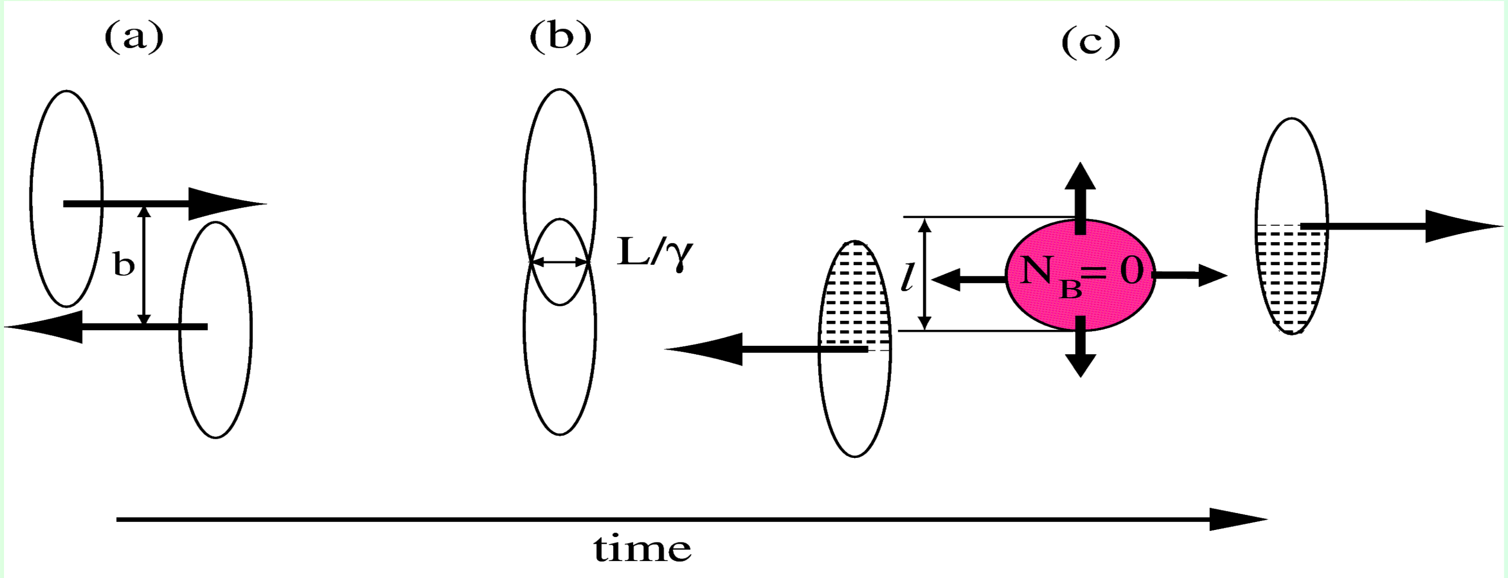
2) .- $\pi + J/\psi \rightarrow D^* + \overline{D^*}$ assuming a hadrons gas where the density and temperature of the hadron gas is limited (T=165-185 MeV).

$$\rho(T) = \frac{N}{2\pi^2} \int_{E_\pi^{th}}^{\infty} dE \, \frac{E_\pi}{e^{E_\pi / kT} - 1}$$

3) Collisions at lower centrality allow us to determine the temperature and density of the pion gas.

4) The experimental suppression can not be reproduced. I fails to reproduce the break in J/ψ absorption.

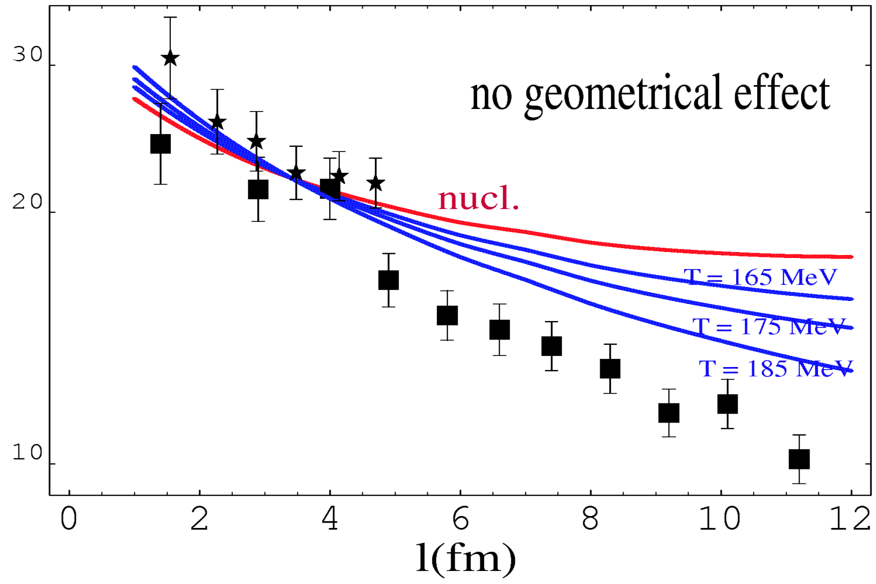
The geometry of the collisions



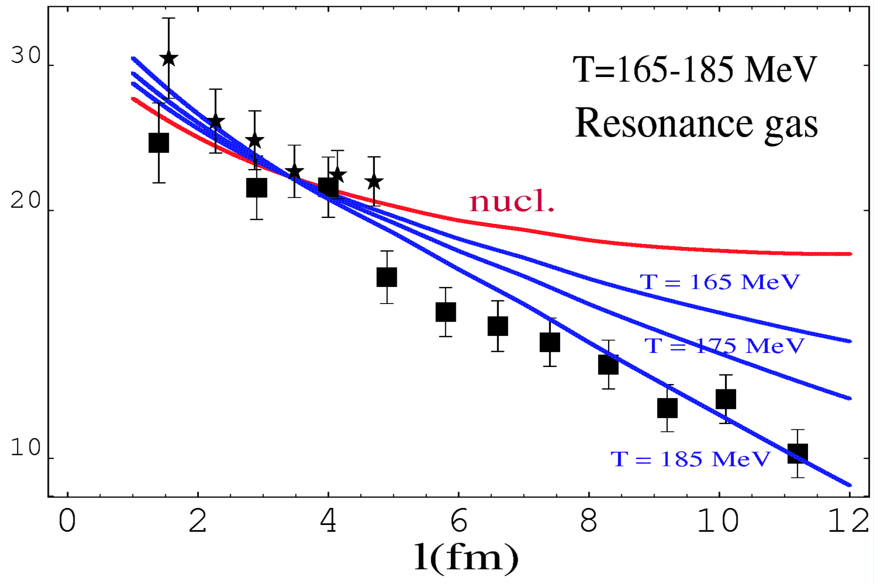
Atenuation of J/ψ as function of *b:*

$$g(b/R)=\frac{\pi}{2}\frac{(1-b/2R)^2(1+b/4R)}{\cos^{-1}(b/2R)-(b/2R)\sqrt{(1-b^2/4R^2)}}$$

Without Lorentz contraction



with Lorentz contraction



Improving models...

- Generally, deconfinement models assume the complete suppression for the charmonium states inside the “QGP” bubble: this is a really extreme assumption !

- Finite-size effects, life-time, surface can modify the suppression pattern in small systems and in peripheral collisions.

Regeneration

[L. Grandchamp et al., Nucl.Phys.A715 (2003) 545; Phys.Rev.Lett.92 (2004) 212301.]

“Two component” model: suppression in hadronic and QGP phase + statistical production at hadronization.

In the QGP phase: in-medium properties of open- and hidden-charm states as deduced from lattice calculations.

The regeneration is very important at higher energies.