QUARK GLUON PLASMA IN THE THRESHOLD MODEL

Xitzel Sánchez

FIPAE seminar

January 22, 2008

CONTENT

Motivation

Review of the Threshold Model (TM)

The characterization of the threshold region

The production of Λ^0 and J/ψ under the TM

Summary

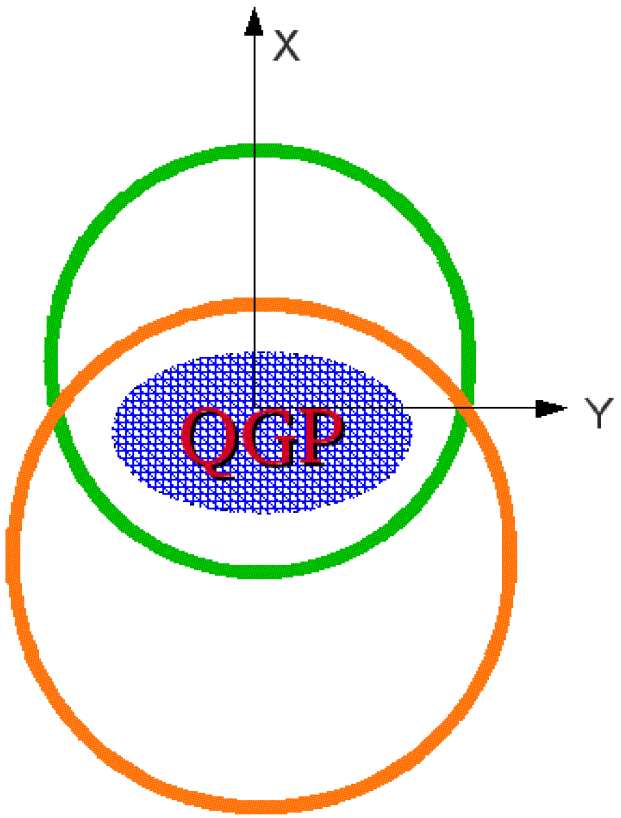
MOTIVATION:

The J/Ψ suppression is not explained with the nuclearabsorption model in Pb+Pb collisions. Blaizot et al. PRL. 85, 4012 (2000). Blaizot et al NPA 610, 452C (1996). Chaudhuri, JPG 32, 229 (2006).

It is used to indicate that change in Λ^0 polarization in the could be a signal of QGP fromation.

A. Ayala, E. Cuautle, L.M, Montaño, G. Herrera. PRC 65, 024902 (2002); RMF 48 S2, 29 (2002)

THRESHOLD MODEL



The threshold model defines two regions with different phenomenology in the particles production.

The interaction region is determinated by the transverse density of participants η_p, which is based on the Glauber Model calculations.

If η_p is larger than a critical density η_c,the quark gluon plasma is created. Otherwise it will be normal nuclear matter (NNM).

PRODUCTION IN THE THRESHOLD MODEL

The hadron production in the two regions is determinated by the properties of the medium. Blaizot et al NPA 610, 452C (1996).
In the QGP region:

$$\frac{d^2\sigma_{Part}^{QGP}}{d^2b} = c\left[\int \eta_p(\boldsymbol{s},\boldsymbol{b})\,\theta\left(\eta_p(\boldsymbol{s},\boldsymbol{b})-\eta_c\right)d^2s\right]^2$$

And in NNM:

$$\frac{d^2\sigma_{Part}^{NNM}}{d^2b} = \sigma_{Part}^{NN}\int T_B(\boldsymbol{b}-\boldsymbol{s})\,T_A(\boldsymbol{s})\,\theta\left(\eta_c-\eta_p(\boldsymbol{s},\boldsymbol{b})\right)d^2s$$

The transverse density of participants is defined as.

$$\eta_p(\boldsymbol{s},\boldsymbol{b}) = T_A(\boldsymbol{s})\left\{1-\exp\left[-\sigma^{NN}T_B(\boldsymbol{b}-\boldsymbol{s})\right]\right\} + T_B(\boldsymbol{b}-\boldsymbol{s})\left\{1-\exp\left(-\sigma^{NN}T_A(\boldsymbol{s})\right)\right\}$$

THE INTERACTION REGION

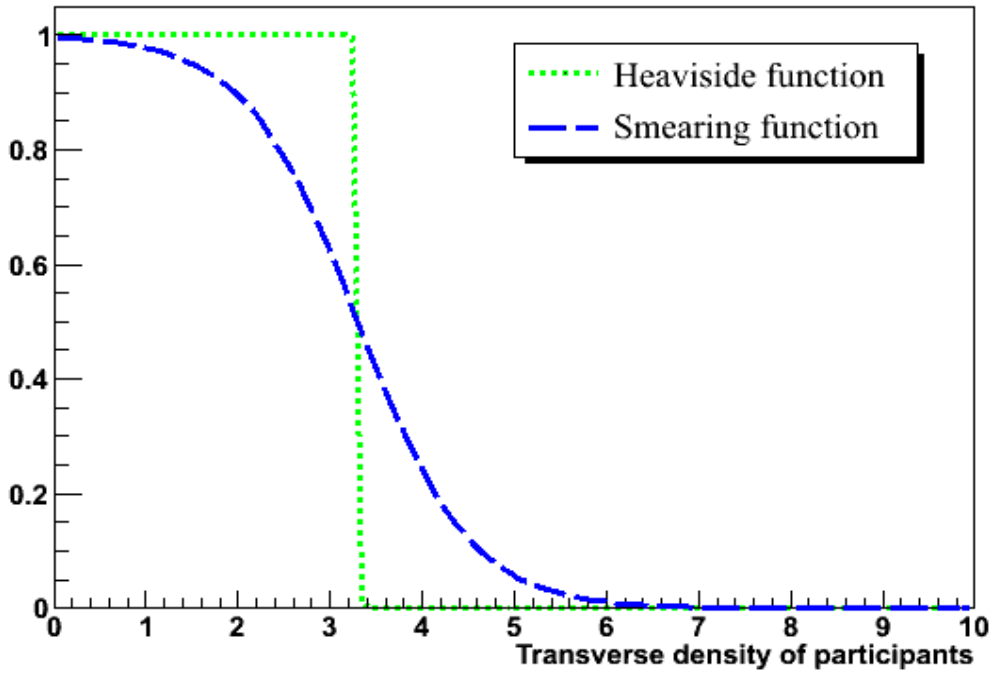
The two regions of interaction are divided by the Heaviside function.

$$\Theta[\eta_p(\boldsymbol{s},\boldsymbol{b})-\eta_c]$$

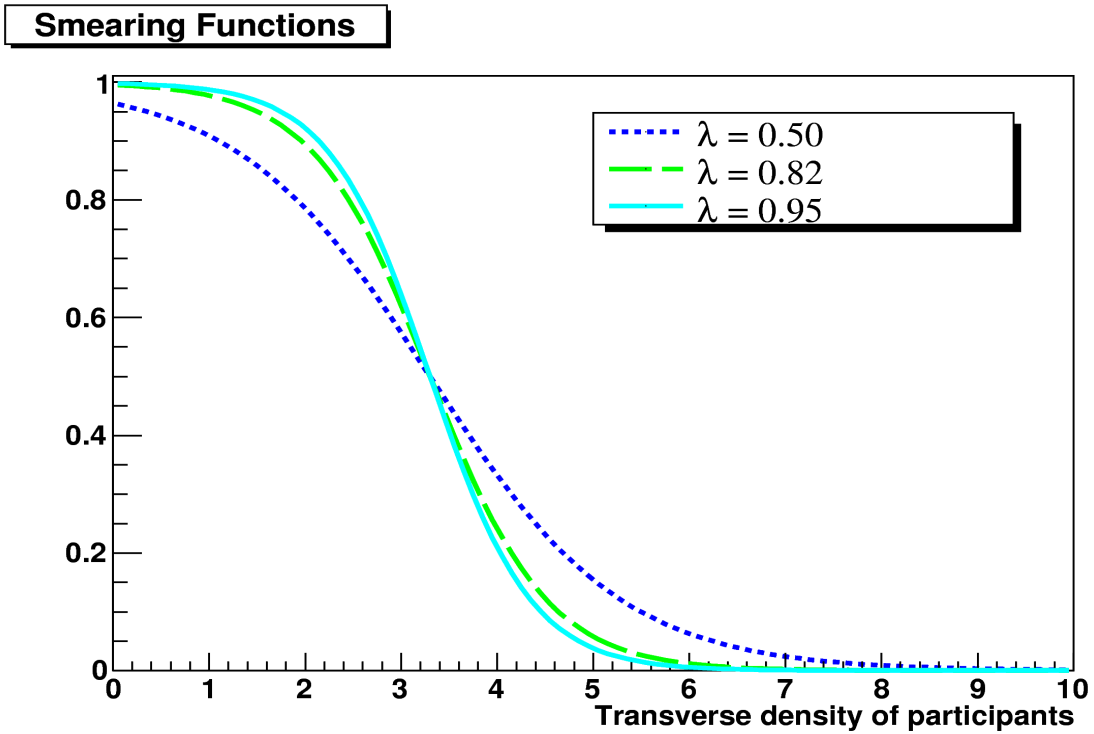
Also it may be changed if the function is smeared as follow. Blaizot et al. PRL. 85, 4012 (2000). Blaizot et al NPA 610, 452C (1996). Chaudhuri, JPG 32, 229 (2006).

$$[1-\tanh\lambda(\eta_p(\boldsymbol{s},\boldsymbol{b})-\eta_c)]/2$$

For Pb we took $\eta_c = 3.3$ fm^{-2} Ayala et al. RMF 48 S2, 29 (2002)) and $\lambda = 0.82$ fm^2 (Chaudhuri, JPG 32, 229 (2006))

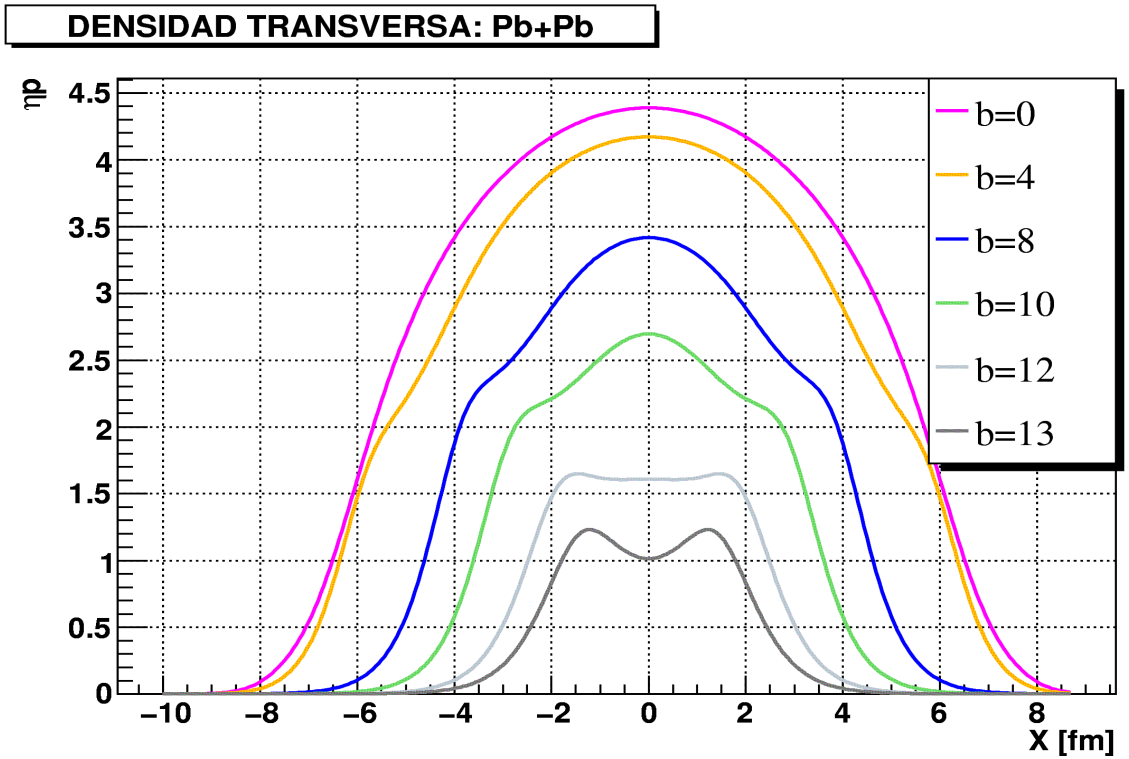


The figure shows how the interaction region changes taking the two different functions.

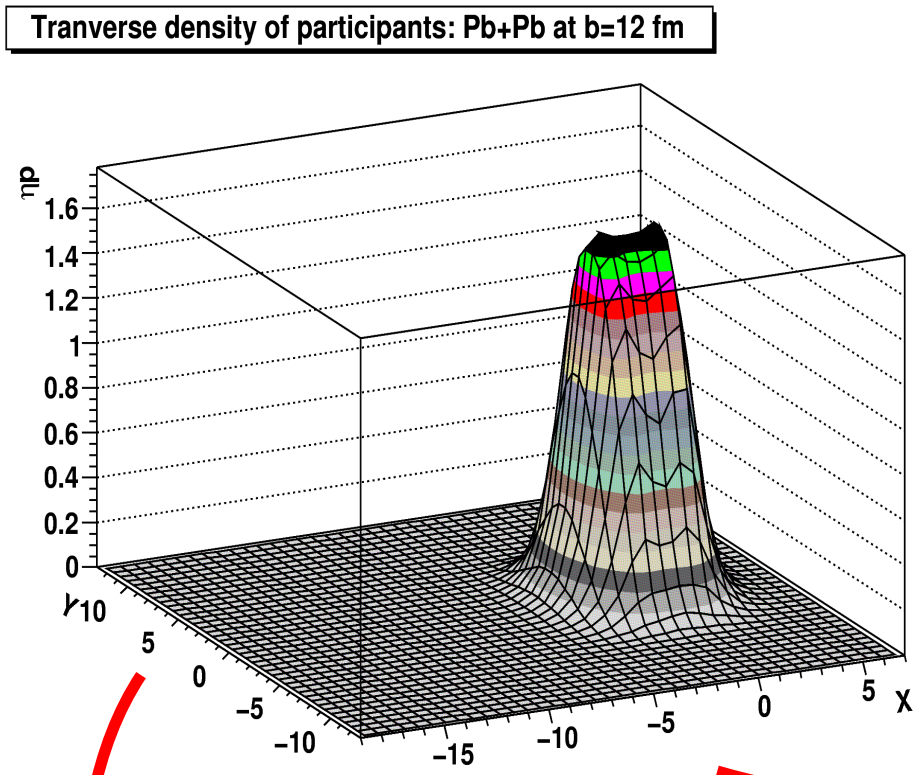


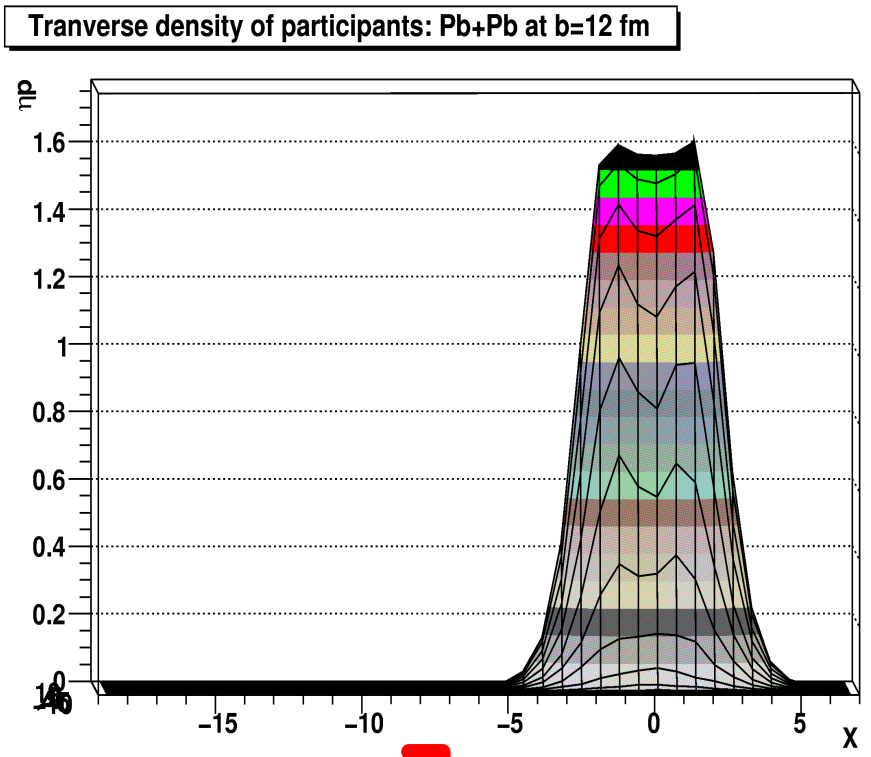
The λ parameter indicates how much the threshold region is smeared for a good agreement with the data.
The figure shows the change in the threshold region for three values of λ = 0.50, 0.82, 0.95.

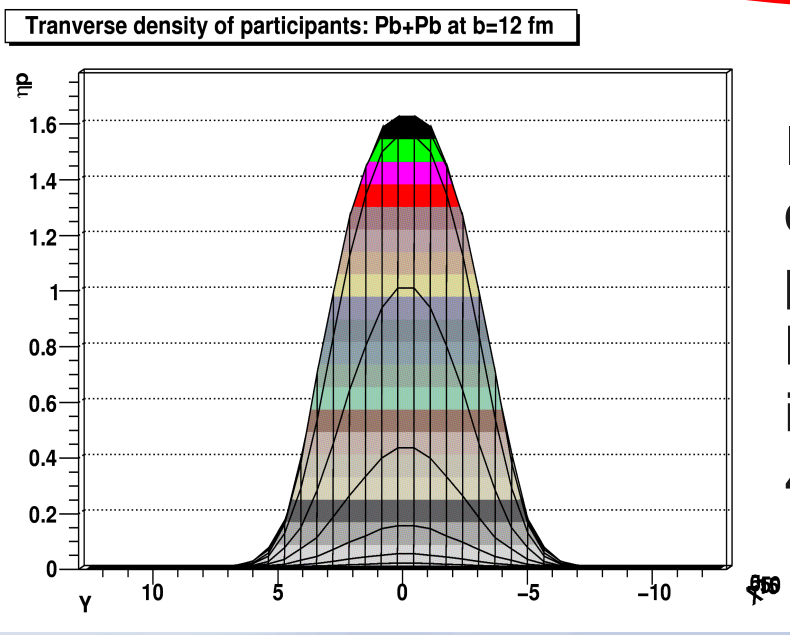
TRANVERSE DENSITY



The transverse density in Pb+Pb collisions along the X-axis, for different impact parameter. These result was not the expected one.



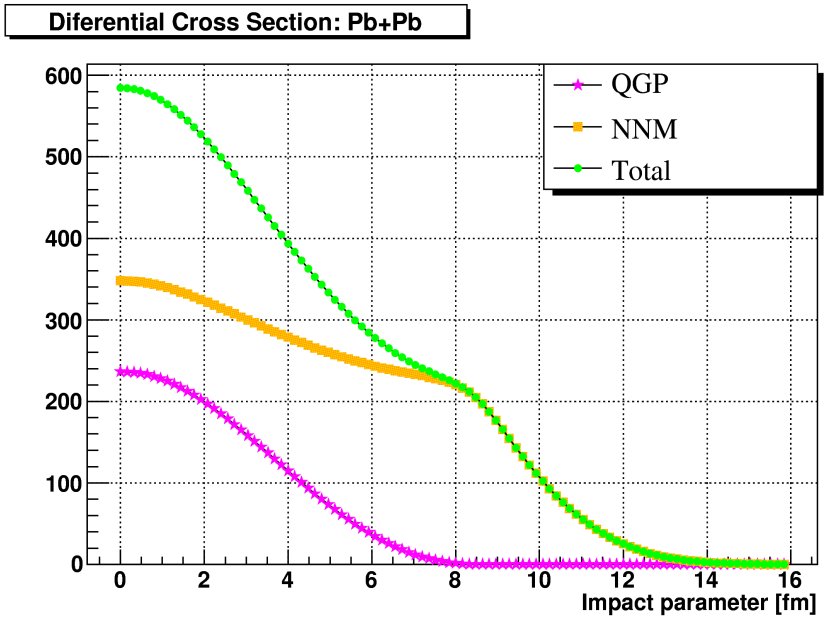




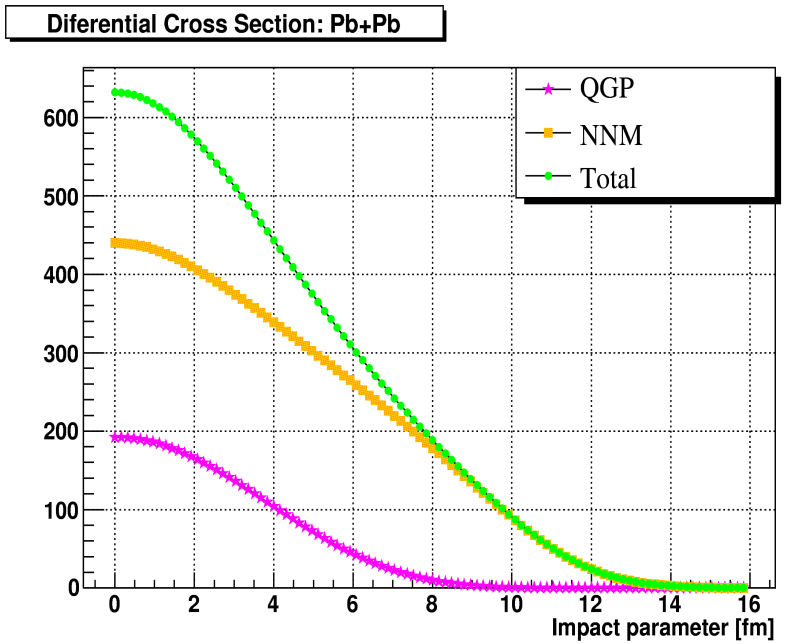
It is found that the density of participants distribution is not symmetric. The projection along the X-axis shows a hump, while the projection in the Y-axis is as expected in Blaizot et al NPA 610, 452C (1996).

Λ^0 CROSS SECTION PRODUCTION IN Pb+Pb

Without smearing



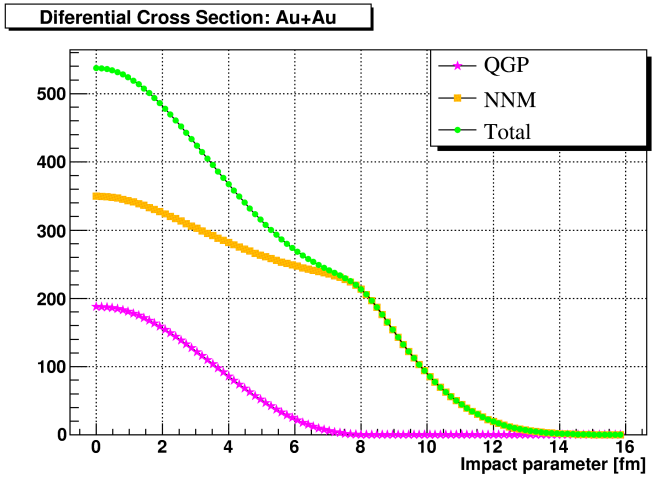
With smearing



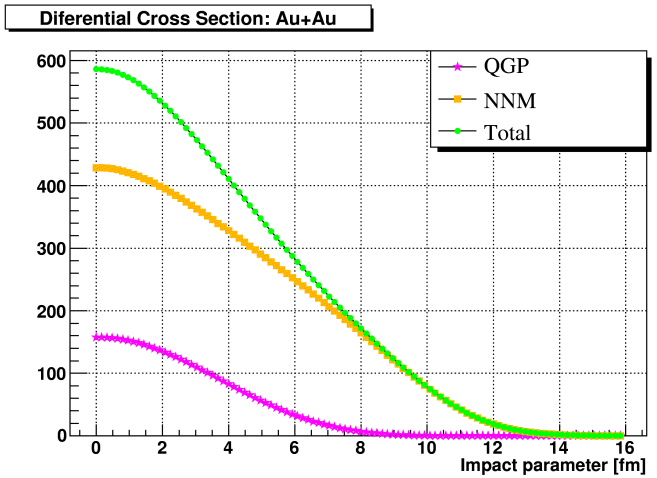
We compare the Λ^0 production in the threshold model when the smearing function is introduced. We see an increment of the NNM region. On the other hand, there is a reduction of Λ^0 production in the QGP.
For the Pb, the critical density is taken as 3.3 fm^{-2} and the λ parameter is 0.82 fm^2.

Λ^0 CROSS SECTION PRODUCTION IN Au+Au AND S+S

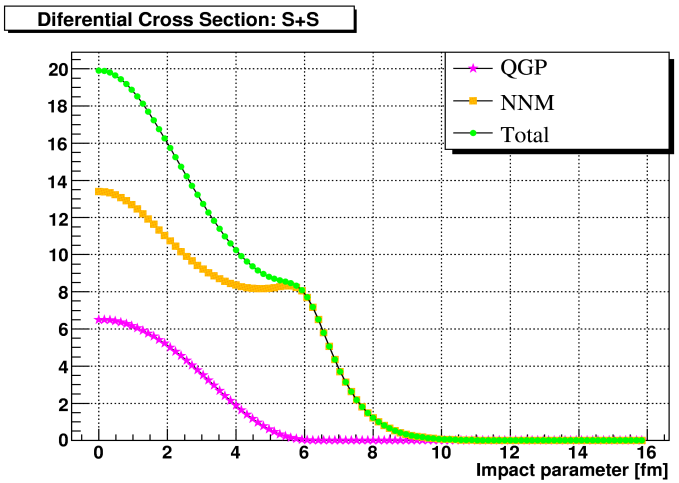
Without smearing

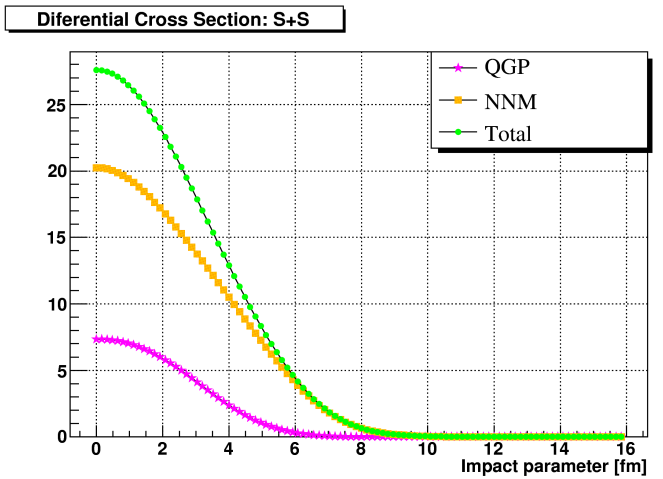


With smearing

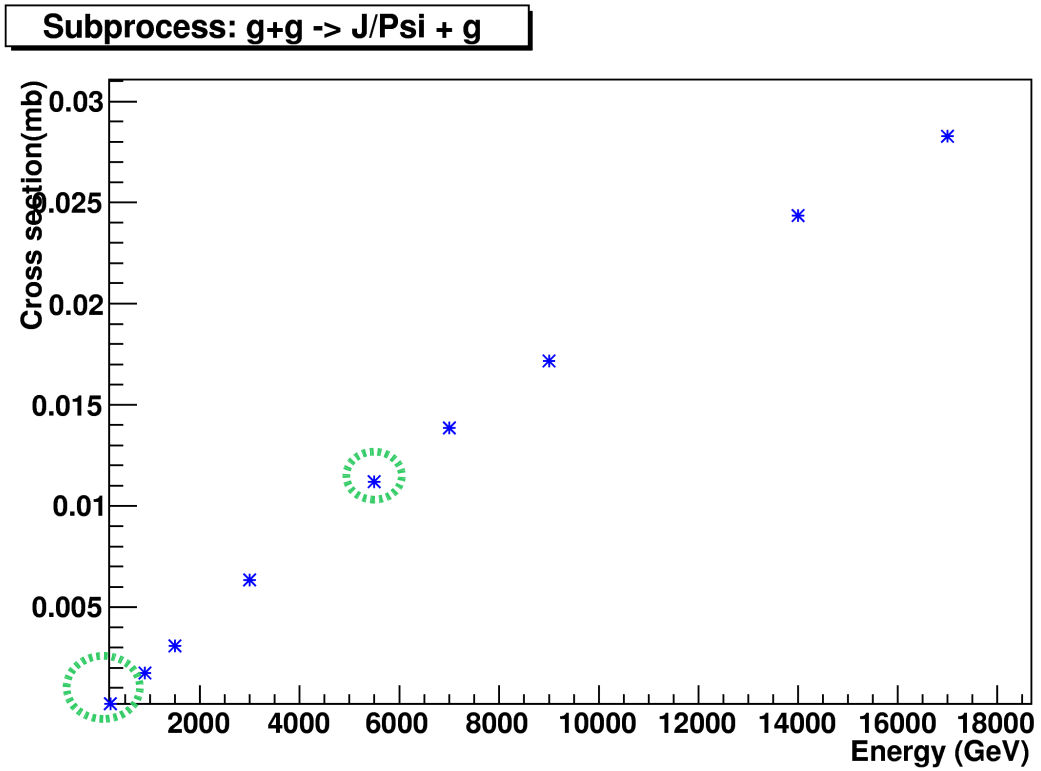


For Au the critical density is 3.3 fm^{-2} and for S is 1 fm^{-2}.





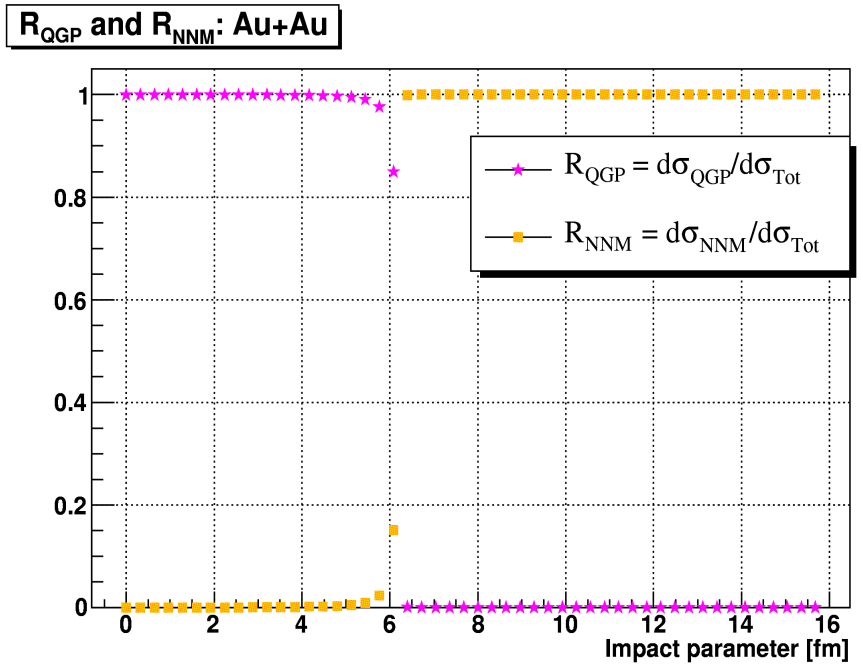
J/Ψ CROSS SECTION PRODUCTION WITH PYTHIA



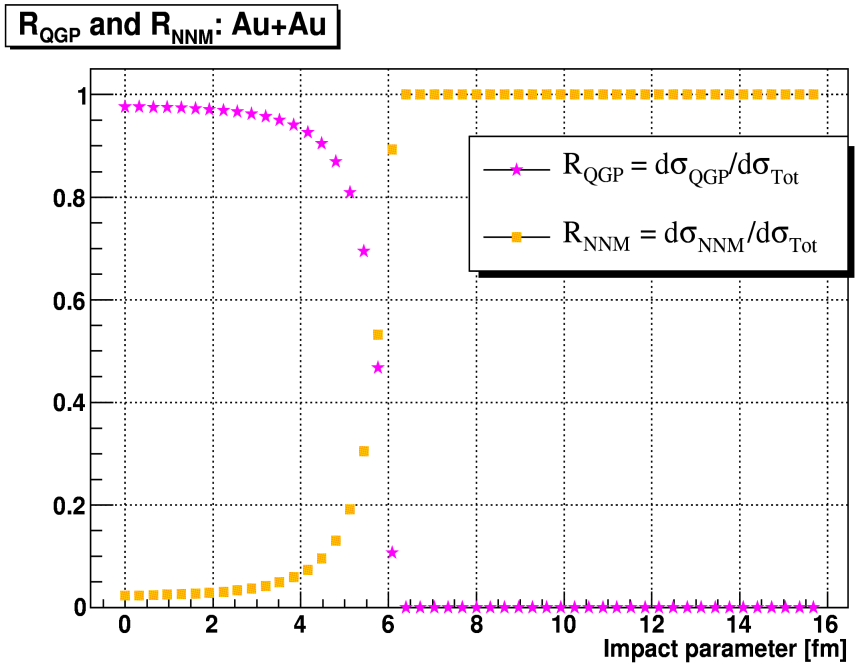
The figure shows the J/Ψ production cross section at different collisions energy, which is calculated with *Pythia 6.2* (pp collisions).

J/Ψ CROSS SECTION RATIO FROM QGP TO RCB REGIONS

200 GeV



5500 GeV



it is calculated the ratio of the differential cross section in QGP to the total differential cross section, as well as the ratio of the NNM, using the J/ψ production cross section ($\sigma_{J/\psi} = 2.382 \times 10^{-4}$ mb at 200 GeV and $\sigma_{J/\psi} = 0.0112$ mb at 5500 GeV), with $\sigma^{NN} = 44$ mb and the parameters in the smearing function as $n_{J/\psi} \approx 3.73$ fm^{-2} and $\lambda = 0.05 n_{J/\psi}$ as found in Chaudhuri, JPG 35, 065105 (2008).

SUMMARY

Using the Threshold Model, the results that were found are:
The distribution in the transverse density is not symmetric for peripherical collisions as it was expected by **Blaizot et al NPA 610, 452C (1996).**
If the function that determinates the threshold region is smeared, it is observed an increase in the total hadron production (Λ^0).
The J/ψ in Au+Au collisions at 5500 GeV is produced principally in the QGP region, this will lead to the J/ψ suppression.

FUTURE WORK

The study of the J/ψ as function of the transverse energy.
The production of other hadrons with strangeness and charm.

REFERENCE

[1] J. P. Blaizot, M. Dinh and J. Y. Ollitrault, Phys. Rev. Lett. 85, 4012 (2000) [arXiv:nuclth/0007020].

[2] J. P. Blaizot and J. Y. Ollitrault, Nucl. Phys. A 610, 452C (1996).

[3] A. K. Chaudhuri, J. Phys. G 32, 229 (2006).

[4] A. Ayala, E. Cuautle, G. Herrera and L. M. Montano, Phys. Rev. C 65 (2002)024902 [arXiv:nucl-th/0110027].

[5] A. Ayala, E. Cuautle, G. Herrera and L. M. Montano, Rev. Mex. Fís. 48 S2 (2002)29

[6] A. K. Chaudhuri, J. Phys. G: Nucl. Part. Phys. 35 (2008) 095107 (15pp)

[7] Chaudhuri A K 2008 J. Phys. G: Nucl. Part. Phys. 35 065105 (Preprint arXiv:0711.2133)