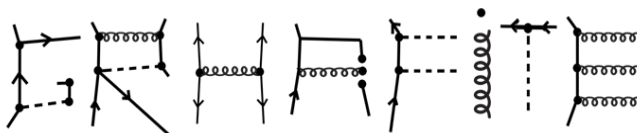


Fotoprodução de Mésons Vetoriais no LHC

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 Fernando Silveira Navarra
 Victor Paulo Barros Gonçalves

XXV RETINHA



Motivação

- Estudo da produção de mésons vetoriais em colisões ultraperiféricas levando em conta efeitos de saturação.

- Estudos recentes

PHYSICAL REVIEW C **87**, 032201(R) (2013)

***J/ψ* production in ultraperipheral Pb + Pb and p + Pb collisions at energies available at the CERN Large Hadron Collider**

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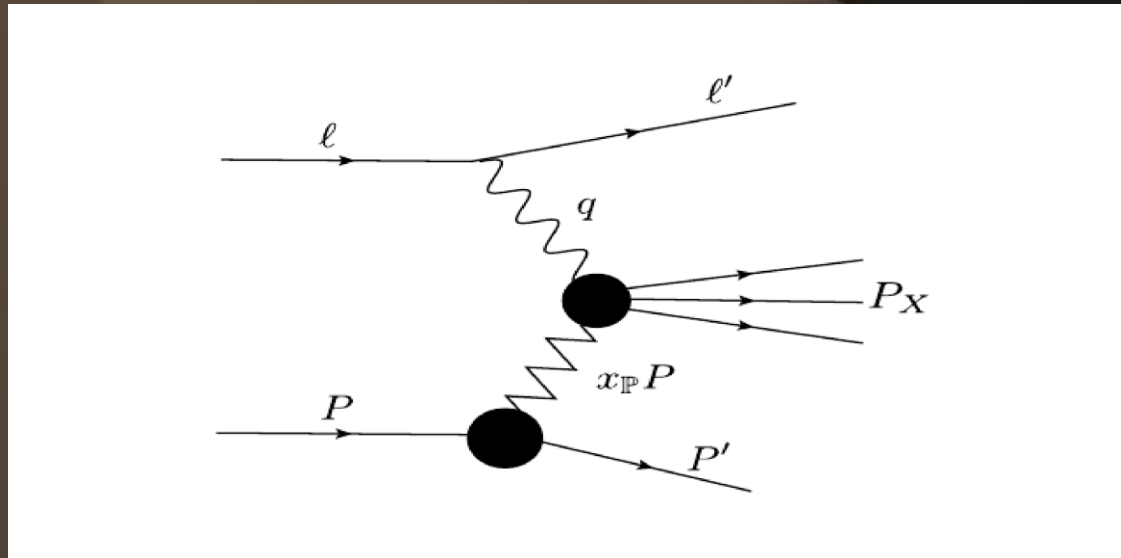
(Received 23 January 2013; published 25 March 2013)

We compute cross sections for incoherent and coherent diffractive *J/ψ* production in ultraperipheral nucleus-nucleus and proton-nucleus collisions using two different dipole models fitted to HERA data. We obtain a reasonably good description of the available ALICE data for coherent *J/ψ* production and present our prediction for the incoherent cross section. We also find that, while the normalization of the cross section depends quite strongly on the dipole model and vector meson wave function used, the rapidity dependence is very well constrained.

- Dados experimentais recentes.
 - LHCb collaboration, R. Aaij et al., arXiv: 1301.7084 [hep-ex]
 - LHCb collaboration, R. Aaij et al., arXiv: 1401.3288 [hep-ex]
 - ALICE collaboration, B. Abelev et. al., arXiv: 1209.3715 [nucl-ex]

Objetivo

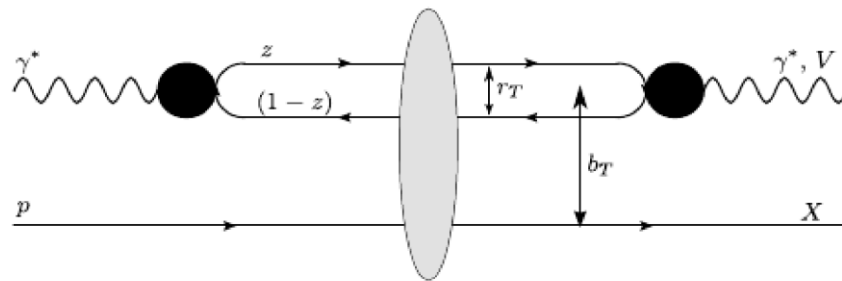
- Cálculo da distribuição de rapidez para a produção difrativa de mésons vetoriais em colisões ultraperiféricas hadron-hadron.



$$\frac{d\sigma(h_1 h_2 \rightarrow V h_1 h_2)}{dy} = n^{h_2}(y) \sigma^{\gamma h_1}(y) + n^{h_1}(-y) \sigma^{\gamma h_2}(-y)$$

Formalismo de Dipolo

- Produção difrativa de mésons vetoriais em colisões fóton-próton.



Formalismo de Dipolo

$$\frac{d\sigma(\gamma^*p \rightarrow Vp)}{dt} = \frac{R_g^2(1 + \beta^2)}{16\pi} \left| \mathcal{A}^{\gamma^*p \rightarrow Vp}(x, Q^2, \Delta_T) \right|^2$$

$$R_g = \frac{2^{2\lambda_e+3} \Gamma(\lambda_e + 5/2)}{\sqrt{\pi} \Gamma(\lambda_e + 4)}$$

$$\beta = \frac{\text{Re } \mathcal{A}}{\text{Im } \mathcal{A}} = \tan\left(\frac{\pi\lambda_e}{2}\right)$$

$$\lambda_e = \frac{\partial \ln[\mathcal{A}(x, Q^2, \Delta)]}{\partial \ln(1/x)}$$

$$\mathcal{A}^{\gamma^*p \rightarrow Vp}(x, Q, \Delta_T) = i \int dz d^2\mathbf{r}_T d^2\mathbf{b}_T [\psi_V^* \psi](\mathbf{r}_T, z, Q) e^{-i\mathbf{b}_T \cdot \Delta_T} 2\mathcal{N}(x, \mathbf{r}_T, \mathbf{b}_T)$$

$$\sigma_{tot}(\gamma^*p \rightarrow Vp) = \frac{1}{B_V} \left[\frac{d\sigma}{dt} \right]_{t=0}$$

Modelos de Saturação

- Cálculo da amplitude de espalhamento frontal para a interação dipolo-hadron

GBW (Golec-Biernat e Wüsthoff)

- K. Golec-Biernat and M. Wüsthoff, Phys. Rev. D 59, 014017 (1999).
- K. Golec-Biernat and M. Wüsthoff, Phys. Rev. D 60, 114023 (1999).

$$\mathcal{N}(x, r) = \left[1 - \exp \left(- \frac{[Q_S(x)r]^2}{4} \right) \right]$$

$$\sigma_{dip}^{GBW}(x, r) = \sigma_0 \mathcal{N}(x, r)$$

$$Q_S^2 = \left(\frac{x_0}{x} \right)^{\lambda_{GBW}} \text{GeV}^2$$

bCGC

- H. Kowalski, L. Motyka and G. Watt, Phys. Rev. D74, 074016 (2006).
- G. Watt and H. Kowalski, arXiv:0712.2670 [hep-ph].
- A. Rezaeian and I. Schmidt, arXiv:1307.0825v3 [hep-ph].

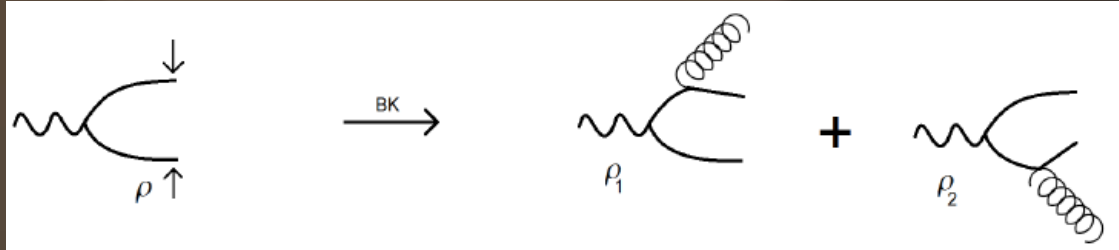
$$\sigma_{dip}(x, r^2) = \int d^2\mathbf{b} 2 \mathcal{N}(x, r, b)$$

$$\mathcal{N}(x, \mathbf{r}, \mathbf{b}) = \begin{cases} \mathcal{N}_0 \left(\frac{rQ_S}{2} \right)^{2\left(\gamma_S + \frac{\ln(2/rQ_S)}{\kappa\lambda Y}\right)} & , \text{ se } rQ_S \leq 2; \\ 1 - \exp \left[-\mathcal{A} \ln^2(\mathcal{B}rQ_S) \right] & , \text{ se } rQ_S > 2. \end{cases}$$

$$Q_S(x, \mathbf{b}) = \left(\frac{x_0}{x} \right)^{\frac{\lambda}{2}} \exp \left[-\frac{b^2}{4\gamma_S B_{CGC}} \right] \text{ GeV}$$

rcBK (“*running coupling BK*”)

- Equação de Balitsky e Kovchegov (Equação BK).



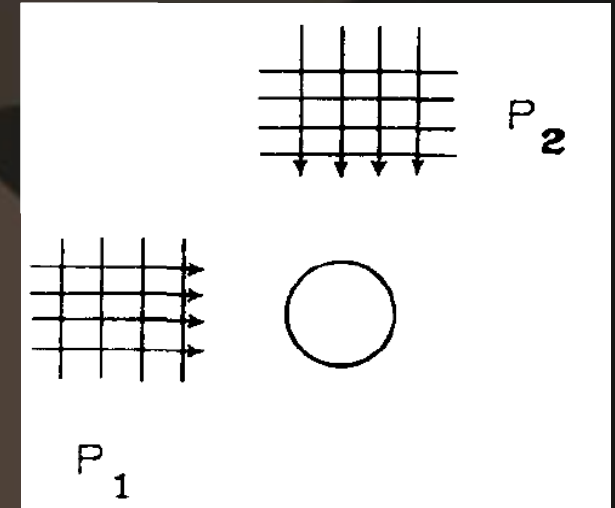
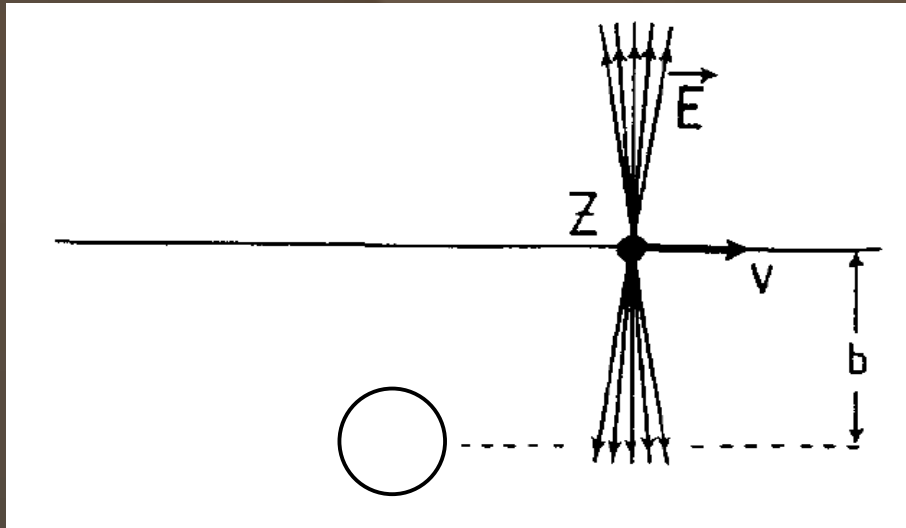
$$\frac{\partial \mathcal{N}(r, Y)}{\partial Y} = \int \frac{d^2 \mathbf{z}}{2\pi} K(\mathbf{r}, \mathbf{r}_1, \mathbf{r}_2) [\mathcal{N}(r_1, Y) + \mathcal{N}(r_2, Y) - \mathcal{N}(r, Y) - \mathcal{N}(r_1, Y)\mathcal{N}(r_2, Y)]$$

$$K(\mathbf{r}, \mathbf{r}_1, \mathbf{r}_2) = \frac{\alpha_S N_C}{\pi} \frac{r^2}{r_1^2 r_2^2}$$

- rcBK

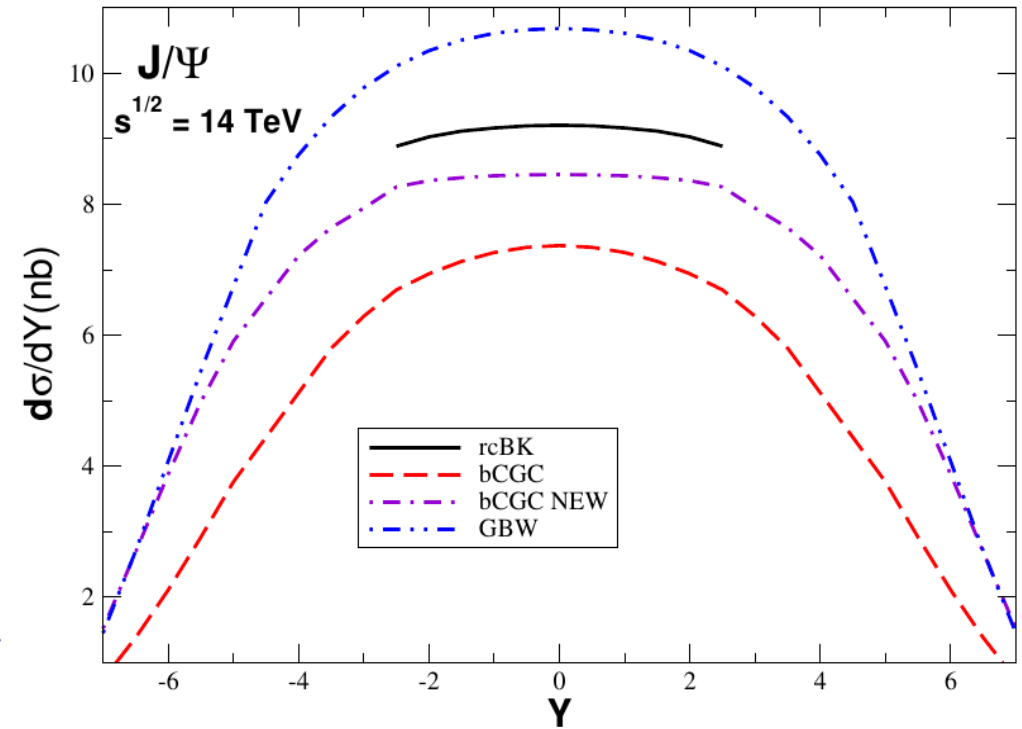
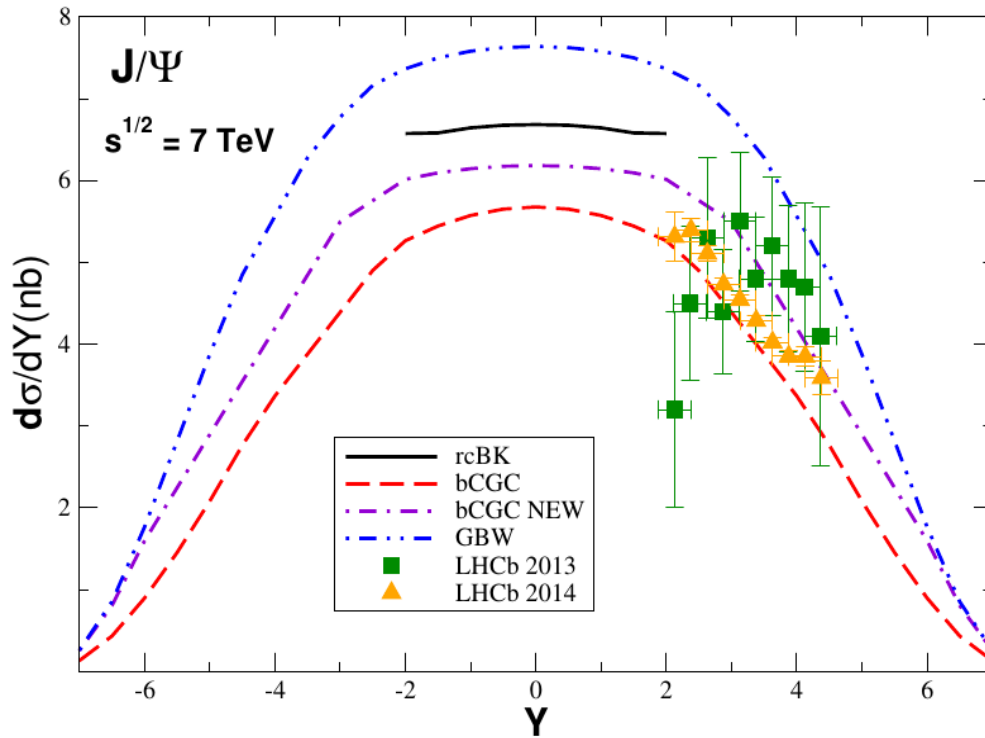
- J. L. Albacete, N. Armesto, J.G. Milhano and C. A. Salgado, arXiv:0902.1112 [hep-ph]

Colisões Ultraperiféricas



$$\frac{d\sigma(h_1 h_2 \rightarrow V h_1 h_2)}{dy} = n^{h_2}(y) \sigma^{\gamma h_1}(y) + n^{h_1}(-y) \sigma^{\gamma h_2}(-y)$$

Resultados para Colisões pp



Núcleo pesado como alvo

- B.Z. Kopeliovich, J. Nemchik, A. Schafer, A.V. Tarasov, Phys. Rev. C 65 (2002) 035201.

$$\sigma^{coh}(\gamma^* A \rightarrow V A) = \int d^2 \mathbf{b} \langle \mathcal{N}^A(x, \mathbf{r}, \mathbf{b}) \rangle^2$$

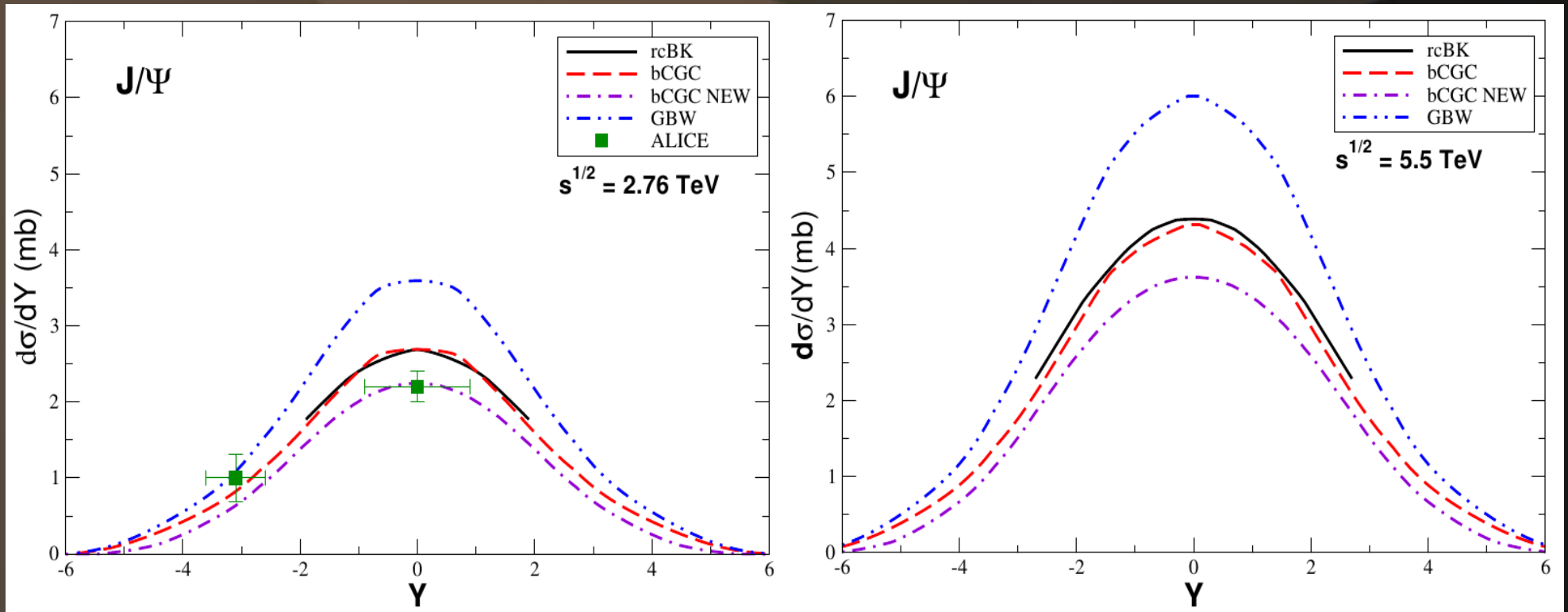
$$\langle \mathcal{N} \rangle = \int d^2 \mathbf{r} \int dz \psi_V^*(\mathbf{r}, z) \mathcal{N}^A(x, \mathbf{r}, \mathbf{b}) \psi_{\gamma^*}(\mathbf{r}, z, Q^2)$$

- N. Armesto, Eur. Phys. J. C 26 (2002) 35.

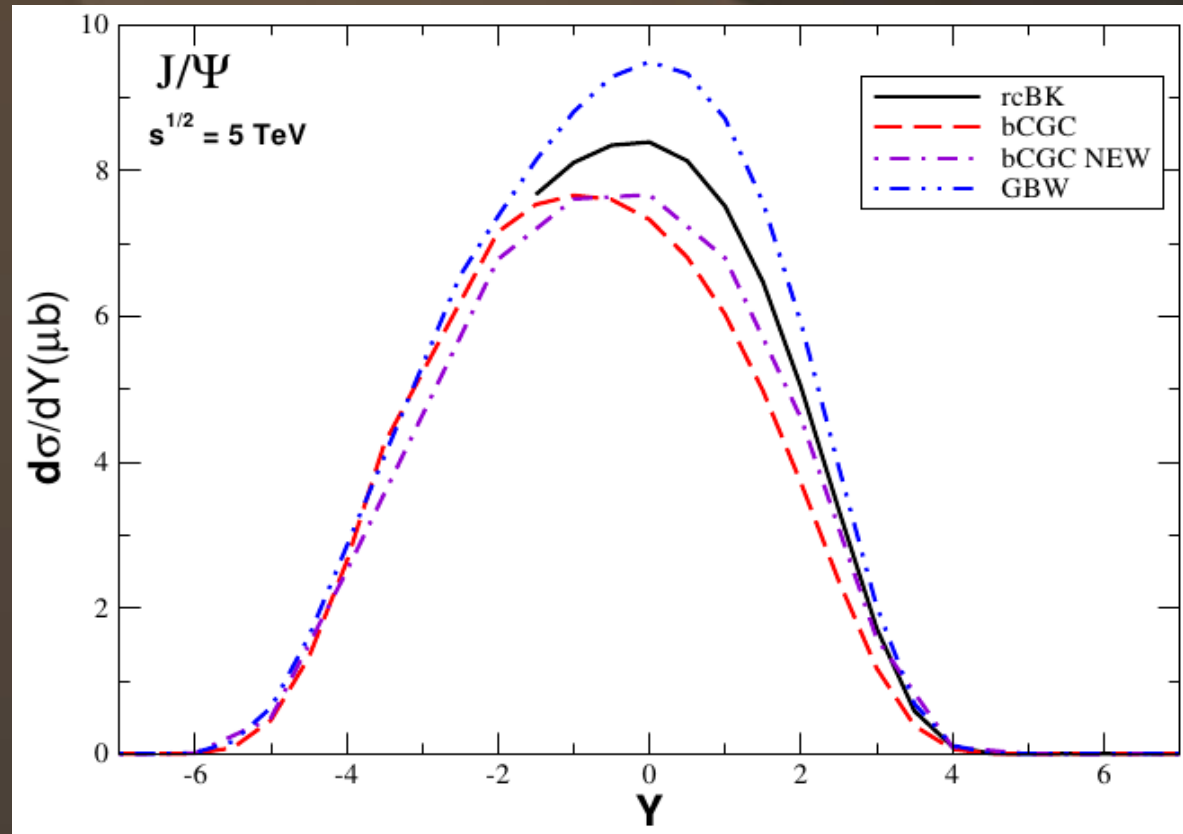
$$\mathcal{N}^A(x, \mathbf{r}, \mathbf{b}) = 1 - \exp \left[-\frac{1}{2} \sigma_{dip}(x, \mathbf{r}^2) T_A(\mathbf{b}) \right]$$

- T_A é a função perfil nuclear, obtida por uma distribuição de Fermi para a densidade nuclear normalizada a A

Resultados para colisões AA



Resultados para colisões pA



Conclusões

- Concordância razoável com os dados experimentais existentes (especialmente para bCGC).
- Região de rapidez central dependente do modelo usado.
- Na região de rapidez frontal os modelos concordam.

Obrigado!