Saturation phenomenology at RHIC

Yacine Mehtar-Tani

ECT*, **T**rento, Italy

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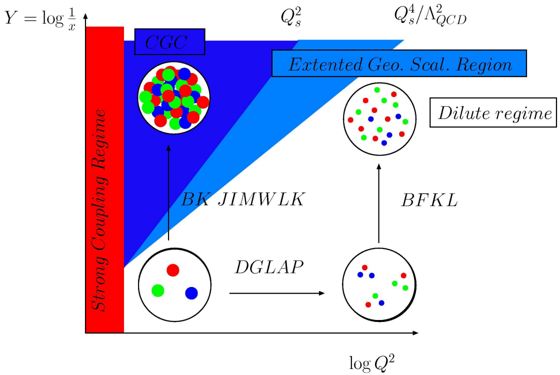
ETRETAT

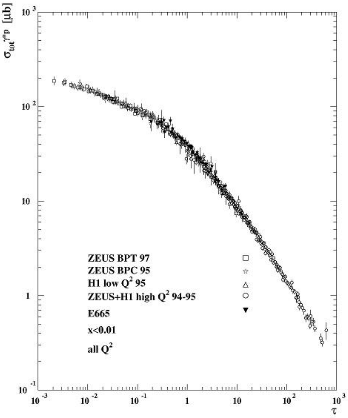
Outline



$$Q_s^2(Y) = Q_0^2\, e^{\lambda Y}$$

The saturated gluon distribution is only a function of

$$\tau = \frac{Q^2}{Q_s^2(Y)}$$



A. M. Stasto, K. Golec-Biernat and J. Kwiecinski (2001)

$$\lambda \simeq 0.3$$

In agreement with NLO-BFKL

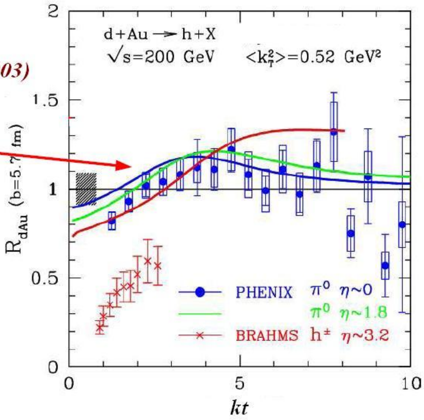
D. N. Tiantafyllopoulos (2003)

pQCD + mul. scat.

A. Accardi and M. Gyulassy (2003)
A. Accardi (QM2004)

η = 0 1.8 3.2

Data are much lower than theory:
Is this a CGC ????



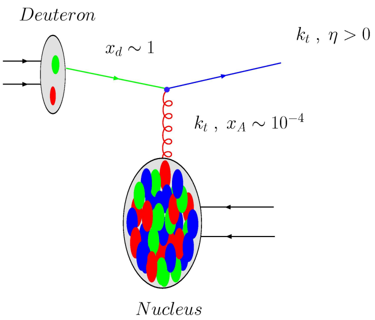
pQCD and the MV model provide a good understanding of the Cronin peak in term of multiple scattering at $\eta = 0$.
But a huge non-perturbative component is needed $Q_s^2 \sim 10\ GeV^2$.

R.Baier, Y. M.-T. and D. Schiff (2006)

D. Kharzeev, Y. V. Kovchegov and K. Tuchin (2004)

A. Accardi and M. Gyulassy (2004)

The evolution with rapidity is missing!



$x_A = k_t/\sqrt{s}\, e^{-\eta}$ and $x_d = k_t/\sqrt{s}\, e^{\eta}$.
The 2 to 1 cross section is proportionnal to the unintegrated gluon distribution:

$$\frac{dN}{dydp_t} \propto \sum_i f_i \otimes D_{f,i} \otimes \varphi_A(p_t/z, log\frac{1}{x_A})$$

R.Baier, Y. M.-T. and D. Schiff (2006)

A. Dumitru, A. Hayashigaki, J. Jalilian-Marian (2006)

The BK-JIMWLK equation in momentum space

$$\partial_Y N = \chi \otimes N - N^2 \ \text{ where } \ N(k_t) = F.T. \left[N(r_t)/r_t^2\right]$$

Asymptotic tail ($k_t^2 \geq Q_s^2(Y)$)

$$N(k_t, y) = C \left(\frac{Q_s^2(Y)}{k_t^2}\right)^{\gamma_s} \ \text{ where } \ \gamma_s = 0.63$$

E. Iancu, K. Itakura, L. McLerran (2002)

A. H. Mueller, D. N. Tiantafyllopoulos (2002)

S. Munier, R. Peschanski (2003)

and when $k_t \ll Q_s$

$$N(k_t, Y) = \pi \log \left(\frac{Q_s^2(Y)}{k_t^2}\right)$$

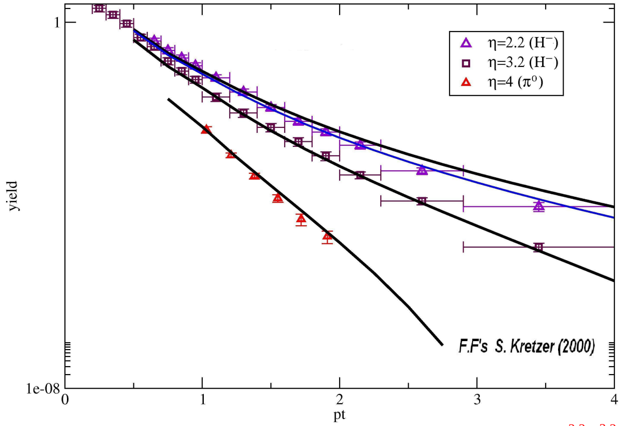
INTERPOLATION

$$N(k_t, Y) = \frac{\pi}{\gamma_s} \log \left(1 + C \left(\frac{Q_s^2(Y)}{k_t^2}\right)^{\gamma_s}\right)$$

E. Iancu, K. Itakura, L. McLerran (2003)

$$Y = \eta + \log \frac{\sqrt{s}}{k_t}$$

HADRON SPECTRA



$\eta = 2.2 - 3.2$ BRAHMS (2004)

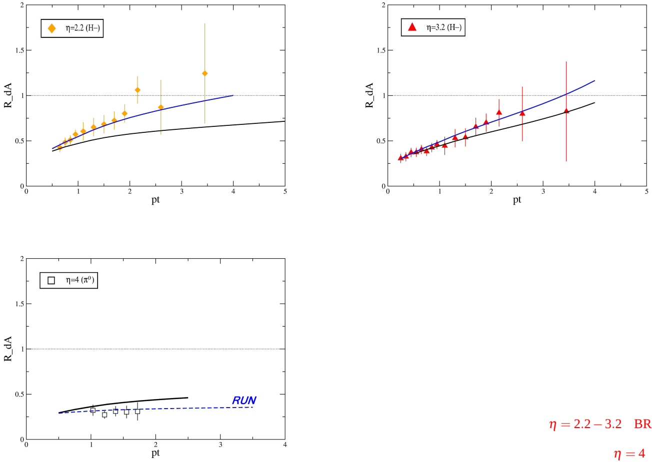
$\eta = 4$ STAR (2006)

The blue curve corresponds to $\gamma \equiv \gamma_s + \frac{\log(p_t^2/Q_s^2(Y))}{\kappa\lambda Y}$

At $\eta = 2.2$ scaling violations start to be relevant.

The CGC in a few words
Hadron production at RHIC
Predictions for LHC

NUCLEAR MODIFICATION FACTOR

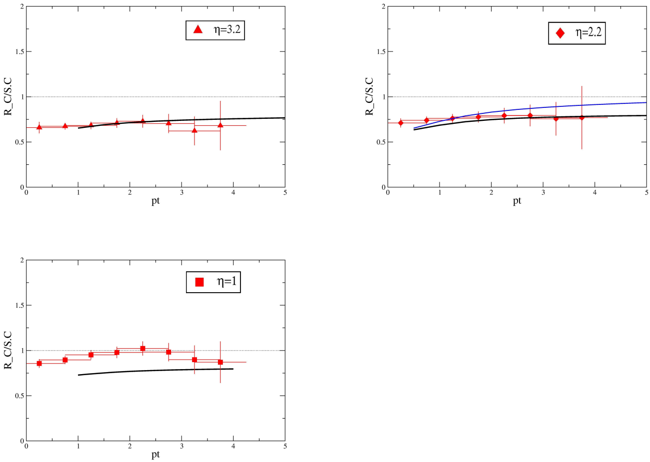


$\eta = 2.2 - 3.2$ BRAHMS (2004)

$\eta = 4$ STAR (2006)

At $\eta = 3.2$: $Q_{s,p} \sim 1\ GeV$ and $Q_{s,A} \sim 2\ GeV$. We also assume $Q_s^2 \propto N_{part}$. R_{dA} is overestimated at $\eta = 4$: indications of the running of the coupling which leads to a harder shadowing and eventually to total shadowing!

CENTRALITY DEPENDANCE (central/semi-central)



$\eta = 1 - 2.2 - 3.2$ BRAHMS (2004)

PREDICTIONS FOR LHC