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LOW x AND DIFFRACTION IN PICTURES*

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In this paper the review of our understanding of diffraction in framework of high density QCD is presented in a collections of pictures.

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In this paper we try to answer three questions: what are the main ideas on diiffraction from QCD, what has been seen experimentally, what are theoretical achievement and progress. Instead of long discussions we just present the collection of pictures that will illustrate our present understanding.

The point of view that diffraction dissociation stems from the elastic rescattering of correct degrees of freedom is shown in Fig. 1. Fig. 2 illustrates why colourless dipoles are correct degrees of freedom.

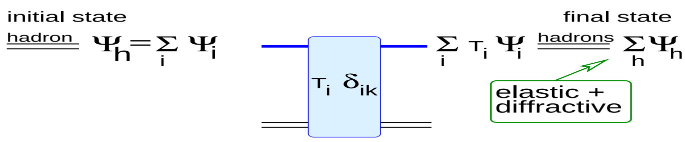
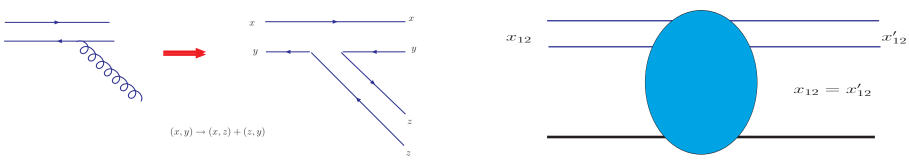


Fig. 1. Degrees of freedom and diffraction.



Interaction: dipole → two dipoles decay

Interaction: dipole does not change the size during scattering

Fig. 2. Correct degrees of freedom at high energy: colourless dipoles (Mueller 1994).

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The main problem that we are trying to solve in high density QCD is to understand what happens with the dense partonic system (see Fig. 3). This problem has been solved in the mean field approximation (MFA) which leads

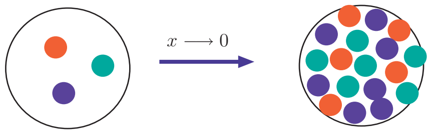

Fig. 3. Saturation: packing factor of partons $\kappa(Q^2, x_{\rm Bj}) \longrightarrow 1$; $Q_{\rm s}^2 \propto x^{-\lambda}$.

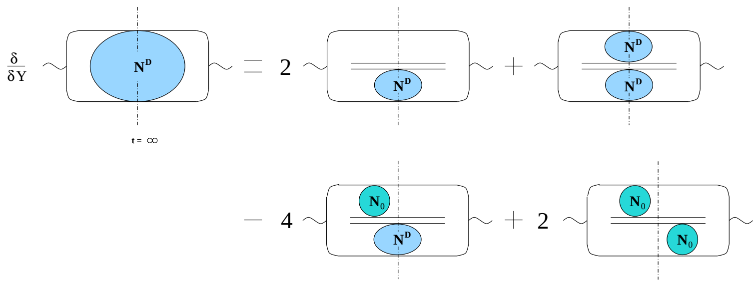

Fig. 4. Kovcheegov–Levin equation for diffractive production in MFA (1999).

to non-linear evolution equation. In Fig. 4 such a non-linear equation is presented for diffraction. The solution of these non-linear equation leads to a geometrical scaling, namely, $\sigma_{\rm tot}(\gamma^* p$ and $\sigma_{sd}(\gamma * p \rightarrow M^2 p$, integrated over $M)$ $\Longrightarrow 1/Q_{\rm s}^2(x)\, F\left(Q^2/Q_{\rm s}^2\right)$ (GLR; Mueller, Qiu; Bartels & E.L..; McLerran & Venogapalan; Kwiecinski, Stasto & Golec-Biernat; Iancu, Itakura &McLerran, E.L & Lublinsky; Kharzeev, E.L. & McLerran, Mueller). The typical distances for difraction in MFA is $r^2 = 1/Q_{\rm s}^2$ (see Fig. 5). The main idea

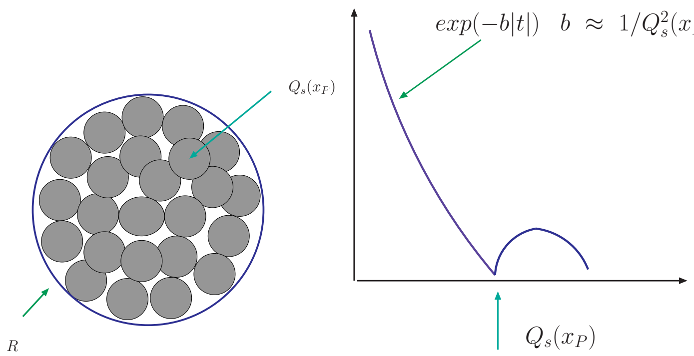

Fig. 5. Hot spots (Mueller, 1992): for $\sigma_{\rm tot}$ the size of hot spot $\propto 1/Q_{\rm s}(x_{\rm Bj})$ and for σ_{sd} the size of hot spot $\propto 1/Q_{\rm s}(x_P)$.

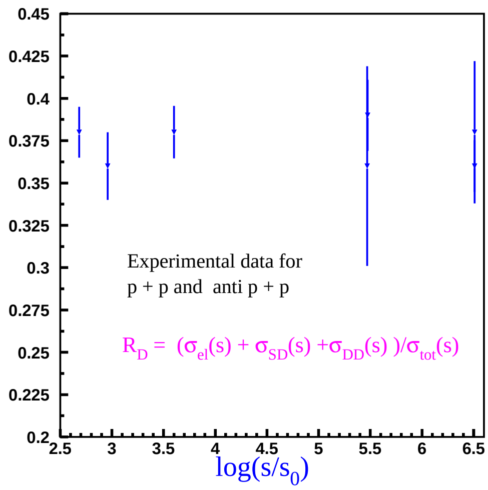

Fig. 6. Soft diffraction: hadron are not correct degrees of freedom, since soft diffraction is large.

for soft processes: there is *no soft Pomeron* but the parton system goes through the *stage of parton saturation*. Fig. 6–Fig. 9 show the comparison with experimental data which lead to conclusions that the idea of saturation is very intsrumental: the nessacity of new degrees of freedom (Fig. 6); the description of soft processes in saturation model (Fig. 7); geometrical scaling behavior (Fig. 8) and shrinkage of the diffraction peak for the hard processes (Fig. 9). Unfortunately the lack of room do not allow me to discuss the theoretical status and ideas.

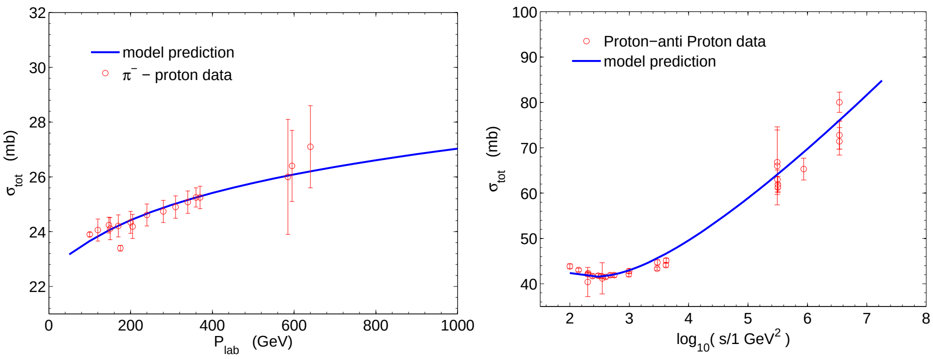

Fig. 7. Soft interaction without soft Pomeron: Bartels, Gotsman, Levin, Lublinsky, Maor, Kormilitzin.

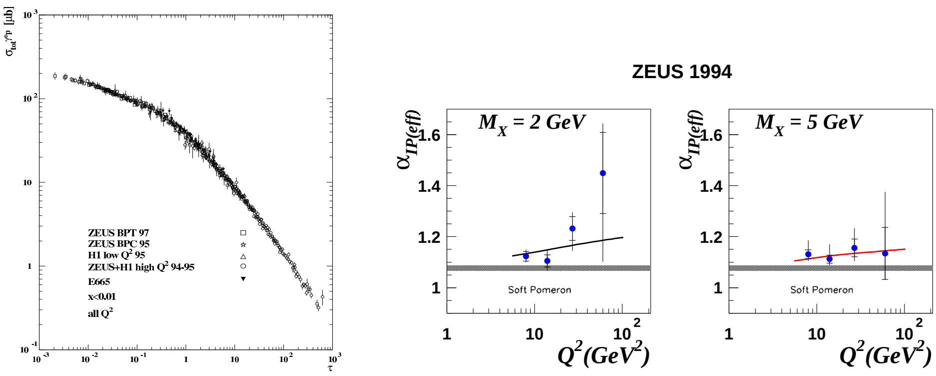

Fig. 8. Left: Geometrical scaling behaviour: for $Q^2 < Q_s^2$ Bartels & Levin; for $Q^2 > Q_s^2$ Iancu, Itakura, McLerran. Right: $\sigma_{\text{diff}} \propto x^{-2\alpha_{\text{eff}}}$ the fact that $\alpha_{P,\text{eff}} > \alpha_{P,\text{soft}}$ means that short distances contribute to the diffracttion production.

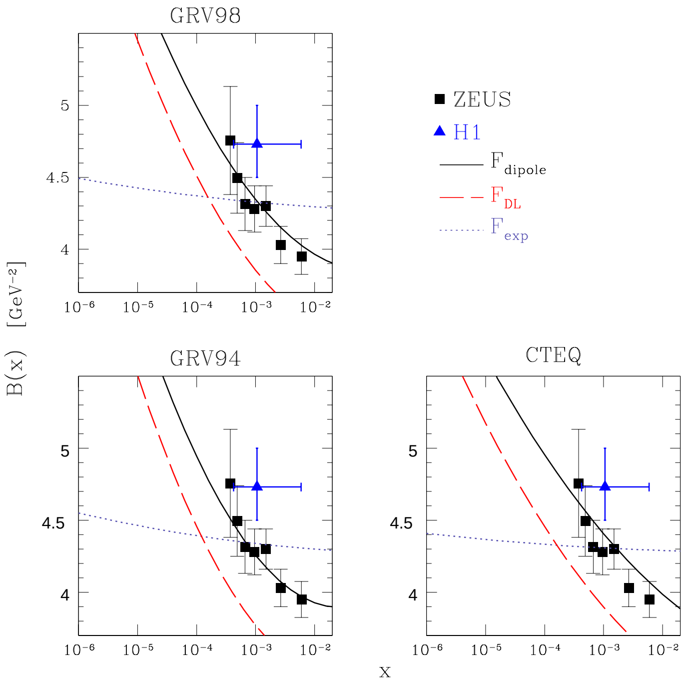

Fig. 9. For soft processes $B = B_0 + 2\alpha'_P \ln(s/s_0)$ where $\alpha'_P = \text{const.}$; for hard processes (without SC) $B = B_0$; but for hard processes (with SC) $B = B_0 + 2\alpha'_P \ln(s/s_0)$ but α'_P increases with energy, since in hot spot scenario $\sigma(\gamma^* p \to J/\Psi + p) \to \frac{1}{Q_s^2} F\left(r^2 Q_s^2(x,b)\right)$ and $Q_s^2(x,b) = Q_s^2(x)\exp(-\mu b)$, therefore, $b \propto (1/\mu)\ln Q_s^2$.