which is shown in Fig.2 and 3. The calculated N approaches to 12 with increasing x. Our results are in good agreement with experiments.

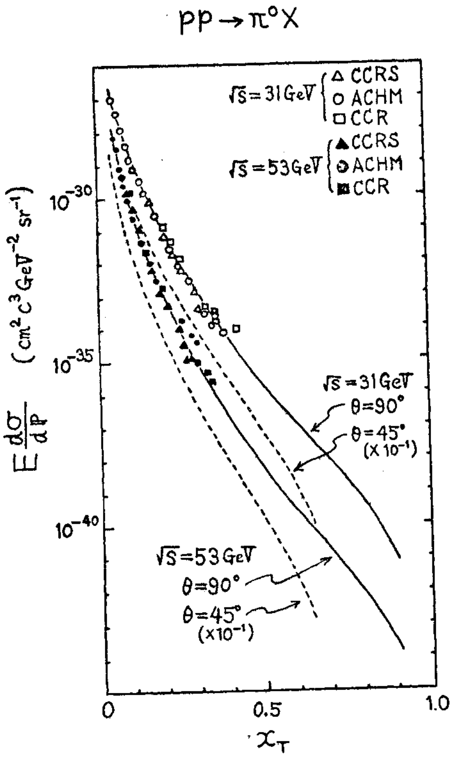

Fig. 2

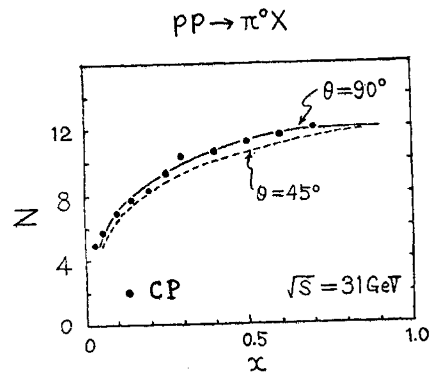

Fig. 3

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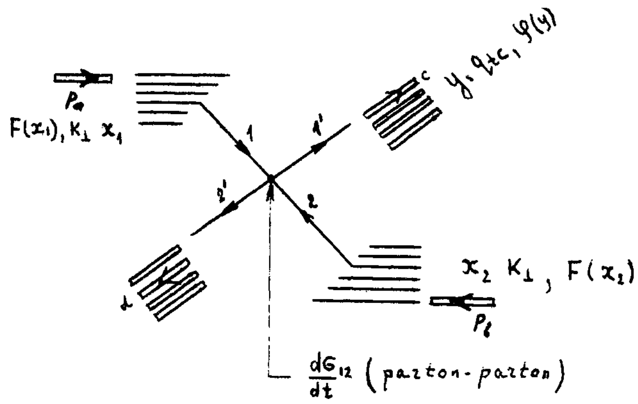
THE HADRON PRODUCTION AT LARGE TRANSVERSE MOMENTUM AND THE PARTON INTERACTION

E.M.Levin, M.G.Ryskin

LINP, Leningrad, USSR

Because of limited space of this report we have to restrict ourselves to a representation of basic ideas and few comments. A more detailed version will be published shortly as a preprint of Leningrad Nuclear Physics Institute.

1. The parton picture for large transverse momentum production:



$$\frac{\omega d\sigma}{d^3 q_c} = \int F_a(x_1) F_b(x_2) \left.\frac{d\sigma_{12}}{d^2 K_{1t}}\right|_{\vec{K}'_{1t} = \vec{q}_{tc}/y} S\delta(x_1 x_2 S - M^2)\frac{dM^2}{M^2}\delta(\eta_1-\eta_c) \times \Phi(y)\frac{dy}{y^2}\,dx_1\,dx_2$$

Fig.1

It is easy to understand that this picture leads to three hadron jets: in the beam direction, toward the trigger particle and at the opposite direction. All these jets have been observed experimentally /1/ .

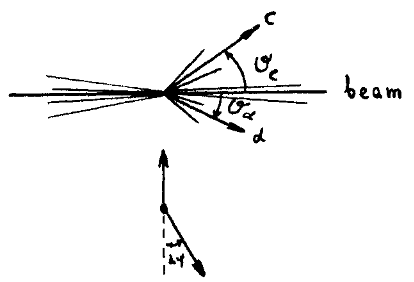


Fig. 2

Such a picture was first suggested by Berman, Bjorken and Kogut /2/ and then was re-discovered and exhaustly discussed in many papers /3/.

II. The parton-parton interaction

The direct information can be obtained from the θ angle distribution for double inclusive process $a+b \to c(q_{tc}) + d(q_{td})$

at $q_{tc} \simeq q_{td} \geq 1.5 \frac{GeV}{c}$ and $\theta_c \neq 90°$ where c is the trigger particle.

Short range-line (in rapidity) parton--parton interaction may be in agreement with the current experimental data. This point we should illustrate by a few qualitative predictions for double inclusive process under the different assumptions.

Assumption	Prediction
1) Parton model (p.m.) with $\frac{d\sigma}{dt}(\text{parton-parton}) = e^{-b\Delta\eta}$ Short range interaction in rapidity $\Delta\eta$	$\theta_c = \theta_d$
2) PM, $\frac{d\sigma}{dt} \sim const \cdot \Delta\eta$ Long range interaction	$\theta_d \sim 90°$ at any θ_c
3) Quark-Parton Model collisions of the valence quarks	$\theta_d \sim \pi - \theta_c$

III. The average transverse momentum of a parton inside a hadron.

1. Large q_t hadron production

$\langle k_\perp \rangle$ can be extracted from the azimuthal angle distribution for $a+b \to c+d+\ldots$ with the aid of equation

$$\langle tg^2 \Delta\varphi \rangle = \frac{\langle k_\perp^2 \rangle}{k'^2} + \frac{\langle q_\perp^2 \rangle}{2q_{t_c}} + \frac{\langle q^2 \rangle}{2q_{t_d}} \quad (1)$$

$\langle k_\perp \rangle$ is the average transverse momentum of a hadron produced by parton decay). Comparing this equation with experiment we have found /4/ that the $\langle k_\perp \rangle$ value is sufficiently large:

$$\langle k_\perp^2 \rangle = (1.5 \div 2.5)\left(\frac{GeV}{c}\right)^2 \text{ if } \langle q_\perp \rangle = 0.4 \; GeV/c \quad (6)$$

This large $\langle k_\perp \rangle$ value is in agreement with broad $\Delta\varphi$ distribution observed in many experiments and the same $\langle k_\perp \rangle$ value can be also estimated from the correlation function $\langle F \rangle$ /1/, which is the probability to find the charged particles in large transverse momentum events.

2. The production for leptonic processes.

a) $h+h \to \mu^+\mu^- + \ldots$. The $\mu^+\mu^-$ production is the direct experiment for measuring $\langle k_\perp \rangle$. Indeed, for large masses $(M^2 \gg 4\langle k_\perp^2 \rangle)$ $\langle q^2_{t\,\mu^+\mu^-} \rangle = 2\langle k_\perp^2 \rangle$

From experiment /7/ for M equal to 1-3 GeV the $\langle q_{t\,\mu^+\mu^-} \rangle$ increases from 0.5 to 1.1 GeV/c.

b) $ep \to e + h(y, q_{th}) + \ldots$ $y = \frac{q_h}{Q/2}$

where Q is the γ-momentum. The value of $\langle q_{t_h} \rangle$ can be calculated from

$$\langle q^2_{t_h} \rangle = \langle q_\perp^2 \rangle + y^2 \langle k_\perp^2 \rangle$$

So, for $y \to 1$ $\langle q_{t_h} \rangle$ should increase and tend to $\langle k_\perp \rangle$.

3. Hadron collisions without large q_t.

In the PM the slope of pomeron exchange directly relates to $\langle k_\perp \rangle$ /8/ by means of $\alpha' = \frac{1}{2}\frac{1}{\langle k_\perp^2 \rangle}\frac{dn}{d\eta}$ /2/ where $\frac{dn}{d\eta} \sim 1$ is the parton density on the unit rapidity interval. For $dn/d\eta \sim 1$ and $\alpha' = 0.25\ (GeV/c)^{-2}$ $\langle k_\perp^2 \rangle \sim 2\ (GeV/c)^2$. At first sight the large $\langle k_\perp \rangle$ value contradicts to the wellknown fact that the average transverse momentum of a secondary pions in the multiparticle reactions is small ($\sim$ 0.4 GeV/c). In the paper /5/ it was shown that it is incorrect. For simplicity, let us turn to eq. (2) for the hadron production in deep inelastic process. The mean value of $\langle y^2 \rangle$ is $\langle y^2 \rangle = \int \varphi(y)\, y^2 dy \approx 0.05$, so $\langle q^2_{t_h} \rangle \approx 0.26\ (GeV/c)^2$ if $\langle q_\perp^2 \rangle \approx$

$\approx$ 0.16 (GeV/c)^2 and $\langle k_\perp^2 \rangle = 2\left(\frac{GeV}{c}\right)^2$

In hadron hadron collision each parton should decay in 4–5 pions, and as a result $\langle q^2_{t_h} \rangle$ becomes small $(1/4 \div 1/5) \langle k_\perp \rangle$.

IV. How does the new scale $(\sim 1/\langle k_\perp \rangle)$ reveal itself in hadronic scattering at high energy?

We think that the new scale $\sim 1/\langle k_\perp \rangle$ leads us to additive quark-parton model. In this model a hadron consists of three or two valence quark whose size R_q is small up to ultra high energies since $R_q^2 = 1/\langle k_\perp^2 \rangle + \alpha' \ln s$. So, for $s \ll 10^8$ GeV^2; $R_N^2 \gg R_q^2$ and the wee partons from different quarks should not strongly overlap and valence quarks interact as free particles separated in space (see fig.3).

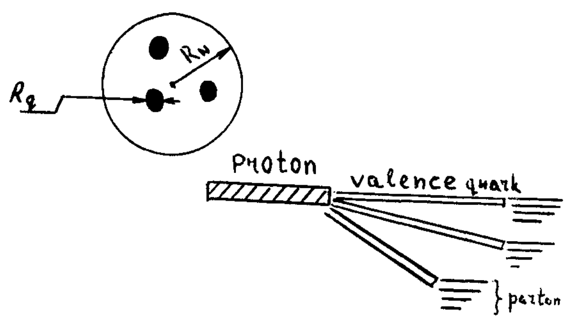


Fig.3

Let us discuss some predictions of the quark-parton model.

1. $\sigma_{tot}(pp) / \sigma_{tot}(\pi p) \simeq 3/2$

$$\frac{f(pp \to c + \ldots)}{f(\pi p \to c + \ldots)} = \frac{3}{2}$$

where $f = \omega_c \, d\sigma/d^3p_c$, is the inclusive cross section.

2. For diffraction dissociation (DD) the slope B should be smaller than for elastic scattering ($d\sigma/dt = A e^{-B|t|}$) , more exactly for single DD $B_D \to B_{el}/2 + k_q^2$ and for double DD $B_{DD} \to R_q^2$ at large masses out of the resonance region.

The agreement with the experimental data seems to be good /9/ .

3. Several numerical estimations under the following assumption $dn/d\eta = 1$ and $d\sigma/dt$ (parton–parton) is the maximal one in wave:

1) $\sigma_{qq} = 16\pi\alpha' = 5$ mb; ($\sigma_{tot}(pp) = 9\sigma_{qq} = 45$ mb); $\sigma_{tot}(\pi p) \simeq 6\sigma_{qq} = 30 mb$

2) $\varkappa = \frac{\sigma_{el}}{\sigma_{tot}} =$ 0.18 for pp- or 0.24 for πp- interactions;

at ISR $\varkappa(pp) =$ 0.175±0.005 (see ref./10/).

3) The triple pomeron vertex

$$G_{3P}(0) / \sqrt{\sigma_{tot}(pp)} = 1/30$$

experimental number 1/30 – 1/50 /9/ .

4. For deep inelastic scattering we predict two scale regions:

(1) $4\langle k_\perp^2 \rangle > Q^2 > 4/R^2$

(2) $Q^2 \gg 4 \langle k_\perp^2 \rangle$

In the region I the photon feels only the valence quark as a pointlike particle. So in this region all the deep inelastic processes should be described by the valence quark distributions (see Fig.4).

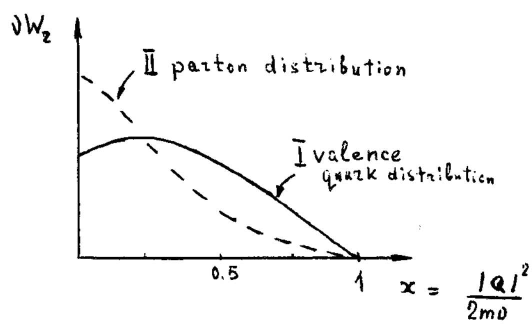


Fig. 4

Only for Q^2 in the region II the photon feels the parton- antiparton sea. So, we predict scale violation. Perhaps, this violation really exists /11/ .

5. It is interesting to suggest that $\sigma_{tot}(qq) \sim \ln^2(s)$. Such a behaviour has been intensively considered theoretically (12) and we can prove that it does not contradict both to s -channel unitarity and to the parton model. Such a behaviour, perhaps is supported by the fact that all the properties of the jet in beam direction are independent of q_{t_c} value of the hadron c . It is evident for black disk since simultaneously with the sea the ring of two fast partons (1 and 2 on Fig.1) two wee partons are to interact.

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