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LARGE $p_{\perp}$ AND QUARK-QUARK CROSS SECTION IN THE DYNAMICAL MODEL OF FACTORIZING QUARKS

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Капшай В.Н., Сидоров А.В., Скачков Н.Б. **E2 - 11932**

Большие $p_\perp$ и кварк-кварковое сечение в динамической модели факторизующихся кварков

В работе описана динамическая модель факторизующихся кварков, которая содержит размерный параметр - массу кварка. Проведено сравнение предсказаний этой модели с экспериментальными данными по сечению инклюзивного рождения мезонов в протон-протонных столкновениях.

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Kapshay V.N., Sidorov A.V., Skachkov N.B. **E2 - 11932**

Large $p_\perp$ and Quark-Quark Cross Section in the Dynamical Model of Factorizing Quarks

It is shown that the data on inclusive reaction $pp \to \pi^0 X$ are well described if the quark-quark scattering cross section is taken to possess the dependence following from the model based on the hypothesis of factorizing quarks.

The investigation has been performed at the Laboratory of Theoretical Physics, JINR.

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The cross sections of inclusive reactions $A+B \to h+X$ with produced hadron h of large transfer momenta $p_\perp$ are described most successfully by the quark-parton model of "hard collisions"[1]

$$E\frac{d^3\sigma}{dp^3}(A+B\to h+X) = \iint dx_a dx_b \sum_{a,b} G_{A\to a}(x_a) G_{B\to b}(x_b) D_c^h(z_c) \times$$

$$\times \frac{1}{z_c}\frac{1}{\pi}\frac{d\hat\sigma}{d\hat t}(qq\to qq), \qquad (1)$$

where $G_{A\to a}(x)$ is the distribution function for quarks in hadron A and $D_c^h(z)$ is the function of fragmentation of quark c into hadron h, $d\hat\sigma/d\hat t\,(qq\to qq)$ being the quark-quark scattering cross section.

As is shown in refs.[2,3], good description can be achieved by changing the dependence $\frac{d\hat\sigma}{d\hat t} \approx \hat s^{-2}$, predicted by the dimensional quark counting rule[4] for the quark-quark scattering cross section, to the pure phenomenological dependence $\frac{d\hat\sigma}{d\hat t} \approx 1/\hat s(-\hat t)^3$ or $\hat s^{-2}\hat t^{-2}$ * .

In this note we show that the data on reaction $pp \to \pi^\circ X$ are well described by using another dependence of the quark-quark cross section which follows from the dy-

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* The physical nature of this deviation from the dimensional quark counting rule has not been established in papers[2,3].

namical model of factorizing quarks (DMFQ)[5]. In contrast to the model of additive quarks, the DMFQ describes the processes with large transfer momenta (elastic pp -scattering, form factors* of pion and proton[5]) and contains the manifest scale parameter, the quark mass M_q .

The DMFQ assumes that the two-hadron scattering amplitude is proportional to the product of scattering amplitudes of individual valence quarks on a certain self-consistent potential, V_{eff} , created by quarks in the process of collision

$$M_{AB\to AB} = \prod_i g_i \prod_j g_j \ . \qquad (2)$$

In paper[5] the quark-quark scattering amplitude was taken in the form $(y = \mathrm{Arch}(1 - \hat{t}/(2M_q^2)))$

$$g_q = y/\mathrm{sh}\,y \xrightarrow[-t\to\infty]{} \frac{\ln(|\hat{t}|/M_q^2)}{|\hat{t}|/M_q^2} \ . \qquad (3)$$

Formulae (2) and (3) produce the following quark-quark cross section

$$\frac{d\hat{\sigma}}{d\hat{t}}(qq \to qq) \underset{-t\to\infty}{=} \frac{A}{\hat{s}^2}\left[\frac{\ln(|\hat{t}|/M_q^2)}{\hat{t}/M_q^2}\right]^4 \approx$$

$$\approx \frac{A}{\hat{s}^2(|\hat{t}|/M_q^2)^{N_{eff}}} \ , \qquad (4)$$

where $N_{eff} = 4 - 4\frac{\ln\ln(|\hat{t}|/M_q^2)}{\ln(|\hat{t}|/M_q^2)}$. The quark mass M_q in (4) and constant A are considered as free model parameters.

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*Note that the asymptotic behaviour of the form factor resulting from the DMFQ obeys the Drell-Yan-West relation, while the dimensional quark counting prediction does not agree with it [5].

We have calculated the cross section of π°-meson inclusive production at angle 90° by formula (1) using the Q^2 -independent functions G(x) and D(z) from paper* . This choice corresponds to a possible conservation of scaling in future experiments on ep-scattering at large Q^2. Masses of u and d quarks were assumed to be equal, and the contribution from other quarks, like in[2], was not taken into account.

The results of analysis of the reaction $pp \to \pi^\circ X$ [6] by formulae (1) and (4) given in the *Table* and in the *Figure* testify to a good agreement with experiments. If the cross section (1) is represented in the form

$E\frac{d^3\sigma}{dp^3}(pp \to \pi^\circ X) \sim p_\perp^{-N}$ then the theoretical curves at $S = \mathrm{const}$ (see the *Figure*) imply that according to (4), the power N grows from $N \approx 9$ at $p_\perp = 2.4$ *GeV/c*

Table

The values of χ^2 per one degree of freedom and quark masses calculated in the description of data[6] on reaction $pp \to \pi^\circ X$ $\Theta_{c.m.} = 90^\circ$, by the DMFQ formula (4)

$\sqrt{s}$ [GeV]	$\chi^2_{d.f.} = \frac{\chi^2}{N-2}$	M_q [GeV]
62.4	51/(40-2)	0.59
52.7	65/(52-2)	0.69
44.8	100/(45-2)	0.59
33.6	28/(27-2)	0.45
23.5	19/(17-2)	0.44

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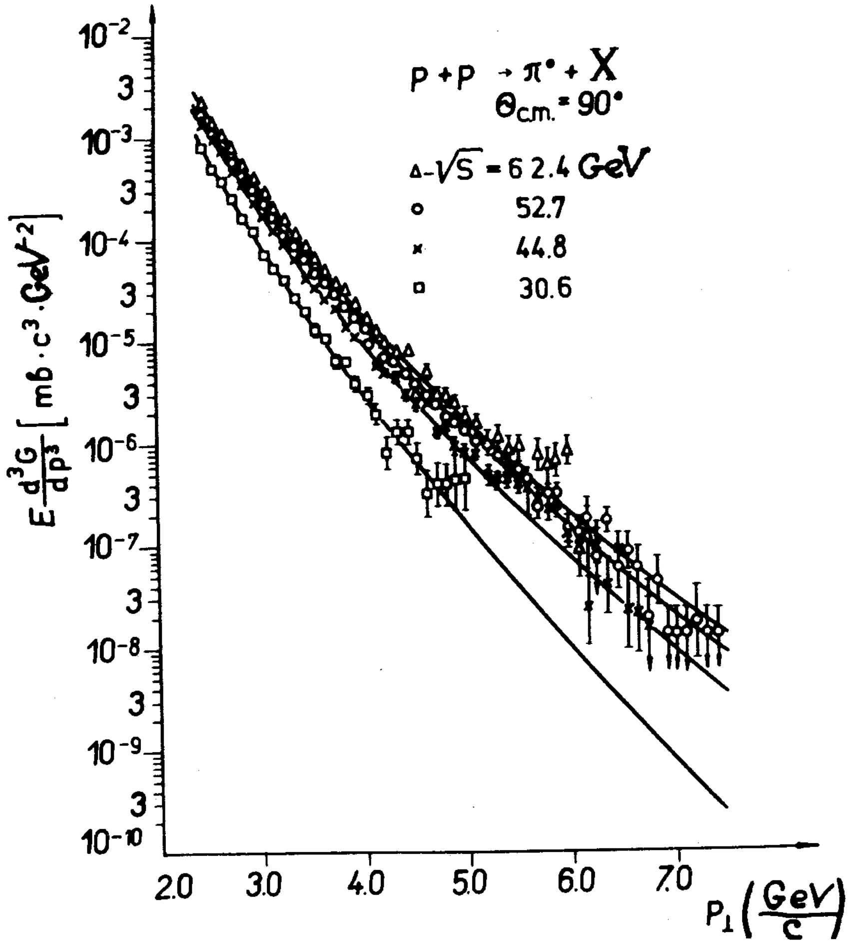
* For another possibility see ref.[7].



Comparison of the DMFQ predictions with experimental data on $pp \to \pi^{\circ}X$ /6/.

till $N \approx 13$ at $p_{\perp} = 7.5$ *GeV/c*. This fact is consistent with the results of fits performed in /6/ at $S = \text{const}$. Note that the quark mass is about 0.3 *GeV* (see the *Table*) which has been obtained in analysing the data on elastic pp-scattering within the DMFQ /5/ and is of the same order as that found in analysing electromagnetic form factors, $M_q \sim 0.2$ *GeV* /5/.

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