The fragmentation $C^{12} \to 2p$ at 4.0 and 7.5 GeV/c

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It is shown that the structure functions in the semi-inclusive reactions $\pi^- C^{12} \to 2p + X$ are the same at 4.0 and 7.5 GeV/c. This fact does not contradict the limiting-fragmentation hypothesis.

In accordance with the limiting-fragmentation hypothesis[1] the invariant inclusive cross section $E_c(d^3\sigma_c/d^3p_c)$ of the process

$$a + b \to c + X \tag{1}$$

should tend to its limiting value for finite momenta of the particle c in the rest system of the particle a or b, i.e.,

$$E_c \frac{d^3\sigma_c}{d^3 \mathbf{p}_c} \equiv f(s, \mathbf{p}_c) \underset{s \to \infty}{\to} f(\mathbf{p}_c), \tag{2}$$

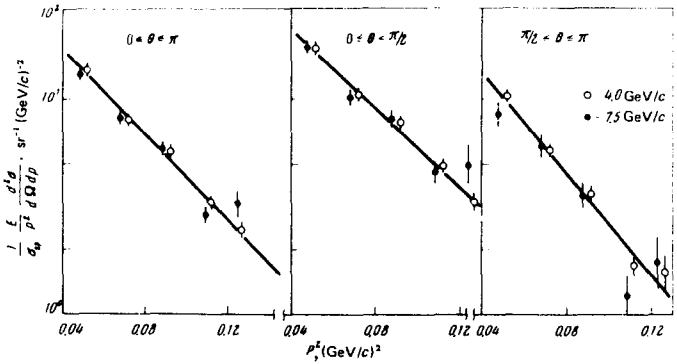
where $\mathbf{p}_c(E_c)$ is the momentum (energy) of the particle c in the rest system of a or b, s is the square of the total energy in the c.m.s., and $f(s, \mathbf{p}_c)$ is the so called structure function.

The experimental data show that the limiting-fragmentation hypothesis holds in hadron-hadron interactions, within the limits of experimental error, already at energies $E_{1ab} \gtrsim 40$ GeV (see e.g., [2–4]). It is therefore of definite interest to study hadron-hadron collisions from the point of view of verifying scale invariance. Unfortunately, the number of experimental data on this problem is quite limited, although there are already indications[5] that phenomena of the scaling type can take place in hadron-hadron collisions at incident-particle energies much lower than in hadron-hadron interactions.

We present here data on the semi-inclusive reactions

$$\pi^- + C^{12} \to 2p + X \tag{3}$$

at incident π^--meson momenta 4.0 and 7.5 GeV/c. The experimental data were obtained by us[6,7] with the 24-liter propane bubble chamber of the High-Energy Laboratory of the Joint Institute for Nuclear Research, bombarded with π^- mesons in the Dubna proton synchrotron. The proton momenta in reaction (3) were in the range $210 \leqslant p \leqslant 360$ MeV/c. An analysis shows that protons with these momenta are essentially anisotropic in the laboratory frame, and this fact excludes any noticeable admixture of evaporation protons. Owing to the possible loss of protons going to the interior of the chamber, a registration weighting factor, determined



Normalized invariant structure functions for the protons in the reaction (3) at 4.0 and 7.5 GeV/c.

by the Monte Carlo method, was introduced for each proton.[6]

The figure shows the distributions of the normalized invariant structure functions

$$f(p) = \frac{1}{\sigma_{2p}} \frac{E}{p^2} \frac{d^2\sigma}{dp\,d\Omega} \qquad (4)$$

at 4.0 and 7.5 GeV/c for three proton-emission angle intervals. The straight lines are the results of an approximation by the dependence

$$f(p) = A e^{-B p^2} \qquad (5)$$

	$0 \leqslant \theta_p \leqslant \pi$		$0 \leqslant \theta_p \leqslant \pi/2$		$\pi/2 < \theta_p \leqslant \pi$	
	4.0 GeV/c	7.5 GeV/c	4.0 GeV/c	7.5 GeV/c	4.0 GeV/c	7.5 GeV/c
A	42.66 ± 2.98	38.79 ± 5.45	47.85 ± 4.11	43.00 ± 7.45	40.92 ± 4.92	37.53 ± 9.18
B	23.00 ± 0.87	21.97 ± 1.74	20.93 ± 1.06	19.12 ± 2.12	27.63 ± 1.56	28.00 ± 3.16

for the data at 4.0 GeV/c. The values of the coefficients A and B, obtained by least square,[8] are listed in the table.

As seen from the figure and from the table, the structure functions in reaction (3) are the same at 4.0 and 7.5 GeV/c within one standard deviation. The results do not contradict the limiting-fragmentation hypothesis and indicate the possible existence of earlier scaling and reactions of the type (3).

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