

Invariant effects in the reaction $\pi^- C^{12} \rightarrow mp + X$, $m \geq 2$, at 4 and 40 GeV/c

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(Submitted January 12, 1976)

Pis'ma Zh. Eksp. Teor. Fiz. **23**, No. 4, 231–233 (20 February 1976)

The inclusive spectra of the protons in the reaction $\pi^- C^{12} \rightarrow mp + X$, $m \geq 2$, coincide at 4 and 40 GeV. This result does not contradict scale invariance in hadron-nuclear interactions.

PACS numbers: 25.80.+f

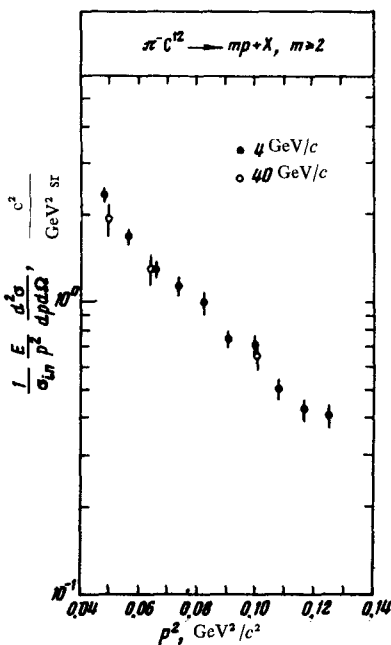
We present here the results of a study of the reaction

$$\pi^- + C^{12} \rightarrow mp + X, \quad m \geq 2 \quad (1)$$

at 4 and 40 GeV/c. The experimental data were obtained with the aid of the 55-cm and 2-meter propane bubble chambers of the Joint Institute for Nuclear Research. We scanned twice 20100 and 8000 frames, on which we found 20197 and 2186 inelastic interactions of π^- mesons with carbon nuclei at 4 and 40 GeV/c, respectively. To obtain the reaction (1), we chose for the measurements events with two and more visually identified protons. The protons were identified by range and ionization. Owing to the small dimensions of the 55-cm chamber (28 × 55 × 14 cm) and for a more reliable identification of the protons, their ranges in the propane were restricted to the interval $1 \leq L \leq 7$ cm, which corresponds to momenta $210 \leq p \leq 360$ MeV/c. Analysis shows that protons with such momenta are essentially anisotropic in the laboratory frame, and this excludes a tangible admixture of evaporation protons. For a comparison with the 4-GeV/c data, we separated at 40 GeV/c the interactions of type (1) in which the momenta of two or more protons were in the interval $210 \leq p \leq 360$ MeV/c.

Primary pion momentum Quantity	4 GeV/c	40 GeV/c
$\langle p \rangle$ (MeV/c)	269 ± 5	279 ± 16
$\langle p_{\perp} \rangle$ (MeV/c)	221 ± 4	223 ± 13
$\langle p_{\parallel} \rangle$ (MeV/c)	48 ± 1	44 ± 3
$\langle \cos \theta_{lab} \rangle$	0.173 ± 0.003	0.150 ± 0.010

The table lists the mean values of the total, transverse, and longitudinal momenta, as well as the average cosines of the proton emission angles in reaction (1) at 4 and 40 GeV/c. We see that the average characteristics of the protons with momenta $210 \leq p \leq 360$ MeV/c do not depend on the energy of the primary π^- meson.



Normalized invariant structure functions for the protons in reaction (1) at 4 and 40 GeV/c.

The figure shows the distribution of the invariant structure function $(1/\sigma_{in})(E/p^2)(d^2\sigma/dpd\Omega)$, normalized to the absorption cross section σ_{in} , plotted as a function of the square of the proton momentum. The data at the two energies coincide within one standard deviation. The result does not contradict the gauge invariance observed in hadron-nuclear interactions.^[1-3]

The authors are deeply grateful to G. A. Leksin for a discussion of the presented data.

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