Concerning the growth of associative multiplicity as a function of the transverse momentum

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A growth of the associative multiplicity as a function of the transverse momentum of the singled-out π^- mesons in certain missing-mass intervals is observed, in $\pi^- p$ interactions at 40 GeV/c.

The growth of the associative multiplicity as a function of $p_\perp^2$ is successfully accounted for by the model of coherent states.

On the basis of more than 10 000 inelastic $\pi^- p$ interactions, registered in the two-meter propane bubble chamber of the High Energy Laboratory of JINR, bombarded by a beam of 40 GeV/c π^- mesons from the accelerator of the Institute of High Energy Physics, we investigated the behavior of the associative multiplicity of charged particles as a function of the transverse momentum $p_\perp$ of the singled-out π^- meson in different intervals of the squared missing mass M_x^2 (Fig. 1).

In most M_x^2 intervals (with the exception of the very largest), the associative multiplicity is seen to increase already at values $p_{\perp\pi^-} \gtrsim 0.5$ GeV/c. It was shown earlier that the associative multiplicity, integrated over all the missing masses, depends little on the transverse momentum of the singled-out particle,[1] but when fast π^- mesons are separated from the fragmentation region of the beams, an increase of the quantity $\langle n(p_\perp)\rangle$ was observed.[2]

An analysis of the distribution of the singled-out π^- mesons with respect to the variable $x = 2p_\parallel^*/\sqrt{s}$ in different intervals of M_x^2 has shown that selection of the region of not very large missing masses (where the most intense growth of

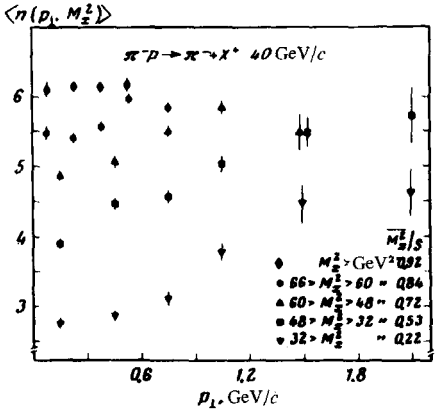

FIG. 1. Dependence of the associative multiplicity on the transverse momentum of the singled-out π^- mesons in different intervals of M_x^2.

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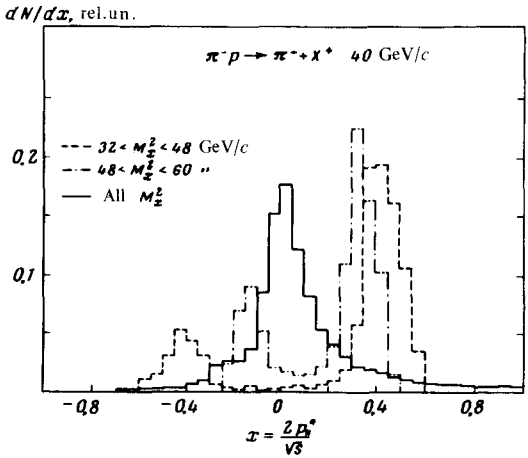

FIG. 2. Distribution of singled-out π^- mesons with respect to the variable x in individual intervals of M_x^2. The distributions for each interval are normalized to unity.

the associative multiplicity is observed) leads to separation of fast π^- mesons (Fig. 2).

An analogous growth of the associative multiplicity from $p_\perp$ in individual intervals of M_x^2 was observed also in pp interactions at 28.5 GeV/c for the case of selected protons and π^+ mesons.[3] We note that the largest growth of $\langle n(p_\perp)\rangle$ in both reactions is observed at approximately the same value of the ratio $M_x^2/s \approx 0.53$—0.54 (in our case this corresponds to $\overline{M}_x^2/s \approx 40$ GeV^2, and for pp interactions to the value $\overline{M}_x = 5.47$ GeV). This can serve as an indication that the mechanism responsible for the growth of the associative multiplicity is the same in both processes, and is possibly connected with the interaction of the hadron components.[2,4]

We investigated also the dependence of the associative multiplicity on the square of the transverse momentum in individual intervals of M_x^2 for fast π^-

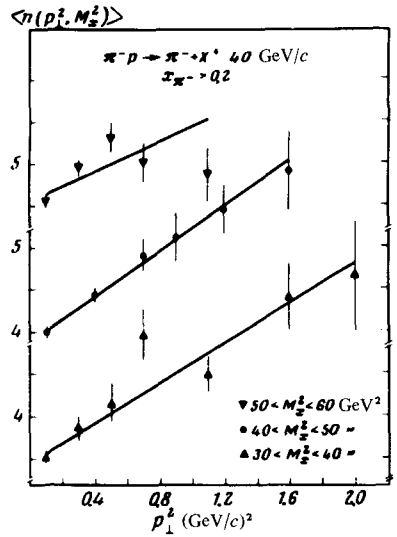

FIG. 3. Dependence of the associative multiplicity on the square of the transverse momentum of the selected fast π^- mesons in individual intervals of M_x^2. Straight lines—results of approximation in accordance with the predictions of the coherent-states model.

TABLE I.

Integral M_x^2, GeV^2	χ^2/N	a	b, (GeV/c)$^{-2}$
30—40	6.2/7	3.43 ± 0.10	1.20 ± 0.18
40—50	0.3/6	3.88 ± 0.09	1.37 ± 0.19
50—60	9.8/5	4.55 ± 0.07	0.92 ± 0.25

mesons (Fig. 3). The experimental results were approximated by the linear relation

$$< n\,(p_\perp^2)> = a + b\,p_\perp^2,$$

which is predicted within the framework of the coherent-states model.[5] The quantitative results of the approximation are given in Table I (N is the number of the experimental points):

We note that the linear growth of the associative multiplicity as a function of $|t|$ (the squared 4-momentum transfer) was observed also for fast π^- mesons in $\pi^- p$ interactions at 147 GeV/c.[6]

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