INCLUSIVE CROSS SECTIONS IN THE DUAL PARTON MODEL FOR PIONS AND NEUTRON TARGETS

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We compare the dual parton model predictions for $\pi^-\pi^- \to \pi^\pm X$ and $\pi^- n \to \pi^\pm X$ with the available experimental data. A good agreement is achieved.

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The dual parton model (DPM) [1] has been extensively compared with the experimental data [2]. The model gives a good description of a wide variety of data: rising of the inclusive cross sections [3], charge and strangeness distributions [4], long range correlations [5], dependence of the average transverse momentum on the multiplicity [6] and multiplicity distributions [7]. Also the extension of the model to hadron-nucleus [8] and nucleus-nucleus [9] interactions is in agreement with the experimental data. In DPM a valence quark from each of the two initial hadrons has, in average a small momentum fraction x. Then, the hadrons produced near $y = 0$ must come mainly from the fragmentation of the "held back" valence quarks. This effect has been studied for different beams using protons as targets in different inclusive cross sections [10]. In this note we study the cases where the targets are pions and neutrons. We use the data of references [11] and [12]. The inclusive pion target data were obtained from the momentum distributions of pions emitted from the recoiling system X^{--} in the reaction $\pi^- n \to pX^{--}$ assuming the one pion exchange model. The considered inclusive cross sections are $\pi^-\pi^- \to \pi^+X$, $\pi^-\pi^- \to \pi^-X$, $\pi^-n \to \pi^-X$ and $\pi^-n \to \pi^+X$. For the two first reactions, the contribution comes from the diagrams of Fig. 1 which are given by the formula

$$\frac{dN^{\pi^-\pi^-\to\pi X}}{dy}(s, y) = \int_0^1 dx_1 \int_0^1 dx_2 \varrho_{d\bar{u}}^{\pi^-\pi^-}(x_1, x_2)$$

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$$\times \left[\frac{dN_{\mathrm{S}}^{(\mathrm{d},\bar{\mathrm{u}})\to\pi}}{dy}(y-\Delta_{\mathrm{S}}, P_{\mathrm{S}}) + \frac{dN_{\mathrm{L}}^{(\bar{\mathrm{u}},\mathrm{d})\to\pi}}{dy}(y-\Delta_{\mathrm{L}}, P_{\mathrm{L}})\right]$$

$$+ \int_0^1 dx_1 \int_0^1 dx_2 \varrho_{\bar{\mathrm{u}}\mathrm{u}}^{\pi^-\pi^-}(x_1, x_2) \left[\frac{dN_{\mathrm{A}}^{(\mathrm{d},\bar{\mathrm{u}})\to\pi}}{dy}(y-\Delta_{\mathrm{A}}, P_{\mathrm{A}}) + \frac{dN_{\mathrm{B}}^{(\bar{\mathrm{u}},\mathrm{d})\to\pi}}{dy}(y-\Delta_{\mathrm{B}}, P_{\mathrm{B}})\right] \quad (1)$$

where we use the standard notation.

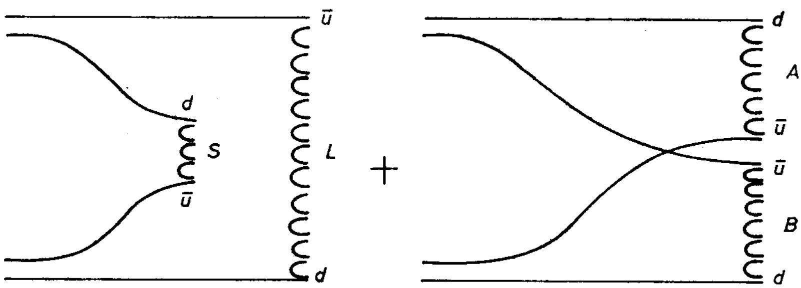

Fig. 1. Diagrams contributing to $\pi^-\pi^- \to \pi X$

For the structure functions we use the standard form

$$\varrho_{\bar{\mathrm{u}}\mathrm{u}}^{\pi^-\pi^-}(x_1, x_2) = \varrho_{\mathrm{d}\bar{\mathrm{u}}}^{\pi^-\pi^-}(x_1, x_2) = 0.75\frac{x_1}{\sqrt{1-x_1}}\,0.75\frac{x_2}{\sqrt{1-x_2}} \quad (2)$$

and the chain distributions are obtained in the usual way from the fragmentation functions

$$D_{\mathrm{u}\to\pi^+}(x) = D_{\bar{\mathrm{d}}\to\pi^+} = D_{\bar{\mathrm{u}}\to\pi^-} = D_{\mathrm{d}\to\pi^-} = \frac{cf(x)}{1+w(x)}, \quad (3)$$

$$D_{\mathrm{u}\to\pi^-}(x) = D_{\bar{\mathrm{d}}\to\pi^-} = D_{\bar{\mathrm{u}}\to\pi^+} = D_{\mathrm{d}\to\pi^+} = \frac{cf(x)w(x)}{1+w(x)}, \quad (4)$$

where

$$f(x) = \frac{(1-x)^2}{1-0.5x}, \quad w(x) = \frac{1-x}{1+x} \quad (5)$$

and $c = 1.1$.

In Fig. 2 we plot the inclusive $\pi^-\pi^- \to \pi^+X$ cross section at $P_{\mathrm{lab}} = 360$ GeV/c together with the experimental data. In Fig. 3 we present the ratio between the inclusive cross sections for π^- and π^+. From the figures we see a remarkable agreement between theory and experiment.

For the $\pi^-n \to \pi^+X$ and $\pi^-n \to \pi^-X$ cross sections we proceed in an analogous way. The obtained $\pi^-n \to \pi^-X$ inclusive cross sections at 360 GeV/c are plotted in Fig. 4 together

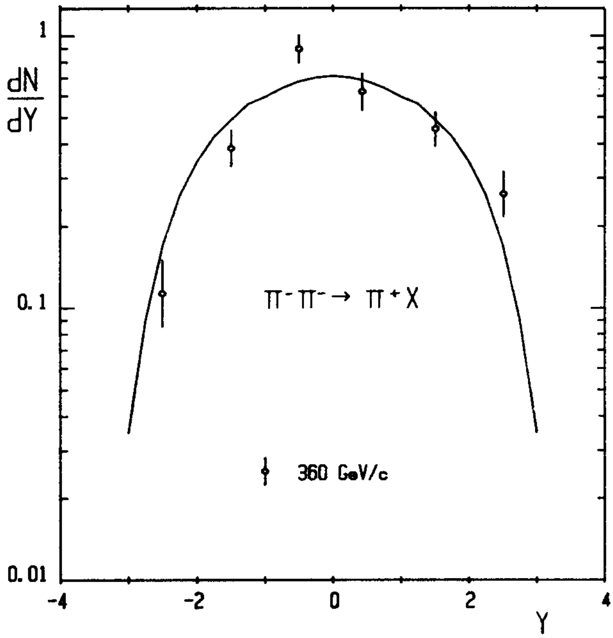

Fig. 2. $\pi^-\pi^- \to \pi^+X$ inclusive cross section at $P_{\text{Lab}} = 360$ GeV/c

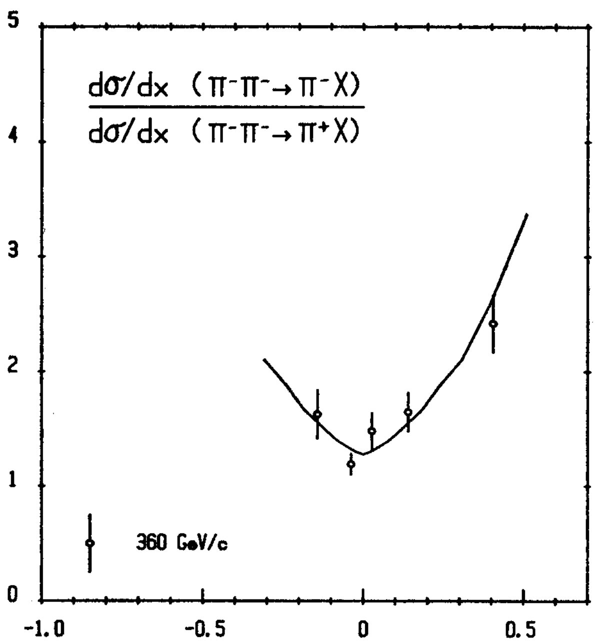

Fig. 3. Ratio between $\pi^-\pi^- \to \pi^-X$ and $\pi^-\pi^- \to \pi^+X$ inclusive cross sections at $P_{\text{Lab}} = 360$ GeV/c

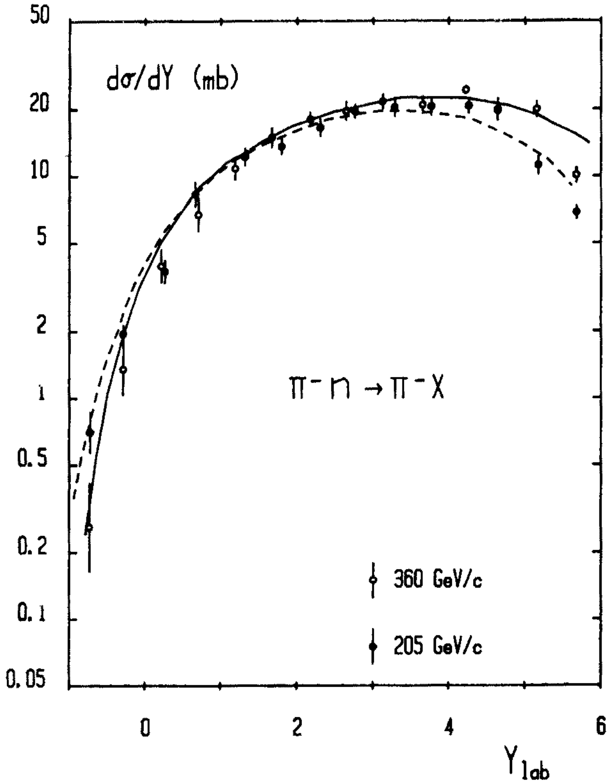

Fig. 4

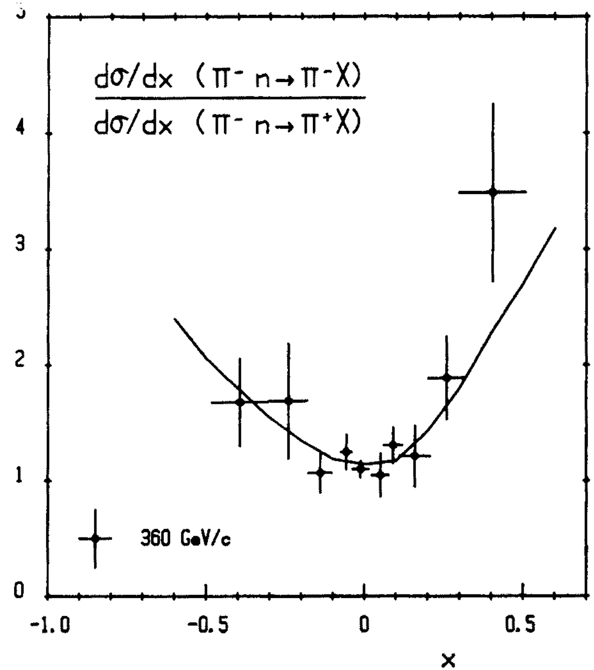

Fig. 5

Fig. 4. $\pi^- n \to \pi^- X$ inclusive cross section at $P_{\text{Lab}} = 360$ GeV/c (solid line) and at $P_{\text{Lab}} = 205$ GeV/c (dashed line)

Fig. 5. Ratio between $\pi^- n \to \pi^- X$ and $\pi^- n \to \pi^+ X$ inclusive cross sections at $P_{\text{Lab}} = 360$ GeV/c

with the experimental data. In Fig. 5 we plot the ratio between the inclusive cross sections for π^- and π^+ at 360 GeV/c. Again a remarkable agreement between theory and experiment is achieved. This agreement is also obtained at the other two energies 21 GeV/c and 205 GeV/c, where there are experimental data. A sample of that is shown in Fig. 4.

In conclusion, the DPM describes rightly the inclusive cross section $\pi^-\pi^- \to \pi^\pm X$ and $\pi^- n \to \pi^\pm X$. Notice that recombination type models [13–14] have problems [12] in the description of the same data.

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