INTERPRETATION OF THE NEGATIVE CORRELATION OBSERVED BETWEEN THE NUMBERS OF NEUTRAL AND CHARGED PIONS PRODUCED IN $\bar{p}p$ ANNIHILATIONS

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Using the statistical model for charge branching ratios it is shown that the difference between the positive correlation between the numbers of charged and neutral pions produced in high energy non-annihilation processes and the corresponding negative correlation for annihilation processes just reflects the fact that the prong number distribution in annihilation processes is much narrower than in non-annihilation ones.

Recently much work has been devoted to studies of the dependence of the average numbers of neutral pions $\langle n_0 \rangle$ on the number of charged particles (for references see Refs [1], [2]). It has been found that the dependence of $\langle n_0 \rangle$ on the number of produced negative pions n_- depends on the reaction and on energy. In particular for pp and meson-p interactions at lower energies $\langle n_0 \rangle$ decreases with increasing n_-, while at higher energies it increases (Refs [1], [2]). This phenomenon has been explained in Ref. [2] as a reflection of the fact that the width of the prong number distribution increases with energy. The authors assumed the Czyżewski–Rybicki distribution for total multiplicities and took charge branching ratios from the statistical model. Thus having fixed the parameters of the Czyżewski–Rybicki distribution to fit the prong number distribution they got absolute predictions for the dependence of $\langle n_0 \rangle$ on n_-. Agreement with the experiment was very good. The results for pp interaction at 69 GeV/c (Ref. [4], [2]) are shown in Fig. 1a.

Recently the dependence of $\langle n_0 \rangle$ on n_- for $\bar{p}p$ annihilation at 4.6 GeV/c has been reported (Ref. [3]). For increasing n_- it was found that $\langle n_0 \rangle$ decreases rapidly (Fig. 1b). This is in marked contrast with pp data at 69 GeV/c where the average multiplicities of charged and neutral pions are almost the same ($\langle n_-(pp) \rangle = 1.95 \pm 0.04$, $\langle n_-(\bar{p}p) \rangle = 2.1$, $\langle n_0(pp) \rangle = 2.57 \pm 0.13$, $\langle n_0(\bar{p}p) \rangle = 2.6$), but $\langle n_0 \rangle$ increases significantly with increasing n_- (Fig. 1a). The comparison of this difference with the fact that the prong number distribution for $\bar{p}p$ annihilation is narrower than for pp interactions ($f_2^{--}(\bar{p}p) = -1.55$ while

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$f_2^{--}(pp) = +0.15 \pm 0.06$) enables us to state that the regularity found in p^-p and meson-p interactions qualitatively holds also in the case of annihilation.

In order to confirm this conclusion quantitatively we calculated the expected dependence of $\langle n_0 \rangle$ on n_- using the model from Ref. [2]. We do not expect exact agreement with the data because the statistical model understimates the π^0 production in annihilation processes (Ref. [5]) but we await that the model from Ref. [2], which in simple way relates

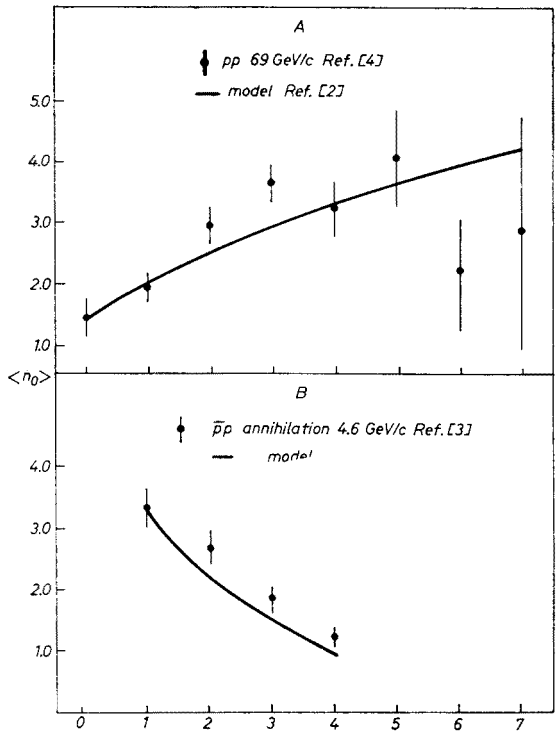

Fig. 1. Average multiplicity of neutral pions $\langle n_0 \rangle$ as a function of number of negative pions n_-: a) for pp interactions at 69 GeV/c (Ref. [4]) b) for $\bar{p}p$ annihilations at 4.6 GeV/c (Ref. [3]). The curves represent predictions of the model from Ref. [2]. (For pp interactions at 69 GeV/c the curve is taken from Ref. [2])

the charged and neutral particle multiplicity distributions, will reproduce the negative correlation between neutral and charged pions. The result of the calculations shown in Fig. 1b reproduces very well the trend of the experimental data. As expected, the calculated average multiplicity of neutral pions (2.0) is too low.

We conclude that the difference between $\langle n_0^- \rangle - n_-$ correlations shown in Fig. 1 can be interpreted as resulting just from the difference between the widths of the prong number distributions for annihilation and non-annihilation processes.

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