ANGULAR CORRELATIONS BETWEEN π° MESONS PRODUCED IN π^- Xe INTERACTIONS AT 9 GeV/c π^- INCOMING MOMENTUM

By K. Eskreys

Academy of Mining and Metallurgy, Cracow*

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Strong angular correlations between neutral pions have been found in the 9 GeV/c π^- Xe interactions observed in the xenon bubble chamber. Angular correlations of the same kind have been previously reported for charged pions produced in $\bar{p}-p$ and $\pi^+ - p$ interactions.

3000 frames from the $550\times270\times153$ mm^3 xenon bubble chamber [4], exposed to the 9 GeV/c π^- beam at Dubna synchrotron, have been scanned. 374 π^- Xe interactions with the associated electron-photon cascades were selected for futher analysis. Energies and angles of emission of all electron-positron pairs were measured. The energy of the photon was determined from the total length of the observed electron tracks in a given cascade using the energy-range curves given by Danysz *et al.* [3] and in the case of a very energetic cascade from the total number of the electron tracks at the cascade maximum. Uncertainity of such a determination of photon energy reaches 30%. All calculations have been done with the help of the GIER çomputer installed in the Institute of Nuclear Research in Świerk near Warsaw.

The angular correlations between charged pions have been primarily observed in $\bar{p}p$ annihilations at 1.6 GeV/c $\bar{p}$ momentum by Goldhaber *et al.* [2]. It was found that the experimental distribution of the cosine of the angle between two pions is remarkably different in the case of like and unlike pions. The ratio $\gamma = B/F$ (where B stands for the number of pion pairs with the opening angle greater than 90°, F — for these with the opening angle smaller than 90°) is much greater for the pairs of unlike pions than that for the like pions. The explanation of this effect was first attempted by Goldhaber, *et al.* [2]. According to the theory developed by them the observed angular correlation of pions is a consequence of the symmetry properties of the boson states. Further experimental data proved this theory to be unable to reproduce the size of the observed effect. Nevertheless it is still an interesting question as to whether the correlation effect exists for other bosons than charged pions. Among the other explanations those attributing

* Address: Akademia Górniczo-Hutnicza, Kraków, Al. Mickiewicza 30, Polska.

the observed correlation effect to the abundant ϱ° meson production [5, 6] seem to be experimentally most justified. From this point of view the existence or non-existence of the effect for π° mesons into which ϱ° cannot decay become an important check of these theories. Recently, the angular correlations between charged pions have been also observed in $\pi^+ p$ interactions [1].

In this paper an analysis is presented which allowed the correlation effect between neutral pions produced in 9 GeV/c π^- Xe interactions to be checked up.

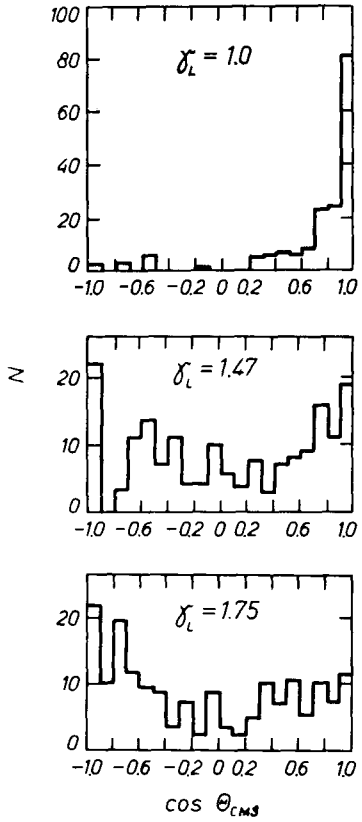

Fig. 1. CMS production angular distributions of π° mesons for different γ_L values

Photons were correlated into π° mesons on the basis of the effective mass value of photon pair. In such a way there were selected 65 interactions in which at least two neutral π° mesons were produced.

Due to the composite structure of the Xe nucleus it is difficult to decide as to with what part of it the interactions of incoming π^- took place. In order to perform then the transformation from the LAB to the CM system for these interactions one has to introduce an average Lorentz factor as to account for all possible kinds of interactions (covering: $\pi^- N$, $\pi^- FR$, where FR stands for the part of Xe nucleus, and π^- Xe type of interactions). Fig. 1 shows the distributions of the cosine of the production angle for mesons in the coordi-

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nate frame moving with respect to the LAB system with different Lorentz factors γ_L. In the coordinate frame moving with $\gamma_L = 1.47$ the π° production angular distributions are symmetrical and this value of γ_L has been accepted as the average value of the Lorentz factor for CM system of our interactions. The distribution of the cosine of the opening angle for the pairs of π° mesons in this CM system is shown in Fig. 2. In the same plot

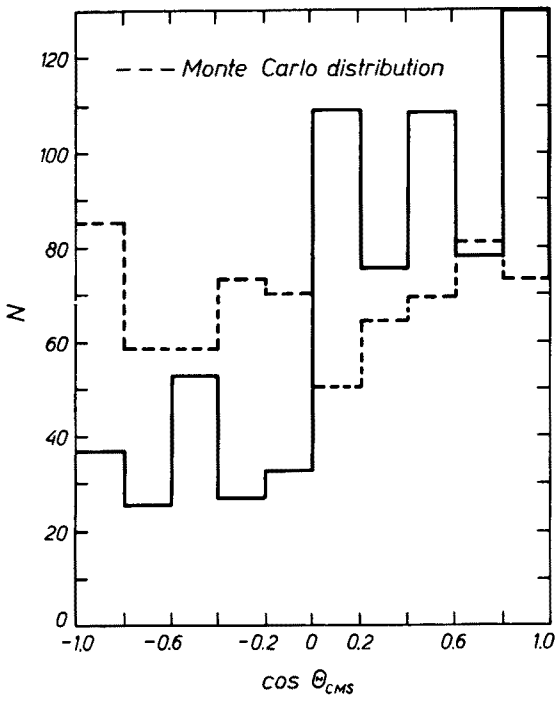

Fig. 2. Distribution of the opening angle of π° meson pairs in the coordinate system moving with the Lorentz factor $\gamma = 1.47$. The experimental distribution is given by the solid line, the Monte-Carlo distribution by the dashed line

the Monte Carlo distribution[1] of the cosine of the opening angle is shown. The values of $\gamma = B/F$ for both distributions are the following:

for the experimental distribution $\gamma^{ex} = 0.417 \pm 0.029$

for the Monte Carlo distribution $\gamma^{MC} = 1.137 \pm 0.047$

The observed difference between γ^{ex} and γ^{MC} shows that the angular correlation effect for neutral pions is of the same kind as for the like charged pions.

In order to check the correctness of the procedure which has been applied in getting the average value of the Lorentz factor γ_L of the CM system, the distribution of the cosine of the angle between the transverse components of the π°-meson momenta was pre-

[1] This calculation does not take into account energy and momentum conservation.

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pared. This distribution is shown in Fig. 3 together with the phase space prediction as calculated by Bertocchi and Zalewski [7]. The effect of the π° mesons attraction is here again very strong. The experimental γ^{P_T} value is much smaller than the predicted value $\gamma^{P_T}_{\text{PRED}}$ ($\gamma^{P_T} = 0.62 \pm 0.02$, $\gamma^{P_T}_{\text{PRED}} = 1.54$).

One can thus conclude that the angular correlations of the same kind as for the charged pions exist also for neutral pions.

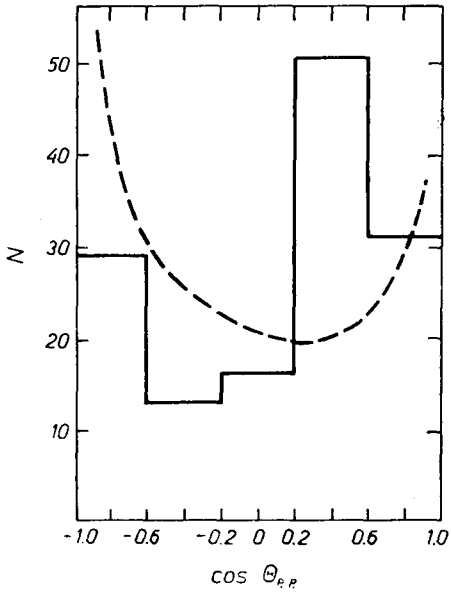

Fig. 3. Distribution of the angle between the transverse components of the π°-meson momenta; solid line — phase space predictions [7]

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