CHARGE-EXCHANGE RESULTS FROM SERPUKHOV

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Differential cross sections for the charge-exchange reactions (I) - (IV) have been measured in the Serpukhov energy range. These reactions

$$\pi^- + p \rightarrow \pi^0 + n \quad , \qquad (I)$$

$$\pi^- + p \rightarrow \eta^0 + n \quad , \qquad (II)$$

$$K^- + p \rightarrow \bar{K}^0 + n \quad , \qquad (III)$$

$$\bar{p} + p \rightarrow \bar{n} + n \quad , \qquad (IV)$$

are among the simplest processes of exchange scattering, because the asymptotic behaviours of their amplitudes are dominated by t-channel contributions from one or two poles with the quantum numbers of the ρ and A_2 mesons. Figures showing some of the results are included in Amaldi's rapporteur talk.

Measurements for the reactions I and II were taken at incident momenta $p = 21$, 25, 32.5, 40 and 48 GeV/c [1]. Photon pairs from $\pi^0(\eta^0)$ decay were detected by an optical spark spectrometer. The differential cross section for (I) has a maximum at $-t \simeq 0.03$ $(GeV/c)^2$; then in the interval $0.1 < -t < 0.6 (GeV/c)^2$ it falls rapidly with increasing $-t$, and for $-t > 0.6$ $(GeV/c)^2$ it goes through a second maximum. In the momentum range $6 \leq p \leq 50$ GeV/c the differential cross section at zero angle is described by the power function

$$d\sigma/dt(t=0) = (1.35 \pm 0.15).p^{-0.83 \pm 0.05} . \quad (1)$$

From Eq.(1) it follows that the value of the ρ trajectory at $t = 0$ is

$$\alpha_\rho(0) = 0.58 \pm 0.03 \quad . \qquad (2)$$

This value is in disagreement with data for the total cross section difference $\Delta\sigma(\pi^\pm)$, and the discrepancy corresponds to two or three standard deviations. The forward peak shrinks as energy increases. The cross section for reaction(I) in the region of the second maximum decreases as $p^{-2.8 \pm 0.1}$. The ρ trajectory is parametrized by a linear function

$$\alpha_\rho(t) = (0.56 \pm 0.02) + (0.97 \pm 0.04)t \quad (3)$$

in the interval $0 < -t < 1.5$ $(GeV/c)^2$.

For reaction(II), the parametrization of the A_2 trajectory is nonlinear :

$$\alpha_{A_2}(t) = (0.52 \pm 0.04) + (1.2 \pm 0.3)t + (0.7 \pm 0.2)t^2 . \quad (4)$$

In the region $t \sim 0$, this A_2 trajectory goes considerably higher than values deduced from data at lower energies. The forward scattering cone shrinks slowly as energy increases, for $0.2 \leq -t \leq 1$, and at $-t = 1.1$ $(GeV/c)^2$ the differential cross section has a flat minimum.

Cross sections for reactions (III) and (IV) have been measured at 25, 35 and 39 GeV/c [2,3] . The energy dependence at $t = 0$ for reaction(III) is described by

$$d\sigma/dt\ (t=0) = (5 \pm 1)\ p^{-1.47 \pm 0.10} \qquad (5)$$

and is below the optical limit defined by the total cross section difference $\Delta\sigma = \sigma(K^-p) - \sigma(K^-n)$, with data above 25 GeV/c. This discrepancy is probably connected with the correction for nucleon screening in the deuteron. To remove the discrepancy it is sufficient to increase the Glauber correction by 13%. The forward peak of $K^-p \rightarrow \bar{K}^0n$ scattering shrinks slowly with increasing energy ; the slope parameter b is described by a logarithmic s-dependence :

$$b = (4.7 \pm 0.5) + (0.8 \pm 0.4)\ \ell n\ (s/s_o) \qquad (6)$$

where b is measured in $(GeV/c)^2$ and $s_o = 10$ GeV^2.

The cross section for $\bar{p}p \rightarrow \bar{n}n$ continues to fall as rapidly, with increasing energy, as at $p \leq 9$GeV/c :

$$\sigma(\bar{p}p \rightarrow \bar{n}n) = (11 \pm 2).p^{-1.8 \pm 0.1} \quad . \qquad (7)$$

A narrow peak is clearly seen in $d\sigma/dt$ $(0 \leq -t \leq 0.02$ $(GeV/c)^2)$, which is analogous to that observed at lower energies. The cross section decrease is equally rapid at all t-values ($\sim 1/p^2$). This means that the contributions of ρ and A_2 exchange are not yet important and the asymptotic regime for reaction(IV) occurs at considerably higher energies.

REFERENCES

[1] BOLOTOV (V.N.) et al., papers 357 and 358

[2] BOLOTOV (V.N.) et al., papers 425 and 426

[3] BALOSHIN (O.N.) et al., paper 444.