2
З-24

J O I N T I N S T I T U T E F O R N U C L E A R R E S E A R C H

Laboratory of Theoretical Physics

P - 130

V.S. Barashenkov

ON THE INTERACTION BETWEEN K-MESONS, PIONS, NUCLEONS AND HYPERONS

ЖЭТФ, 1958, т 34, в 4, с 1016-1017
Nucl. Phys., 1958, v 7, n 2, p146

1 9 5 8.

J O I N T   I N S T I T U T E   F O R   N U C L E A R   R E S E A R C H

Laboratory of Theoretical Physics

P - 130

V.S. Barashenkov

ON THE INTERACTION BETWEEN K-MESONS, PIONS, NUCLEONS AND HYPERONS

1 9 5 8.

A model for description of multiple productions of strange particles has been proposed in ref.[1,3]. The structure of a "compound particle" resulting from the collision between two fast particles was found to markedly depend on the magnitude of the interaction assumed to exist between the various types of particles. Coupling constants do not explicitly enter the multiple production formulae of the statistical theory. "Strong" or "weak" are understood here with respect to the magnitude of the cross sections which determine statistical equilibrium between the created particles. In our opinion, conclusions regarding "strong" or "weak" interaction between various types of particles that can be drawn by comparting statistical theory computations with experiment in a broad energy range, probably yield information on the relative magnitude of the coupling constants for these particles.* Since at present diverse opinions are held regarding

---

* A detailed analysis of this problem will be presented at a later date.

---

the magnitude of interaction between π or K mesons and hyperons and between K - mesons and nucleons, even indirect information on these interactions would be of interest. We shall proceed from the well known experimental fact that the interaction between pions and nucleons is a strong one ($g^2/4\pi\hbar c \gg 1$).

If one assumes a strong interaction between pions and K-mesons (or between K-mesons and nucleons) the following choices of space volumes are possible for a "compound particle".

1. Statistical equilibrium between all secondary particles takes place in a single volume $V = V_1$ **. In this case the ratio

---

** The notations are those employed in ref.[1,2].

of created strange particles to pions and nucleons considerably exceeds the experimental value.

2. Statistical equilibrium between nucleons, pions and K-mesons occurs in the same space volumes $V = V_1$, whereas hyperon equilibrium takes place in a smaller volume. In this case the fraction of produced strange particles is close to the experimental value[6,7/]; however, for E = 6.2 BeV the ratio of K^- to K^+ mesons created in nucleon-nucleon collisions is $N^+/N^- = 3$. On the other hand a value $N^+/N^- \approx$ 100-150 was observed in ref.[4/] for K-meson momenta $P \simeq 250$ MeV/c - 350 MeV/c. Even if the momentum distribution is taken into account it is difficult to remove a discrepancy of two orders of magnitude between these values.*

---

* Exact calculations with account of momenta distributions will be published in Acta Physica Polonica.

---

3. The K-meson equilibrium volume is larger than the respective volume for nucleons and pions. Neither the fraction of created strange particles nor the ratio N^+/N^- can be made to agree with the experimental data.

Agreement between the statistical theory of plural particle production and experiment can be attained only if weak interaction of K-mesons with pions and nucleons is assumed. Statistical equilibrium for K-mesons will then occur in a space volume that is smaller than that for pions and nucleons. The best agreement can be obtained by assuming, following ref.[5/], symmetrical interaction of pions with nucleons and hyperons Thus in this case the calculated effective cross section σ_s for strange particle production in 4.3 GeV π^- meson-nucleon collisions is 3 Mb. The mean experimental value for this cross section is approximately 2.2 Mb. However, if one assumes that all strange particles weakly interact with pions and nucleons ($V = V_3$)$_1$, one finds σ_s = 0.3 Mb. The discrepancy between the theoretical and experimental values in this case considerably exceeds the experimental error.*

---

* The experimental error is ≤ 50%. σ_{tot} = (25 ± 2.5) Mb.

For $V = V_2$, $N^+/N^- \simeq 160$ and for $V = V_3$, $N^+/N^- \simeq 8$. Assuming again that all strange particles weakly interact with pions and nucleons, we find a large discrepancy between the computed values of N^+/N^- and the experimental ones.

The author wishes to thank D.I. Blokhintsev for numerous discussions and M.A. Markov, B.V. Medvedyev and V.I. Ogievetsky for discussion and valuable critical remarks. I am also thankful to K.D. Tolstov for discussion of the experiments[6].

References

1. V.S. Barashenkov, B.M. Barbashov, E.G. Bubelyev and V.M.Maksimenko, Nuclear Physics 4 (1957), V.S. Barashenkov, B.M. Barbashov and E.G. Bubelyev, Nuovo Cimento (in print).
2. V.S. Barashenkov and V.M. Maltsev, Acta Physica Polonica (in print).
3. V.S. Barashenkov. Report at Conference on Pion and New Particle Physics, Padua- Venice 1957.
4. W.W. Chapp et al., Nuovo Cimento 4, Suppl. 2 (1956) 359.
5. M. Gell-Mann, Phys. Rev. 106 (1957) 1296.
6. C. Besson et al., Nuovo Cimento 6 (1957) 1168.
7. Proceedings of the 7th Rochester Conference and of the Conference in Padua-Venice (1957).