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CHARGE DISTRIBUTION OF UNSTABLE PARTICLES PRODUCED IN PION NUCLEON COLLISIONS

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The problem consists in obtaining statiatical weights for the creation of one or more strange particles with one defined charge, in pion nucleon collisions.

Projecting the isotopic space of the initial pion-nucleon system, into the subspaces of each strange particle, we find the generation probability for one or more strange particles, taking into account the sing of the charge of each one. At the same time we use of course the statistical weights [1] for the appearance of the strange particles independent of the charge.

The initial system may consist of either π^-p, π^-n, π^+p or π^+n. We investigate only the π^- cases, because, as it is well known, the other two cases can be obtained from the former by interchanging p and n, and reversing the sign of the other particles.

We investigate also the statistical weights only for the strange particles resulting from collisions, as the charge distribution of the produced p and N has already been investigated [2].

In isotopic space the system π^-n is characterized by the isotopic spin $T=\frac{3}{2}$ and its projection $T_z=-\frac{3}{2}$. Then there exists only one possibility, $(\frac{3}{2}-\frac{3}{2})$ and the system has a well-defined isotopic spin.

But the π^-p system has the isotopic spin projection $T = -\frac{1}{2}$. Then there are two possibilities for the system for $T = \frac{3}{2}$ and for $T = \frac{1}{2}$, and the isotopic spin is not well defined. The case $(\frac{3}{2} - \frac{1}{2})$ is realised with $\frac{1}{3}$ probability and $(\frac{3}{2} - \frac{1}{2})$ with $\frac{2}{3}$ probability.

Taking into account the fact that apart from the strange particles a certain number of pions may be generated, which is limited by the energy of the incident pions, we used the statistical weights for the generation of I,2,3 not over 4 pions from the given tables [3].

The charge distribution has been computed also for the case when quasiparticles or isobars can be generated. The statistical weights for the appearance of one isobar with a certain number of pions, for different values of the isotopic spin, have been taken from the paper [4].

In this way we obtained the table I and II for charge distribution of different kinds of strange particles.

The groups are chosen in accordance with the conservations of the strangeness, of the baryonic number and of the isotopic spin.

We used afterwards the results from the work of Barashenkov and Maltsev [1], who calculated the statistical weights, according to Fermi's statistical theory, of unstable particles in pion nucleon collision (for 5 and 7 Bev) without taking into account the sign of the charge of the particles.

The author give the results in two cases: the first case corresponds to the Schwinger and Gell-Mann hypothesis on the global pion interaction with baryons; the second case will take place if pion interaction with Λ, Σ, Ξ particles is considerably less than with the nucleons.

Using these data and our results, one can obtain the statistical weights for the appearance of one or more strange particles with one definite charge in pion nucleon collision.

For instance for pion of about 5 Bev the experimental [5] and theoretic values are:

	exp.	theory first hypothes	theory second hypothesis
K^+	2.8 ± 1.2 %	3.3408 %	0.3994 %
K^-	1.2 ± 0.6 %	0.6545 %	0.7412 %

It is clear that in order to obtain a convincing conclusion we must know separately the statistical weights for K^- and K^+. As K^- (or $\tilde{K}^+$) are only in the group $K\tilde{K}$ where there is practically no difference between the two hypotheses, we cannot expect any difference in the results.

But for the K^+, which also enter the group ΣK, we obtain an obvious distinction, because in this case there is a essential difference between the two hypotheses.

As it can be seen the result which corresponds to the first hypotheses is found to be closer to the experiment.

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Table I

Number of π / Reaction	0		I		2		3		4	
	$(\frac{3}{2}-\frac{1}{2})$	$(\frac{1}{2}-\frac{1}{2})$	$(\frac{3}{2}-\frac{1}{2})$	$(\frac{1}{2}-\frac{1}{2})$	$(\frac{3}{2}-\frac{1}{2})$	$(\frac{1}{2}-\frac{1}{2})$	$(\frac{3}{2}-\frac{1}{2})$	$(\frac{1}{2}-\frac{1}{2})$	$(\frac{3}{2}-\frac{1}{2})$	$(\frac{1}{2}-\frac{1}{2})$
$\Sigma^0 K^0$	0,667	0,333	0,267	0,333	I,I33	0,800	2,037	I,600	5,3I5	3,800
$\Sigma^- K^0$	0	0	0,400	0,500	0,800	0,600	2,II4	I,700	5,I43	3,600
$\Sigma^+ K^0$	0	0	0,400	0,500	0,867	0,600	2,248	I,700	5,543	3,600
$\Sigma^0 K^+$	0	0	0,466	0,333	0,667	0,533	2,029	I,400	4,685	3,200
$\Sigma^- K^+$	0,333	0,667	0,466	0,333	I,I33	I,067	2,485	I,800	6,057	4.400
$\Sigma^+ K^+$	0	0	0	0	0,400	0,400	I,086	0,800	3,257	2,400
	I	I	2	2	5	4	I2	9	30	2I
$N\ K^0 \tilde{K}^0$	0,333	0,667	0,867	0,833	I,933	I,667	4,600	3,500	II,200	8
$N\ K^0 \tilde{K}^+$	0,333	0,667	0,867	0,833	I,933	I,667	4,600	3,500	II,200	8
$N\ K^+ \tilde{K}^0$	0	0	0,400	0,500	I,200	I	3,200	2,500	8,400	6
$N\ K^+ \tilde{K}^+$	0,333	0,667	0,867	0,833	I,933	I,667	4,600	3,500	II,200	8
	I	2	3	3	7	6	I7	I3	42	30
$N'\ K^0 \tilde{K}^0$	0,533	0,I67	I,067	0,833	2,670	I,833	6,600	4,500		
$N'\ K^0 \tilde{K}^+$	0,533	0,I67	I,067	0,833	2,670	I,833	6,600	4,500		
$N'\ K^+ \tilde{K}^0$	0,400	0,500	0,800	0,500	2	I,500	5,200	3,500		
$N'\ K^+ \tilde{K}^+$	0,533	0,I66	I,067	0,833	2,670	I,833	6,600	4,500		
	2	I	4	3	I0	7	25	I7.		
λK^+	0	0	0,333	0,667	0,934	0,667	2,200	2,00I	5,604	4,002
λK^0	0	I	0,667	0,333	I,066	I,333	2,800	I,999	6,396	4,998
	0	I	I	I	2	2	5	4	I2	9
$\Xi^- K^0 K^+$	0,667	I,333	0,933	0,667	2,600	2,300				
$\Xi^0 K^0 K^+$	0	0	0,800	I	I,600	I,200				
$\Xi^- K^0 K^0$	0	0	0,400	0,500	0,800	0,600				
$\Xi^0 K^0 K^0$	0,333	0,667	0,467	0,333	0,800	0,900				
$\Xi^- K^+ K^+$	0	0	0,400	0,500	0,800	0,600				
$\Xi^0 K^+ K^+$	0	0	0	0	0,400	0,400				
	I	2	3	3	7	6				

Table II

Number of Reaction	0	I	2	3	4
$\Sigma^0 K^0$	0	0,600	0,934	2,545	5,830
$\Sigma^- K^0$	I	0,600	I,800	3,228	7,886
$\Sigma^+ K^0$	0	0	0,666	I,429	4,290
$\Sigma^0 K^+$	0	0	0,534	I,259	3,770
$\Sigma^- K^+$	0	0,800	I,066	2,969	6,5I0
$\Sigma^+ K^+$	0	0	–	0,570	I,7I4
	I	2	5	I2	30
$N\ K^0\ K^0$	0	0,800	I,733	4,400	I0,800
$N\ K^0\ K^+$	I	I,400	2,867	6,200	I4,400
$N\ K^+\ K^0$	0	–	0,667	2	6
$N\ K^+\ K^+$	0	0,800	I,733	4,400	I0,800
	I	3	7	I7	42
$N'\ K^0\ K^0$	0,800	0,933	2,667	6,400	
$N'\ K^0\ K^+$	0,400	I,467	3,333	8,200	
$N'\ K^+\ K^0$	–	0,667	I,333	4	
$N'\ K^+\ K^+$	0,800	0,933	2,667	6,400	
	2	4	I0	25	
$\lambda\ K^0$	0	I	I,200	3,400	7,200
$\lambda\ K^+$	0	0	0,800	I,600	4,800
	0	I	2	5	I2
$\Xi^- K^0\ K^+$	0	I,600	2,I33		
$\Xi^0 K^0\ K^+$	0	0	I,333		
$\Xi^- K^0\ K^0$	0	0,600	I,800		
$\Xi^0 K^0\ K^0$	I	0,800	I,067		
$\Xi^- K^+\ K^+$	0	0	0,667		
$\Xi^0 K^+\ K^+$	0	0	0		
	I	3	7		

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