COMPARISON OF SOME CHARACTERISTICS OF CHARGED PIONS IN P^{12}C AND N^{12}C COLLISIONS AT 4.2 GEV/*C*

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Abstract

The new experimental data on various characteristics of the secondary charged pions produced in n^{12}C collisions at 4.2 GeV/*c* are presented.A comparative analysis of the average multiplicities and various kinematic characteristics of the charged pions produced in n^{12}C and p^{12}C collisions at 4.2 GeV/*c*is made. The experimental data are compared systematically with the predictions of the modified FRITIOF model.

Keywords: neutron-carbon collisions, proton-carbon collisions, intermediate energies, pion production,average multiplicities, total and transverse momentum distributions, rapidity distributions, emission angle distributions.

1. Introduction

This work is a continuation of a series of the papers [1, 2] andis devoted to the comparative analysis of various characteristics of the charged pionsproduced in p^{12}C and n^{12}C collisions at 4.2 GeV/*c*. The experimental data are compared with the results of Monte Carlo calculations in the framework of the modified version of the FRITIOF model [3, 4].

2. Experimental results and their discussion

Table 1 shows the experimental data on the average multiplicities of charged pions (the mean number of the charged pions per one inelastic collision event)produced in p^{12}C and n^{12}C collisions at 4.2 GeV/*c*.

From Table 1 one can see that the average multiplicity of negative (positive) pions coincides with the average multiplicity of positive (negative) pions in p^{12}C and n^{12}C collisions, respectively. This resultis obvious from the isotopic invariance of the strong interactionsconsidered by us. However, as seen from Table 1, the model overestimates theaverage multiplicities in comparison with the experimental data by approximately 10%, both for negative and positive pions.

Table 1.Average multiplicities of π^- and π^+ mesons, as well as their absolute differences ΔR in the experiment and in the modified FRITIOF model in p^{12}C and n^{12}C collisions at 4.2 GeV/*c*

Quantity	**Type of collision**			
	p^{12}C		**n^{12}C**	
	xperiment	**Model**	**Experiment**	**Model**
<$n(\pi^-)$>	0.36±0.02	0.40±0.01	0.64±0.02	0.70±0.01
<$n(\pi^+)$>	0.63±0.02	0.71±0.01	0.37±0.02	0.39±0.01
Δ*R*	0.27 ± 0.03	0.31 ± 0.01	0.27 ± 0.03	0.31 ± 0.01

In order to determine the contribution of inelastic charge exchange reactionsof the initial neutron (proton) to the formation of negative (positive) pions, let us consider the difference in the average multiplicities of the negative (positive) and positive (negative) pions in n^{12}C (p^{12}C) collisions (see the last line of Table 1).

Figs. 1 and 2 show thetotal momentum distributions of π^- (a) and π^+ (b) mesons in n^{12}C (Fig. 1) and p^{12}C (Fig. 2) collisions at 4.2 GeV/*c*, normalized by the total number of inelastic events (N_{events}) and the width of the momentum interval (ΔP). The corresponding distributions calculated using the modified FRITIOF model are shown as histograms for comparison.

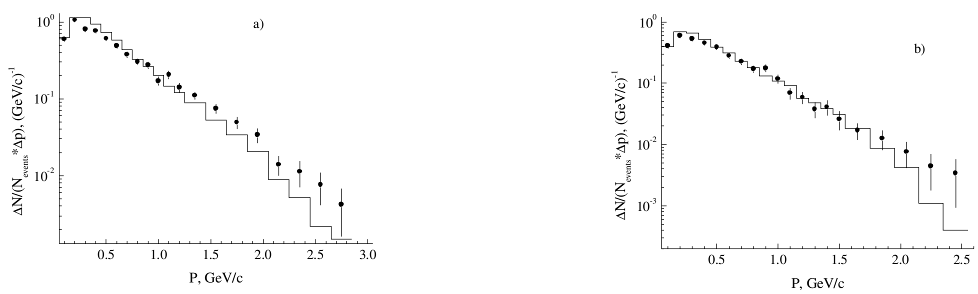

Fig. 1. Thenormalizedtotalmomentumdistributionsofthenegative (a) andpositive (b) pionsinn^{12}C collisionsat 4.2 GeV/*c*. Histograms–the calculations within the framework of the modified FRITIOF model.

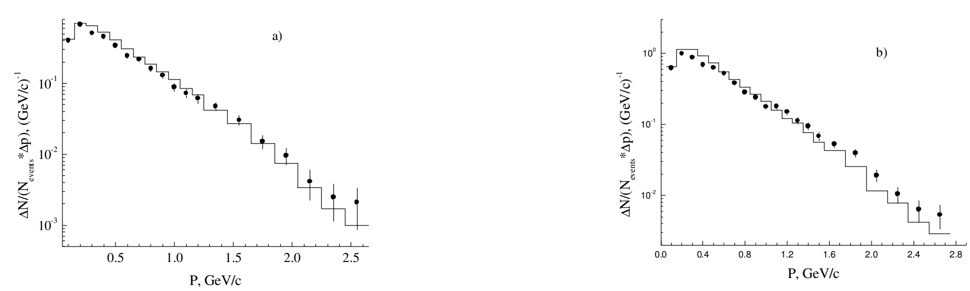

Fig. 2. Thenormalizedtotalmomentumdistributionsofthenegative (a) andpositive (b) pionsinp^{12}C collisions. Histograms–the calculations within the framework of the modified FRITIOF model.

Figs. 1 and 2 show also that the calculated momentum spectra of the charged pions for both π^- (a) and π^+ (b) mesons are single-modal ones and there are no deviations from the general smooth behavior of the spectra with increasing the momentum [5]. The theoretical data exceed the experimental ones for both π^- (a) and π^+ (b) mesons for both types of collisions in the momentum range of $p \leq 1$ GeV/c. The model describes well the shape of the experimental momentum distributions of the negative (positive) pions in n^{12}C (p^{12}C) collisionsin the range $1 \leq p \leq 2$ GeV/c. Regarding the high momentum tail of the momentum distributions ($p \geq 1$ GeV/c), the model systematically underestimates the experimental data for the negative (positive) pions in n^{12}C (p^{12}C) collisions.

3. Conclusions

We have presented the new experimental data on various characteristics of the secondary charged pions produced in n^{12}C collisions at 4.2 GeV/c. We have also performed a comparative analysis of the average multiplicities and various kinematic characteristics of the charged pionsproduced in n^{12}C and p^{12}C collisions at 4.2 GeV/c. Experimental data were compared systematically with thecalculationsusing the modified FRITIOF model.

It is shown that in n^{12}C (p^{12}C) collisions at 4.2 GeV/$c$around half of the negative (positive) pions are produced due to inelastic charge exchange reaction (conversion)of the initial neutron (proton) into proton (neutron) and the negative (positive) pion.

References

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