STUDY OF THE CHARGE EXCHANGE PROCESSES OF A TARGET PROTON IN ^{16}Op-COLLISIONS AT A MOMENTUM OF 3.25A GeV/c PER NUCLEON

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The processes of charge exchange of a target proton in ^{16}Op-collisions at a momentum of 3.25A GeV/c have been studied for the first time under the conditions of 4π-geometry. New data are reported concerning the average multiplicities of fragments and pions, as well as the data on the inelastic cross-sections of topological channels of oxygen nucleus fragmentation in the reactions of charge exchange of the target proton with and without the transfer of its charge to the projectile nucleus. The mechanism of transfer of the target proton charge to the projectile nucleus has been studied.

1. Introduction

This work continues the cycle of our researches [1–6] devoted to the fragmentation of oxygen nuclei at their interaction with protons at a momentum of 3.25A GeV/c. In our previous works, we reported data concerning the multiplicities of various fragments and particle types, the topological cross-sections of final states, the isotopic compositions of fragments, the characteristics of α-particles and light fragments (^{1}H, ^{2}H, ^{3}H, and ^{3}He), the cross-sections of the formation of short-lived nuclei, as well as the data on the dependences of the formation of fragments on the excitation degree of the fragmenting oxygen nucleus. However, the charge exchange processes and their role in the formation of fragments at ^{16}Op-interactions have not been studied yet. This work is devoted to the experimental study of the recharging of the target proton into a neutron with and without the transfer of its charge to the projectile nucleus, as well as the influence of those processes on the formation of fragments and pions in ^{16}Op-interactions at a momentum of 3.25A GeV/c.

The experimental material was obtained with the help of a 1-m hydrogen bubble chamber at the Laboratory of High Energies (JINR, Dubna, Russia). The chamber was irradiated by relativistic ^{16}O nuclei produced by the Dubna synchrophasotron. The data of this work are based on the analysis of 8712 completely measured ^{16}Op-events at a momentum of 3.25A GeV/c. The homogeneity of the target and the low density of a working liquid in the chamber allowed us to identify the charges of all secondary fragments unambiguously and to measure their momenta with a high accuracy. Single- and double-charged fragments with the lengths L of their tracks in the working volume of the chamber exceeding 35 cm were taken into account. Provided such a selection, the mean relative error of the momentum determination did not exceed 3.5% for all fragments. While determining the average multiplicities, corrections for the losses of fragments owing to their interactions with a working liquid in the chamber along the length $L \leq 35$ cm were made. For fragments with charges $3 \leq z \leq 8$, such a limitation on the length of their tracks was not introduced, because the identification of their masses was not carried out. Note that no event with the total charge of multi-charge fragments ($z \geq 2$) exceeding the charge of a fragmenting oxygen nucleus has been revealed within the total body of experimental material.

Positive single-charged particles with the momenta in the intervals $p = 1.75 \div 4.75$ GeV/c, $p = 4.75 \div 7.75$ GeV/c, and $p \geq 7.75$ GeV/c were considered as proton-fragments, deuterium, and tritium nuclei, respectively. Such a selection with respect to the momentum interval allows the isotopes of single-charged fragments to be identified with a probability of more than 96%. Double-charged fragments with the momenta $p < 10.75$ GeV/c were considered as ^{3}He nuclei, and those with the momenta $p > 10.75$ GeV/c as ^{4}He nuclei. In this case, the ratios of ^{3}He- and ^{6}He-nucleus admixtures to ^{4}He ones did not exceed 4 and 0.5%, respectively. In more details, the methodical features of the experiment are given in works [7,8].

Note that the recharging of the proton-target into a neutron can occur either through the transfer of its charge to the projectile nucleus (a nucleon or a cluster) or without such a charge transfer, through an inelastic decay of the target proton into a neutron and a slow

π^+-meson. In this work, we analyzed the reaction of the target-proton charge exchange with the charge transfer to the oxygen nucleus,

$$^{16}\mathrm{O} + (\mathrm{p}) \to \sum_i [\mathrm{X}_i] + (\mathrm{n}), \quad (1)$$

with the total charge of X_i's equal to $\sum_i Z(X_i) = 9$, where X_i is a fragment or a pion of the projectile nucleus and $Z(\mathrm{X}_i)$ is its charge, as well as the reaction of charge exchange of the target proton without the transfer of its charge to the projectile nucleus,

$$^{16}\mathrm{O} + (\mathrm{p}) \to \sum_j [\mathrm{X}_j] + (\mathrm{n} + \pi^+) \quad (2)$$

with the total charge of X_j's equal to $\sum_j Z(\mathrm{X}_j) = 8$.

The events of reaction (1) with the transfer of a target proton charge to the projectile nucleus were selected by the following criteria:
1) there was no identified recoil proton in the event;
2) all identified positive single-charged fragments were fast with momenta p>1.75 GeV/c in the laboratory frame;
3) there were no slow π^+-mesons with momenta p<0.6 GeV/c in the laboratory frame;
4) the total charge of fragments and pions was equal to $\sum_i Z(\mathrm{X}_i) = 9$.

The events of reaction (2) – the charge exchange of the target proton without charge transfer to the oxygen nucleus – were selected by the following criteria:
1) there was no identified recoil proton in the event;
2) in the event, there was at least one slow π^--meson with the momentum p<0.6 GeV/c in the laboratory frame, which can be connected with the reaction $\mathrm{p} \to \mathrm{n} + \pi^+$, i.e. the inelastic recharging of the target proton into a neutron;
3) the total charge of fragments and pions X_j (except a slow π^+-meson of the target) was equal to $\sum_j Z(\mathrm{X}_j)$= 8.

2. Experimental Data and Their Discussion

It should be noted that the correctness of selection criteria for experimental events described by reactions (1) and (2) is confirmed by the result obtained for the coefficient of inelastic recharging of the target proton into a neutron by the formula

$$W(\mathrm{p} \to \mathrm{n}) = \frac{N_1 + N_2}{N_{\mathrm{tot}} - N_{\mathrm{el}} - N_{\mathrm{dif}}},$$

where $N_1 = 1423$ and $N_1 = 1431$ are the event numbers in reactions (1) and (2), respectively; $N_{\mathrm{tot}} = 8712$ is the total number of ^{16}Op-events; $N_{\mathrm{el}} = 751$ is the number of elastic events; and $N_{\mathrm{dif}} = 167$ is the event number for the diffraction dissociation of oxygen nuclei. The value $W(\mathrm{p} \to \mathrm{n}) = 0.37 \pm 0.01$ obtained in such a way for the coefficient of inelastic recharging of the proton into a neutron in ^{16}Op-collisions at a momentum of 3.25 GeV/c per nucleon is in good agreement with the data of other experiments [9–11].

In the Table, the inelastic cross-section values, the numbers of events, and the average multiplicities of protons over various topological channels of the fragmentation of oxygen nuclei for reactions (1) and (2) are listed. In the topology column, the charge compositions of multi-charge fragments with charges $z \geq 2$ in the event are specified. The topology (0) means the events with a complete destruction of the oxygen nucleus, when there were no multi-charge fragments with the charge $z \geq 2$ among fragments and there were only single-charged fragments. From the Table, one can see that the total number of events of reactions (1) and (2), as well as the corresponding values of inelastic cross-sections (59.70 ± 1.58) and (60.04 ± 1.59) mb, respectively), practically coincide within the limits of statistical errors. The coincidence of the values for inelastic cross-sections of reactions (1) and (2) can be explained, if one assumes that reaction (1) with the transfer of a target proton charge occurs mainly through the inelastic scattering of the target proton by a neutron of the oxygen nucleus, whereas reaction (2) is mainly realized through the scattering of the target proton by a proton of the projectile nucleus. In this case, since the numbers of protons and neutrons in the oxygen nucleus are equal, the probabilities of pn- and pp-scattering of the target proton by a neutron and a proton, respectively, of the projectile nucleus will be equal to each other too, and, hence, the equality between the cross-sections of reactions (1) and (2) will be observed. Then, in the former case, the recharging of the target proton into a neutron is realized by transferring its charge to the projectile's neutron, which, in its turn, transforms into a proton. Concerning reaction (2), the charge exchange of the target proton, according to the event selection criteria, is fulfilled by means of the reaction $\mathrm{p} \to \mathrm{n} + \pi^+$. From the Table, it follows that, on the average, the topological channels of reaction (1) contain approximately one proton more than those in reaction (2), which agrees well with the fact that the transfer of an additional charge to the projectile by the target proton in the former reaction is carried out through the inelastic scattering of a target proton by a quasifree neutron (or by a neutron of a cluster) of the oxygen nucleus.

The Table demonstrates that, except for a few topologies, the inelastic cross-sections for the majority of topologies in reactions (1) and (2) are equal within the limits of statistical errors. Note an appreciable excess of the inelastic cross-section value for topological channel (22) in reaction (1) over the corresponding value in reaction (2). Attention is attracted by a significant excess of the inelastic cross-section of topology (7) with the yield of a seven-fold-charged fragment in reaction (2), in comparison with that in reaction (1). This agrees well with the fact that reaction (2) is realized through the scattering of the target proton by a projectile's proton; in this case, this proton can be knocked out – with a certain probability – from the oxygen nucleus, thus rising up the probability of the formation of a seven-fold-charged fragment in reaction (2) in comparison with reaction (1).

It is interesting to note that the inelastic cross-sections of topological channels (25), (223), and (34) of reaction (2) with the total charge of multi-charge fragments equal to seven exceed the cross-sections of corresponding channels in reaction (1). This also agrees with the appreciable role of the process of knocking out a projectile's proton in reaction (2), where the residual excited seven-fold-charged fragment can break up, through the topologies indicated above, into multi-charge fragments with the total charge equal to seven.

We also considered the average multiplicities of charged fragments and pions in reactions (1) and (2). Here and everywhere in this article, the average multiplicities of π^+-mesons in reaction (2) do not take the slow π^+-meson of the target into account. It turned out that the average multiplicities of single-charged fragments, except protons, and multi-charge fragments, except fragments with the charge $z = 7$, were close to each other in reactions (1) and (2). As was demonstrated above, the excess of the average multiplicity of protons in reaction (1) in comparison with that for reaction (2) is caused by the process of additional charge transfer to a projectile's neutron by the target proton, while the excess of the multiplicity of seven-fold-charged fragments in reaction (2) in comparison with that in the former reaction can be explained by the scattering of the target proton by a proton of the oxygen nucleus.

It should be noted that the average multiplicity of π^+-mesons in reaction (1) turned out equal to the average multiplicity of π^--mesons in reaction (2) within the limits of statistical errors; and vice versa, the average multiplicity of π^+-mesons in reaction (2) coincided with the average multiplicity of π^--mesons in reaction (1), with the average multiplicity of π^+-mesons in reaction (1) being higher than that in reaction (2). The equality between the average multiplicities of pions with opposite charge signs in reactions (1) and (2) gives rise to a conclusion that the probability of the formation of π^+-mesons in reaction (1) is equal to the probability of the formation of π^--mesons in reaction (2); and vice

Inelastic cross-sections, event numbers, and average multiplicities of protons in topological channels of the fragmentation of oxygen nuclei for reactions (1) and (2)

Topology	Reaction (1)		Reaction (2)	
	Event number (σ, mb)	$\langle n(^1\mathrm{H})\rangle$	Event number (σ, mb)	$\langle n(^1\mathrm{H})\rangle$
(0)	39 (1.64 ± 0.26)	5.72 ± 0.30	41 (1.72 ± 0.27)	4.57 ± 0.26
(2)	144 (6.04 ± 0.50)	5.04 ± 0.13	151 (6.34 ± 0.52)	3.58 ± 0.13
(22)	234 (9.82 ± 0.64)	3.74 ± 0.10	185 (7.76 ± 0.57)	2.88 ± 0.12
(222)	154 (6.46 ± 0.52)	2.24 ± 0.13	153 (6.42 ± 0.52)	1.59 ± 0.13
(2222)	10 (0.42 ± 0.13)	0.68 ± 0.51	12 (0.50 ± 0.15)	0.19 ± 0.46
(23)	60 (2.52 ± 0.32)	2.97 ± 0.21	53 (2.22 ± 0.31)	2.10 ± 0.22
(24)	41 (1.72 ± 0.27)	2.35 ± 0.25	23 (0.96 ± 0.20)	1.02 ± 0.32
(25)	23 (0.96 ± 0.20)	1.07 ± 0.32	31 (1.30 ± 0.23)	0.75 ± 0.29
(26)	25 (1.05 ± 0.21)	0.83 ± 0.32	25 (1.05 ± 0.21)	0.19 ± 0.18
(223)	11 (0.46 ± 0.14)	1.76 ± 0.48	16 (0.67 ± 0.17)	0.89 ± 0.40
(224)	4 (0.17 ± 0.08)	0.77 ± 0.80	2 (0.08 ± 0.06)	0.51 ± 0.50
(3)	28 (1.17 ± 0.22)	4.43 ± 0.30	37 (1.55 ± 0.26)	3.32 ± 0.26
(33)	7 (0.29 ± 0.11)	2.89 ± 0.60	9 (0.38 ± 0.13)	1.79 ± 0.53
(34)	1 (0.04 ± 0.04)	0.0	6 (0.25 ± 0.10)	1.36 ± 0.65
(4)	34 (1.43 ± 0.24)	3.53 ± 0.27	25 (1.05 ± 0.21)	2.77 ± 0.32
(5)	85 (3.57 ± 0.39)	3.19 ± 0.17	87 (3.65 ± 0.39)	2.04 ± 0.17
(6)	255 (10.70 ± 0.67)	2.41 ± 0.10	237 (9.94 ± 0.65)	1.52 ± 0.10
(7)	183 (7.68 ± 0.57)	1.49 ± 0.12	249 (10.45 ± 0.66)	0.74 ± 0.10
(8)	85 (3.57 ± 0.39)	0.74 ± 0.17	89 (3.73 ± 0.40)	0.23 ± 0.17
Total	1423 (59.70 ± 1.58)	2.81 ± 0.05	1431 (60.04 ± 1.59)	1.85 ± 0.04

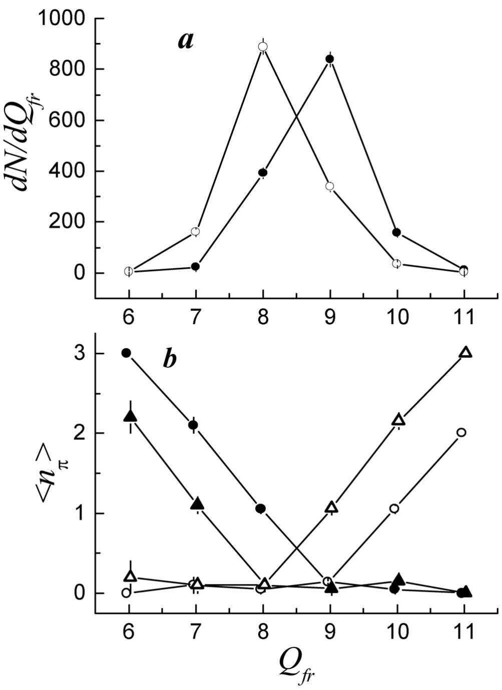

Fig. 1. *a* – Distributions of event numbers over the total charge of fragments $Q_{\rm fr}$ in the event in reactions (1) (●) and (2) (○); *b* – dependences of the average multiplicity of π^+-mesons in reactions (1) (●) and (2) (▲) and the average multiplicity of π^--mesons in reaction (1) (○) and in reaction (2) (△) on the total charge of fragments $Q_{\rm fr}$ in the event

versa, the probability of the formation of π^--mesons in reaction (1) is equal to the probability of the formation of π^+-mesons in reaction (2). Such a circumstance may be probably induced by the conservation law of electric charge in the events and by the fact that the total charge $\sum_i Z({\rm X}_i) = 9$ of fragments and pions of the projectile nucleus in reaction (1) is by unity higher than their total charge $\sum_j Z({\rm X}_j) = 8$ in reaction (2).

We now consider the distributions of event numbers in reactions (1) and (2) over the total charge $Q_{\rm fr}$ of the fragments in the event (except pions) (see Fig. 1,*a*). The corresponding dependences of the average multiplicities of π^+- and π^--mesons on $Q_{\rm fr}$ in the event for reactions (1) and (2) are depicted in Fig. 1,*b*. Figures 1,*a* and *b* testify that, for any value of $Q_{\rm fr}$, the total charge of π^+- and π^--mesons together with $Q_{\rm fr}$ gives the value $\sum_i Z(X_i) = 9$ for reaction (1) and $\sum_j Z({\rm X}_j) = 8$ for reaction (2), as it should be expected on the basis of the selection rules for events of those reactions. From Fig. 1,*a*, one can see that the distributions of event numbers in reactions (1) and (2) have maxima at $Q_{\rm fr} = 9$ and 8, respectively, where the average multiplicities of π^+- and π^--mesons are practically equal to zero. It is also evident that the distributions of the event numbers in reactions (1) and (2) are approximately symmetric to each other with respect to a straight line that crosses the $Q_{\rm fr}$-axis normally at $Q_{\rm fr} = 8.5$. The approximate symmetry of those distributions brought us to a conclusion that the event numbers in reaction (1) with $Q_{\rm fr} = 6$, 7, 8, 9, 10, and 11 are approximately equal to the event numbers in reaction (2) with $Q_{\rm fr} = 11$, 10, 9, 8, 7, and 6, respectively. Such a regularity can be explained, if one considers the behavior of the spectra of average multiplicities of π^+- and π^--mesons presented in Fig. 1,*b*. This figure makes it evident that, similarly to the distributions of the event numbers, the distributions of the average multiplicities of π^+- and π^--mesons in reaction (1) are approximately symmetric to those of π^-- and π^+-mesons, respectively, in reaction (2) with respect to a straight line that crosses the $Q_{\rm fr}$-axis normally at $Q_{\rm fr} = 8.5$. Since the probabilities of the formation of pions with opposite signs in reactions (1) and (2), as well as the total numbers of events in those reactions, turned out practically identical, all that, together with the observable symmetry of the spectra of average multiplicities of pions, does explain the observable symmetry occurring between the distributions of event numbers in reactions (1) and (2) over the $Q_{\rm fr}$ in the event.

Consider the angular distributions of all protons in the laboratory frame with respect to the direction of the initial beam of oxygen nuclei in reactions (1) and (2) (see Figs. 2,*a* and *b*, respectively). Both distributions have a peak at the output angles of about 1–2°, with the peak in reaction (1) being a little more pronounced. Figure 2,*a* and *b* also demonstrates that the angular distribution of protons in reaction (1) has a distinct "shoulder" within the angle interval 4–8°, which is absent from the angular distribution of protons in reaction (2). In other sections, the behaviors of angular distributions of protons in those two reactions qualitatively coincide.

In order to explain the differences between the angular distributions of protons in reactions (1) and (2) that were pointed out above, we must remember that the transfer of a target proton charge in reaction (1) occurs most likely through its scattering by a neutron of the projectile nucleus. In this case, it is natural to expect that the projectile's neutron, having been recharged into a proton, would possess the minimal momentum among all other protons, if the event is analyzed in the laboratory frame (LF). In Figs. 3,*a* and *b*, the angular distributions of protons, which have the minimal momentum $p_{\rm min}$ in one event, are shown for reactions (1)

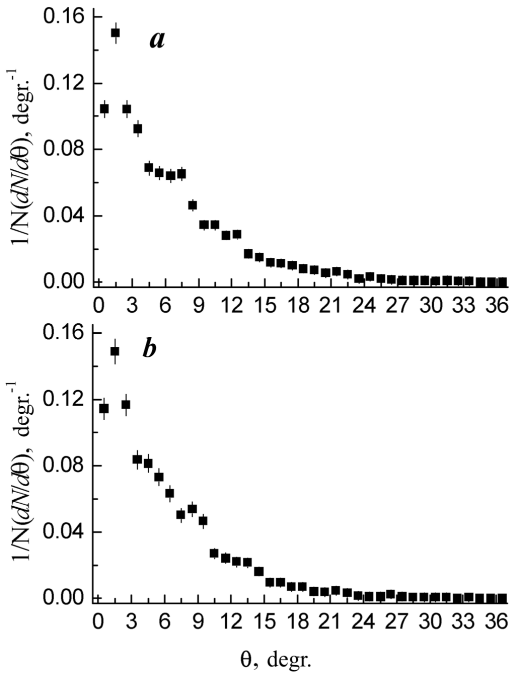

Fig. 2. Angular distributions of all protons normalized by their total number in events of reactions (1) (*a*) and (2) (*b*)

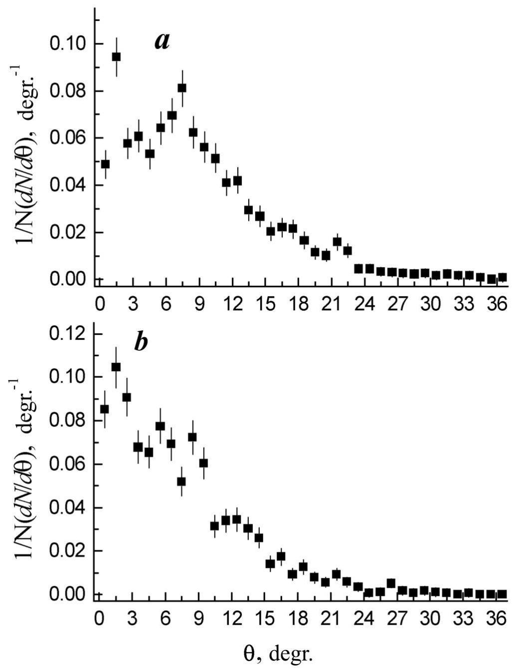

Fig. 3. Angular distributions of protons with the minimal momentum in one event in the laboratory frame, normalized to their total number, in the events of reactions (1) (*a*) and (2) (*b*)

and (2), respectively. It is evident that the angular distribution of protons in reaction (1) which have $p_{\rm min}$ in the LF is characterized – in contrast to the corresponding distribution for reaction (2) – by a well-defined peak at $\vartheta \approx 1 \div 2^\circ$ and a wide maximum in the angle range 4–10°, which explains the observable distinctions between the angular distributions of protons in Figs. 2,*a* and *b*. Such a behavior of the angular distribution of protons with $p_{\rm min}$ in reaction (1) can indicate that the mechanisms of the formation of protons are different in those cases.

More illustratively, this effect can be seen from the momentum distribution of such protons in the antilaboratory frame (ALF), i.e. in the system where the oxygen nucleus is at rest (see Fig. 4). This distribution is characterized by a narrow peak in the momentum interval 50–100 MeV/c and a wide maximum in the interval 300–750 MeV/c. Note that the mean relative error for the measurement of spectator fragment momenta in the ALF did not exceed 25 MeV/c. Protons outcoming at small angles in the LF and with small momenta in the ALF could most likely be formed as a result of the decay of an excited projectile nucleus (or its cluster), with the excitation of the latter arising owing to the transfer of the target's charge. The cross-section of this process was estimated on the basis of the momentum distribution of protons in the ALF (Fig. 4), taking into account the number of events with a proton which had $p_{\rm min}$ in the LF and the momentum $p <$ 150 MeV/c in the ALF. The cross-section of this process turned out small; it did not exceed (6.25 ± 0.51) mb, which amounted to less than 2% of the inelastic cross-section of ^{16}Op-interactions or about 10% of the inelastic cross-section of reaction (1). As is seen from Figs. 3,*a* and 4, the transfer of the target proton charge to the projectile nucleus is mainly accompanied by the output of protons at the angles $\vartheta > 4^\circ$ in the LF and with rather high momenta $p > 300$ MeV/c in the ALF. This testifies that, in ^{16}Op-collisions at 3.25A GeV/c, the process of charge transfer of the target proton to the projectile nucleus is basically realized through the inelastic scattering of the proton by a neutron of the oxygen nucleus.

It should be noted that the formation of protons in reaction (1) was observed in approximately 97% of events, whereas, in the case of reaction (2), protons were formed in about 84% of events. The larger fraction of events with proton output in reaction (1) may be due to the fact that the system consisting of 9 protons and 7 neutrons, which can be formed by the transfer of the

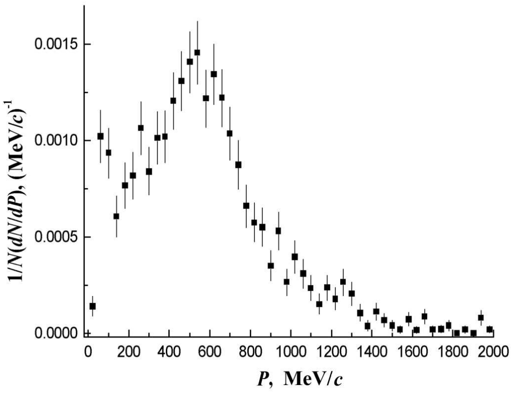

Fig. 4. Momentum distribution of protons (with the minimal momentum in the event in the laboratory frame) in events of reaction (1) in the antilaboratory frame (in the rest system for the oxygen nucleus) normalized to their total number

target proton charge to the oxygen nucleus, is unstable, because the stable isotope of the ^{16}F nucleus does not exist. In the overwhelming majority of events of reaction (1), this results in the formation – in addition to the process of direct scattering of a proton that emerges as a recharged neutron of the projectile in the course of the target proton charge transfer to the latter – of at least one proton carrying an extra charge that is transferred to the projectile nucleus. At the same time, in the case of reaction (2), since there is no transfer of the target proton charge to the oxygen nucleus, the system consisting of 8 protons and 8 neutrons will be more stable with respect to the output of protons; certainly, excluding the processes of direct knocking out of the projectile's proton by the target one following by the inelastic charge exchange of the latter.

In order to understand the mechanism of transfer of the target proton charge in the events without proton formation, the average multiplicities of charged fragments and pions were examined in those events of reactions (1) and (2), where protons were absent. It turned out that the average multiplicity of π^+-mesons in this class of events of reaction (1) was more than 2 times higher that the multiplicity of π^+-mesons in all events of this reaction. The average multiplicity of π^+-mesons in these events of reaction (1) was approximately by unity larger than that in reaction (2); with all the pions in them being faster, with the average momentum of (944 ± 47) MeV$/c$ in the LF, which is characteristic of pions formed at nucleons of the projectile nucleus in the reaction $\mathrm{p} \rightarrow \mathrm{n} + \pi^+$. Apparently, these pions were formed as a result of the repeated charge exchange of a proton of the projectile, which was formed due to the transfer of the target proton charge to a neutron of the oxygen nucleus.

To verify such an assumption, the average multiplicities of charged fragments and pions in the events of reactions (1) and (2) without proton formation but with the formation of an eight-fold-charged fragment were considered. Such events of reaction (1) were observed 23 times; among them, in 21 events was registered only the output of an eight-fold-charged fragment and a fast π^+-meson with the average momentum of (872 ± 40) MeV$/c$ in the LF, which is typical of pions formed at nucleons of the projectile nucleus in the reaction $\mathrm{p} \rightarrow \mathrm{n} + \pi^+$. It is interesting to note that the average momentum of eight-fold-charged fragments in those events was approximately 49 GeV$/c$ in the LF, which corresponds to the ^{15}O isotope of the oxygen nucleus, if the initial momentum was 3.25 GeV$/c$ per nucleon. This result agrees perfectly with the model, where this pion was formed owing to the repeated charge exchange of a proton of the projectile, which was formed as a result of the transfer of the target proton charge to a neutron of the oxygen nucleus.

In two remaining events, one eight-fold-charged fragment and one deuteron were observed, which evidences for a low probability of events with the output of a deuteron, whose proton could be formed due to the charge transfer of the target proton to the projectile neutron.

Again, in the events without the formation of protons and the eight-fold-charged fragment, the average multiplicities of π^+-mesons in reaction (1) turned out approximately by unity larger than those in reaction (2); with all pions in reaction (1) being faster, with the average momentum of (994 ± 73) MeV$/c$ in the LF. Therefore, it is possible to conclude that, in the case of events of reaction (1) without the formation of protons, the additional charge transferred to the projectile nucleus by the target proton manifests itself predominantly in the output of a relatively fast π^+-meson formed as a result of the repeated charge exchange of a proton of the projectile, which, in its turn, was formed due to the target proton scattering by a neutron of the oxygen nucleus with the transfer of the charge to the latter. Hence, in this class of events belonging to reaction (1) without the formation of protons in its final state, the transfer of the target proton charge to a neutron of the projectile nucleus is primary as well.

3. Conclusions

For the first time, we have studied the processes of charge exchange of the target proton in ^{16}Op-collisions at a momentum of $3.25A$ GeV/c. The coefficient of inelastic recharging of the proton into a neutron in ^{16}Op-collisions has been determined to be equal to 0.37 ± 0.01.

Inelastic cross-sections of the charge exchange reactions of a target proton with and without transfer of a charge to the projectile nucleus, as well as those for the majority of topological channels in these reactions, turned out practically identical.

The available distinctions between the average multiplicities of protons and π^+- and π^--mesons in these two reactions, as well as between the values of inelastic cross-sections of some topological channels, are caused by the influence of an additional charge transferred by the target proton to the projectile nucleus, and also by the conservation law of electric charge in the events.

For the charge exchange reactions of a target proton with and without transfer of its charge to the projectile nucleus, the distributions of event numbers over the total charge of fragments $Q_{\rm fr}$ in the event turned out approximately symmetric to each other with respect to a straight line that crosses the $Q_{\rm fr}$-axis perpendicularly at the point $Q_{\rm fr} = 8.5$.

It is shown that the transfer of the target proton charge to the projectile nucleus in ^{16}Op-collisions at $3.25A$ GeV/c is predominantly realized through the inelastic scattering of the proton by a neutron of the oxygen nucleus. The cross-section of the transfer of the target proton charge to the oxygen nucleus as a whole entity (or to its cluster) turned out small, being not higher than (6.25 ± 0.51) mb, which amounts to less than 2% of the inelastic cross-section of ^{16}Op-interactions.

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ВИВЧЕННЯ ПРОЦЕСІВ ПЕРЕЗАРЯДЖАННЯ ПРОТОНА-МІШЕНІ У ^{16}Op-СПІВУДАРАХ ПРИ ІМПУЛЬСІ $3{,}25A$ ГеВ/c НА НУКЛОН

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Р е з ю м е

Вперше в умовах 4π-геометрії досліджено процеси перезаряджання протона-мішені у ^{16}Op-співударах при імпульсі 3,25 A ГеВ/c. Наведено нові результати з середніх множинностей фрагментів і піонів, а також з непружних перерізів топологічних каналів фрагментації ядра кисню у реакціях перезаряджання протона мішені з передаванням і без передавання його заряду ядру снаряда. Досліджено механізм передавання заряду протона-мішені ядру снаряда.